FISHERY RESEARCH

LOWER SNAKE RIVER COMPENSATION PLAN CHINOOK SALMON FISH HATCHERY EVALUATIONS—IDAHO

PART I. BROOD YEAR 2002, 2003, 2004 HATCHERY CHINOOK SALMON REPORT
PART II. SUMMARY OF BROOD YEAR 1997, 1998, 1999 SAWTOOTH FISH HATCHERY NATURES REARING STUDY

Project Progress Report

John Cassinelli, Regional Fisheries Biologist
Shane Knipper, Senior Fisheries Technician

IDFG Report Number 11-18
August 2011

Lower Snake River Compensation Plan
Chinook Salmon Fish Hatchery Evaluations—Idaho

PART I. Brood Year 2002, 2003, 2004 Hatchery Chinook Salmon Report
PART II. A Summary of Brood Year 1997, 1998, 1999 Sawtooth Fish Hatchery Natures Rearing Study

Project Progress Report

By

John Cassinelli
Shane Knipper

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

To

U.S. Fish and Wildlife Service
Lower Snake River Compensation Plan Office
1387 S. Vinnell Way, Suite 343
Boise, ID 83709

Cooperative Agreement
14110-B-J008

IDFG Report Number 11-18
August 2011

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

List of Tables, continued.

Page

LIST OF FIGURES

Page

LIST OF APPENDICES

ABSTRACT

This annual report provides a finalized summary of brood year 2002, 2003, and 2004 Chinook salmon *Oncorhynchus tshawytscha* released from Lower Snake River Compensation Plan (LSRCP) and Idaho Power Company (IPC) hatcheries operated by the Idaho Department of Fish and Game (IDFG).

Idaho-LSRCP (McCall [MFH], Clearwater [CFH], and Sawtooth [SFH]) and IPC (Rapid River [RRFH] and Pahsimeroi [PFH]) hatcheries collected 12,955,207 green eggs and released 9,072,656 brood year 2002 Chinook salmon. For brood year 2003, 10,404,847 green eggs were collected and 7,802,950 juvenile Chinook salmon were released. For brood year 2004, 12,631,530 green eggs were collected and 9,415,754 juvenile Chinook salmon were released. CFH, MFH, RRFH, and PFH were all above or within 95% of the desired on-station goals for green eggs taken and smolts released for the three brood years covered. SFH fell short of the desired goals for green eggs taken and smolts released for all three years due to low numbers of returning broodstock.

Representative groups from all three brood years were tagged with passive integrated transponder (PIT) tags to estimate survival to Lower Granite Dam (LGD). Estimated survival rates across the brood years ranged from a low of 0.8% for presmolts released from Crooked River Pond in 2003 to a high of 83.6% for smolts released from Powell Pond in 2005.

Adult returns from brood years 2002, 2003, and 2004 occurred from 2005 through 2009. Return estimates were generated by brood year, age, and release site for each hatchery and include estimates of harvest (ocean, downriver, and terminal), strays, below-weir dropouts, and escapement. For all three brood years, Idaho-origin fish were recovered in all of the main downriver fisheries and in the Pacific Ocean. The percentage of each hatchery's brood-specific adult return that was harvested below LGD ranged from a low of 0.0% for PFH to a high of 38.4% for CFH, both for brood year 2004. Stray rates were low for all groups across all brood years both above and below LGD, with the exception of brood year 2002 CFH fish, which strayed at a rate of 10.07% above LGD. However, these strays were exclusively in the Clearwater basin.

Contributions to the brood-year specific total hatchery returns of adult Chinook salmon from individual LSRCP and IPC fish hatcheries ranged from a low of 545 PFH adults from brood year 2003 to a high of 20,797 RRFH adults from brood year 2004. Associated smolt-to-adult survival (SAS) rates from these adult returns ranged from a low of 0.056% for brood year 2003 PFH Chinook salmon to a high of 0.976% for brood year 2004 MFH Chinook salmon. Progeny-to-parent (PTP) ratios were highly variable across brood years and release sites. All groups across all brood years had a PTP ratio above replacement (>1.0) with the exception of CFH's Powell group in brood year 2002 and PFH in both brood year 2002 and 2003.

The three LSRCP funded hatcheries outlined in this report have specific return-year adult mitigation goals for adult returns to LGD. Because this is a brood year report, we looked at mitigation goals at the brood year level. Brood year 2004 from MFH was the only group that exceeded the adult return mitigation goal to LGD for the three years reported.

Of the three brood years outlined in this report, brood year 2004 had the highest overall smolt-to-adult returns (SAR)s, SASs, and number of adults returning to LGD despite release numbers and juvenile survival estimates similar to earlier years.

In addition to the brood year reporting, this report also summarizes a Natural Rearing Enhancement System (NATURES) rearing study for brood years 1997, 1998, and 1999 at Sawtooth Fish Hatchery. For all three brood years, a treatment group of fish was reared using various NATURES modification to rearing raceways. In addition, for brood years 1997 and 1998, additional fish were reared as control groups using traditional rearing practices. For both brood year 1997 and 1998, significant differences were found between treatment and control groups for both juvenile survival to LGD and smolt-to-adult return rates. However, these differences were not consistent and this study was confounded by other research, limiting the validity and application of the results.

Authors:

John Cassinelli
Regional Fisheries Biologist

Shane Knipper
Senior Fisheries Technician

PART I. BROOD YEAR 2002, 2003, 2004 HATCHERY CHINOOK SALMON REPORT

INTRODUCTION

The U.S. Army Corps of Engineers (USACE) constructed four hydroelectric dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) on the lower Snake River between 1961 and 1975. Fishery managers and biologists expected the survival of downstream migrating smolts and upstream migrating adults to be negatively impacted by dam construction and operation, as well as by the alteration of the river ecosystem. A joint Coordination Act Report (CAR) written by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) in 1972 was submitted to the USACE describing the impacts of the four lower Snake River dams on both fish and wildlife. Based on that report, the USACE submitted a Special Report to Congress (United States Army Engineer District 1975) which was used to authorize the Lower Snake River Compensation Plan (LSRCP) through the Water Resources Development Act of 1976 (90 Stat. 2917). Intent of the LSRCP is to mitigate the reduced survival of anadromous fish resulting from the construction and operation of the four lower Snake River dams. The primary compensation tool specified in the LSRCP is a hatchery mitigation program. In 1977, the USFWS was given budgeting and administrative responsibility for operation and maintenance funding of LSRCP fish hatchery programs through an interagency agreement among the USACE, NMFS, and the USFWS.

The LSRCP hatchery program specified the use of fish hatcheries to produce and release enough juvenile anadromous salmonids to meet adult return goals established to offset the estimated mortality caused by the four lower Snake River dams. Original mortality estimates for spring- and summer-run Chinook salmon O*ncorhynchus tshawytscha* attributable to the four lower Snake River dams were derived by applying a 15% smolt mortality rate at each of the four dams (a total estimated loss of 48%) (U.S. Army Engineer District 1975). That expected loss was multiplied by the estimated return of spring/summer Chinook salmon adults (122,200) to the Snake River in 1957 (pre-dam construction). This resulted in an annual mitigation goal of 58,677 spring- and summer-run (50,677 spring-run and 8,000 summer-run) Chinook salmon above Lower Granite Dam (LGD) (LSRCP 1991). Additionally, a return goal of 18,300 adult fall run Chinook salmon above LGD was also established using similar criteria, but those fish are not included in this report.

To achieve the established mitigation goals, LSRCP-funded hatcheries were constructed in Idaho, Oregon, and Washington. Hatcheries located in Idaho include three operated by the Idaho Department of Fish and Game (IDFG) and one operated by the USFWS. Facilities operated by IDFG include Clearwater, McCall, and Sawtooth fish hatcheries (with four associated satellite facilities) (Figure 1). Facilities operated by USFWS include Dworshak National Fish Hatchery (DNFH) and the associated Kooskia satellite facility (Figure 1). Adult return goals for LSRCP hatcheries operated by IDFG account for 39,360 of the 58,677 return goal above LGD (Table 1). Hatchery capacity specifications for LSRCP facilities operated by IDFG were based on adult escapement goals (U.S. Army Engineer District 1975) and an average smolt-to-adult return (SAR) rate of 0.87%.

In addition to the LSRCP funded hatcheries located in Idaho, Idaho Power Company (IPC) owns and maintains two additional spring/summer Chinook salmon hatcheries that are operated by IDFG. These hatcheries were constructed as mitigation for the construction of the Hells Canyon Dam Complex (Brownlee, Oxbow, and Hells Canyon dams). Rapid River Fish Hatchery resulted from mitigation mandated by the Federal Energy Regulatory Commission (FERC) that required IPC to transplant a run of spring Chinook from the Snake River to the

Salmon River. Pahsimeroi Fish Hatchery was originally built as a trapping and spawning facility for steelhead, but was expanded to include Chinook salmon production following the implementation of the Hells Canyon Settlement Agreement in 1980. Mitigation goals established through the Hells Canyon Settlement Agreement specify juvenile production targets of three million spring Chinook salmon smolts at the Rapid River Fish Hatchery and one million summer Chinook salmon smolts at the Pahsimeroi Fish Hatchery (Table 2).

Table 1. Adult spring- and summer-run Chinook salmon return goals for LSRCP funded hatcheries located in Idaho and operated by IDFG. Return goals listed for satellite facilities are a subset of the overall hatchery return goal (in bold font).

Hatchery and Satellite	First Year of Operation	Run Type	Adult Return Goal Below LGD	Adult Return Goal Above LGD
McCall	1979	Summer	**32,000**	**8,000**
Sawtooth	1985	Spring	**77,780**	**19,445**
E.F. Salmon	1984	Spring	24,360	6,090
Clearwater	1990	Spring	**47,660**	**11,915**
Powell	1989	Spring	10,212	2,553
Red River	1986	Spring	10,212	2,553
Crooked River	1990	Spring	27,236	6,809
		TOTAL	**157,440**	**39,360**

Table 2. Adult spring and summer run Chinook salmon release goals for IPC-funded hatcheries located in Idaho and operated by IDFG.

Hatchery	First Year of Operation	Run Type	Smolt Release Goal
Rapid River	1965	Spring	3,000,000
Pahsimeroi	1968	Summer	1,000,000
		TOTAL	**4,000,000**

Hatchery Evaluation Component

The LSRCP includes a Hatchery Evaluation Study (HES) component to monitor and evaluate the hatchery mitigation program. The primary goal of the HES is to work with individual hatcheries to help determine the best hatchery management practices that allow the hatcheries to meet LSRCP and IDFG anadromous fisheries goals. The objectives of the HES are: 1) to monitor and document the extent to which hatcheries meet their mitigation goals, and 2) to conduct small-scale manipulative studies involving modified or alternative hatchery practices that show potential for increasing adult returns and achieving LSRCP and IDFG goals. These small-scale studies may be printed and bound as independent reports.

The primary purpose of this report is to summarize activities at each of the LSRCP- and IPC-funded spring/summer Chinook salmon hatcheries operated by IDFG and to estimate at what level each facility contributed to various adult return components. These include fisheries in the Pacific Ocean and Columbia River as well as the adult return above LGD, the contributions to fisheries within Idaho, and the numbers of fish back to the respective hatchery trapping facilities. Additionally, life-stage specific survival post-release is reported to address overall survival from release to return. In each annual report, a given brood year is summarized by consolidating the spawning, juvenile rearing and release information, and the adult returns from that particular brood year. Because of the five-year generation length of Chinook salmon and the additional two years required to obtain all downriver harvest information, there is a seven-year lag associated with summarizing the productivity of a brood year. Hence, brood years 2002, 2003, and 2004 are finalized in the current 2011 report so that reporting is caught up to the most recent brood year that can be summarized.

This report covers the complete life cycle of brood year 2002, 2003, and 2004 hatchery-origin spring and summer Chinook salmon reared at the three LSRCP funded hatcheries (Clearwater, McCall, and Sawtooth) and the two IPC funded hatcheries (Rapid River and Pahsimeroi). All five of these facilities are operated by staff from the IDFG. To avoid unnecessary duplication of data reporting, only the major components of data collected by hatchery staff are reported. Specific hatchery broodstock collection, spawning, incubation, and rearing summaries can be found in hatchery specific brood year reports available from IDFG (https://research.idfg.idaho.gov/Fisheries%20Research%20Reports/Forms/Show%20All%20Reports.aspx).

LSRCP Spring/Summer Chinook Hatcheries Operated by IDFG

McCall Fish Hatchery

McCall Fish Hatchery (MFH) was built in 1979 and is located in the city of McCall, Idaho on the North Fork of the Payette River approximately 0.16 km below the outlet of Payette Lake (Figure 1). The hatchery is the incubation and rearing facility for the South Fork Salmon River (SFSR) summer Chinook salmon program and has a rearing capacity for 1,100,000 smolts at 17 fish per pound. An adult trapping and spawning satellite facility is located on the upper SFSR near Warm Lake (Figure 1). The adult escapement goal for the SFSR is 8,000 adults above LGD with an additional 32,000 adults available for downriver (Columbia and Snake rivers) harvest (Table 1).

The original broodstock for the SFSR program was composed of summer run adults collected at Little Goose Dam from 1974 to 1978, from Lower Granite Dam in 1979, and from LGD and the SFSR trap in 1980 (Kiefer et al. 1992). Adults collected between 1974 and 1980

were spawned at Rapid River or Dworshak National fish hatcheries. Resulting juveniles were released into the upper SFSR near the current location of the adult trap. Since 1980, all broodstock collection has come exclusively from adults captured at the adult trap site on the upper SFSR. From the inception of the SFSR program through brood year 1990, not all of the juvenile Chinook salmon released were marked with a fin clip. Therefore, an unknown proportion of the unmarked retuning adults through 1995 were hatchery-origin. Beginning with brood year 1991, all juvenile Chinook salmon released into the upper SFSR were marked with a fin clip, a visual implant tag, or a coded wire tag (CWT), allowing the differentiation of hatchery and naturally produced adults.

Sawtooth Fish Hatchery

Sawtooth Fish Hatchery (SFH) was completed in 1985. The hatchery is located on the main-stem Salmon River approximately 10 km upstream from the town of Stanley, Idaho (Figure 1). The hatchery consists of an adult weir, adult trap, spawning and incubation facilities, and rearing capacity for 1.7 million Chinook salmon smolts at 15 fish per pound. The original escapement goal for Sawtooth Fish Hatchery was 19,445 adult spring Chinook salmon above LGD from juvenile releases at SFH, the East Fork Salmon River, and Valley Creek with an additional 77,780 adults available for downriver (Columbia and Snake rivers) harvest (Table 1). However, these adult return goals were based on a release of 2.3 million smolts, not the current target of 1.7 million.

The history of the Chinook salmon broodstock at SFH is complex. In 1966, a rearing pond was constructed at the current SFH site and received hatchery fry releases from Hayden Creek (Idaho), Rapid River (Idaho), and Marion Forks Fish Hatchery (Oregon) (Bowles and Leitzinger 1991). During the 1970s, there were several releases of the Rapid River stock into the rearing pond. However, Bowles and Leitzinger (1991) note that adult returns from these releases were negligible. The original brood source for the SFH program came from adults captured at a temporary weir operated from 1981-1984 at the site of the current hatchery location. It was estimated that at least 50% of the adults trapped in 1981 resulted from a hatchery smolt release (914,000) in 1979 from Rapid River stock raised at the Mullen Fish Hatchery (Moore 1981). Also, an unknown proportion of adults trapped in 1982 consisted of age-5 adults from the same Rapid River smolt release. Since 1982, all returning hatchery adults have been SFH stock. Eggs collected from adults trapped at the temporary weir were incubated and reared at the McCall Fish Hatchery from 1981-1983 and at Pahsimeroi Fish Hatchery in 1984 and released in the upper Salmon River at the current hatchery location. Brood year 1985 was the first year that all adult trapping, incubation, and rearing occurred at the SFH. Through brood year 1990, not all of the juvenile Chinook salmon released were marked with a fin clip. Because of this, an unknown proportion of the unmarked retuning adults through 1995 were hatchery-origin. Beginning with brood year 1991, all juvenile Chinook salmon released at or above the Sawtooth Fish Hatchery weir were fin clipped or CWT and the origin of the retuning adults could be distinguished from naturally produced adults.

The East Fork Salmon River adult trap is a satellite facility of SFH that began operation in 1984. The trap is located approximately 29 km upstream of the mouth of the East Fork Salmon River (Figure 1). The escapement goal for the East Fork weir is 6,090 above LGD with an additional 24,360 adults available for downriver (Columbia and Snake rivers) harvest (Table 1). Eggs from adults that are trapped and spawned at the East Fork satellite facility are transferred to the SFH for incubation and rearing. Adult collection and spawning occurred at the East Fork satellite from 1985-1993. However, due to low numbers of returning adults, all adults captured were released above the weir to spawn naturally from 1994-1997. Juvenile releases of

hatchery Chinook salmon were discontinued after the release of brood year 1993 smolts and trapping operations for Chinook salmon were discontinued from 1998-2003. Trapping resumed in 2004, but all Chinook salmon trapped since then have been released above the trap to spawn naturally.

Valley Creek, a tributary to the Salmon River just below the town of Stanley, was initially slated to receive an annual off-site release of up to 300,000 smolts from SFH. However, no juvenile releases have occurred in Valley Creek.

Clearwater Fish Hatchery

Clearwater Fish Hatchery (CFH) was constructed in 1992 and is located on the North Fork Clearwater River, approximately 1 km above the mouth near the town of Orofino, Idaho. The adult escapement goal for CFH is 11,915 adult spring Chinook salmon above LGD with an additional 47,660 adults available for downriver (Columbia and Snake rivers) harvest (Table 1). CFH contains adult holding, spawning, incubating facilities, and rearing space for 1,500,000 Chinook smolts and 1,700,000 steelhead smolts. Three satellite facilities (Red River, Crooked River, and Powell) associated with CFH were constructed prior to CFH (Figure 1). Incubation and rearing of all Chinook salmon juveniles released at the three satellite facilities occurs at CFH. Original broodstock for the Clearwater program was primarily made up of Rapid River stock but also included the Dworshak, Kooskia, Carson, and Cowlitz stocks.

Red River Satellite — The facility is located 24 km east of Elk City, Idaho on the Red River, a tributary to the South Fork Clearwater River. The Red River satellite facility is located approximately 21 km upstream from the mouth of Red River and approximately 183 km upstream from Clearwater Fish Hatchery. The mitigation goal for the Red River facility is 2,553 adult spring Chinook salmon above LGD with an additional 10,212 adults available for downriver (Columbia and Snake rivers) harvest (Table 1). In 1976, a rearing pond and temporary weir were constructed at the site of the current satellite facility as part of the Columbia River Fisheries Development Program (Kiefer et al. 1992). In 1986, the satellite facility was updated and a permanent weir was installed near the rearing pond as part of the LSRCP program. Both fall presmolt and spring smolt releases have occurred at Red River. All adult fish trapped at Red River are temporarily held and then transported to CFH for final holding and spawning.

