FISHERY RESEARCH

CHINOOK FISH HATCHERY EVALUATIONS—IDAHO

Project Progress Report

Report Period October 1, 1999 to September 30, 2000

Dmitri Vidergar
Fisheries Research Biologist

Tracy Petering
Technical Records Specialist I

Paul Kline
Principal Fisheries Research Biologist

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LSRCP Chinook Evaluation Studies in Idaho
Part 1: Chinook Salmon

2000 Annual Report
October 1, 1999 to September 30, 2000

By

Dmitri Vidergar
Tracy Petering
Paul Kline

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

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ABSTRACT

This annual report summarizes Idaho-Lower Snake River Compensation Plan (LSRCP) Hatchery Evaluation Studies from October 1, 1999 through September 30, 2000. Included in this report are all 2000 adult chinook salmon *Oncorhynchus tshawytscha* returns and all releases of juvenile spring and summer chinook salmon made within the reporting period. Release information includes data from 2000 as well as some emigration data from spring 2001. Information presented in this report supercedes that included in previous reports.

Total adult and jack returns of spring and summer chinook salmon (combined) to the upper Snake River drainage in 2000 were above the most recent 10-year average but below the LSRCP return goal of 58,700 total chinook salmon above Lower Granite Dam (LGR). Lower Granite Dam adult counts included 44,140 spring chinook salmon and 7,669 summer chinook salmon from wild-, natural-, or hatchery-origin, of which 10,318 and 3,736, respectively, were jacks. Total LGR counts were 660.64% and 58.32% of the respective 1999 spring and summer chinook salmon counts. (Wild- or natural-origin fish include some supplementation fish that cannot be differentiated because of the presence of an adipose fin.) The 2000 LGR counts included an estimated 3,266 and 4,067 wild- or natural-origin spring and summer chinook salmon, respectively. Wild- or natural-origin spring and summer chinook were 195.83% and 156.76% of the respective 1999 counts.

Adult and jack spring and summer chinook salmon returns to Idaho hatchery racks (LSRCP, Idaho Power Company, and U.S. Fish and Wildlife Service) totaled 14,816 and 7,271 fish, respectively; these numbers include fish of wild-, natural-, and hatchery-origin. The 2000 hatchery rack totals were 502.03% and 211.00% greater than the 1999 spring and summer chinook salmon total hatchery rack returns. Returns to LSRCP chinook salmon hatcheries in Idaho totaled 7,262 spring and 6,812 summer chinook salmon. These numbers represent an increase of 441.94% (spring run) and 247.37% (summer run) over the 1999 returns.

Total adult and jack spring chinook salmon returns in 2000 to specific LSRCP trapping locations were: Sawtooth Fish Hatchery, 986; Red River/Crooked River satellites, 1,472; Powell satellite, 1,602; and Dworshak National Fish Hatchery, 3,202. A total of 6,812 summer chinook salmon returned to the South Fork Salmon River trap, the collection site for McCall Fish Hatchery.

Total chinook salmon returns to non-LSRCP Idaho hatcheries included 8,013 spring chinook salmon (Kooskia National Fish Hatchery, 1,581; Rapid River Fish Hatchery, 4,799; Oxbow Fish Hatchery, 1,174) and 459 summer chinook salmon (Pahsimeroi Fish Hatchery). These numbers may include a small number of naturally produced fish.

Smolt-to-adult return rates (from smolt release to total adult and jack detections at LGR) for marked (passive integrated transponder-tagged) adults from brood year 1995 LSRCP spring and summer chinook salmon ranged from 0.00% for Sawtooth and Clearwater fish hatcheries to 0.55% for McCall Fish Hatchery.

Idaho-LSRCP hatcheries operated by the Idaho Department of Fish and Game released 1,118,880 summer chinook salmon smolts, 178,714 summer chinook salmon presmolts, 1,435,076 spring chinook salmon smolts, and 185,342 spring chinook salmon presmolts during the 2000 fiscal year. Smolts released within the 2000 reporting period were the progeny of 1998

adult returns and emigrated in 2000, whereas presmolts were the progeny of 1999 adult returns and emigrated in 2001.

Detection rates at the lower Snake River dams for passive integrated transponder-tagged Idaho hatchery reared chinook salmon, including those from LSRCP and Idaho Power Company facilities, ranged from 21.80% for smolts released into Johnson Creek (South Fork Salmon River tributary) to 51.60% for smolts released from the Rapid River Fish Hatchery.

A sport fishery for hatchery origin (adipose-clipped) salmon was held on the Clearwater River, the Little Salmon River, and the South Fork Salmon River in 2000. Sport anglers harvested 7,941 chinook salmon, and tribal members harvested in excess of 5,355 chinook salmon in tribal subsistence fisheries.

Authors:

Dmitri Vidergar
Fisheries Research Biologist

Tracy Petering
Technical Records Specialist I

Paul Kline
Principal Fisheries Research Biologist

INTRODUCTION

The U.S. Army Corps of Engineers constructed four hydroelectric dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) on the lower Snake River between 1962 and 1975. Fishery managers and biologists expected the survival of downstream migrating smolts and upstream migrating adults to be reduced by the dam construction and operation and the alteration of the river ecosystem. The Lower Snake River Compensation Plan (LSRCP) was authorized by the Water Resources Development Act of 1976 (90 Stat. 2917) to compensate for the reduced survival and anadromous fish losses caused by dam construction and operation. The primary compensation tool specified in the LSRCP was a hatchery mitigation program. In 1977, the U.S. Fish and Wildlife Service (USFWS) was given budgeting and administration responsibility for operation and maintenance funding of LSRCP fish hatchery programs through an interagency agreement among the U.S. Army Corps of Engineers, National Marine Fisheries Service (NMFS), and the USFWS.

The LSRCP hatchery program specifies the use of fish hatcheries to produce and release large numbers of juvenile anadromous salmonids to meet adult return goals. Adult return goals established by the LSRCP are 8,000 summer chinook salmon *Oncorhynchus tshawytscha*, 50,700 spring chinook salmon, and 18,300 fall chinook salmon to the Snake River basin. At the present time only Oxbow Fish Hatchery, an Idaho Power Company (IPC) facility on the Snake River bordering Idaho and Oregon, raises fall chinook salmon. The majority of these fish are destined to return to Idaho waters. To achieve these goals, the Idaho Department of Fish and Game (IDFG) and the USFWS currently operate five hatcheries and five satellite facilities in Idaho: McCall Fish Hatchery and the South Fork Salmon River trap; Dworshak National Fish Hatchery; Kooskia National Fish Hatchery; Clearwater Fish Hatchery and the Red River, Crooked River, and Powell satellite facilities; Sawtooth Fish Hatchery and the East Fork Salmon River satellite facility (Figure 1). The Powell and Crooked River satellite facilities became fully operational in 1989 and 1990, respectively. Clearwater Fish Hatchery, the final hatchery authorized under the LSRCP, became operational in 1992. The IPC operates three additional chinook salmon hatcheries in Idaho (Rapid River, Oxbow, and Pahsimeroi fish hatcheries; Figure 1).

Specific information pertaining to the LSRCP program at Dworshak National Fish Hatchery and IPC facilities are reported under separate covers. We include selective information in this report for comparative purposes.

The LSRCP included a Hatchery Evaluation Study (HES) component to monitor and evaluate the mitigation hatchery program. The primary objective of the HES is to determine the best hatchery management practices that allow the mitigation hatcheries to meet the LSRCP and IDFG anadromous fisheries goals. Only if we understand the effects of hatchery operations on adult return characteristics (e.g., return rates, sex ratios, age structure) can we prescribe effective management actions. Tasks we defined to satisfy the primary objective are divided into two categories: 1) monitoring and documentation, and 2) investigation. We monitor and document hatchery practices for each brood year or cohort of fish. Investigation tasks are generally manipulative experiments involving modified or alternative hatchery practices that show potential for increasing adult returns and achieving LSRCP and IDFG goals.

This report summarizes chinook salmon HES activities carried out from October 1, 1999 through September 30, 2000. Specific objectives identified in Cooperative Work Agreement 14110-0-J007 and covered in this report are as follows:

Objective 1. Document the success of the IDFG-LSRCP program in meeting specific adult return goals.

Objective 2. Identify factors limiting hatchery success and recommend possible improvements based on existing knowledge and experimentation.

Subobjective 2.1 Continue ongoing documentation and monitoring to determine the relationships between adult returns and hatchery practices, characteristics of hatchery products, and juvenile survival.

Subobjective 2.2 Conduct controlled studies (short-term experiments) to determine the relationships between adult returns and hatchery practices, characteristics of hatchery products, and juvenile survival.

Reports addressing Subobjective 2.2 may be printed and bound as independent reports. Some results from those experiments, such as juvenile out-migration characteristics and adult return rates for experimental groups, are included in this report.

METHODS

IDFG-LSRCP Program Success Documentation

Success of the IDFG-LSRCP program was determined by comparing the return of adults in 2000 to the program goal. In addition, the success of individual hatchery programs in meeting their individual facility goals was assessed. Juvenile releases that contributed to the return were compared to annual hatchery release targets. Parr and presmolt release numbers were converted to smolt equivalents using the multipliers 0.75 and 0.90, respectively (Hassemer et al. 2000). Parr and presmolt multipliers represent the average survival expected during hatchery rearing between the parr or presmolt to smolt stage. Juvenile releases included LSRCP fish as well as fish released for other purposes (e.g., Idaho Supplementation Studies Project or tribal agreements).

Hatchery Operations Documentation

Information on selected hatchery operations, including juvenile rearing and release, weir management, and spawning protocols, was obtained from written and oral communication with hatchery personnel. Written documents from which we extracted relevant information included "Run" and "Brood Year" reports from Clearwater, McCall, Rapid River, Oxbow, Pahsimeroi, and Sawtooth fish hatcheries, monthly hatchery rearing summaries, stocking slips, the Idaho release and retrieval database, and memoranda pertinent to trapping, spawning, rearing, and release operations. Personal communications through formal and informal meetings provided additional information. We attempted to avoid duplication of hatchery documents while highlighting information (e.g., fish health) that may have affected adult return characteristics. Documentation includes number of eggs taken, size of juvenile fish (fish per kilogram), strain, tagging or marking of experimental groups, number of fish released, and release locations. Although an

attempt was made to standardize all numbers in this report, minor discrepancies may be found between the appendices and text or tables resulting from the multiple origins of these data.