Crooked River Satellite —An adult trap and juvenile rearing ponds were constructed on Crooked River, a tributary to the South Fork Clearwater River, in 1989. The adult trap is located on Crooked River approximately 1 km upstream from the mouth. The juvenile rearing ponds are located approximately 16 km upstream of the adult trap. The Crooked River satellite facility is located approximately 150 km upstream from CFH. The mitigation goal for the Crooked River facility is 6,809 adult spring Chinook salmon above LGD with an additional 27,236 adults available for downriver (Columbia and Snake rivers) harvest (Table 1). Both fall presmolt and spring smolt releases have occurred at Crooked River. There are no adult holding facilities at Crooked River, so all adults retained for broodstock are transported to the Red River satellite facility. Initially, Red River and Crooked River adults were kept separate and treated as two different stocks. However, in 1997, it was decided to treat the Red River and Crooked River adults as a single stock and adults trapped from each of the facilities are combined into the same holding ponds and are referred to as the “South Fork” stock (McGhee and Patterson 1999). For this report, harvest and escapement estimates for the South Fork stock will represent the combined juvenile release and adult recovery data from Red River and Crooked River satellite facilities.

Powell Satellite —The Powell satellite facility is located on the upper Lochsa River approximately 200 km upstream from CFH near the confluence of Crooked Fork and Colt Killed creeks (Figure 1). Both fall presmolt and spring smolt releases have occurred at the Powell facility, and the mitigation goal is to return 2,553 adults above LGD with an additional 10,212 adults available for downriver (Columbia and Snake rivers) harvest (Table 1). Construction of an adult trap, weir, holding ponds, and a juvenile rearing pond was completed in 1989 but adult trapping began in 1988. Originally, a floating weir that spanned the Lochsa River was used to guide fish into Walton Creek where another weir guided them into the trap box. The floating weir was operated from 1988 to 1992. High water events in 1992 caused extensive damage to weir panels and the floating weir has not been operated since. Since 1992, fish have no longer been guided to Walton Creek by a mechanical structure, but rather by attraction flow from the creek, which is a small tributary with no natural run of Chinook salmon and the water source for the Powell satellite facility. Adults retained for broodstock are spawned at the Powell facility and eggs are transferred to CFH for incubation and rearing.

IPC Spring/Summer Chinook Hatcheries Operated by IDFG

Rapid River Fish Hatchery

Rapid River Fish Hatchery (RRFH) was constructed in 1964 and is located about 11 km southwest of Riggins, Idaho. The hatchery lies on Rapid River, a tributary of the Little Salmon River (Figure 1). The hatchery is located about 5 km up Rapid River from its confluence with the Little Salmon River. The facilities include a fish trap located on Rapid River approximately 2.5 km downstream from the hatchery. Mitigation mandated by the FERC required IPC to transplant a run of spring Chinook from the Snake River to the Salmon River drainage and provide funds for the annual production of three million smolts at this facility (since 1969). Currently, 2.5 million of these fish are designated for release into Rapid River. Fish in excess of the 2.5 million are split between the Snake River below Hells Canyon Dam and the Little Salmon River (Figure 1) as stipulated in the 2008–2017 US v. Oregon Management Agreement (2008).

Original broodstock for Rapid River spring Chinook salmon were collected from the middle Snake River at Oxbow and Hells Canyon dams from 1964 through 1969. Since then, the hatchery has relied upon returns to the Rapid River weir for broodstock. More recently, adults returning to Hells Canyon Dam, as a result of RRFH smolt releases below the dam, have been trapped and transported to the hatchery. These fish are combined with the Rapid River fish and incorporated into the broodstock.

Pahsimeroi Fish Hatchery

Pahsimeroi Fish Hatchery (PFH) is located near the town of Ellis, Idaho near the confluence of the Pahsimeroi River and Salmon River (Figure 1). The hatchery was built in 1967 by IPC to mitigate for the losses incurred in the construction and operation of the Hells Canyon Complex. Hatchery operations and management are the responsibility of IDFG with funding provided by IPC. From 1998 through 2007 all Chinook incubation and early rearing was completed at SFH in an attempt to limit fry exposure to whirling disease. Fish were later returned to the upper Pahsimeroi facility to complete the final rearing/volitional smolt release process. Recent renovations (including three new wells) to the upper facility allow for the complete rearing of Chinook salmon smolts beginning with brood year 2008 and currently PFH functions as a complete rearing facility for the annual production of 1 million summer Chinook salmon. However, the brood years covered in this report were incubated and early reared at SFH. Original broodstock for the Pahsimeroi Hatchery program originated from indigenous

Pahsimeroi summer Chinook salmon combined with eggs from spring Chinook salmon from the Lemhi and Rapid Rivers. However, over time the spring returning component of the broodstock was phased out and by 1990, all returns were considered summer run.

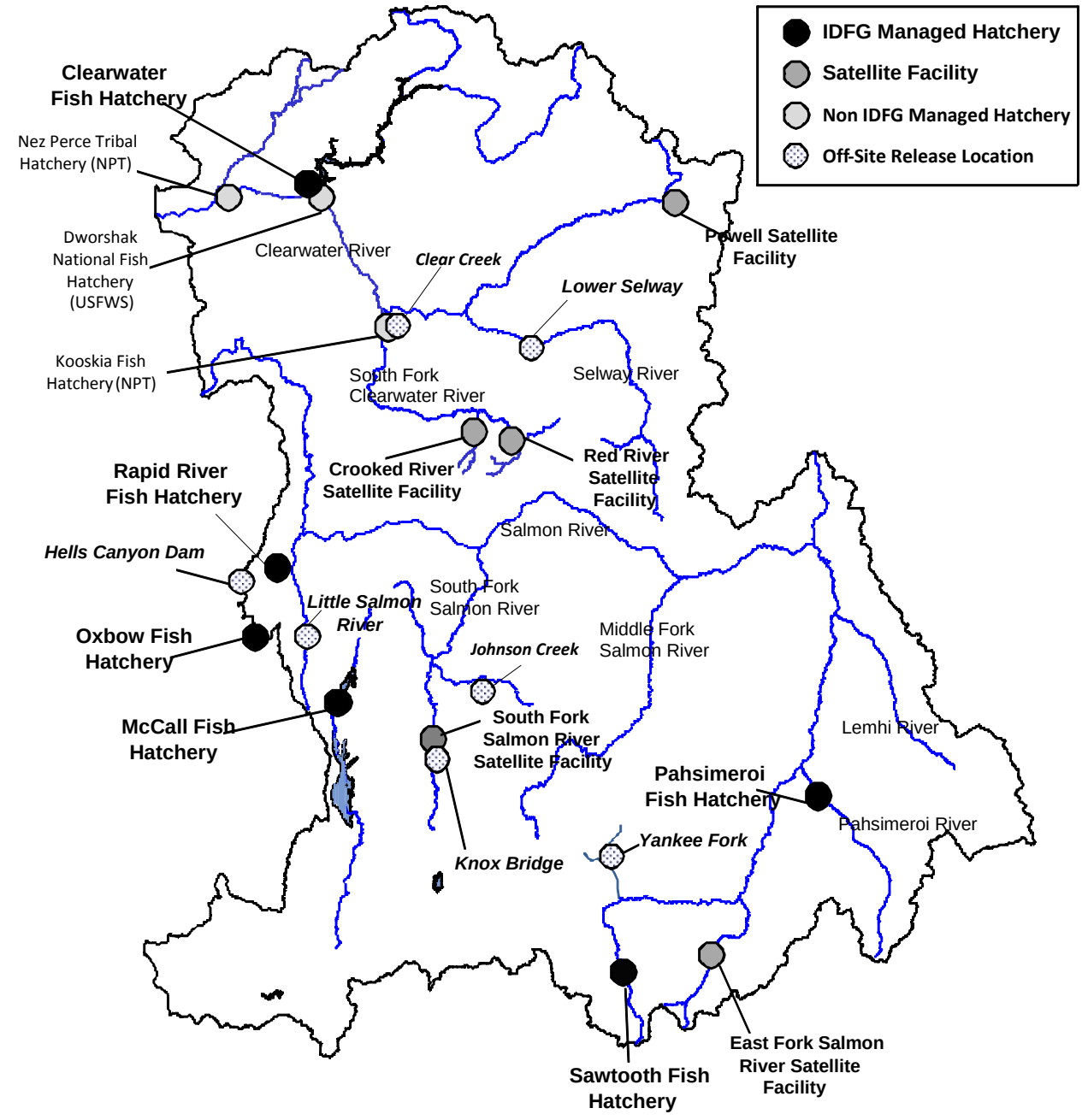


Figure 1. State-, federal-, and tribal-operated anadromous fish hatcheries located in the Clearwater, Salmon, and mid-Snake river basins along with associated satellite facilities and off-site release locations.

METHODS

The information used to report in-hatchery performance for metrics such as spawning, eye-up, and green egg to release survival is pulled from individual Brood Year Reports and Run Year Reports generated by each hatchery. These reports are available electronically through IDFG at https://research.idfg.idaho.gov/Fisheries%20Research%20Reports/Forms/Show%20All%20Reports.aspx.

Prespawn Mortality

Prespawn mortalities include any female or male that is ponded for broodstock and dies before it is spawned. For females, any mortality that occurs before the fish is spawned is considered prespawn, while for males, any mortality that occurs prior to or within two weeks after the first sorting event in considered prespawn. In this report, prespawn mortalities are reported as the percentage of the broodstock, by sex, that died prespawn based on the above criteria.

Egg Culling

The main driver behind the number of females that are culled in a given year at a given location is the prevalence of observed bacterial kidney disease (BKD) (*Renibacterium salmoninarum*) that is determined from enzyme-linked immunosorbent assay (ELISA) optical density levels (Munson et al. 2010). IDFG has incorporated a culling program at all of its hatcheries where kidney samples are taken from all females that are spawned and used to test for BKD. Eggs from females that show an ELISA optical density value greater than 0.25 are culled from the population. In addition, if the green egg inventory after culling at the 0.25 level is still greater than the number needed to fill the hatchery to full production, then additional eggs are culled starting with those that are closest to the 0.25 level and working down until a desired inventory is achieved (Munson et al. 2010). It is not uncommon for two females to be loaded into a single egg tray at some facilities. In these situations, culling eggs from a single female that tests high for BKD is not possible, and eggs from both females in the given tray must be culled. Numbers of females culled are reported as the total number of females whose eggs were removed from production, regardless of culling purpose (high BKD or inventory reduction).

Juvenile Survival from Release To Lower Granite Dam

One of the roles of Passive Integrated Transponder (PIT)-tagged Chinook salmon groups released from LSRCP and IPC facilities is to evaluate migration timing and survival of hatchery-reared juveniles to LGD. We calculated survival estimates of hatchery-origin juvenile Chinook salmon from release to arrival at LGD using PIT tag release groups from all hatchery facilities. Juvenile survival rates of PIT-tagged Chinook salmon are estimated using the PitPro program (Westhagen and Skalski 2009). This program generates a point estimate and a standard error that is used to generate 95% confident intervals. The program uses the Cormack-Jolly-Seber model for single release and multiple recapture events (Cormack 1964; Jolly 1965; Seber 1965). Recaptures at all Snake River and Columbia River dams with PIT tag detection capabilities, both at and downriver of LGD, are used in generating the PitPro estimates. Interrogation data is queried from the PTAGIS database (http://www.ptagis.org).

To compare out-migration arrival timing at LGD among the different release groups, we also reported the 50% arrival date and the “80% arrival window” in which the middle 80% of PIT

tag detections occurred. This interval provides a measure of when fish arrive at LGD and how "spread out" the major component of each release group of juveniles as they pass LGD.

Estimating Downriver Harvest and Strays

In order to estimate the total adult production of the LSRCP and IPC hatchery facilities in Idaho, estimates of harvest from "downriver" fisheries in the Pacific Ocean, Columbia River, and lower Snake River, as well as stray rates, must be evaluated. We generated harvest and stray estimates by utilizing CWT data retrieved from the Regional Mark Information System (RMIS) database (www.rmpc.org), maintained by the Pacific States Marine Fisheries Commission (PSMFC). Coded wire tags recovered from harvested fish were expanded based on two factors: 1) the estimated sample rate of the fishery or recovery location, and 2) the proportion of the release group that was tagged with CWTs. These expanded values represent the total estimated harvest and stray rate of each brood year-specific release group within each fishery/recovery area.

Not all release groups within a given brood year contained a CWT group. In the absence of CWT, a surrogate was used to estimate downriver harvest and stray rates, and those rates were applied to the non-tagged group. In order for a full surrogate to be used, it had to be a tagged group from the same release hatchery that was released as the same life stage (smolt, parr, etc.) with the same marks. In some cases a partial surrogate was used, meaning that the external mark (adipose fin clip) was different between the non-tagged and surrogate group or that the non-tagged and surrogate groups were released as different life stages but had the same marks. The reason these types of surrogates are considered partial, is because they cannot be used as a surrogate for all the different adult estimates. For example, if marks are different, the surrogate can only be used to generate estimates for non-mark selective fisheries. In some cases, duel surrogates were used; one released as the same life stage to generate survival rates back to release site, and another released with the same mark type to generate downriver harvest rates. If there was not a valid surrogate group available, no estimates were made for that release group.

A stray was defined as any adult fish recovered in a location outside of the direct migratory route from the Pacific Ocean to the fish's juvenile release location. It is important to note that estimates of stray rates are considered minimum, as there are many places where strays are not recovered because there are no carcass surveys or weirs present.

Estimating Harvest from Fisheries in Idaho

From 2005 to 2009, Idaho sport fisheries occurred in both the Salmon and Clearwater rivers. Harvest from these fisheries was estimated by IDFG regional staff and by IDFG staff, funded through the LSRCP Harvest Monitoring Program (HMP) and IPC, from data collected through a combination of angler check stations, roving creel, and voluntary drop-off check station boxes. CWTs were used in the mixed-stock fisheries to estimate the age composition and proportion of the harvest that each stock contributed. An example of a mixed-stock fishery is the lower Salmon River, where anglers may encounter fish destined for the Rapid River, Pahsimeroi, or Sawtooth fish hatcheries, or the South Fork Salmon River Satellite facility.

For the years covered in this report, tribal fisheries occurred on both the Salmon and Clearwater rivers. Both the Nez Perce Tribe (NPT) and the Shoshone Bannock Tribe (SBT) monitor their respective tribal fisheries and provide those harvest estimates to IDFG staff.

However, tribal harvest estimates are not broken down by age, so the age composition of the sport fishery harvest is used as a surrogate to assign an age composition to the tribal harvest.

Adult Age Classification

We determined the age composition of adults returning to individual LSRCP and IPC hatchery facilities and to fish harvested in Idaho sport fisheries by one of two methods, depending on the availability of known age information (e.g., CWTs, PIT tags, or other age-specific marks) recovered from returning adults. In cases where enough known age information is available, the computer program *Rmix* was used. *Rmix* was developed by Du (2002) as an add-on program to the R computing environment (R-Development Core Team 2004) that utilized the original MIX program developed by MacDonald and Pitcher (1979). *Rmix* was designed to estimate the parameters of a mixture distribution with overlapping components, such as the overlapping length distributions associated with adult salmon returns composed of multiple age classes. *Rmix* utilizes the maximum likelihood estimation method. If known age information was lacking, then age composition was determined using length frequency histograms and the estimated mean length at age imputed into the NORMSEP feature in the FAO-ICLARM Stock Assessment Tools (FiSAT II) software (FAO Computerized Information Series 2005). This method applies the maximum likelihood concept to the separation of the normally distributed components of a length frequency sample and provides an estimated number of fish for each age class.

The age notations used throughout this report for returning adults refer to the total age of the fish (fresh plus saltwater) and assume all juveniles migrate to the ocean as age-1+ smolts. Therefore, fish that spend one, two, or three years in the ocean are classified as three-, four-, and five-year-olds, respectively.

Determination of Origin

Being able to identify a Chinook salmon as hatchery- or natural-origin is an important component of both research and management. Chinook salmon that originate in a hatchery can carry one or more marks, depending on the program of origin. Chinook salmon bearing an external mark, typically an adipose or ventral fin clip, are classified as hatchery-origin. However, some hatchery-origin fish have no external mark but do have a CWT and are also classified as hatchery-origin. Hatchery-origin fish are referred to as either production fish or supplementation fish. The term production is used in reference to a hatchery-origin Chinook salmon with an adipose fin clip (AD) that can be legally harvested in a mark selective fishery, while supplementation refers to Chinook salmon that are part of the Idaho Supplementation Study (ISS) or the Nez Perce Tribal (NPT) hatchery program and are not intended to contribute to mark-selective fisheries. Supplementation fish are typically marked with a right ventral (RV) or left ventral (LV) fin clip or with a CWT and no external mark. While these are the general marking guidelines, the above stipulations are not exclusive and occasional exceptions to this marking and tagging outline exist. For example, the brood year 2003 SFH production release was LV clipped-only due to a small release size. All releases and associated mark/tag types are outlined in Tables 4, 5, and 6 of this report. The last brood year that contained releases associated with the ISS was 2002. For a more detailed explanation of the ISS program, refer to Bowles and Leitzinger (1991) and Venditti et al. (2006 and 2008).

Brood Year Reconstruction, Smolt-to-Adult Returns, Smolt-to-Adult Survivals, and Progeny-to-Parent Ratios

In order to reconstruct a brood year of hatchery-origin Chinook salmon, adults that return from a given brood year over three return years are summarized. For example, the 2002 brood year includes age-3 fish that returned in 2005, age-4 fish that returned in 2006, and age-5 fish that returned in 2007. In addition, there is a portion of the run that returns as minijacks. These fish out-migrate to the lower Columbia River or estuary but return after only a few months. Because minijacks are seldom recovered, no estimates were made of their abundance for the brood years covered in this report. For future brood years, PIT tag expansions will be used to estimate minijacks returning to Columbia River and Snake River dams.

Smolt-to-adult return rates (SARs) were estimated by summing the total returns from a given brood year that made it all the way back to LGD, divided by the number of smolts released from the brood in question. Smolt-to-adult survival rates (SASs) were estimated by summing the total returns and recoveries from a given brood year for the entire Columbia basin and Pacific Ocean. Both estimates include age-3 (jack) recoveries. While both the SAS and SAR acronyms indicate the metric is applied to "smolt," for the purposes of this report SAS and SAR are also used to describe release to adult survival rates for subyearlings.

Progeny-to-parent ratios (PPR) were estimated by dividing the total number of adult returns from a brood year by the number of males and females that were spawned to create the brood in question. For example, the brood year 2002 progeny-to-parent ratio was calculated by dividing the number of age-4 and age-5 males and females that returned in 2006 and 2007, respectively, by the number of males and females that were spawned in 2002. Jacks are excluded from PPR ratios because they are used in low numbers in hatchery brood stocks (less than 10% of males used). A one-to-one ratio signifies the brood was at replacement or, simply stated, that each male/female pair that was spawned in 2002 produced two returning adults. Two different progeny-to-parent ratios are provided in this report. The first includes only the number of age-4 and age-5 progeny that returned to LGD (PPR Project Area), and the second includes the estimated number of all age-4 and age-5 progeny recovered throughout the Columbia basin and in the Pacific Ocean (PPR Total). Because adult returns from some releases could not be accounted for due to lack of tag/marks and sufficient surrogates (see Estimating Downriver Harvest and Strays section above), progeny-to-parent ratios only include actual parents that contributed to returns that could be fully accounted for within a brood year at a given hatchery. Contributing parents within progeny-to-parent ratios were adjusted to include prespawn mortalities. Females culled were only included if fish were culled resulting in egg numbers lower than the hatchery target. If culling occurred as a means to reduce eggs on hand to target numbers, those culled females were not included in the progeny to parent ratios.

RESULTS AND DISCUSSION

Spawning and Eye-Up

Spawning was conducted across all spring/summer Chinook salmon facilities in August and September of each brood year. It is important to note that estimates of total green eggs collected includes eggs that were later culled and may also include eggs that were later transferred to another facility or organization. These culled or transferred eggs and their parents were not used in estimating on-station survival or progeny to parent ratios.

Prespawn mortality rates were highly variable across facilities and sexes for the brood years reported and ranged from a low of 1.5% for brood year 2002 PFH males to a high of 48.2% for brood year 2003 RRFH females (Table 3). This high level of variation is driven by variability in fish health, fish condition, fish handling, water temperatures, and water levels that occur between each trap from year to year.

Fecundity was also highly variable across brood years and facilities, with a low of 3,522 average eggs/female at RRFH in 2002 and a high of 5,587 average eggs/female at PFH in 2003 (Table 3). Variation in female age at return is the main driver in the variability of female fecundity.

For the three brood years, the majority of the green egg takes met or exceeded the level needed to fill the hatcheries to production. The only facility that fell short was SFH for brood years 2003 and 2004. The reduced number of green eggs taken at SFH for these brood years was due to insufficient numbers of returning adults.

Table 3. Brood year 2002, 2003, and 2004 spring/summer Chinook salmon prespawn mortality, number of fish spawned, fecundity, number of females culled, and green eggs collected for LSRCP and IPC hatcheries operated by IDFG.

Brood Year	Collection Facility / Stock	Male Prespawn Mortality %	Female Prespawn Mortality %	# Males Spawned	# Females Spawned*	Fecundity	# Females Culled	Total Green Eggs Collected**
2004		9.9	21.3	691	457	4,460	82	2,038,292
2003	McCall	17.6	45.9	632	481	5,401	100	2,598,233
2002		18.3	38.4	571[a]	381[b]	4,735	61	1,804,033
2004		2.2	1.8	312	434	4,607	10	1,999,254
2003	Sawtooth	11.5	8.3	54	33	5,290	1	174,575
2002		4.1	29.1	161	194[c]	5,348	3	1,037,558
2004	SF Clrwtr.	5.1	7.8	477	436	3,818	93	1,309,624
2004	Powell	21.8	3.0	590	492	4,064	97	1,605,432
2003	SF Clrwtr.	4.9	11.9	499	428	5,249	109	1,588,998
2003	Powell	4.8	18.1	383	369	4,409	18	1,255,390
2002	SF Clrwtr.	14.1	23.6	391	485	4,077	52	1,726,885
2002	Powell	2.5	2.8	371	554	3,900	51	1,930,703
2004		12.6	24.3	1,223	1,222	3,586	95	4,382,092
2003	Rapid R.	31.9	48.2	793	767	4,603	107	3,530,501
2002		16.9	22.1	1,150	1,374	3,522	263	4,839,228
2004		5.0	2.6	347	368	4,404	70	1,620,513
2003	Pahsimeroi	7.4	7.5	275	346	5,587	121	1,933,102
2002		1.5	9.9	263	263	4,917	14	1,293,123

* Total females spawned includes those females later culled.

** Total Green Eggs Collected includes eggs that were later culled and often includes eggs that were later transferred to another facility or organization. For numbers of eggs collected for hatchery-specific smolt releases, see Table 6.

[a] Total includes four natural males spawned as part of the final brood year for the ISS study.

[b] Total includes 38 natural females spawned as part of the final brood year for the ISS study.

[c] Total includes 24 natural females spawned as part of the final brood year for the ISS study.

Green Egg to Release Survival

The number of green eggs collected at each facility for each brood year is outlined in Table 4 below along with percent eye-up, number of eyed eggs, smolt released, and green egg to release survival rates. Due to rearing practices at CFH, it was not possible to track green egg

to smolt survival while excluding subyearling releases, so estimates shown for that facility include parr and presmolts. Also, due to eggs transferred in for brood year 2003 and discrepancies between inventory pre- and post-tagging for brood year 2002, there are no green egg to release survival estimates generated for RRFH for those years. With the exception of CFH, the number of green eggs shown in Table 4 represents green eggs collected for smolt releases post culling. Green egg to release survival rates, for the brood years covered, were similar to those observed from brood year 1990 through 2001 (Appendix A).

Table 4. Number of green eggs collected, percent survival to eye-up, number of eyed eggs, smolts released, and green egg to smolt survival for LSRCP and IPC hatcheries operated by IDFG for brood years 2002, 2003, and 2004.

Brood Year	Collection Facility / Stock	# Green Eggs Collected for Smolt Production	% Eye	# Eyed Eggs	Yearling Smolts Released	Green Egg to Smolt Survival
2004	McCall	1,417,440	86.5	1,226,086	1,094,264	77.2%
2003		1,465,077	83.1	1,217,479	1,047,530	71.5%
2002		1,351,814	87.3	1,180,133	1,088,210	80.5%
2004	Sawtooth	1,953,368	87.7	1,713,103	1,552,444	79.5%
2003		169,280	83.7	141,687	134,769	79.6%
2002		1,021,468	88.7	906,042	812,200	79.5%
2004	Clearwater	2,915,056	93.9	2,739,433	2,562,906*	87.9%*
2003		2,844,388	89.2	2,536,167	1,980,046*	69.6%*
2002		3,028,970	97.9	2,906,538	2,421,106*	79.9%*
2004	Rapid R.	3,670,292	87.7	3,217,320	3,130,528	85.3%
2003		3,037,967	92.6	2,812,795	3,261,430	[a]
2002		3,670,292	87.7	3,217,320	3,562,154	[b]
2004	Pahsimeroi	1,312,392	86.9	1,140,469	1,073,951	81.8%
2003		1,257,180	87.4	1,098,831	975,252	77.6%
2002		1,224,333	90.8	1,111,694	1,108,998	90.6%

* Includes parr and presmolt releases

[a] Eyed eggs were brought in from Clearwater (370,000) and Dworshak and mixed with the production group so no green egg to smolt survival was calculated.

[b] At marking, estimated number of fish on hand increased significantly from hatchery estimates; no green egg to smolt survival was calculated.

Juvenile Releases

From July 28, 2003 through April 25, 2004, a total of 9,072,656 brood year 2002 juvenile spring and summer Chinook salmon were released from the three LSRCP and two IPC fish hatcheries (Table 5). This was the last brood year that contained releases from the ISS study. A total of 7,802,940 brood year 2003 juveniles were released from September 1, 2004 to April 22, 2005 (Table 6) and 9,415,764 brood year 2004 juveniles were released from June 21, 2005 to April 24, 2006 (Table 7). Each specific release, by hatchery, stock, and life stage at release is outlined in Tables 5, 6, and 7.

Mark and tag types are also outlined for each release group in the tables below. The majority of Chinook salmon from the three brood years were adipose clipped for the purpose of mark-selective fisheries. However, some supplementation releases were CWT-, right ventral (RV) clip-, or left ventral (LV) clip-only. The majority of the release groups also contained a group of PIT tags so that juvenile survivals to LGD could be estimated. The mark/tag types for each release group are outlined in Tables 5, 6, and 7.

Table 5. Brood year 2002 juvenile spring/summer Chinook salmon released in 2003 (subyearling parr or presmolts) and 2004 (yearling smolts) from LSRCP and IPC hatcheries operated by IDFG.

Migr. Year	Hatchery-Program	Rel. Site	Release Date(s)	AD Only	AD/CWT	CWT Only	PIT TAG*	Total Release	Size at Release (fpp)
2004	McCall-Prod	SFSR-Knox	3/21 - 3/25	590,159	323,901	0	51,577	914,060	20.9
2004	McCall-ISS	SFSR-Knox	3/21 - 3/25	0	0	174,150	600	174,150	20.9
2003**	McCall-ISS	SFSR- Stolle Pond	7/14 - 7/16	0	0	80,340	589	80,340	112.0
McCall Total Release				**590,159**	**323,901**	**254,490**	**52,766**	**1,168,550**	
2004	Rap R-Prod	Rapid R. Pond	3/15 - 4/25	2,445,059	316,999	0	51,969	2,762,058	24.5
2004	Rap R-Prod	Little Sal. R.	3/18	300,140	0	0	0	300,140	24.5
2004	Rap R-Prod	Hells Can. Dam	3/15 -3/17	499,956	0	0	0	499,956	24.5
Rapid River Total Release				**3,245,155**	**316,999**	**0**	**51,969**	**3,562,154**	
2004	Clrwtr-Prod	Powell Pond	3/25 - 4/8	376,797	0	0	292	376,797	15.5
2004	Clrwtr-Prod	Red River Pond	4/7 - 4/9	354,868	0	0	296	354,868	15.5
2004	Clrwtr-Prod	Crooked R. Pond	4/7 - 4/9	750,317	0	0	299	750,317	16.1
2004	Clrwtr-ISS	Papoose Cr.	4/8	4,107	52,067	0	801	56,174	16.3
2003**	Clrwtr-ISS	Colt Killed Cr.	7/29 - 7/31	0	0	0	708	122,152[a]	45.0
2003**	Clrwtr-Prod	Powell Pond	9/16	385,431	0	0	0	385,431	19.7
2003**	Clrwtr-ISS	Red River Pond	9/26	0	0	0	496	108,323[b]	34.0
2003**	Clrwtr-ISS	Crooked R. Pond	9/17	0	0	0	499	234,361[a]	40.0
2003**	Clrwtr-ISS	Pete King Cr.	7/28	0	0	16,293	1,001	16,293	47.0
2003**	Clrwtr-ISS	Lochsa @ Fishing	7/28	0	0	16,038	797	16,038	NA
Clearwater Total Release				**1,871,520**	**52,067**	**32,331**	**5,189**	**2,420,754**	
2004	Saw-Prod	Sawtooth Weir	4/13	521,765	102,974	0	498	624,739	20.9
2004	Saw-ISS	Sawtooth Weir	4/13	0	0	187,461	499	187,461	18.3
Sawtooth Total Release				**521,765**	**102,974**	**187,461**	**997**	**812,200**	
2004	Pahsim-Prod	Pahsimeroi R.	4/11 - 4/21	888,612	95,897	0	486	984,509	15.4
2004	Pahsim-ISS	Pahsimeroi R.	4/11 - 4/21	0	0	124,489	484	124,489	15.4
Pahsimeroi Total Release				**888,612**	**95,897**	**124,489**	**970**	**1,108,998**	

* PIT tag total is not in addition to other mark/tag columns but is included in those groups.
** Brood year 2002 subyearlings, released in 2003, and out-migrated in 2004.
[a] Left ventral clipped only.
[b] Right ventral clipped only.

Table 6. Brood year 2003 juvenile spring/summer Chinook salmon released in 2004 (subyearling parr or presmolts) and 2005 (yearling smolts) from LSRCP and IPC hatcheries operated by IDFG.

Migr. Year	Hatchery-Program	Rel. Site	Release Date(s)	AD Only	AD/CWT	CWT Only	PIT TAG*	Total Release	Size at Release (fpp)
2005	McCall-Prod	SFSR-Knox	3/18 - 3/21	782,636	264,894	0	51,872	1,047,530	20.9
2004**	McCall-Prod	SFSR-Knox	9/23 - 9/24	220,000	0	0	0	220,000	32.5
McCall Total Release				**1,002,636**	**264,894**	**0**	**51,872**	**1,267,530**	
2005	Rap R-Prod	Rapid R. Pond	3/15 - 4/22	2,655,505	105,925	0	51,975	2,761,430	19.1
2005	Rap R-Prod	Little Sal. R.	3/11	200,000	0	0	0	200,000	24.4
2005	Rap R-Prod	Hells Can. Dam	3/8 -3/10	300,000	0	0	0	300,000	20.8
2004**	Rap R-Prod	Selway-Magruder	9/1 - 9/8	183,923	0	0	0	183,923	56.3
Rapid River Total Release				**3,339,428**	**105,925**	**0**	**51,975**	**3,445,353**	
2005	Clrwtr-Prod	Powell Pond	3/24 - 4/5	317,291	86,626	0	300	403,917	15.7
2005	Clrwtr-Prod	Red River Pond	3/21 – 4/4	313,831	87,531	0	300	401,362	15.5
2005	Clrwtr-Prod	Crooked R. Pond	3/29 - 3/31	264,332	85,862	0	150	350,194	15.8
2005	Clrwtr-Prod	Crooked R. Trap	3/29 - 3/31	350,193	0	0	147	350,193	15.8
2004**	Clrwtr-Prod	Powell Pond	9/24 – 9/26	410,117	0	0	707	410,117	20.9
2004**	Clrwtr-Prod	Crooked River	9/23	64,263	0	0	0	64,263	24.5
Clearwater Total Release				**1,720,027**	**260,019**	**0**	**1,604**	**1,980,046**	
2005	Saw-Prod	Sawtooth Weir	3/31	0	0	0	500	134,769[a]	19.0
Sawtooth Total Release				**0**	**0**	**0**	**500**	**134,769[a]**	
2005	Pahsim-Prod	Pahsimeroi R.	3/22 - 3/25	869,408	105,844	0	499	975,252	18.2
Pahsimeroi Total Release				**869,408**	**105,844**	**0**	**499**	**975,252**	

* PIT tag total is not in addition to other mark/tag columns but is included in those groups.
** Brood year 2003 subyearlings, released in 2004, and out-migrated in 2005.
[a] Left ventral clipped only.

Table 7. Brood year 2004 juvenile spring/summer Chinook salmon released in 2005 (subyearling parr or presmolts) and 2006 (yearling smolts) from LSRCP and IPC hatcheries operated by IDFG.

Migr. Year	Hatchery-Program	Rel. Site	Release Date(s)	AD Only	AD/CWT	CWT Only	PIT TAG*	Total Release	Size at Release (fpp)
2006	McCall-Prod	SFSR-Knox	3/20 - 3/23	836,933	257,331	0	51,904	1,094,264	18.1
McCall Total Release				**836,933**	**257,331**	**0**	**51,904**	**1,094,264**	
2006	Rap R-Prod	Rapid R. Pond	3/15 - 4/24	2,422,988	107,540	0	51,952	2,530,528	19.3
2006	Rap R-Prod	Little Sal. R.	3/16 - 3/18	200,000	0	0	0	200,000	21.1
2006	Rap R-Prod	Hells Can. Dam	3/14 -3/17	400,000	0	0	0	400,000	21.1
Rapid River Total Release				**3,022,988**	**107,540**	**0**	**51,952**	**3,130,528**	
2006	Clrwtr-Prod	Powell Pond	3/22 - 4/6	342,078	81,555	0	15,274	423,633	16.0
2006	Clrwtr-Prod	Red River Pond	3/30 - 4/3	381,960	41,643	0	15,273	423,603	16.5
2006	Clrwtr-Prod	Crooked R. Pond	3/27 - 3/30	140,989	0	0	300	140,989	15.9
2006	Clrwtr-Prod	Crooked R. Trap	4/3 - 4/5	567,082	41,390	0	15,278	608,472	17.0
2006	Clrwtr-Supp	Selway River	4/3 - 4/4	9,520	203,584	104,314	0	317,418	15.3
2005**	Clrwtr-Supp	Selway River	6/21 - 6/29	0	0	0	0	301,528[a]	32.8
2005**	Clrwtr-Prod	Powell Pond	9/16 - 9/18	348,934	0	0	694	348,934	17.4
Clearwater Total Release				**1,790,563**	**368,172**	**104,314**	**46,819**	**2,564,577**	
2006	Saw-Prod	Sawtooth Weir	3/30 - 4/21	1,425,847	126,597	0	500	1,552,444	21.7
Sawtooth Total Release				**1,425,847**	**126,597**	**0**	**500**	**1,552,444**	
2006	Pahsim-Prod	Pahsimeroi R.	3/13 - 3/30	969,816	104,135	0	497	1,073,951	22.0
Pahsimeroi Total Release				**969,816**	**104,135**	**0**	**497**	**1,073,951**	

* PIT tag total is not in addition to other mark/tag columns but is included in those groups.
** Brood year 2004 parr that were OTC marked, released in 2005, and out-migrated in 2006.
[a] No tags or marks.

Juvenile Migration Timing and Survival

Representative groups from all hatchery facilities were PIT tagged to evaluate migration timing and survival to LGD. These evaluation groups include fish released as subyearling parr and presmolts as well as yearling smolts.

Yearling Smolts

The majority of Chinook salmon released as yearling smolts from Idaho fish hatcheries arrived at LGD from late April to mid-May (Tables 8, 9, and 10). The unweighted average across release groups for the “80% arrival window” for yearling smolt releases was 14.7 days (range 7 to 21 days) for migration year 2004 (Table 8), 14.6 days (range 13 to 21 days) for migration year 2005 (Table 9), and 17.5 days (range 14 to 21 days) for migration year 2006 (Table 10).

In migration year 2004, survival estimates for yearling smolts from release to LGD had an unweighted average of 60.3% and ranged from a low 48.0% for the Crooked River Pond release to a high of 77.5% for the Powell Pond release group (Table 8).

In migration year 2005, the unweighted mean survival was 55.6% and ranged from a low of 22.0% for the Sawtooth Weir release to a high of 83.6% for the Powell Pond release (Table 9). Migration year 2005 Sawtooth and Pahsimeori Fish Hatchery smolt releases had exceptionally low outmigration survivals when compared to previous brood years (Appendix B).

In migration year 2006, the unweighted mean survival was 57.9% and ranged from a low of 26.7% for the Pahsimeroi release to a high of 79.0% for the Powell Pond release (Table 10). Like migration year 2005, the 2006 outmigrating Pahsimeroi Fish Hatchery smolts had a lower than average juvenile survival when compared to brood years 1991 through 2001 (Appendix B).

Survival of hatchery-origin yearling smolts released in 2004, 2005, and 2006 is inversely related with distance from the release sites to Lower Granite Dam (Figure 2). This relationship is typical of previous years (Leth et. al. 2004, Leth 2007, Leth and Lindley 2008, Cassinelli and Lindley 2008, Cassinelli and Knipper 2009), as the increased travel distance results in a higher mortality levels.

Subyearling Parr and Presmolts

For all three of the brood years covered in this report, the only parr release that contained PIT tags was the brood year 2002 MFH parr release at Stolle Pond. The LGD "80% arrival window" for this release was 19 days with a 3.8% survival, well below the 60.3% average survival observed in the smolts released from the same brood year (Table 8).