Composition of Brood Year 2000 Adult Returns

Age Determinations—We used a variety of methods to determine the age composition of adult returns to the various facilities. We aged fish according to the following hierarchy of methods. Coded-wire tags (CWTs) and passive integrated transponder (PIT) tags provided the known age of fish from which tags were recovered. Presence/absence of a ventral fin provided a fairly reliable estimate of age, because in many cases we have been alternating left and right clips annually at hatcheries. Additionally, a small number of visual implant and elastomer marks have been used in recent years. Lastly, we deferred to length-frequency distributions for runs trapped at each weir to age fish for which we had no other information (Table 1). When possible, we relied on the length-frequency distribution of known-age fish (CWT or fin clipped).

When available, CWT recoveries were pooled from all recovery methods to provide length distributions for known-age adult fish returning to McCall and Sawtooth fish hatcheries and Clearwater Fish Hatchery satellite facilities (Idaho retrieval and release databases). When CWT data was not available, PIT tag recoveries to the respective hatcheries were used to provide length distributions for known-age adult fish. Recovery data did not include sex of individual fish.

The age notations we use throughout the text and tables for adults that returned in 2000 refer to the total age of the fish and assume all juveniles smolt as yearlings. Three-year-old fish (jacks) originated from releases of brood year 1997 progeny; four-year-olds originated from releases of brood year 1996 progeny, and five-year-olds originated from releases of brood year 1995 progeny.

Sex Composition—Hatchery personnel provide the sex composition data we report. Sex ratios were calculated for total adult returns, including and excluding jacks (three-year-old males), and for specific age groups where appropriate. In some years, sex composition data were not available. When this occurred, total adult numbers are reported.

Fish Origin—We classified any chinook salmon bearing an external mark, typically an adipose or ventral fin clip, as a hatchery-origin fish; however, visual implant and elastomer marks have also been used instead of fin clips in recent years to identify specific hatchery-origin fish. Hatchery-origin fish may also be referred to as reserve or production fish; the terms reserve and production are often used in reference to a hatchery-origin chinook salmon that can be legally harvested in a sport fishery. Supplementation fish refer to chinook salmon that are part of the Idaho Supplementation Study (ISS); for a further explanation of supplementation fish or the ISS program refer to Lutch et al. 2003.

Fish Health Monitoring—Tissue samples from adult female chinook spawned at IDFG hatcheries were tested for bacterial kidney disease (BKD) at the Eagle Fish Health Laboratory, Eagle, Idaho. The IDFG standards dictated that all eggs tested by Enzyme-Linked Immunosorbent Assay (ELISA) methods with optical density values exceeding 0.25 be culled in 2000 (K. Johnson, IDFG, personal communication).

Brood Year 1995 Smolt-to-Adult Return Rates

Within the text, we identify releases as fry, parr, presmolts, or smolts and provide juvenile release-to-adult return estimates based on this terminology. The terms fry, parr, and presmolts refer to chinook salmon in their first spring, summer, or fall of life, respectively. Smolts are juveniles released in their second spring of life. Typically, we are unable to provide return rates for fry and parr, because these fish are not marked or the numbers marked are insufficient for statistical analysis. Most hatchery reared spring and summer chinook salmon in Idaho and throughout the Columbia Basin are released as smolts. Commonly, a large number of these smolts are marked. Therefore, the smolt-to-adult return rate (SAR) of marked fish (the number of marked fish returning divided by the number of marked fish released) is the most commonly used estimator of survival and is assumed to represent overall smolt-to-adult survival. Smolt-to-adult ratios in this report represent a minimum estimate of survival from tagging to adult detections at LGR and are not expanded to include fish harvested or detected downstream of LGR. Lastly, although we freely use the term smolt in reference to yearling chinook salmon, some fish show no signs of smoltification at release and may not immediately emigrate. Kiefer et al. (2002) reported that a small percent of wild-origin Snake River chinook salmon appear to rear for two years in fresh water prior to smolting.

Juvenile Out-migration Conditions

Snake River water flow during smolt out-migration is a significant factor affecting survival of Idaho's anadromous fishes (Berggren and Filardo 1993). River flows during emigration periods for brood year returns completed in 2000 are of particular interest for this reporting period. Flow conditions during the 1997 emigration of brood year 1995 chinook salmon are reported in Figure 2. Flow conditions for the 2000 emigration period for brood year 1998 chinook salmon are reported in Figure 3. We obtained river flow data from the Fish Passage Center (FPC) (http://www.fpc.org/adult_history/YTD-LGR) and the Columbia River Data Access in Real Time (DART) (http://www.cqs.washington.edu/dart/dart.html) databases.

Two periods were defined to summarize juvenile out-migration flows at LGR. The "peak" period, April 15 to May 5, is defined as the period of time during which 50% of the emigration of yearling chinook salmon occurs. The "extended" period, April 20 to May 30, includes most of the known out-migration of wild- and natural-origin yearling chinook salmon. For further explanation of emigration periods identified in this report, refer to Petrosky 1991.

Out-migration Timing and Juvenile Survival

We retrieved PIT tag data from the PIT Tag Information System (PTAGIS) (http://www.psmfc.org/pittag/) database maintained by the Pacific States Marine Fisheries Commission in Gladstone, Oregon. These data pertain to wild-, natural- and hatchery-origin fish PIT tagged by various entities for numerous purposes and were used to assess migration survival and timing.

The detection (interrogation) rate of PIT-tagged juvenile salmonids at the lower Snake River dams serves as a relative or minimum survival index. The index is considered relative or minimum because: 1) an unknown (but we believe small) number of PIT-tagged fish that die in the hatchery may go undetected, although all dead fish are scanned; 2) not all fish pass through detectors; 3) approximately 0.30% of PIT tags fail (Kiefer and Lockhart 1994) or are lost

between tagging and arrival at detection sites; 4) some fish arrive while detection gear is not being operated; and 5) mortality occurs between dams.