There were two presmolt releases from brood year 2002 that contained PIT tags. These fish arrived at LGD from mid-April through early July with an average "80% arrival window" of 50 days and an average survival of 3.7%. Only one presmolt release of hatchery origin Chinook salmon contained PIT tags for both brood year 2003 and 2004. Individuals from the brood year 2003 release arrived at LGD from early April through early May with an "80% arrival window" of 30 days and a survival of 12.2% compared to averages of 14.6 days and 55.6% for the brood year 2003 yearling smolt releases (Table 9). The majority of the presmolts from the brood year 2004 release arrived at LGD throughout the month of April with an "80% arrival window" of 25 days and a survival of 4.6% compared to averages of 17.4 days and 57.9% for the brood year 2004 yearling smolt releases (Table 10).

The estimated survival to LGD of hatchery-origin juveniles released as parr and presmolts shows a substantial decrease from the hatchery-origin smolt survival and is likely due to the overwinter mortality associated with fish released as subyearlings in the fall. Differential survival between subyearling and yearling hatchery-origin juveniles observed in 2004, 2005, and 2006 was consistent with previous years (Leth et al. 2004, Leth 2007, Leth and Lindley 2008, Cassinelli and Lindley 2008, Cassinelli and Knipper 2009).

Table 8. Estimated survival, migration, and arrival timing of brood year 2002 juvenile Chinook salmon released from fish hatcheries located in Idaho.

Rearing Hatchery	Life Stage	Release Site	Program	Distance to LGD (Km)	Number PIT Tagged	Number of Unique Detections at LGD	Estimated Survival (%) to LGD (95% CI)	Probability of Detection	Median Arrival Date	80% Arrival Window (# of Days)
Clearwater	Presmolt	Red River Pond	ISS	299	496	28	**6.5** (4.3 - 8.8)	0.8615	5/21	4/13 - 6/10 (59)
	Presmolt	Crooked River Pond	ISS	280	499	4	**0.8** (0.0 - 1.6)	1.0000	6/24	5/24 - 7/2 (40)
	Smolt	Crooked R. Pond	Prod.	280	299	95	**48.0** (42.0 - 54.1)	0.6615	5/11	5/4 - 5/24 (21)
	Smolt	Powell Pond	Prod.	321	292	154	**77.5** (71.3 - 83.8)	0.6802	5/4	4/28 - 5/7 (10)
	Smolt	Red R. Pond	Prod.	299	296	151	**72.2** (66.4 - 77.9)	0.7091	5/5	5/1 - 5/21 (21)
McCall	Smolt	S. Fork Salmon R.	Prod.	457	51,577	21,659	**56.0** (55.5 - 56.5)	0.7502	5/4	4/28 - 5/10 (13)
	Smolt	S. Fork Salmon R.	ISS	457	600	274	**62.8** (58.4 - 67.1)	0.7274	5/5	4/28 - 5/10 (13)
	Parr	Stolle Pond	ISS	470	589	17	**3.8** (2.2 - 5.4)	0.7619	5/9	5/3 - 5/21 (19)
Sawtooth	Smolt	Sawtooth Weir	Prod.	747	498	239	**59.2** (54.4 - 63.9)	0.8105	5/4	5/1 - 5/9 (9)
	Smolt	Sawtooth Weir	ISS	747	499	234	**56.8** (52.1 - 61.4)	0.8260	5/4	4/29 - 5/6 (8)
Pahsimeroi	Smolt	Pahsimeroi R.	Prod.	630	486	160	**50.1** (44.5 - 55.7)	0.6572	5/5	4/29 - 5/7 (9)
	Smolt	Pahsimeroi R.	ISS	630	484	159	**50.9** (44.5 - 56.3)	0.6455	5/5	5/1 - 5/7 (7)
Rapid River	Smolt	Rapid River Hatchery	Prod.	283	51,969	22,625	**69.4** (68.9 – 69.9)	0.6274	5/1	4/21 - 5/5 (15)

Table 9. Estimated survival, migration, and arrival timing of brood year 2003 juvenile Chinook salmon released from fish hatcheries located in Idaho.

Rearing Hatchery	Life Stage	Release Site	Program	Distance to LGD (Km)	Number PIT Tagged	Number of Unique Detections at LGD	Estimated Survival (%) to LGD (95% CI)	Probability of Detection	Median Arrival Date	80% Arrival Window (# of Days)
Clearwater	Presmolt	Powell Pond	Prod.	321	707	66	**12.2** (9.6 - 14.7)	0.7700	4/27	4/12 - 5/10 (30)
	Smolt	Crooked R. Trap	Prod.	266	147	69	**67.6** (58.6 - 76.6)	0.6946	4/29	4/20 - 5/6 (17)
	Smolt	Crooked R. Pond	Prod.	280	150	39	**47.9** (37.8 - 57.8)	0.5435	5/2	4/27 - 5/17 (21)
	Smolt	Powell Pond	Prod.	321	300	151	**83.6** (77.1 - 90.1)	0.6021	4/28	4/21 - 5/2 (13)
	Smolt	Red R. Pond	Prod.	299	300	113	**67.6** (60.0 - 75.1)	0.5576	5/1	4/26 - 5/9 (14)
McCall	Smolt	S. Fork Salmon R.	Prod.	457	51,872	21,142	**60.4** (59.9 - 60.9)	0.6756	5/6	4/29 - 5/12 (14)
Sawtooth	Smolt	Sawtooth Weir	Prod.	747	500	79	**22.0** (18.1 - 25.9)	0.7191	5/6	4/30 - 5/10 (11)
Pahsimeroi	Smolt	Pahsimeroi R.	Prod.	630	499	92	**22.1** (18.1 - 26.1)	0.8358	4/27	4/20 - 5/3 (14)
Rapid River	Smolt	Rapid River Hatchery	Prod.	283	51975	26,573	**73.6** (73.1 - 74.0)	0.6957	5/5	4/27 - 5/9 (13)

Table 10. Estimated survival, migration, and arrival timing of brood year 2004 juvenile Chinook salmon released from fish hatcheries located in Idaho.

Rearing Hatchery	Life Stage	Release Site	Program	Distance to LGD (Km)	Number PIT Tagged	Number of Unique Detections at LGD	Estimated Survival (%) to LGD (95% CI)	Probability of Detection	Median Arrival Date	80% Arrival Window (# of Days)
Clearwater	Presmolt	Powell Pond	Prod.	321	694	12	**4.6** (2.1-7.2)	0.3731	4/22	4/5 - 4/29 (25)
	Smolt	Crooked R. Trap	Prod.	266	15,278	2,401	**62.8** (58.8-66.7)	0.2505	5/8	4/25 - 5/8 (14)
	Smolt	Crooked R. Pond	Prod.	280	300	32	**36.9** (28.3-45.5)	0.2904	5/9	5/1 - 5/20 (20)
	Smolt	Powell Pond	Prod.	321	15,274	3,164	**79.0** (74.6-83.3)	0.2625	5/4	4/25 - 5/11 (17)
	Smolt	Red R. Pond	Prod.	299	15,273	2,217	**52.4** (49.3-59.6)	0.2769	5/7	4/27 - 5/14 (20)
McCall	Smolt	S. Fork Salmon R.	Prod.	457	51,904	9,725	**63.8** (62.5-65.1)	0.2937	5/6	4/26 - 5/15 (21)
Sawtooth	Smolt	Sawtooth Weir	Prod.	747	500	100	**65.3** (56.2-74.4)	0.3064	5/8	5/3 - 5/16 (14)
Pahsimeroi	Smolt	Pahsimeroi R.	Prod.	630	497	43	**26.7** (21.7-31.6)	0.3243	5/2	4/26 - 5/11 (16)
Rapid River	Smolt	Rapid River Hatchery	Prod.	283	51,952	13,161	**75.9** (74.7-77.1)	0.3339	5/5	4/26 - 5/13 (18)

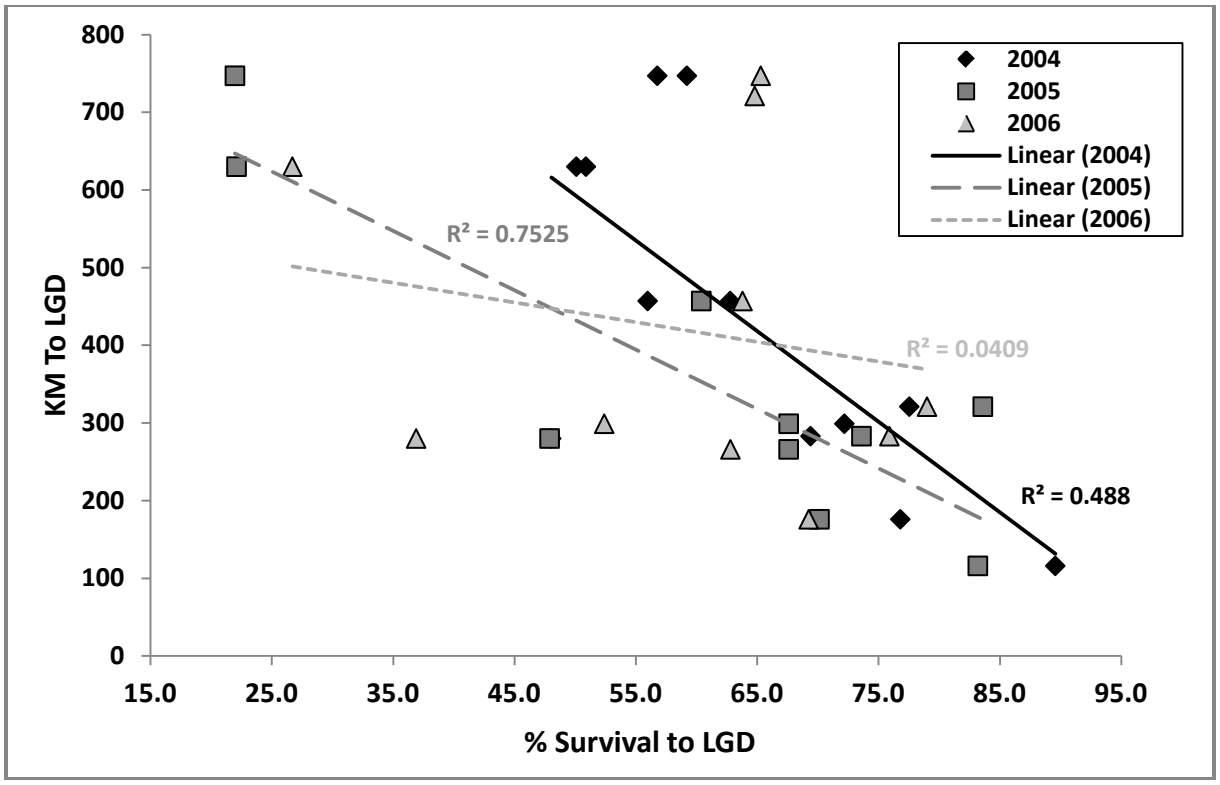


Figure 2. Relationship between estimated survival (%) and distance (km) from release site to Lower Granite Dam for hatchery-origin Chinook salmon PIT tagged and released as yearling smolts in 2004, 2005, and 2006.

Adult Returns and Harvest Information

Adult returns from brood years 2002, 2003, and 2004 were estimated from stock-specific basinwide harvest, stray, and trapping estimates. These estimates take into account harvest from the Pacific Ocean, Columbia River, Snake River, and terminal areas as well as any strays collected throughout the Columbia basin. In Idaho, roving creel and check stations were used to generate estimates for specific tribal and sport fisheries throughout the Clearwater and Salmon River basins. Return estimates are listed by each fishery/stray reach and by age at return for a given brood year and are outlined in Tables 11, 12, and 13.

Table 11. Estimated harvest, strays, and escapement of hatchery-origin Chinook salmon from brood year 2002. Estimates correspond with each brood year 2002 release from Table 3.

			HARVEST										STRAYS			TRIBUTARY ESCAP.			TOTAL
Hatchery - Program	Release Site	Return Year	Ocean	Zone 1-5 Sport	Zone 1 - 5 Comm. Net	Zone 6 Sport	Zone 6 Tribs	Zone 6 Tribal	Col. R. Above MCN	Snake Below Idaho	Idaho Sport	Idaho Tribal	Col. River	Snake Below LGD	Snake Above LGD	Below Weir	Above Weir	Weir/ Term	Total Return
		2007	0	57	0	0	0	12	0	0	43	20	0	0	0	33	0	235	400
MFH -		2006	24	201	132	0	0	336	0	0	342	173	9	0	0	525	12	1,208	2,962
Production	Knox B.	2005	0	42	12	0	0	15	0	0	23	11	0	0	0	43	0	358	504
MFH	**Knox B.**	**Total**	**24**	**300**	**144**	**0**	**0**	**363**	**0**	**0**	**408**	**204**	**9**	**0**	**0**	**601**	**12**	**1,801**	**3,866**
		2007	0	0	0	0	0	0	0	0	0	6	0	0	0	25	6	53	90
		2006	8	10	1	0	0	40	0	0	1	47	0	0	0	17	55	300	479
MFH - ISS	Knox B.	2005	0	0	0	0	0	2	0	0	0	2	0	0	0	0	5	107	116
MFH	**Knox B.**	**Total**	**8**	**10**	**1**	**0**	**0**	**42**	**0**	**0**	**1**	**55**	**0**	**0**	**0**	**42**	**66**	**460**	**685**
		2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
MFH - ISS		2006	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	9	10
(Subyear.)	Stolee M.	2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MFH	**Stolee**	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**12**	**13**
McCall Hatchery TOTAL			**32**	**310**	**145**	**0**	**0**	**405**	**0**	**0**	**409**	**260**	**9**	**0**	**0**	**643**	**78**	**2,273**	**4,564**
		2007	0	65	228	61	0	0	0	0	148	275	9	0	0	0	0	701	1,487
RRFH -		2006	39	185	11	226	0	53	0	0	770	1,164	18	0	0	0	0	2,322	4,788
Production	RRFH.	2005	0	0	0	0	0	0	0	0	10	14	0	0	0	0	0	109	133
RRFH	**RR Hat.**	**Total**	**39**	**250**	**239**	**287**	**0**	**53**	**0**	**0**	**1,029**	**1,453**	**27**	**0**	**0**	**0**	**0**	**3,132**	**6,408**
		2007	0	7	23	6	0	0	0	0	16	30	1	0	0	/	/	76	159
RRFH. -	L. Sal.	2006	4	18	1	23	0	6	0	0	84	126	2	0	0	/	/	252	516
Production	R*[a]	2005	0	0	0	0	0	0	0	0	1	1	0	0	0	/	/	12	14
RRFH	**L. Sal. R**	**Total**	**4**	**25**	**24**	**29**	**0**	**6**	**0**	**0**	**101**	**157**	**3**	**0**	**0**	**/**	**/**	**340**	**689**
		2007	0	11	38	10	0	0	0	0	0	0	2	0	0	/	0	203	264
RRFH	HC	2006	7	31	2	38	0	9	0	0	0	0	3	0	0	/	0	770	860
Production	Dam*[a]	2005	0	0	0	0	0	0	0	0	0	0	0	0	0	/	0	24	24
RRFH	**HC Dam**	**Total**	**7**	**42**	**40**	**48**	**0**	**9**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**/**	**0**	**997**	**1,148**
Rapid River Hatchery TOTAL			**50**	**317**	**303**	**364**	**0**	**68**	**0**	**0**	**1,130**	**1,610**	**35**	**0**	**0**	**0**	**0**	**4,469**	**8,245**
		2007	0	0	0	0	0	0	0	0	0	0	0	0	0	/	0	151	151
CFH -	Powell	2006	0	0	0	0	0	0	7	0	36	0	7	7	45	/	0	258	360
Production	Pond*	2005	0	0	0	0	0	0	0	0	0	0	0	0	8	/	0	7	15
CFH	**Powell**	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**36**	**0**	**7**	**7**	**53**	**/**	**0**	**416**	**526**
	Red	2007	0	0	0	0	0	0	0	0	0	0	0	0	0	61	0	62	123
CFH -	River	2006	0	0	0	0	0	0	10	0	37	0	10	10	67	40	0	447	621
Production	Pond*	2005	0	0	0	0	0	0	0	0	1	0	0	0	13	3	0	15	32
CFH	**Red R.**	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**38**	**0**	**10**	**10**	**80**	**104**	**0**	**524**	**776**
		2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	88	88
CFH -	Crooked	2006	0	0	0	0	0	0	12	0	52	0	12	12	80	0	0	628	796
Production	R. Pond*	2005	0	0	0	0	0	0	0	0	1	0	0	0	14	0	0	21	36
CFH	**Crk. P.**	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**12**	**0**	**53**	**0**	**12**	**12**	**94**	**0**	**0**	**737**	**920**
		2007	0	0	0	0	0	0	0	0	0	0	0	0	0	/	/	23	23
	Papoose	2006	0	0	0	0	0	0	1	0	5	0	1	1	6	/	/	38	52
CFH - ISS	Cr. [a]	2005	0	0	0	0	0	0	0	0	0	0	0	0	1	/	/	1	2
CFH	**Papoose**	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**5**	**0**	**1**	**1**	**7**	**/**	**/**	**62**	**77**

Table 11. Continued.