We compared the relative survival of fish from various groups of hatchery-origin juveniles arriving at the dams with interrogation capabilities. We restricted our comparisons to groups of fish arriving at similar times, because seasonally varying flow and spill conditions affect sampling rates, making comparisons of groups arriving at different times inappropriate. In addition, if a fish was detected at more than one dam or more than once at the same dam, we used the first detection. Fish that were detected at any one of these dams were counted as survivors to LGR.

Detection rates reflect the total number of first detections of individual fish at any of the detection sites: Lower Granite, Little Goose, Lower Monumental, or McNary dams. The total number of unique first detections also represents the number of marked fish that were alive to LGR (the first dam out-migrating fish encounter) whether the fish were detected at LGR or not. Detection rates are reported only to LGR, because disposition of smolts past LGR is variable (e.g. smolts can be barged, spilled, or pass through the turbines at any of the dams). We present arrival-timing graphs for various PIT tag groups for comparative purposes. These graphs are constructed from detections at LGR only. For releases that occurred over an extended period, such as volitional releases, we used the middle date of the release period as the date from which to calculate travel times.

We used graphic interpretation to determine if arrival-timing patterns were similar among release groups. To examine the effect of release distance on detection and travel time and release date on travel time, the graphical interpretation included an estimate of the coefficient of determination (R^2). The coefficient of determination was used to make inferences about the variability in the dependant variables (distance to LGR and release date) that was explained by the independent variables (median travel time to LGR and cumulative percent detection to LGR) in a general linear model (Ott 1993).

Progeny:Parent Ratios

The female progeny:parent ratio is the number of adult females that returned to their hatchery of origin for each female used in a given brood year's spawning. The number of females used includes all females spawned, those that died prior to spawning, and those killed but not spawned. A small amount of error is introduced into the ratio estimate because of inaccurate sexing of adults at the time of trapping. In addition, only fish of known hatchery origin are compiled to estimate progeny:parent ratios; although assumed to be a minor problem, misidentification of a fish's origin would also bias the ratios.

Fish Disposition

In 2000, adult returns reached holding capacity at some hatchery facilities, requiring disposition of excess fish. Some hatchery-origin fish were recycled back through fisheries, allowing anglers additional harvest opportunity. All recycled fish released downstream were opercule punched to identify them as previously trapped fish. Some hatchery-origin jacks were killed for consumptive uses and distributed to the Nez Perce Tribe, the Shoshone-Bannock Tribe, and various local health and welfare organizations. Additionally, to provide potential production in areas without natural production, hatchery-origin adults (South Fork Salmon River

stock) were released at three sites located near the Stibnite mine (East Fork of the South Fork Salmon River).

Return Year 2000 Weir Management Protocols

McCall Fish Hatchery

Following the guidelines established by NMFS in the application for the section 10 permit for McCall Fish Hatchery trapping and spawning activities, IDFG defined the following weir management plan:

1. Maintain a minimum of 20 pairs of spawners in the natural environment above the weir with a preferred target of at least 35 pairs by releasing 67% of the wild- or natural-origin (listed) adults, then supplementation and reserve adults, in that order of preference.

2. Maintain the composition of adults released to spawn naturally above the weir at 50% wild- or natural-origin and 50% hatchery-produced where the number of reserve adults released does not exceed the number of natural adults, except where this is necessary to maintain the 20 pair minimum. That is, if the number of natural + supplementation pairs of adults released is approximately 18, then the 35 pair goal could be met by releasing reserve fish only (i.e. 17 pairs). If there are less than 10 pairs of natural fish released, then any combination of supplementation + reserve fish will be used to bring the total number of pairs released to 20 (approximately 11 pairs). In this situation, the number of reserve fish could exceed the number of natural fish released; i.e., genetic criteria will be subordinated to demographic concerns in order to maintain 20 pairs of spawners in the natural environment.

Sawtooth Fish Hatchery

Following the guidelines established by NMFS in the application for the Section 10 permit for Sawtooth Fish Hatchery trapping and spawning activities, IDFG defined the following weir management plan:

1. Maintain a minimum of 20 pairs of spawners in the natural environment above the weir with a preferred target of at least 35 pairs by releasing 67% of the wild- or natural-origin (listed) adults, then supplementation and reserve adults, in that order of preference.

2. Maintain the composition of adults released to spawn naturally above the weir at 50% wild- or natural-origin and 50% hatchery-produced where the number of reserve adults released does not exceed the number of natural adults, except where this is necessary to maintain the 20 pair minimum. That is, if the number of natural + supplementation pairs of adults released is approximately 18, then the 35 pair goal could be met by releasing reserve fish only (i.e. 17 pairs). If there are less than 10 pairs of natural fish released, then any combination of supplementation + reserve fish will be used to bring the total number of pairs released to 20 (approximately 11 pairs). In this situation, the number of reserve fish could exceed the number of

natural fish released; i.e., genetic criteria will be subordinated to demographic concerns in order to maintain 20 pairs of spawners in the natural environment.

In addition, Sawtooth Fish Hatchery is presently required by Permit #919 to retain no unmarked fish for supplementation broodstock if the predicted return is less than 100 adults.