Hatchery - Program	Release Site	Return Year	HARVEST										STRAYS			TRIBUTARY ESCAP.			TOTAL
			Ocean	Zone 1-5 Sport	Zone 1 - 5 Comm. Net	Zone 6 Sport	Zone 6 Tribs	Zone 6 Tribal	Col. R. Above MCN	Snake Below Idaho	Idaho Sport	Idaho Tribal	Col. River	Snake Below LGD	Snake Above LGD	Below Weir	Above Weir	Weir/ Term	Total Return
	Colt	2007	0	/	0	/	/	0	/	/	0	0	0	0	0	/	/	0	0
CFH - ISS	Killed	2006	0	/	0	/	/	0	/	/	0	0	0	0	0	/	/	0	0
(Subyear.)	Cr.*[a]	2005	0	/	0	/	/	0	/	/	0	0	0	0	0	/	/	2	2
CFH	**Colt Kill**	**Total**	**0**	**/**	**0**	**/**	**/**	**0**	**/**	**/**	**0**	**0**	**0**	**0**	**0**	**/**	**/**	**2**	**2**
CFH -		2007	0	0	0	0	0	0	0	0	0	0	0	0	0	/	0	1	1
Production	Powell	2006	0	0	0	0	0	0	0	0	**1**	0	0	0	0	/	0	8	9
(Subyear.)	Pond*	2005	0	0	0	0	0	0	0	0	0	0	0	0	0	/	0	2	2
CFH	**Powell**	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**/**	**0**	**11**	**12**
	Red	2007	0	/	0	/	/	0	/	/	0	0	0	0	0	0	/	0	0
CFH - ISS	River	2006	0	/	0	/	/	0	/	/	0	0	0	0	0	0	/	7	7
(Subyear.)	Pond*	2005	0	/	0	/	/	0	/	/	0	0	0	0	0	0	/	0	0
CFH	**Red R.**	**Total**	**0**	**/**	**0**	**/**	**/**	**0**	**/**	**/**	**0**	**0**	**0**	**0**	**0**	**0**	**/**	**7**	**7**
		2007	0	/	0	/	/	0	/	/	0	0	0	0	0	0	0	1	1
CFH - ISS	Crooked	2006	0	/	0	/	/	0	/	/	0	0	0	0	0	0	0	0	0
(Subyear.)	R. Pond*	2005	0	/	0	/	/	0	/	/	0	0	0	0	0	0	0	2	2
CFH	**Crk. P.**	**Total**	**0**	**/**	**0**	**/**	**/**	**0**	**/**	**/**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**3**
		2007	0	/	0	/	/	0	/	/	/	0	0	0	0	/	/	0	0
CFH - ISS	Pete King	2006	0	/	0	/	/	0	/	/	/	0	0	0	0	/	/	0	0
(Subyear.)	Cr.[a]	2005	0	/	0	/	/	0	/	/	/	0	0	0	0	/	/	0	0
CFH	**Pete K.**	**Total**	**0**	**/**	**0**	**/**	**/**	**0**	**/**	**/**	**/**	**0**	**0**	**0**	**0**	**/**	**/**	**0**	**0**
	Lochsa	2007	0	/	0	/	/	0	/	/	/	0	0	0	0	/	/	0	0
CFH - ISS	@	2006	0	/	0	/	/	0	/	/	/	0	0	0	0	/	/	1	1
(Subyear.)	Fishing[a]	2005	0	/	0	/	/	0	/	/	/	0	0	0	0	/	/	0	0
CFH	**Lochsa**	**Total**	**0**	**/**	**0**	**/**	**/**	**0**	**/**	**/**	**/**	**0**	**0**	**0**	**0**	**/**	**/**	**1**	**1**
Clearwater Hatchery TOTAL			**0**	**0**	**0**	**0**	**0**	**0**	**30**	**0**	**130**	**0**	**30**	**30**	**234**	**104**	**0**	**1,763**	**2,324**
		2007	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	96	146
SFH -	Saw.	2006	0	0	19	6	0	0	0	0	0	31	0	0	0	35	12	384	487
Production	Hatch.	2005	0	0	0	0	0	0	0	0	0	5	0	0	0	0	12	99	116
SFH	**Saw. H.**	**Total**	**0**	**0**	**19**	**6**	**0**	**0**	**0**	**0**	**0**	**36**	**0**	**0**	**0**	**85**	**24**	**579**	**749**
		2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	22
SFH -	Saw.	2006	0	0	0	0	0	0	0	0	0	9	0	0	0	1	2	36	48
Production	Hatch.	2005	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	52	54
SFH	**Saw. H.**	**Total**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**0**	**0**	**1**	**2**	**110**	**124**
Sawtooth Hatchery TOTAL			**0**	**0**	**19**	**6**	**0**	**0**	**0**	**0**	**0**	**47**	**0**	**0**	**0**	**86**	**26**	**689**	**873**
		2007	0	0	0	0	0	78	0	0	0	/	0	0	0	0	0	130	208
PFH -	Pahsim.	2006	0	0	0	0	0	107	0	0	0	/	0	0	0	0	0	339	446
Production	Ponds	2005	0	0	0	0	0	0	0	0	0	/	0	0	0	0	0	58	58
PFH	**Pahsim.**	**Total**	**0**	**0**	**0**	**0**	**0**	**185**	**0**	**0**	**0**	**/**	**0**	**0**	**0**	**0**	**0**	**527**	**712**
		2007	0	0	0	0	0	16	0	0	0	/	0	0	0	0	0	0	16
	Pahsim.	2006	0	0	0	0	0	0	0	0	0	/	0	0	0	0	0	27	27
PFH - ISS	Ponds	2005	0	0	0	0	0	0	0	0	0	/	0	0	0	0	0	4	4
PFH	**Pahsim.**	**Total**	**0**	**0**	**0**	**0**	**0**	**16**	**0**	**0**	**0**	**/**	**0**	**0**	**0**	**0**	**0**	**31**	**47**
Pahsimeroi Hatchery TOTAL			**0**	**0**	**0**	**0**	**0**	**201**	**0**	**0**	**0**	**/**	**0**	**0**	**0**	**0**	**0**	**558**	**759**

Table 11. Continued.

* These releases had no CWT and a surrogate was used to generate downriver harvest and stray rates.
[a] These release sites were “off-site” meaning there was not a hatchery trap for fish to return to. Estimates of rack returns here are surrogate estimates of returns to terminal areas.
/ These fields were not valid for that release group based on mark type, or there was not enough data to make an estimate based on a lack of marks/tags.

Table 12. Estimated harvest and escapement of hatchery-origin Chinook salmon from brood year 2003. Estimates correspond with each brood year 2003 release from Table 4.

			HARVEST										STRAYS			TRIBUTARY ESCAP.			TOTAL
Hatchery - Program	Release Site	Return Year	Ocean	Zone 1-5 Sport	Zone 1 - 5 Comm. Net	Zone 6 Sport	Zone 6 Tribs	Zone 6 Tribal	Col. R. Above MCN	Snake Below Idaho	Idaho Sport	Idaho Tribal	Col. River	Snake Below LGD	Snake Above LGD	Below Weir	Above Weir	Weir/ Term	Total
		2008	0	0	12	40	0	0	0	0	160	14	0	0	0	96	0	211	533
MFH		2007	20	141	24	4	0	213	0	0	420	250	8	0	0	329	0	1,578	2,987
Production	Knox B.*	2006	0	0	4	0	0	0	0	0	8	6	0	0	0	60	2	256	336
MFH	**Knox B.**	**Total**	**20**	**141**	**40**	**44**	**0**	**213**	**0**	**0**	**588**	**270**	**8**	**0**	**0**	**485**	**2**	**2,045**	**3,856**
MFH -		2008	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Production		2007	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
(Subyear.)	Knox B.*	2006	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
MFH	**Knox B.**	**Total**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**
McCall Hatchery TOTAL			**20**	**141**	**40**	**44**	**0**	**213**	**0**	**0**	**588**	**270**	**8**	**0**	**0**	**485**	**2**	**2,045**	**3,856**
		2008	0	561	0	26	0	26	0	0	295	114	0	0	0	0	0	345	1,367
RRFH -		2007	0	196	0	297	0	0	0	0	619	568	26	0	0	26	0	2,317	4,049
Production	RRFH	2006	0	0	0	0	0	0	0	0	5	3	0	0	0	0	0	209	217
RRFH	**RRFH**	**Total**	**0**	**757**	**0**	**323**	**0**	**26**	**0**	**0**	**919**	**685**	**26**	**0**	**0**	**26**	**0**	**2,871**	**5,633**
		2008	0	33	0	2	0	2	0	0	21	8	0	0	0	/	/	25	91
RRFH -	L. Sal.	2007	0	11	0	19	0	0	0	0	45	41	2	0	0	/	/	168	286
Production	R**[a]	2006	0	0	0	0	0	0	0	0	0	0	0	0	0	/	/	15	15
RRFH	**L. Sal. R**	**Total**	**0**	**44**	**0**	**21**	**0**	**2**	**0**	**0**	**66**	**49**	**2**	**0**	**0**	**/**	**/**	**208**	**392**
		2008	0	49	0	3	0	3	0	0	0	0	0	0	0	/	0	82	137
RRFH -	HC	2007	0	17	0	29	0	0	0	0	0	0	3	0	0	/	0	381	427
Production	Dam**[a]	2006	0	0	0	0	0	0	0	0	0	0	0	0	0	/	0	24	24
RRFH	**HC Dam**	**Total**	**0**	**66**	**0**	**32**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**/**	**0**	**487**	**588**
RRFH -	Selway	2008	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Production	@	2007	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
(Subyear.)	Magrud.	2006	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
RRFH	**Selway**	**Total**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**
Rapid River Hatchery TOTAL			**0**	**867**	**0**	**376**	**0**	**31**	**0**	**0**	**985**	**734**	**31**	**0**	**0**	**31**	**0**	**3,566**	**6,618**
		2008	0	29	0	0	0	0	0	0	37	5	0	0	0	/	0	199	270
CFH -	Powell	2007	0	87	64	38	0	0	0	0	89	40	5	0	9	/	0	809	1,141
Production	Pond	2006	0	0	0	0	0	0	0	0	0	0	12	0	0	/	0	167	179
CFH	**Powell**	**Total**	**0**	**116**	**64**	**38**	**0**	**0**	**0**	**0**	**126**	**45**	**17**	**0**	**9**	**/**	**0**	**1,175**	**1,590**
	Red	2008	0	77	14	0	0	0	0	0	0	3	5	0	0	57	/	68	224
CFH -	River	2007	0	17	0	5	0	0	0	0	68	36	14	0	14	141	/	151	446
Production	Pond	2006	0	0	0	0	0	0	0	0	1	0	0	0	5	11	/	7	24
CFH	**Red R.**	**Total**	**0**	**94**	**14**	**5**	**0**	**0**	**0**	**0**	**69**	**39**	**19**	**0**	**19**	**209**	**/**	**226**	**694**
		2008	0	26	4	0	0	0	0	0	0	2	0	0	0	1	0	60	93
CFH -	Crooked	2007	12	15	0	20	0	0	0	0	60	32	0	0	8	1	0	132	280
Production	R. Pond	2006	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	10	12
CFH	**Crk. P.**	**Total**	**12**	**41**	**4**	**20**	**0**	**0**	**0**	**0**	**61**	**34**	**0**	**0**	**8**	**3**	**0**	**202**	**385**
		2008	0	18	2	0	0	0	0	0	0	2	0	0	0	1	0	42	65
CFH -	Crooked	2007	9	11	0	14	0	0	0	0	43	22	0	0	6	0	0	94	199
Production	R. Trap*	2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7
CFH	**Crk. T.**	**Total**	**9**	**29**	**2**	**14**	**0**	**0**	**0**	**0**	**43**	**24**	**0**	**0**	**6**	**1**	**0**	**143**	**271**

Table 12. Continued.

Hatchery - Program	Release Site	Return Year	HARVEST										STRAYS			TRIBUTARY ESCAP.			TOTAL
			Ocean	Zone 1-5 Sport	Zone 1 - 5 Comm. Net	Zone 6 Sport	Zone 6 Tribs	Zone 6 Tribal	Col. R. Above MCN	Snake Below Idaho	Idaho Sport	Idaho Tribal	Col. River	Snake Below LGD	Snake Above LGD	Below Weir	Above Weir	Weir/ Term	Total
CFH -		2008	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Production	Powell	2007	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
(Subyear.)	Pond	2006	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
CFH	**Powell**	**Total**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**
CFH -		2008	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Production	Crooked	2007	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
(Subyear.)	R. Pond	2006	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
CFH	**Crk. P.**	**Total**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**
Clearwater Hatchery TOTAL			**21**	**239**	**84**	**77**	**0**	**0**	**0**	**0**	**299**	**142**	**36**	**0**	**42**	**213**	**0**	**1,746**	**2,940**
		2008	/	/	/	/	/	/	/	/	/	/	/	/	/	41	0	13	54
SFH -	Saw.	2007	/	/	/	/	/	/	/	/	/	/	/	/	/	90	0	46	136
Production	Hatch.	2006	/	/	/	/	/	/	/	/	/	/	/	/	/	8	0	15	23
Sawtooth Hatchery TOTAL			**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**139**	**0**	**74**	**213**
		2008	0	34	0	0	0	0	0	0	0	0	0	0	0	0	/	60	94
PFH -	Pahsim.	2007	0	0	0	0	0	45	0	39	0	0	0	0	0	0	/	304	388
Production	Ponds	2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	/	63	63
Pahsimeroi Hatchery TOTAL			**0**	**34**	**0**	**0**	**0**	**45**	**0**	**39**	**0**	**0**	**0**	**0**	**0**	**0**	**/**	**427**	**545**

* These releases were not differentially marked so Idaho harvest and tributary escapement estimates could include fish from both releases. However, due to the historically low adult returns from parr releases, all returns were assumed to be from the smolt release.

[a] These release sites were "off-site," meaning there was not a hatchery trap for fish to return to. Estimates of rack returns here are surrogate estimates of returns to terminal areas.

** These releases had no CWT and a surrogate was used to generate downriver harvest and stray rates.

/ These fields were not valid for that release group based on mark type, or there was not enough data to make an estimate based on a lack of marks/tags.

Table 13. Estimated harvest and escapement of hatchery-origin Chinook salmon from brood year 2004. Estimates correspond with each brood year 2004 release from Table 5.

			HARVEST										STRAYS			TRIBUTARY ESCAP.			TOTAL
Hatchery - Program	Release Site	Return Year	Ocean	Zone 1-5 Sport	Zone 1 - 5 Comm. Net	Zone 6 Sport	Zone 6 Tribs	Zone 6 Tribal	Col. R. Above MCN	Snake Below Idaho	Idaho Sport	Idaho Tribal	Col. River	Snake Below LGD	Snake Above LGD	Below Weir	Above Weir	Weir/ Term	Total
		2009	0	0	4	0	0	0	0	0	187	36	0	0	0	28	0	254	509
MFH -		2008	0	16	19	489	0	0	0	0	2,885	61	0	0	0	703	0	3,809	7,982
Production	Knox B.	2007	0	202	7	9	0	14	0	31	260	52	4	0	0	55	4	1,583	2,221
McCall Hatchery TOTAL			**0**	**218**	**30**	**498**	**0**	**14**	**0**	**31**	**3,332**	**149**	**4**	**0**	**0**	**786**	**4**	**5,637**	**10,712**
		2009	0	35	16	0	0	0	0	0	62	19	9	0	0	0	0	158	299
RRFH-		2008	0	4,612	329	518	0	47	0	0	3,004	2,446	0	0	0	0	0	3,178	14,134
Production	RRFH	2007	0	88	0	99	0	0	0	0	112	232	0	0	0	0	0	2,327	2,858
RRFH	**RR Hat.**	**Total**	**0**	**4,735**	**345**	**617**	**0**	**47**	**0**	**0**	**3,178**	**2,697**	**9**	**0**	**0**	**0**	**0**	**5,663**	**17,291**
		2009	0	3	1	0	0	0	0	0	5	2	0	0	0	/	/	13	24
RRFH -	L. Sal.	2008	0	173	24	36	0	4	0	0	244	193	0	0	0	/	/	251	925
Production	R*[a]	2007	0	7	0	8	0	0	0	0	8	18	0	0	0	/	/	184	225
RRFH	**L. Sal. R**	**Total**	**0**	**183**	**25**	**44**	**0**	**4**	**0**	**0**	**257**	**213**	**0**	**0**	**0**	**/**	**/**	**448**	**1,174**
		2009	0	6	3	0	0	0	0	0	0	0	0	0	0	/	0	39	48
RRFH -	HC	2008	0	345	47	71	0	7	0	0	0	0	0	0	0	/	0	1,364	1,834
Production	Dam*[a]	2007	0	13	0	15	0	0	0	0	0	0	0	0	0	/	0	422	450
RRFH	**HC Dam**	**Total**	**0**	**364**	**50**	**86**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**/**	**0**	**1,825**	**2,332**
Rapid River Hatchery TOTAL			**0**	**5,282**	**420**	**747**	**0**	**58**	**0**	**0**	**3,435**	**2,910**	**9**	**0**	**0**	**0**	**0**	**7,936**	**20,788**
		2009	0	16	9	0	0	0	0	0	0	0	5	0	0	/	0	105	135
CFH -	Powell	2008	0	665	841	114	0	5	0	0	432	79	5	0	31	/	0	884	3,056
Production	Pond	2007	0	0	0	0	0	0	0	0	0	0	0	0	5	/	0	268	273
CFH	**Powell**	**Total**	**0**	**681**	**850**	**114**	**0**	**5**	**0**	**0**	**432**	**79**	**10**	**0**	**36**	**/**	**0**	**1,257**	**3,464**
	Red	2009	0	10	0	0	0	0	0	0	24	0	0	0	0	82	/	26	142
CFH -	River	2008	0	463	387	131	0	0	0	0	544	244	0	0	0	208	/	720	2,697
Production	Pond	2007	0	0	0	0	0	0	0	0	0	0	10	0	10	32	/	57	109
CFH	**Red R.**	**Total**	**0**	**473**	**387**	**131**	**0**	**0**	**0**	**0**	**568**	**244**	**10**	**0**	**10**	**322**	**/**	**803**	**2,948**
		2009	0	3	4	0	0	0	0	0	3	0	0	0	0	0	0	5	15
CFH -	Crooked	2008	0	47	55	21	0	0	0	0	62	29	0	0	0	0	0	44	258
Production	R. Pond	2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	34
CFH	**Crk. P.**	**Total**	**0**	**50**	**59**	**21**	**0**	**0**	**0**	**0**	**65**	**29**	**0**	**0**	**0**	**0**	**0**	**83**	**307**
		2009	0	14	31	0	0	0	0	0	19	0	0	0	0	0	0	36	100
CFH -	Crooked	2008	0	361	417	160	0	0	0	0	421	189	0	0	0	2	0	332	1,882
Production	R. Trap	2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	259	259
CFH	**Crk. T.**	**Total**	**0**	**375**	**448**	**160**	**0**	**0**	**0**	**0**	**440**	**189**	**0**	**0**	**0**	**2**	**0**	**627**	**2,241**
		2009	0	6	0	0	0	0	0	0	0	0	0	0	0	/	/	79	85
	Selway	2008	0	151	145	38	0	2	0	0	170	146	1	0	1	/	/	665	1,319
CFH - Supp	River[a]	2007	0	0	0	7	0	0	0	0	81	0	0	0	27	/	/	198	313
CFH	**Selway**	**Total**	**0**	**156**	**145**	**45**	**0**	**2**	**0**	**0**	**251**	**146**	**1**	**0**	**28**	**/**	**/**	**942**	**1,717**
		2009	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	0
CFH - Supp	Selway	2008	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	0
(Subyear.)	River	2007	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	0
Clearwater	**Selway**	**Total**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**0**

Table 13. Continued.

Hatchery - Program	Release Site	Return Year	HARVEST										STRAYS			TRIBUTARY ESCAP.			TOTAL
			Ocean	Zone 1-5 Sport	Zone 1 - 5 Comm. Net	Zone 6 Sport	Zone 6 Tribs	Zone 6 Tribal	Col. R. Above MCN	Snake Below Idaho	Idaho Sport	Idaho Tribal	Col. River	Snake Below LGD	Snake Above LGD	Below Weir	Above Weir	Weir/ Term	Total
Clear. -		2009	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	0
Production	Powell	2008	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	0
(Subyear.)	Pond	2007	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	0
CFH	**Powell**	**Total**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**/**	**0**
Clearwater Hatchery TOTAL			**0**	**1,735**	**1,889**	**471**	**0**	**7**	**0**	**0**	**1,756**	**687**	**21**	**0**	**74**	**324**	**0**	**3,712**	**10,677**
		2009	0	0	0	0	0	0	0	0	0	63	0	0	0	7	0	279	349
SFH -	Saw.	2008	20	45	39	195	0	0	0	0	388	268	0	0	0	230	135	3,495	4,815
Production	Hatch.	2007	0	87	0	12	0	59	0	0	0	0	0	0	0	0	12	1,238	1,408
Sawtooth Hatchery TOTAL			**20**	**132**	**39**	**207**	**0**	**59**	**0**	**0**	**388**	**331**	**0**	**0**	**0**	**237**	**147**	**5,012**	**6,572**
		2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	121	122
PFH -	Pahsim.	2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	890	890
Production	Ponds	2007	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	145	165
Pahsimeroi Hatchery TOTAL			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**20**	**0**	**0**	**0**	**0**	**1,156**	**1,177**

* These releases had no CWT and a surrogate was used to generate downriver harvest and stray rates.