Clearwater Fish Hatchery

No ESA listed chinook salmon are identified in the Clearwater River Basin; therefore, Clearwater Fish Hatchery and satellite facilities are not required to adhere to the requirements outlined in the IDFG application to NMFS for a Section 10 permit. Weir management plans for the Red River, Crooked River, and Powell satellite facilities are established by IDFG management, research, and hatchery staff.

Red River and Crooked River Satellite Facilities

The weir management plan called for releasing only unmarked chinook salmon above both weirs; however, because adult returns were expected to be in excess of broodstock needs, 16 pairs of hatchery-origin fish were to be released above the Crooked River weir to spawn naturally.

Powell Satellite Facility

In 2000, the Powell satellite facility operated two weirs: one at Walton Creek and the other at Crooked Fork Creek. The Walton Creek weir was located at the mouth of Walton Creek into the Lochsa River (Powell satellite effluent). The Crooked Fork weir was located on Crooked Fork Creek approximately 1.6 kilometers upstream of Walton Creek. Adult returns for the Powell satellite facility include fish trapped at both weirs.

The weir management plan called for immediately releasing all unmarked fish above either of the two weirs.

Harvest

In 2000, a sport fishery for adipose-clipped (hatchery-origin) spring and summer chinook salmon was held on the Clearwater River, the Little Salmon River, and the South Fork Salmon River. The Clearwater River (basin) season was open from May 5 to July 4. The Little Salmon River fishery was open from May 12 to July 4. The South Fork Salmon River fishery was open from June 30 to July 5.

RESULTS

Summary of Releases

2000 Reporting Period

Idaho-LSRCP hatchery facilities operated by IDFG released 1,435,076 spring chinook salmon smolts, 185,342 spring chinook salmon presmolts, 1,118,880 summer chinook salmon smolts, and 178,714 summer chinook salmon presmolts in fiscal year 2000 (Table 2). Most of the chinook released in 2000 had their adipose fins removed allowing the potential for harvest; however, 395,137 smolts and 238,648 presmolts were released with adipose fins (Nez Perce Tribe and Idaho Supplementation Studies releases; Appendix A). Other marks or tags may have been applied to a portion of some releases from each hatchery for ongoing experiments.

A more comprehensive review of brood years is found in the brood year reports from each hatchery. For a better understanding of individual brood year releases during the 2000 reporting period, brood year 1998 and brood year 1999 releases are described below.

Brood Year 1998

Brood year 1998 releases during reporting year 2000 included only smolts. Presmolt releases are reported in the fiscal year 1999 annual report.

Idaho-LSRCP hatchery facilities operated by IDFG released 1,435,076 spring chinook salmon smolts and 1,118,880 summer chinook salmon smolts from brood year 1998 (Table 2).

Brood Year 1999

Brood year 1999 releases during reporting year 2000 include only presmolts. Smolt releases for brood year 1999 are reported in the reporting year 2001 annual report.

Idaho-LSRCP hatchery facilities operated by IDFG released 185,342 spring chinook salmon presmolts and 178,714 summer chinook salmon presmolts from brood year 1999 (Table 2).

Summary of Adult Returns

Spring Chinook Salmon

The total count of adult spring chinook salmon (wild-, natural-, or hatchery-origin) crossing LGR in 2000 was 44,140 fish (Table 3). Included in this total were 10,318 jacks or three-year-old fish and an estimated 3,266 wild- or natural-origin fish (Table 4). The total LGR count was 660.64% greater than the respective 1999 count. (Wild- and natural-origin fish include some supplementation fish that cannot be differentiated because of the presence of an adipose fin.)

Returns to all Idaho hatchery racks, including fish of wild-, natural-, or hatchery-origin, totaled 14,816 spring chinook salmon (Table 5); this return was 502.03% greater than the 1999 return of 2,416 fish. Returns to Idaho-LSRCP hatchery racks totaled 7,262 spring chinook salmon; this return was 441.94% greater than the 1999 LSRCP rack return of 1,340 fish. A total of 7,554 spring chinook salmon returned to non-LSRCP Idaho hatcheries (Kooskia National Fish Hatchery, Rapid River Fish Hatchery, and Oxbow Fish Hatchery). This return was 573.86% greater than the 1999 non-LSRCP rack return of 1,121 fish.

Hatchery-Origin Returns

Returns to all Idaho hatchery racks of hatchery-origin only spring chinook totaled 9,213 (Table 6); this return was 581.94% greater than the 1999 return of 1,351 hatchery-origin fish. Returns to Idaho-LSRCP hatchery racks totaled 3,361 hatchery-origin spring chinook salmon; this return was 731.93% greater than the 1999 LSRCP rack return of 404 fish. A total of 5,852 hatchery-origin spring chinook salmon returned to non-LSRCP Idaho hatcheries (Kooskia National Fish Hatchery, Rapid River Fish Hatchery, and Oxbow Fish Hatchery). This return was 517.95% greater than the 1999 non-LSRCP hatchery-origin rack return of 947 fish.

Summer Chinook Salmon

The total count of summer chinook salmon (wild-, natural-, or hatchery-origin) crossing LGR in 2000 was 7,669 (Table 3). Included in this total were 3,736 jacks or three-year-old fish and an estimated 4,067 wild- or natural-origin fish (Table 4). The total LGR count was 58.32% greater than the respective 1999 count. (Wild- and natural-origin fish include some supplementation fish that cannot be differentiated because of the presence of an adipose fin.)