[a] These release sites were "off-site," meaning there was not a hatchery trap for fish to return to. Estimates of rack returns here are surrogate estimates of returns to terminal areas.

/ These fields were not valid for that release group based on mark type, or there was not enough data to make an estimate based on a lack of marks/tags.

The downriver (Columbia and Lower Snake rivers) harvest rates across the hatcheries and stocks were highly variable both across and within brood years (Tables 14, 15, and 16). The percent of each hatchery's total return estimate, from adipose clipped smolt releases, that was harvested below LGD ranged from a low of 0% for PFH to a high of 38.4% for CFH, both for brood year 2004 (Table 16). Run timing for adults migrating through the Columbia and Lower Snake rivers is highly correlated with harvest rates, as returning fish are harvested at greater rates if migration timing coincides with the downriver fishing seasons. Rapid River and Clearwater hatcheries typically show an earlier adult migration than do McCall, Sawtooth, and Pahsimeroi hatcheries, so those facilities typically have higher harvest downriver. However, McCall and Pahsimeroi return groups can be harvested at high rates in the Zone 6 summer Chinook salmon fishery if they return later than average.

Like downriver harvest, harvest above LGD in Idaho was variable as well (Tables 14, 15, and 16). However, unlike downriver harvest rates that are mostly impacted by run timing and susceptibility to fisheries, Idaho harvest is driven by each stock's abundance and the presence or absence of adult returns in excess of broodstock needs for both sport and tribal fisheries. While sport fisheries typically reach their harvestable share, tribal fisheries are more limited by access and angler numbers, so tribal harvest shares are not always met.

Table 14. Total harvest above and below LGD and the percentages of the total Columbia basinwide adult return harvested below LGD and the LGD return harvested above LGD for adipose-clipped smolts released from brood year 2002.

Hatchery	Total Returns (Basinwide)	Harvest Below LGD	% of Total Return Harvested Downriver	Total Returns Above LGD	Harvest Above LGD	% of LGD Return Harvested Above LGD	% of Total Return Harvested (Total)
McCall	3,866	831	21.5%	3,026	612	20.2%	37.3%
Rapid R.	8,346	1,102	13.2%	7,209	2,740	38.0%	46.0%
Clearwater	2,299	30	1.3%	2,239	132	5.9%	7.0%
Sawtooth	749	25	3.3%	724	36	5.0%	8.1%
Pahsimeroi	712	185	26.0%	527	0	0.0%	26.0%

Table 15. Total harvest above and below LGD and the percentages of the total Columbia basinwide adult return harvested below LGD and the LGD return harvested above LGD for adipose-clipped smolts released from brood year 2003.

Hatchery	Total Returns (Basinwide)	Harvest Below LGD	% of Total Return Harvested Downriver	Total Returns Above LGD	Harvest Above LGD	% of LGD Return Harvested Above LGD	% of Total Return Harvested (Total)
McCall	3,856	458	11.9%	3,390	858	25.3%	34.1%
Rapid R.	6,613	1,274	19.3%	5,308	1,719	32.4%	45.3%
Clearwater	2,940	421	14.3%	2,442	441	18.1%	29.3%
Sawtooth	NA	NA	NA	NA	NA	NA	NA
Pahsimeroi	545	118	21.7%	427	0	0.0%	21.7%

Table 16. Total harvest above and below LGD and the percentages of the total Columbia basinwide adult return harvested below LGD and the LGD return harvested above LGD for adipose-clipped smolts released from brood year 2004.

Hatchery	Total Returns (Basinwide)	Harvest Below LGD	% of Total Return Harvested Downriver	Total Returns Above LGD	Harvest Above LGD	% of LGD Return Harvested Above LGD	% of Total Return Harvested (Total)
McCall	10,675	791	7.4%	9,880	3,481	35.2%	40.0%
Rapid R.	20,797	6,507	31.3%	14,281	6,345	44.4%	61.8%
Clearwater	10,677	4,102	38.4%	6,553	2,443	37.3%	61.3%
Sawtooth	6,572	457	7.0%	6,115	719	11.8%	17.9%
Pahsimeroi	1,177	0	0.0%	1,157	0	0.0%	0.0%

Overall, hatchery-specific stray rates were low across all facilities and brood years (Table 17). CFH consistently had the highest stray rates, with an above-LGD stray rate of 13.13% for brood year 2002 being the highest by far. However, all of these strays were still recovered in the Clearwater River basin. The higher stray rates seen in the CFH group are likely due to the large number of off-site release that occurs through the Clearwater River basin.

Table 17. Stray rates for brood year 2002, 2003, and 2004 returning adult Chinook salmon. Below LGD stray rates are based on total basinwide return numbers and above LGD stray rates are based on adult returns to LGD.

	Percent of Return recovered as Strays (BY 2002)		Percent of Return recovered as Strays (BY 2003)		Percent of Return recovered as Strays (BY 2004)	
Hatchery	Below LGD	Above LGD	Below LGD	Above LGD	Below LGD	Above LGD
McCall	0.20%	0.00%	0.21%	0.00%	0.04%	0.00%
Rapid River	0.42%	0.00%	0.47%	0.00%	0.04%	0.00%
Clearwater	2.58%	13.13%	1.22%	3.19%	0.20%	3.89%
Sawtooth	0.00%	0.00%	NA	NA	0.00%	0.00%
Pahsimeroi	0.00%	0.00%	0.00%	0.00%	1.70%	0.00%

Trap Recoveries and Average Length

The numbers of brood year-specific fish that escaped to the hatchery traps are outlined in Tables 18, 19, and 20 by sex and age. Also included is the average length-at-age of each age class by sex. At RRFH, sex cannot be determined at the time of trapping. For the trap years associated with the brood years outlined in this report, the subsample held for broodstock was not considered representative enough to extrapolate sex by age to the entire return. Therefore, the RRFH estimates in all three tables are not broken down by sex.

Table 18. Adults returning to hatchery traps from brood year 2002 and average length, by sex and age, for all hatchery traps associated with LSRCP and IPC hatcheries operated by IDFG. All age-3 returns were assumed to be males (jacks).

Hatchery / Trap	Trap Year	Age	Rack Return Estimate - Males	Rack Return Estimate - Females	Average Length (cm) - Males	Average Length (cm) - Females
	2007	5	89	202	87.6	89.0
	2006	4	747	770	75.9	77.4
McCall / SFSR	2005	3	465	/	57.4	/
	2007	5		701		83.7
	2006	4		2,322		70.7
Rapid River*	2005	3		109		48.2
	2007	5	93	59	87.6	87.6
Clearwater /	2006	4	57	209	74.6	72.6
Powell	2005	3	9	/	54.4	/
	2007	5	90	61	87.9	87.9
Clearwater /	2006	4	438	644	73.6	70.4
South Fork**	2005	3	38	/	51.2	/
	2007	5	64	54	93.9	88.3
	2006	4	228	192	71.8	75.6
Sawtooth	2005	3	151	/	51.2	/
	2007	5	67	63	91.2	86.3
	2006	4	150	216	75.4	73.1
Pahsimeroi	2005	3	62	/	57.4	/

* The Rapid River returns are not given a sex determination at time of trapping and the subsample later sexed for broodstock was not considered representative. Therefore, sexes were combined for the estimate.

** The Red River and Crooked River traps were combined to generate single estimates for fish returning to the South Fork Clearwater River.

Table 19. Adults returning to hatchery traps from brood year 2003 and average length, by sex and age, for all hatchery traps associated with LSRCP and IPC hatcheries operated by IDFG. All age-3 returns were assumed to be males (jacks).

Hatchery / Trap	Trap Year	Age	Rack Return Estimate - Males	Rack Return Estimate - Females	Average Length (cm) - Males	Average Length (cm) - Females
	2008	5	65	146	97.6	91.7
	2007	4	854	724	78.4	78.3
McCall / SFSR	2006	3	256	/	55.9	/
	2008	5		345		84.3
	2007	4		2,317		72.7
Rapid River*	2006	3		209		45.0
	2008	5	157	42	87.0	87.0
Clearwater /	2007	4	311	498	72.8	72.8
Powell	2006	3	167	/	49.5	/
	2008	5	118	52	90.6	87.0
Clearwater /	2007	4	133	244	74.3	74.3
South Fork**	2006	3	24	/	55.6	/
	2008	5	7	6	95.5	85.2
	2007	4	13	33	82.0	75.6
Sawtooth	2006	3	15	/	56.5	/
	2008	5	44	16	87.5	86.4
	2007	4	115	189	73.8	72.3
Pahsimeroi	2006	3	63	/	57.9	/

* The Rapid River returns are not given a sex determination at time of trapping and the subsample later sexed for broodstock was not considered representative. Therefore, sexes were combined for the estimate.

** The Red River and Crooked River traps were combined to generate single estimates for fish returning to the South Fork Clearwater River.

Table 20. Adults returning to hatchery traps from brood year 2004 and average length, by sex and age, for all hatchery traps associated with LSRCP and IPC hatcheries operated by IDFG. All age-3 returns were assumed to be males (jacks).

Hatchery / Trap	Trap Year	Age	Rack Return Estimate - Males	Rack Return Estimate - Females	Average Length (cm) - Males	Average Length (cm) - Females
	2009	5	29	225	97.4	90.6
	2008	4	1,399	2,410	80.7	76.9
McCall / SFSR	2007	3	1,583	/	56.0	/
	2009	5		158		84.5
	2008	4		3,178		68.6
Rapid River	2007	3		2,327		48.1
	2009	5	84	21	88.1	88.1
Clearwater /	2008	4	349	535	76.1	75.9
Powell	2007	3	268	/	52.3	/
	2009	5	31	36	87.9	87.9
Clearwater /	2008	4	450	646	76.3	74.5
South Fork	2007	3	350	/	52.1	/
	2009	5	48	231	100.1	90.3
	2008	4	1,792	1,702	76.0	78.6
Sawtooth	2007	3	1,238	/	54.1	/
	2009	5	77	44	89.7	88.1
	2008	4	445	445	77.2	77.2
Pahsimeroi	2007	3	145	/	51.9	/

* The Rapid River returns are not given a sex determination at time of trapping and the subsample later sexed for broodstock was not considered representative. Therefore, sexes were combined for the estimate.

** The Red River and Crooked River traps were combined to generate single estimates for fish returning to the South Fork Clearwater River.

Smolt-to-Adult Returns and Smolt-to-Adult Survival

For brood year 2002 smolt releases, SAS ranged from a low of 0.038% for the ISS group released at PFH to a high of 0.423% for the production group released at Knox Bridge in the South Fork Salmon River (Table 21). Parr SAS for brood year 2002 ranged from a low of 0.000% for the ISS release in Pete King Creek to a high of 0.016% for the ISS group released at Stolle Meadows in the South Fork Salmon River (Table 21). The overall SAS for all brood year 2002 smolt releases was 0.208% while the overall SAS for all parr releases was 0.004%.

For brood year 2003 smolt releases, SAS ranged from a low of 0.056% for the production group released at PFH to a high of 0.394% for the production group released at the Powell Satellite facility in the upper Lochsa River (Table 22). Due to the lack of differential marking, no SAS estimates could be estimated for any brood year 2003 parr releases. The overall SAS for all brood year 2003 smolt releases was 0.205%.

For brood year 2004 smolt releases, SAS ranged from a low of 0.110% for the production group released at PFH to a high of 0.976% for the production group released at Knox Bridge in the South Fork Salmon River (Table 23). Due to the lack of differential marking, no SAS estimates could be generated for brood year 2004 subyearling releases. The overall SAS for all brood year 2004 smolt releases was 0.563% while no SAS rates were estimated for the two subyearling releases.

The higher SARs and SASs of smolt releases in comparison to subyearling releases are typical of previous brood years and the difference is largely driven by poor overwinter survival of subyearlings post release (Leth et. al. 2004, Leth 2007, Cassinelli and Lindley 2008, Cassinelli

and Knipper 2009). The poor survival coupled with the completion of the ISS releases in brood year 2002 has resulted in an overall decrease in the number of subyearling releases over time. Appendix D. shows that, compared to historic SASs, there was a dip in SAS across all facilities in brood years 2002 and 2003 but that SASs were on an upswing in brood year 2004.

Table 21. Brood year 2002 smolt-to-adult returns and smolt-to-adult survivals for all release groups from LSRCP and IPC hatcheries operated by IDFG.

Hatchery	Program / Life Stage	Release Site	Number Released	Returns to LGD	Smolt-to-Adult Returns (SAR)	Total Returns (Basinwide)	Smolt-to-Adult Survival (SAS)
	Prod. / Smolt	Knox Br.	914,060	3,026	0.331%	3,866	0.423%
	ISS / Smolt	Knox Br.	174,150	624	0.358%	685	0.393%
McCall	ISS / Parr	Stolle M.	80,340	13	0.016%	13	0.016%
McCall Hatchery Total			**1,168,550**	**3,663**	**0.314%**	**4,564**	**0.391%**
	Prod. / Smolt	RR Hatch.	2,762,058	5,614	0.200%	6,509	0.230%
Rapid	Prod. / Smolt	L. Sal. R	300,140	598	0.200%	689	0.230%
River	Prod. / Smolt	Hells C.	499,956	997	0.200%	1,148	0.230%
Rapid River Hatchery Total			**3,562,154**	**7,209**	**0.200%**	**8,346**	**0.230%**
	Prod. / Smolt	Powell	376,797	512	0.136%	526	0.140%
	Prod. / Smolt	Red River	354,868	756	0.213%	776	0.219%
	Prod. / Smolt	Crook. R.	750,317	896	0.119%	920	0.123%
	NPT / Smolt	Papoose	56,174	75	0.134%	77	0.137%
	ISS / Parr	Colt Kill	122,152	2	0.002%	2	0.002%
	Prod. / Parr	Powell	385,431	12	0.003%	12	0.003%
	ISS / Parr	Red River	108,323	7	0.007%	7	0.007%
	ISS / Parr	Crook. R.	234,361	3	0.001%	3	0.001%
	ISS / Parr	Pete K.	16,293	0	0.000%	0	0.000%
Clearwater	ISS / Parr	Lochsa	16,038	0	0.000%	1	0.006%
Clearwater Hatchery Total			**2,420,754**	**2,263**	**0.094%**	**2,324**	**0.096%**
	Prod. / Smolt	Saw. Hat.	624,739	724	0.116%	749	0.120%
Sawtooth	ISS / Smolt	Saw. Hat.	187,461	124	0.066%	124	0.066%
Sawtooth Hatchery Total			**812,200**	**848**	**0.104%**	**873**	**0.108%**
	Prod. / Smolt	Pahsim. P.	984,509	527	0.054%	712	0.072%
Pahsimeroi	ISS / Smolt	Pahsim. P.	124,489	31	0.025%	47	0.038%
Pahsimeroi Hatchery Total			**1,108,998**	**558**	**0.050%**	**759**	**0.068%**
BROOD YEAR TOTAL			**9,072,656**	**14,541**	**0.160%**	**16,866**	**0.186%**

Table 22. Brood year 2003 smolt-to-adult returns and smolt-to-adult survivals for all release groups from LSRCP and IPC hatcheries operated by IDFG.

Hatchery	Program / Life Stage	Release Site	Number Released	Returns to LGD	Smolt-to-Adult Returns (SAR)	Total Returns (Basinwide)	Smolt-to-Adult Survival (SAS)
	Prod. / Smolt	Knox B.	1,047,530	3,390	0.324%	3,856	0.368%
McCall	Prod. / Parr	Knox B.	220,000	/	NA	/	NA
McCall Hatchery Total			**1,267,530**	**3,390**	**0.267%**	**3,856**	**0.304%**
	Prod. / Smolt	RR Hatch.	2,761,430	4,501	0.163%	5,633	0.200%
	Prod. / Smolt	L. Sal. R	200,000	323	0.163%	392	0.200%
Rapid	Prod. / Smolt	HC Dam	300,000	484	0.163%	588	0.200%
River	Prod. / Parr	Selway	183,923	/	NA	/	NA
Rapid River Hatchery Total			**3,445,353**	**5,308**	**0.154%**	**6,613**	**0.192%**
	Prod. / Smolt	Powell	403,917	1,355	0.336%	1,590	0.394%
	Prod. / Smolt	Red River	401,362	562	0.140%	694	0.173%
	Prod. / Smolt	Crook. P.	350,194	308	0.088%	385	0.110%
	Prod. / Smolt	Crook. T.	350,193	217	0.062%	271	0.077%
	Prod. / Parr	Powell	410,117	/	NA	/	NA
Clearwater	Prod. / Parr	Crook. R.	64,263	/	NA	/	NA
Clearwater Hatchery Total			**1,980,046**	**2,442**	**0.123%**	**2,940**	**0.149%**
Sawtooth	Prod. / Smolt	Saw. Hat.	134,769	213	0.158%	213	0.158%
Sawtooth Hatchery Total			**134,769**	**213**	**0.158%**	**213**	**0.158%**
Pahsimeroi	Prod. / Smolt	Pahsim. P.	975,252	427	0.045%	545	0.056%
Pahsimeroi Hatchery Total			**975,252**	**427**	**0.045%**	**545**	**0.056%**
BROOD YEAR TOTAL			**7,802,950**	**11,780**	**0.151%**	**14,167**	**0.182%**

/ Indicates that these releases were not differentially or uniquely marked so an independent estimate of SAR or SAS could not be made. Some of the returns for the smolt releases could be from these releases.

Table 23. Brood year 2004 smolt-to-adult returns and smolt-to-adult survivals for all release groups from LSRCP and IPC hatcheries operated by IDFG.

Hatchery	Program / Life Stage	Release Site	Number Released	Returns to LGD	Smolt-to-Adult Returns (SAR)	Total Returns (Basinwide)	Smolt-to-Adult Survival (SAS)
McCall	Prod. / Smolt	Knox B.	1,094,264	9,880	0.903%	10,675	0.976%
McCall Hatchery Total			**1,094,264**	**9,880**	**0.903%**	**10,675**	**0.976%**
	Prod. / Smolt	RR Hatch.	2,530,528	11,538	0.456%	17,291	0.600%
Rapid	Prod. / Smolt	L. Sal. R	200,000	918	0.456%	1,174	0.600%
River	Prod. / Smolt	HC Dam	400,000	1,825	0.456%	2,332	0.600%
Rapid River Hatchery Total			**3,022,988**	**14,281**	**0.456%**	**20,797**	**0.600%**
	Prod. / Smolt	Powell	423,633	1,804	0.426%	3,464	0.818%
	Prod. / Smolt	Red River	423,603	1,947	0.460%	2,948	0.696%
	Prod. / Smolt	Crook. P.	140,989	177	0.126%	307	0.218%
	Prod. / Smolt	Crook. T.	608,472	1,258	0.207%	2,241	0.368%
	Supp. / Smolt	Selway	209,842	1,367	0.651%	1,717	0.818%
	Supp. / Fry	Selway	301,528	/	NA	/	NA
Clearwater	Prod. / Parr	Powell	348,934	/	NA	/	NA
Clearwater Hatchery Total			**2,564,577**	**6,553**	**0.256%**	**10,677**	**0.416%**
Sawtooth	Prod. / Smolt	Saw. Hat.	1,552,444	6,115	0.394%	6,572	0.423%
Sawtooth Hatchery Total			**1,552,444**	**6,115**	**0.394%**	**6,572**	**0.423%**
Pahsimeroi	Prod. / Smolt	Pahsim. P.	1,073,951	1,157	0.108%	1,177	0.110%
Pahsimeroi Hatchery Total			**1,073,951**	**1,157**	**0.108%**	**1,177**	**0.110%**
BROOD YEAR TOTAL			**9,308,224**	**37,986**	**0.408%**	**49,898**	**0.536%**

/ Indicates that these releases were not differentially or uniquely marked so an independent estimate of SAR or SAS could not be made.

Progeny-to-Parent Ratio

In almost all years, both the project area PPR and the total PPR are greater than one, indicating that that particular brood year is above replacement. The few exceptions where both PPR types were less than zero were at Powell for brood year 2002 and at Pahsimeroi for brood year 2003. Also, the project area PPR was less than one at Pahsimeroi for brood year 2002. In these few instances, those particular brood years were not above replacement.

Table 24. Progeny-to-parent ratios for brood year 2002, 2003, and 2004 hatchery Chinook salmon from LSRCP and IPC hatcheries located operated by IDFG.

Brood Year	Collection Facility /Stock	Total Parents (Actual Spawned + Prespawn Morts)	Total Progeny to LGD (excluding Jacks)	Progeny to Parent Ratio (Project Area)	Total Progeny (excluding Jacks)	Progeny to Parent Ratio (Total)
2004		757	7,935	10.48	8,463	11.18
2003	McCall	830	3,058	3.68	3,520	4.24
2002		812	3,101	3.82	3,931	4.84
2004		761	4,617	6.07	4,916	6.46
2003	Sawtooth	67	190	2.84	190	2.84
2002		432	678	1.57	703	1.63
2004	SF Clrwtr.	733	2,990	4.08	5,094	6.95
2004	Powell	912	2,592	2.84	4,595	5.04
2003	SF Clrwtr.	697	1,044	1.50	1,307	1.88
2003	Powell	798	1,188	1.49	1,411	1.77
2002	SF Clrwtr.	1,022	1,584	1.55	1,628	1.59
2002	Powell	898	570	0.63	586	0.65
2004		2,525	10,118	4.01	16,404	6.50
2003	Rapid R.	2,243	3,172	1.41	4,477	2.00
2002		2,592	3,898	1.50	5,035	1.94
2004		620	835	1.35	835	1.35
2003	Pahsimeroi	525	354	0.67	472	0.90
2002		529	496	0.94	697	1.32

SUMMARY

The goal of this report is to provide a summary of the life cycle of three brood years (2002, 2003, and 2004) of hatchery-origin spring/summer Chinook salmon from three LSRCP and two IPC hatcheries operated by IDFG.

Spawning, Rearing, and Release

All facilities met, or were within 95% of, their smolt release goal across the three brood years, except for SFH (Table 25). SFH did not reach the release target of 1.3 million smolts for brood years 2002 or 2003 due to reduced egg takes because of low numbers of broodstock. Although variable across facilities and between brood years, green egg to smolt survival rates were consistently high (≥70%) for all five facilities across all three years.

Table 25. Smolt release numbers versus smolt release goals for brood year 2002, 2003, and 2004 hatchery Chinook salmon from LSRCP and IPC hatcheries operated by IDFG.

Hatchery	Smolt Release Goal	Smolt Released (BY 2002)	Smolt Released (BY 2003)	Smolt Released (BY 2004)
McCall	1,100,000	1,088,210	1,047,530	1,094,264
Rapid River	3,000,000	3,562,154	3,261,430	3,130,528
Clearwater	1,500,000	1,538,156	1,505,666	1,914,115
Sawtooth	1,300,000	812,200	134,769	1,552,444
Pahsimeroi	1,000,000	1,108,998	975,252	1,073,951

Post Release Monitoring

Juvenile survival rates from release to LGD were highly variable for the releases covered in this report. Many factors can play a role in juvenile survival rates and contribute to this high level of variation including size and condition at release, flow levels, water temperature, water turbidity, and migration distance (Reisenbichler et al. 1982, Smith et al. 2002, Zabel and Achord 2004). Juvenile survival rates to LGD were much higher for smolt releases than they were for subyearling releases across all three brood years.

There was a moderate relationship between juvenile survival percentages and SAS rates for brood year 2004 (R^2 = 0.505), a weak relationship for brood year 2002 (R^2 = 0.307), and a poor relationship for brood year 2003 (R^2 = 0.076) (Figure 3). However, all three brood years showed a trend towards higher juvenile survival rates resulting in higher SAS rates. We would expect this relationship to exist, at some level, given the rationale that the higher the percentage of fish that make it to the Pacific Ocean, the higher the percentage that will reach maturity and return as adults.

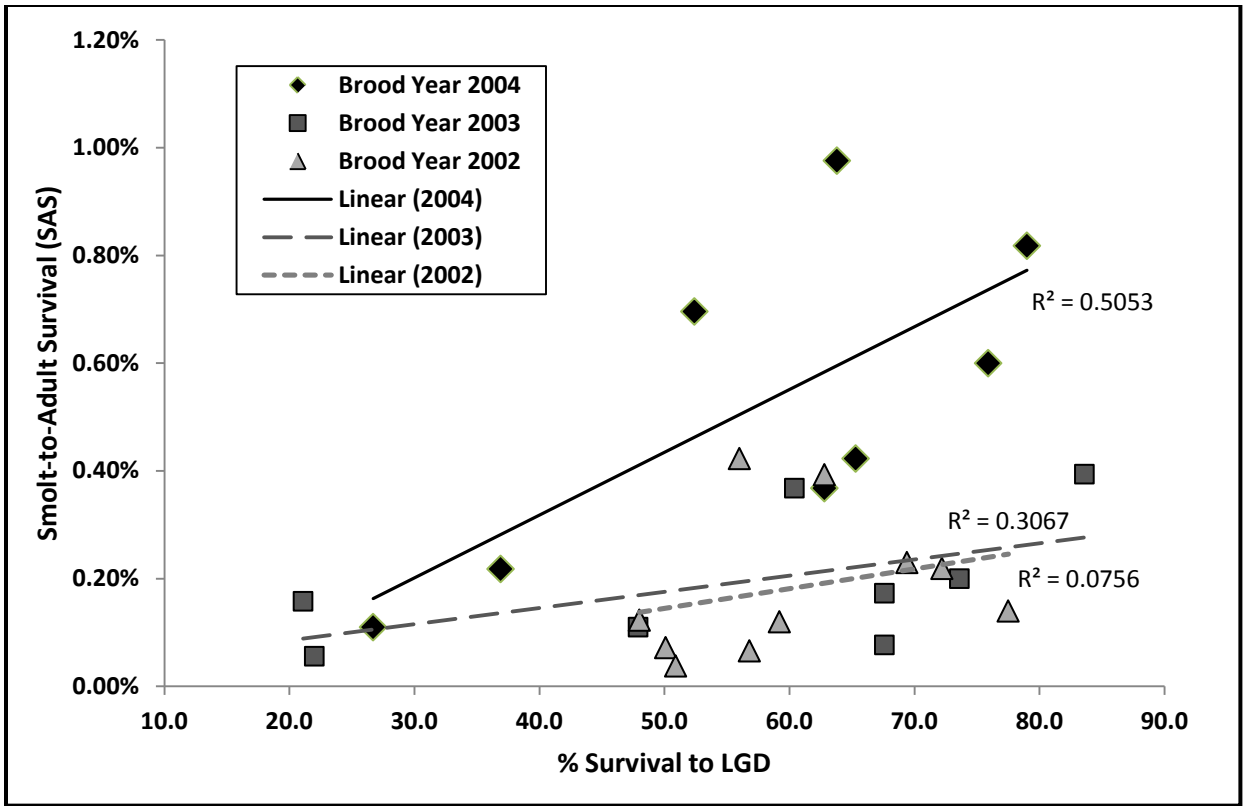


Figure 3. Relationship between estimated survival (%) from release site to Lower Granite Dam and Smolt-to-Adult Survival (SAS) for hatchery-origin Chinook salmon PIT tagged and released as yearling smolts in 2004, 2005, and 2006.

Returning adult Chinook salmon from brood years 2002, 2003, and 2004 contributed to many of the lower Snake River and Columbia River fisheries as well as to harvest in the Pacific Ocean. Adult migration timing is correlated with downriver harvest contribution. The earlier returning Rapid River and Clearwater groups and the later migrating McCall, Pahsimeroi, and Sawtooth groups can all be impacted at different levels depending on how their run timing fluctuates around the fisheries. There was some level of straying within each hatchery group, but overall, stray rates were low for all stocks across all brood years, especially below LGD.

The three LSRCP-funded hatcheries outlined in this report have specific return-year adult mitigation goals for adult returns to LGD. The LSRCP return goals provide a target for returns made up of three age classes of Chinook salmon (age-3, age-4, age-5) within a given return year. However, this report does not outline multiple brood years returning in a given return year but instead looks at given brood years returning in multiple return years. Because this is a brood year report, we looked at mitigation goals at the brood year level. Table 26 compares the adult return mitigation goals versus the actual returns to LGD for brood years 2002, 2003, and 2004. Brood year 2004 from MFH was the only group that exceeded the adult return goal to LGD.

Table 26. Adult return numbers to LGD versus adult return mitigation goals for brood year 2002, 2003, and 2004 hatchery Chinook salmon from LSRCP and IPC hatcheries operated by IDFG.

Hatchery/Stock	Adult Mitigation Goal (LGD)	Brood Year 2002 Actual Return (LGD)	Brood Year 2003 Actual Return (LGD)	Brood Year 2004 Actual Return (LGD)
McCall	8,000	3,663	3,390	9,880
Rapid River*	NA	7,209	5,313	14,281
Clearwater	11,915	2,263	2,442	6,553
Sawtooth	19,445	848	213	6,115
Pahsimeroi*	NA	558	427	1,157

* These hatcheries do not have specified adult mitigation goals

Of the three brood years outlined in this report, brood year 2004 had the highest SARs, SASs, and number of adults returning to LGD despite release numbers and juvenile survival estimates similar to earlier years. This greater than two-fold increase in SAR and SAS for brood year 2004, despite similar juvenile performance, emphasizes the role that factors such as ocean condition play in overall survival and performance of Idaho's Chinook salmon.

Table 27. Overall summary of juvenile releases, survival to LGD, and adult return information for brood year 2002, 2003, and 2004 hatchery Chinook salmon smolt and subyearling releases from LSRCP and IPC hatcheries operated by IDFG.

Brood Year	Juvenile Release	Release Life Stage	Weighted Average Juvenile Survival	Adult Returns to LGD	SAR	Total Adult Returns	SAS
2002	8,109,718	Smolt	61.8%	14,074	0.1735%	16,399	0.2022%
2002	962,938	Subyearling	2.2%	37	0.0038%	38	0.0039%
2003	5,783,867	Smolt	61.1%	11,498	0.1988%	14,000	0.2421%
2003	878,303	Subyearling*	12.2%	NA	NA	NA	NA
2004	8,765,302	Smolt	62.6%	37,986	0.4334%	49,898	0.5693%
2004	650,462	Subyearling*	4.6%	NA	NA	NA	NA

* None of these subyearling releases were differentially marked so no adult return estimates were made.

PART II. A SUMMARY OF BROOD YEAR 1997, 1998, 1999 SAWTOOTH FISH HATCHERY NATURES REARING STUDY

For over a century, fish hatcheries have been used to supplement selected runs of anadromous salmonid fishes and by 1910, all Pacific salmon species had been supplemented using hatchery programs (Brannon et al. 1998, Mahnken et al. 1998). The controlled environment of hatchery rearing for anadromous fishes allows for intervention during virtually the entire freshwater juvenile lifecycle, resulting in increased egg-to-smolt survival. Hatchery-reared anadromous fishes generally exhibit greater egg-to-smolt survival than their wild counterparts. However, domestication selection in the hatchery environment may lead to lower post-release survival, reductions in fitness, lower SARs, and altered adult return timing and age at maturity potentially negating the advantages of increased egg-to-smolt survival (Reisenbichler and McIntyre 1977; Nickelson et al. 1986; Goodman 1990; Waples 1991; Hilborn 1992; Mahnken et al. 1998; Waples 1999).

Increased post-release survival of hatchery-reared Chinook salmon could benefit hatchery programs by reducing broodstock needs and operational costs associated with rearing fish. Furthermore, releasing fewer fish could potentially reduce competition between hatchery-reared and natural-origin fish. Increased post-release survival should also enable the return of more hatchery-origin fish back to sport fisheries or for natural production (Flagg and Nash 1999; Levin and Williams 2002).

Since the early 1990s, much work has been done to assess the potential for increasing post-release survival of hatchery-reared fish by using a variety of methods to make rearing conditions more natural in hopes of producing fish that exhibit more “wild-like” behavior. Natural Rearing Enhancement Systems (NATURES) have shown, in some cases, that enriched rearing environments can increase the post-release survival of hatchery-reared juvenile fishes by 10 to 50% over conventional hatchery rearing environments (Maynard et al. 1996b). Natural Rearing Enhancement System modifications may include simulated substrate, in-stream structure, overhead cover, automated underwater feeders, altered current velocities, live food diets, reduced rearing densities, and predator avoidance training.

Starting in the mid-1990s IDFG tested the utility of NATURES as a possible means to increase juvenile out-migration survival and smolt-to-adult survivals (SASs) for spring Chinook salmon. A pilot study was conducted at the Clearwater Fish Hatchery with brood years 1992, 1993, and 1994 and at the Sawtooth Fish Hatchery with brood year 1992. The pilot study was designed to determine if NATURES technology could be adapted to a production-level facility, and if fish reared in these environments would exhibit increased out-migration survival and adult returns. The results of that pilot study are outlined in Vidergar et al. (2003).

Upon completion of the pilot study, a formal research study was initiated at Sawtooth Fish Hatchery using brood years 1997, 1998, and 1999. Brood year 1997 juveniles were separated into six groups—three treatments and three controls. Brood year 1998 juveniles were separated into five groups—three treatments and two controls. Brood year 1999 only contained a treatment group and no controls, due to a small number of smolts. Brood year 1997-1999 treatment raceways were modified to include simulated substrate, in-stream structure, and overhead cover. To simulate substrate, epoxy (Rapid Response Color System, Ameron International) was used to paint rock patterns on the bottom of the raceways. Epoxy was painted on the floor of selected raceways using templates to provide consistent results. Templates were cut into sheets of plywood and acetate using cobble-sized substrate collected from the local Salmon River. Separate overlapping templates were made for each color. Six

colors representing those commonly observed in the local Salmon River were chosen. Raceways were painted during the summer while they were vacant to allow adequate curing before being used in the fall. All epoxy was approved by the Environmental Protection Agency for use in water storage containers. To simulate in-stream structure, deneedled trees (conifers; approximately 10 cm in diameter and two meters long) were suspended from a cable over the center and along the length of each raceway. Trees were submerged but removed periodically during raceway cleaning. To simulate overhead cover, camouflage colored lattice-shaped cloth sheets (1.2 x 2.5 m) were suspended over half of each raceway, alternating from left to right side down the length of the raceway. Control raceways had conventionally painted floors, no in-stream cover, but some form of overhead cover (periodic panels of shade cloth) to guard against bird predation.

These fish were released as smolts directly into the Salmon River. Out-migration survival and SASs for groups of fish reared in raceways retrofitted with NATURES modifications and for those reared in conventional raceways were evaluated (see Methods in Part I of this report). Table 28 shows the numbers of fish released, juvenile survival to LGD, adult returns, and SARs for all study groups for all three brood years of Sawtooth Fish Hatchery Chinook salmon.

Table 28. Summary of the Natures Rearing experiment conducted by IDFG Monitoring and Evaluation staff for brood years 1997, 1998, and 1999 at Sawtooth Fish Hatchery.

Rearing Hatchery	Release Site	Brood Year	Control / Treatment	Total Release	# CW Tagged	PIT Tags	Juvenile Survival LGD	Total Rack Returns	Total Adult Returns	Smolt-to-Adult Survival
			Control	31,146	30,033	486	50.0%	296	319	1.0242%
		1997	Treatment	39,929	39,414	487	40.4%	82	122	0.3055%
			Control	54,880	52,833	508	50.7%	140	259	0.4719%
	Sawtooth	1998	Treatment	50,140	49,249	496	58.7%	119	215	0.4288%
Sawtooth	Weir	1999	Treatment	57,134	55,600	500	52.4%	38	72	0.1260%

A critical ratio test (Z-test) using the methods outlined in Fleiss et al. (2003) was used to evaluate potential differences in out-migrating juvenile survival to LGD and SARs for both brood year 1997 and 1998. No analysis could be performed for brood year 1999 due to the lack of a control group.

For brood year 1997, out-migration survival was significantly higher for conventionally-reared fish than for NATURES-reared fish ($Z = 2.94$, CI for difference in proportions = 0.0317 – 0.1603). Smolt-to-adult survival for brood year 1997 was also significantly higher for conventionally-reared fish than for the NATURES-reared fish ($Z = 195.04$, CI for difference in proportions = 0.7145 – 0.7229). However, the treatment group from this brood year was also part of the integrated supplementation group from the Idaho Supplementation Study (ISS). Because the treatment group was part of ISS, it is highly likely that adult returns from this group would have been passed above the Sawtooth Fish Hatchery weir, and CWTs from this group that were passed were subsequently not recovered at a similar rate to conventionally-reared fish. In addition, smolts created from integrated broodstock typically show lower SARs than smolts from hatchery by hatchery crosses (See Table 21, this report). Therefore, the significant differences seen for this brood year are likely confounded by the use of an ISS release.

For brood year 1998, NATURES-reared juveniles had a significantly higher juvenile survival to LGD than conventionally-reared juveniles (Z = 2.48, CI for difference in proportions = -0.1434 – -0.0166). Brood year 1998 SARs were also significantly different between treatment and control groups with the control group having higher SARs (Z = 14.01, CI for difference in proportions = 0.0371 – 0.0491). Both the treatment and control groups used from brood year 1998 were part of the ISS study, so the issues associated with using ISS fish should have affected both groups equally. Interestingly, while the NATURES treatment group showed better juvenile survival to LGD, ultimately the control group had significantly higher SARs indicating that for this particular brood year, any benefits that NATURES rearing may have had for juvenile survival, did not carry over to adult returns.

The results of this study provide only limited insight into the utility of a NATURES-type rearing environment due to the confounding effects of including this research on the top of established ISS research. There is also limited replication across space and time. Because of these limitations, no significant conclusions can be made regarding potential benefits of the NATURES rearing protocol tested at Sawtooth Fish Hatchery. There are currently no plans for any further NATURES rearing research in the immediate future.