Returns to all Idaho hatchery racks, including fish of wild-, natural-, or hatchery-origin, totaled 7,271 summer chinook salmon (Table 7); this return was 210.99% greater than the 1999 rack return of 2,338 fish. Returns to Idaho-LSRCP hatchery racks totaled 6,812 summer chinook salmon; this return was 318.68% greater than the 1999 LSRCP rack return of 1,627 fish. A total of 459 summer chinook salmon returned to non-LSRCP Idaho hatcheries (Pahsimeroi Fish Hatchery). This return was 21.75% greater than the 1999 non-LSRCP rack return of 377 fish.

Hatchery-Origin Returns

Returns to all Idaho hatchery racks of hatchery-origin only summer chinook total 6,384 (Table 7); this return was 224.72% greater than the 1999 return of 1966 hatchery-origin fish. Returns to Idaho-LSRCP hatchery racks (McCall Fish Hatchery) totaled 6,093 hatchery-origin spring chinook salmon; this return was 264.85% greater than the 1999 LSRCP rack return of 1,670 fish. A total of 291 hatchery-origin summer chinook salmon returned to non-LSRCP Idaho hatcheries (Pahsimeroi Fish Hatchery). This return was 1.69% less than the 1999 non-LSRCP hatchery-origin rack of 296 fish.

Hatchery Operations

McCall Fish Hatchery

2000 Juvenile Releases—McCall Fish Hatchery released 1,118,880 summer chinook salmon smolts (including 247,293 supplementation fish and 78,950 tribal fish) into the South Fork Salmon River and Johnson Creek in 2000 (Table 2; Appendix A Table 2). Green-egg-to-smolt (release) survival of brood year 1998 summer chinook salmon reared at McCall Fish Hatchery averaged 61.70% (Table 8).

2000 Adult Return—A total of 6,812 adult summer chinook salmon were trapped at the South Fork Salmon River weir in 2000, which included 1,771 females, 1,625 males, and 3,416 jacks (Table 9). Male returns included 3,416 three-year-olds, 1,582 four-year-olds, and 43 five-year-olds. Female returns included zero three-year-olds, 1,724 four-year-olds, and 47 five-year-olds (Table 10). Included in this total were 719 wild- or natural-origin or supplementation fish consisting of 121 females, 170 adult males, and 428 jacks (McPherson 2000).

Adult Releases—A total of 1,120 wild-, natural-, or hatchery-origin chinook salmon were released above the South Fork trap, including 421 adults (200 female and 221 male) and 699 jacks. Downstream releases at Dollar Creek (414) and Goat Creek (1,297) totaled 1,711 hatchery-origin fish. Additionally, 200 adult hatchery-origin fish (100 female and 100 male) were stocked into the East Fork of the South Fork Salmon River.

Adult releases met the guidelines defined by NMFS in IDFG's application for a Section 10 permit. Of the 1,120 fish released above the weir, 645 were of wild- or natural-origin, 308 were supplementation broodstock, and 167 were hatchery-origin.

1. Ninety percent of the unmarked, adult, ESA-listed, naturally-produced summer chinook salmon trapped were released above the weir to spawn naturally.

2. One hundred three pairs of spawners were released above the weir to spawn naturally, and

3. Fifty-eight percent of the total fish released above the weir were wild- or natural-origin.

Brood Year 2000 Spawning Protocols—At ponding, adult chinook salmon larger than 66 cm fork length were injected with erythromycin 200 (Gallimycin) into the peritoneal cavity posterior to the pelvic fins at a rate of 20 mg/kg body weight as a preventive measure for BKD.

There were 162 prespawning mortalities, including 36 females, 119 males, and seven jacks that died in the trap. There were 361 females spawned (344 marked and 17 unmarked). Of the marked females spawned, 335 were for reserve groups and 26 were for supplementation. Reserve fish were spawned with reserve fish, supplementation with supplementation, supplementation with unmarked, and unmarked with unmarked. Each female's eggs were split into two groups. Each group was fertilized with the sperm of one male. A total of 710 adult males and 12 jacks were used to fertilize the different groups. The two groups of eggs were then recombined, rinsed with well water, and water hardened in a 100 ppm solution of Argentyne. Eggs from reserve females were double loaded into hatchery egg trays.

Eggs from supplementation and unmarked fish were single loaded to allow listed fish to be culled individually if necessary.

The green egg take was 1,487,809. These green eggs yielded 1,071,378 eyed-eggs for a 72.00% eye-up survival. Average fecundity based on the green egg count was 4,121 eggs per female (Table 9; McPherson 2000). Eggs from 36 females, including three wild-origin fish, were culled because BKD ELISA values exceeded brood year 2000 spawn management criteria.

Johnson Creek Stock—Nez Perce Tribe fisheries staff held 73 Johnson Creek fish (16 female, 25 male, and 32 jacks) on site at the South Fork Trap; all 16 females were spawned (McPherson 2000).

Mark/Tag Recovery—Personnel from IDFG recovered 353 CWTs from the South Fork Salmon River weir and 152 from sport fisheries in 2000 from fish that were reared at McCall Fish Hatchery. Coded-wire tag releases included 62,235 from brood year 1995, 130,110 from brood year 1996, and 565,023 from brood year 1997. Coded-wire tag recoveries at the weir included two fish from brood year 1995, 147 from brood year 1996, and 204 from brood year 1997. Coded-wire tag recoveries from sport fisheries included zero from brood year 1995, 99 from brood year 1996, and 53 from brood year 1997. All CWT recoveries were from adipose-clipped fish except for eight unmarked supplementation-origin jacks collected at the weir (Appendix B, C, D; Table 2).