ACKNOWLEDGMENTS

We would like to acknowledge the Pacific States Marine Fisheries Commission (PSMFC) and Idaho Power Company (IPC) for providing assistance with data collection and compilation. We thank all of the hatchery managers and their staffs for providing data. We thank Larry Barrett, Donald Whitney, Kim Apperson, Paul Janssen, and Jon Hansen for providing sport harvest information and both the Nez Perce and Shoshone Bannock tribes for providing tribal harvest information. We thank Brian Leth, Tim Copeland, Martin Koenig, and Stuart Rosenberger for providing comments on the draft report and Cheryl Zink for providing formatting and editing.

LITERATURE CITED

Bowles, E., and E Leitzinger. 1991. Salmon Supplementation Studies in Idaho Rivers; Idaho Supplementation Studies. Technical Report, Project No. 198909800, 204 electronic pages, (BPA Report DOE/BP-01466-1).

Brannon, E., K. Currens, D. Goodman, C. McConnaha, J. Lichatowich, B. Riddle, and R. Williams. 1998. Review of salmonid artificial production in the Columbia River Basin. Program Evaluation and Analysis Section Northwest Power Planning Council. Portland, Oregon.

Cassinelli, J., and D. Lindley. 2008. Lower Snake River Compensation Plan Chinook salmon fish hatchery evaluations-Idaho. Project progress report Oct 1, 2004 to Sep 30, 2005. IDFG Report Number 08-15.

Cassinelli, J., and S. Knipper. 2009. Lower Snake River Compensation Plan Chinook salmon fish hatchery evaluations-Idaho. Project progress report Oct 1, 2005 to Sep 30, 2006. IDFG Report Number 09-09.

Cormack, R. M. 1964. Estimates of survival from the sighting of marked animals. Biometrika 51:429-438.

Du, Juan B. Sc. 2002. Combined algorithms for constrained estimation of finite mixture distributions with grouped data and conditional data. Masters thesis. McMaster University, Hamilton, Ontario, California.

FAO Computerized Information Series (Fisheries). 2005. No. 8, Revised version. Rome, FAO. 168 p.

Flagg, T. A., and C. E. Nash. 1999. A conceptual framework for conservation hatchery strategies for pacific salmonids. National Oceanic and Atmospheric Administration Report # NMFS-NWFSC-38. Seattle, Washington.

Fleiss, J. L., Levin, B., and Paik, M. C. 2003. Statistical Methods For Rates and Proportions (3rd ed.). Hoboken, NJ: John Wiley & Sons.

Goodman, M. L. 1990. Preserving the genetic diversity of salmonid stocks: a call for federal regulation of hatchery programs. Environmental Law 20:111-166.

Hilborn, R. 1992. Hatcheries and the future of salmon in the Northwest. Fisheries 17:5-8.

Jolly, G. M. 1965. Explicit estimates from capture-recapture data with both death and immigrations—stochastic model. Biometrika 52:225-247.

Kiefer, S., M. Rowe, and K. Hatch. 1992. U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife, Project No. 88-108, Contract No. DE-FC79-89BP94402, 548 electronic pages (BPA Report DOE/BP-94402-4).

Leth, B., T. Petering, D. Vidergar, and P. Kline. 2004. Snake River Compensation Plan Chinook salmon fish hatchery evaluations-Idaho. Project progress report—October 1, 2000 to September 30, 2001. IDFG Report Number 04-37.

Leth, B. 2007. Lower Snake River Compensation Plan Chinook salmon fish hatchery evaluations-Idaho. Project progress report—October 1, 2001 to September 30, 2002. IDFG Report Number 07-21.

Leth, B., and D. Lindley. 2008. Lower Snake River Compensation Plan Chinook salmon fish hatchery evaluations-Idaho. Project progress report—October 1, 2003 to September 30, 2004. IDFG Report Number 08-03.

Levin, P. S., and J. G. Williams, 2002. Interspecific effects of artificially propagated fish: an additional conservation risk for salmon. Conservation Biology 16:1581-1587.

LSRCP (Lower Snake River Compensation Plan). 1991. Snake River hatchery review workshop. Compiled by Lower Snake River Compensation Plan Office. US Fish and Wildlife Service. Boise, Idaho.

MacDonald, P. D. M., and T. J. Pitcher. 1979. Age-groups from size-frequency data: a versatile and efficient method of analyzing distribution mixtures. Journal of the Fisheries Research Board of Canada, 36, 987-1001.

Mahnken, C. V. W., G. T. Ruggerone, F. W. Waknitz, and T. A. Flagg. 1998. A historical perspective on salmonid production from Pacific Rim hatcheries. North Pacific Anadromous Fish Commission Bulletin 1:38-53.

Maynard, D. J., M. Crewson, E. P. Tezak, W. C. McAuley, S. L. Schroder, C. Knudsen, T. A. Flagg, and C. V. W. Mahnken. 1996b. The post release survival of Satsop River fall Chinook salmon reared in conventional and seminatural raceway habitats, 1994. p 78-97. *In* D. J. Maynard, T. A. Flagg and C. V. W. Mahnken (editors). Development of a Natural Rearing System to improve supplemental fish quality, 1991-1995. Report to Bonneville Power Administration. Contract DE-A179-91BP20651.

McGhee, J., and S. Patterson. 1999. Clearwater Fish Hatchery brood year 1997 Chinook and brood year 1998 steelhead report. Idaho Department of Fish and Game. Boise, Idaho.

Moore, B. 1981. Sawtooth salmon trap annual report. Idaho Department of Fish and Game. Boise, Idaho.

Munson, D. A., D. G. Elliott, and K. A. Johnson. 2010. Management of Bacterial Kidney Disease in Idaho Department of Fish and Game Hatcheries on Broodstock Testing by Enzyme Linked Immunosorbent Assay (ELISA): A Multi-year Study. North American Journal of Fishery Management 30:940-955.

Nickelson, T. E., M. F. Solazzi, and S. L. Johnson. 1986. Use of hatchery coho salmon *Oncorhynchus kisutch* presmolts to rebuild wild populations in Oregon coastal streams. Canadian Journal of Fisheries and Aquatic Science 43:2443-2449.

R Development Core Team. 2004. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org.

Reisenbichler, R. R., J. D. McIntyre, and R. J. Hallock. 1982. Relation between size of Chinook salmon, Oncorhynchus tshawytscha, released at hatcheries and returns to hatcheries and ocean fisheries. California Fish and Game 68(1): 57-59.

Seber, G. A. F. 1965. A note on the multiple recapture census. Biometrika 52:249-252.

Smith, S. G., W. D. Muir, R. W. Zabel, E. E. Hockersmith, G. A. Axel, W. P. Connor, B. D. Arnsberg. 2002. Survival of Hatchery Subyearling Fall Chinook Salmon in the Free-Flowing Snake River and Lower Snake River Reservoirs, 1998-2001. Report by National Marine Fisheries Service to the U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife, Seattle, Washington, Contract DE-AI79-93BP10891, Project No. 93-29, 104 p.

United States Army Engineer District. 1975. Special report Lower Snake River Fish and Wildlife Compensation Plan. Department of the Army, Walla Walla District, Corps of Engineers. Walla Walla, Washington.

US v Oregon Technical Advisory Committee. 2008. Biological assessment of incidental impacts of salmon species listed under the Endangered Species Act in the 2008-2017 non-Indian and treaty Indian fisheries in the Columbia River Basin.

Venditti, D. A., A. Kohler, K. A. Apperson, B. Barnett, A. Brimmer, and N. Brindza. 2006. Idaho supplementation studies. Joint project progress report—January 1, 2002 to July 31, 2002. IDFG report number 06-47.

Venditti, D. A., A. Kohler, K. A. Apperson, A. Brimmer, B. Bowersox, C. Bretz, and J. Lockhart. 2008. Idaho supplementation studies brood year 2005 cooperative report. IDFG report number 08-07.

Vidergar, D., T. Petering, and P. Kline. 2003. Chinook salmon seminatural rearing experiment: Sawtooth and Clearwater fish hatcheries, Idaho. IDFG Report No. 03-35.

Waples, R. S. 1991. Genetic interactions between hatchery and wild salmonids: lessons from the Pacific Northwest. Canadian Journal of Fisheries and Aquatic Science 48:124-133.

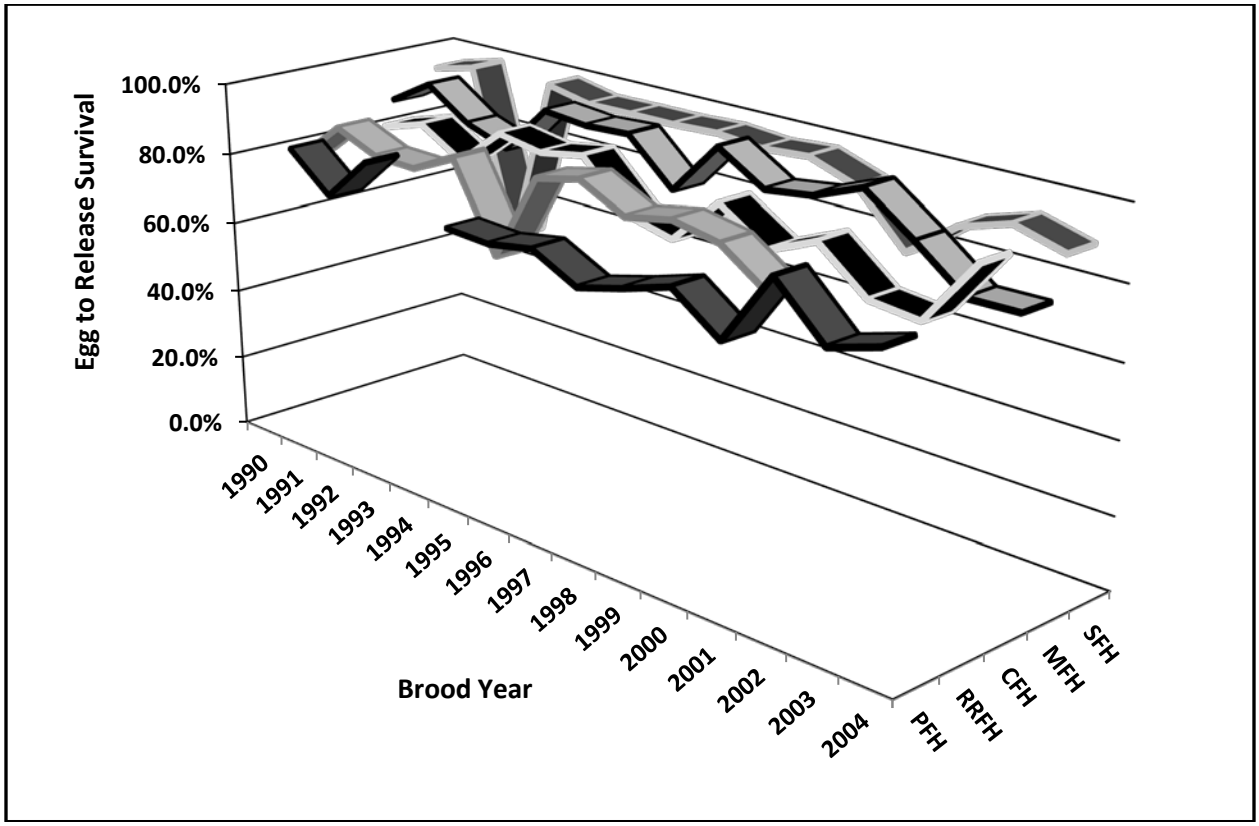
Waples, R. S. 1999. Dispelling some myths about hatcheries. Fisheries 24(2): 12-21.

Westhagen, P., and J. R. Skalski. 2009. PitPro (version 4.0). School of Aquatic and Fishery Sciences. University of Washington. Seattle. Available at http://www.cbr.washington.edu/paramest/pitpro/.

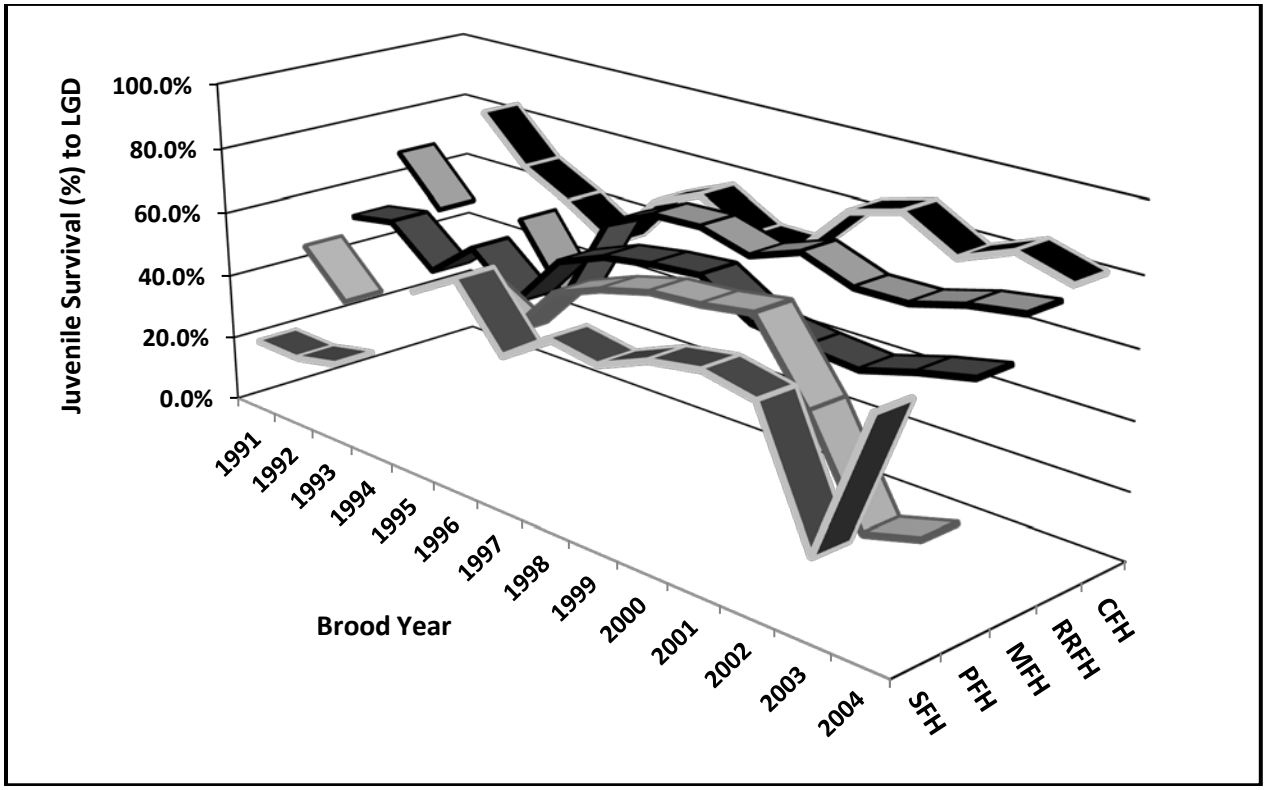
Zabel, R. W., and S. A. Achord. 2004. Relating size of juveniles to survival within and among populations of Chinook salmon. Ecology 85: 795-806.

APPENDICES

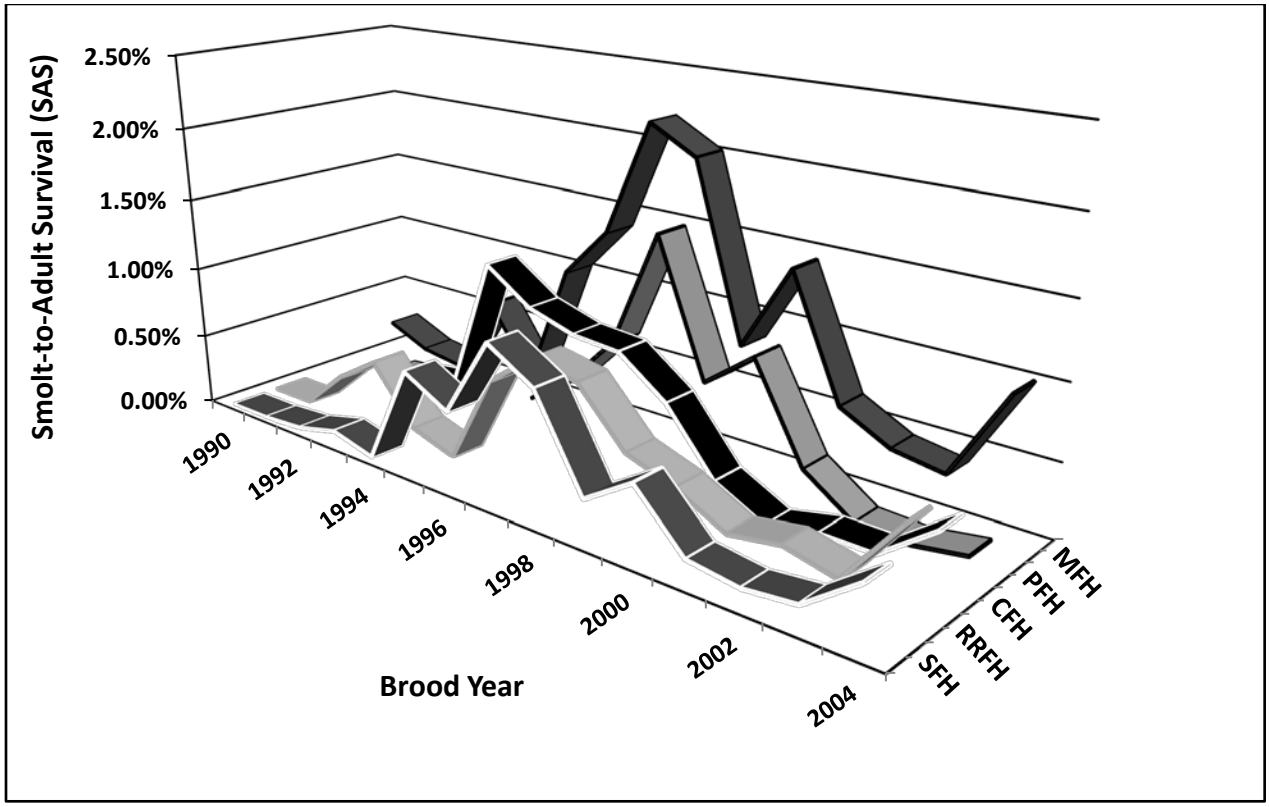
Appendix A. Green egg to release survival percentages for McCall, Pahsimeroi, Clearwater, Rapid River, and Sawtooth fish hatcheries for brood years 1990 through 2004.



Appendix B. Juvenile out-migration survival percentages for McCall, Pahsimeroi, Clearwater, Rapid River, and Sawtooth fish hatchery smolts for brood years 1991 through 2004.



Appendix C. Smolt-to-adult survival (SAS) percentages for McCall, Pahsimeroi, Clearwater, Rapid River, and Sawtooth fish hatchery smolts for brood years 1990 through 2004.



Prepared by:

John Cassinelli
Regional Fisheries Biologist

Shane Knipper
Senior Fisheries Technician

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Sam Sharr
Fisheries Anadromous Coordinator

Edward B. Schriever, Chief
Bureau of Fisheries