Three-year-old fish ranged from 50 to 55 cm fork length with a median of 53 cm (n = 121). Four-year-old fish ranged from 75 to 80 cm with a median of 77 cm (n = 139). Five-year-old fish ranged from 90 to 93 cm with a median of 91 cm (n = 4).

Other tags detected at the weir included 454 PIT-tagged fish, 14 fish with visual implant tags, 18 fish with visual implant elastomer tags, and 24 fish with radio tags.

Brood Year 1995 Smolt-to-Adult Return Rate—We estimated 1,157 summer chinook salmon of hatchery-origin returned to the rack from a release of 238,647 brood year 1995 smolts (Table 11). Adult PIT tag detections at LGR from the brood year 1995 PIT tag release of 52,701 full-term smolts included 291 summer chinook salmon of hatchery-origin, yielding an SAR of 0.55% (release to adult detection at LGR; Appendix D Table 2).

Consumptive Releases—Fish were distributed to the Nez Perce tribe (817), the Shoshone-Bannock tribe (824), and to three local health and welfare organizations (405).

Sawtooth Fish Hatchery and East Fork Salmon River Satellite

2000 Juvenile Releases—Sawtooth Fish Hatchery released 123,425 spring chinook salmon smolts (including 123,425 supplementation fish) into the Salmon River in 2000 (Table 2; Appendix A Table 5). All fish were part of a Natural Rearing System (NATURES) study (Snider et al. 2000). Green-egg-to-smolt (release) survival of brood year 1998 spring chinook salmon reared at Sawtooth Fish Hatchery was 88.50% (Table 8).

NATURES—Brood year 1998 fish were reared as part of NATURES, including 50,140 fish reared in camouflage-painted raceways and 73,285 fish reared as a control in unpainted (traditional) raceways. Study fish were differentially marked according to their rearing treatment by using CWT and representative PIT tag groups (IDFG unpublished data). All fish were marked

with CWTs, some were also PIT tagged, and all fish were released into the upper Salmon River at the Sawtooth Fish Hatchery (Snider et al. 2000).

2000 Adult Return—986 adult spring chinook salmon were trapped at the Sawtooth Fish Hatchery in 2000, which included 252 females, 358 males, and 376 jacks (Table 7). Male returns included 376 three-year-olds, 299 four-year-olds, and 59 five-year-olds. Female returns included zero three-year-olds, 201 four-year-olds, and 51 five-year-olds (Table 8). Included in this total were 535 wild- or natural-origin or supplementation fish consisting of 130 females, 308 adult males, and 97 jacks (Schilling 2000).

Adult Releases—525 wild- or natural-origin or supplementation chinook salmon were released above the Sawtooth Fish Hatchery weir on the Salmon River, including 434 adults (159 female and 275 male) and 91 jacks. No downstream releases occurred in 2000.

Adult releases met the guidelines defined by the NMFS in the IDFG's application for a Section 10 permit. Of the 159 females released above the weir, 116 were of wild- or natural-origin and 43 were supplementation. Of the 366 males released, 275 were unmarked adult males and 91 were unmarked jacks; no supplementation males were released above the weir in 2000 (Schilling 2000).

1. Eighty-nine percent of the unmarked, ESA-listed, naturally-produced spring chinook salmon trapped were released above the weir to spawn naturally.

2. One-hundred sixteen pairs of spawners were released above the weir to spawn naturally, and

3. Ninety-two percent of the total fish released above the weir were of wild- or natural-origin.

Brood Year 2000 Spawning Protocols—At ponding, adult chinook salmon were injected with erythromycin 200 (Gallimycin) into the peritoneal cavity posterior to the pelvic fins at a rate of 20 mg/kg body weight as a preventive measure for BKD. Additionally, all ponded fish were treated three times per week in a one-hour 170 ppm formalin flush.

There were five prespawning mortalities, including two females, two males, and one jack. There were 89 females spawned (75 marked and 14 unmarked). Of the marked females spawned, 63 were for reserve groups and 12 were for supplementation groups. All unmarked females spawned were used for supplementation. Each female's eggs were split into two groups. Each group was fertilized with the sperm of one male. Mark and age class determined preferred male to female crosses. A total of 81 adult males and 84 jacks were used to fertilize the different groups. The two groups of eggs were then recombined, rinsed with well water, and water-hardened in a 100 ppm solution of Argentyne. Eggs from each female were incubated separately and isolated based on BKD designation.

The green egg take was 417,709. These green eggs yielded 386,671 eyed-eggs for a 92.60% eye-up survival. Average fecundity based on the green egg count was 4,693 eggs per female (Table 9; Schilling 2000). Eggs from one female were culled due to zero percent eye-up.

Mark/Tag Recovery—Personnel from IDFG recovered 71 CWT from the Sawtooth Fish Hatchery weir and zero from sport fisheries in 2000 from fish that were reared and released at Sawtooth Fish Hatchery. Coded-wire tag releases that contributed to recoveries in 2000

included only a brood year 1997 release of 40,727 CWT fish; there were no CWT releases for either brood year 1995 or 1996. Coded-wire tag recoveries at the weir included 71 brood year 1997 jacks. All CWT recoveries were from adipose-clipped fish (Appendix B, C, D; Table 5).

Three-year-old fish ranged from 50 to 55 cm fork length with a mean of 52 cm (n = 89). No brood year 1995 or 1996 fish were CWT from Sawtooth Fish Hatchery; however, 2 four-year-old PIT-tagged fish returned to the weir that measured 76 and 79 cm. No five-year-old fish were collected with CWT or PIT tags.

Other tags detected at the weir included 16 PIT-tagged fish: two with visual implant tags and three fish with radio tags.

Brood Year 1995 Smolt-to-Adult Return Rate—We estimated 192 spring chinook salmon returned to the rack from a release of 9,795 brood year 1995 full-term smolts (Table 11). Adult PIT tag detections at LGR from the brood year 1995 PIT tag release of 1,500 full-term smolts included zero fish yielding an SAR of 0.00% (release to adult detection at LGR; Appendix D Table 5).

Consumptive Releases—Fish were distributed to the Shoshone-Bannock Tribe (100) and the Operation Help Food Bank (100).

East Fork Salmon River Satellite (Sawtooth Fish Hatchery)—The East Fork Salmon River satellite weir has not been operated for the collection of chinook salmon since 1997.

Red River/Crooked River Satellite (Clearwater Fish Hatchery)

2000 Juvenile Releases—Clearwater Fish Hatchery released 185,342 presmolt and 1,018,129 (includes releases from Rapid River Fish Hatchery) spring chinook salmon smolts into the South Fork Clearwater River in 2000 (Table 2; Appendix A Table 1). Green-egg-to-smolt (release) survival of brood year 1998 spring chinook salmon reared at Clearwater Fish Hatchery was 77.20% (Table 8).

2000 Adult Return—A total of 1,472 adult spring chinook salmon were trapped at the Red River/Crooked River satellites in 2000, which included 503 females, 305 males, 655 jacks, and nine fish of unknown sex (Table 9). Male returns included 655 three-year-olds, 284 four-year-olds, and 19 five-year-olds. Female returns included 3 three-year-olds, 483 four-year-olds, and 4 five-year-olds (Table 10). Included in this total were 105 fish of wild- or natural-origin (36 three-year-olds, 81 four-year-olds and zero five-year-olds). Of the 105 wild- or natural-origin fish, 74 were trapped at the Crooked River weir and 31 at the Red River weir.

Adult Releases—A total of 711 wild-, natural-, or hatchery-origin chinook salmon were released above the South Fork Clearwater River traps, including 105 wild- or natural-origin fish. Downstream releases included 500 jacks released near the town of Stites on the South Fork Clearwater River and a cooperative release with the Nez Perce Tribe of 120 jacks to Newsome Creek for natural spawning.

Only 16 pairs of hatchery-origin fish were scheduled for release above the Crooked River weir; however, larger than anticipated hatchery-origin returns forced managers to make in-season revisions to the weir management plan. On July 24, an additional 18 pairs of hatchery-

origin fish were released above the Crooked River weir. On August 8, ten more females were released, and on August 22, all additional fish trapped (528) were released above the weir.

Brood Year 2000 Spawning Protocol—At ponding, adult chinook salmon were injected with erythromycin 200 (Gallimycin) into the peritoneal cavity posterior to the pelvic fins at a rate of 20 mg/kg body weight as a preventive measure for BKD. Additionally, all ponded fish were treated three times per week in a one-hour 150 ppm formalin flush.

There were 116 prespawning mortalities, including 61 females, 54 males, and one of unknown sex. There were 376 females spawned (all were marked). The eggs from each female were fertilized with milt from one male; some males were used more than once. Approximately one minute after milt from the first male had been in contact with the eggs, milt from a second male was introduced as a safety measure to offset the possibility of the first male being nonviable. A total of 397 adult males including jacks were used. Eggs were water hardened in a 100 ppm Argentyne solution for one hour, rinsed, chilled, and placed in egg trays.

The green egg take was 715,014. These green eggs yielded 588,217 eyed-eggs for an 82.30% eye-up survival. Average fecundity based on the green egg count was 3,611 eggs per female (Table 9; George 2000).

Disease sampling included collecting kidney samples from all females and 60 ovarian and 20 head wedge samples. Eggs from 178 females were culled because BKD ELISA values exceeded brood year 2000 spawn management criteria (George 2000).

Mark/Tag Recovery—Personnel from IDFG recovered a total of 75 CWTs from the Red River and Crooked River satellite racks and zero from sport fisheries in 2000 from fish that were reared at Clearwater Fish Hatchery (Appendix B, C, D; Table 5). No CWT releases at either satellite contributed to recoveries in 2000. (These CWTs were likely from fish that returned to Powell Satellite racks but were transferred to the South Fork Clearwater satellites for spawning [George 2000]).

Three-year-old fish ranged from 47 to 54 cm fork length with a median of 51 cm (n = 6). Four-year-old fish ranged from 69 to 76 cm fork length with a median of 73 cm (n = 7). No five-year-old fish were collected with CWT or PIT tags.

Other tags detected at Crooked River Satellite included 10 PIT-tagged fish and one radio-tagged fish. Other tags detected at Red River Satellite included three PIT-tagged fish.

Brood Year 1995 Smolt-to-Adult Return Rate—We estimated 34 spring chinook salmon of hatchery-origin returned to the rack from a release of 2,970 brood year 1995 smolts (Table 11). Adult PIT tag detections at LGR from the brood year 1995 PIT tag release of 500 full-term smolts included zero fish yielding an SAR of 0.00% (release to adult detection at LGR; Appendix D Table 1).

Powell Satellite (Clearwater Fish Hatchery)

2000 Juvenile Releases—Clearwater Fish Hatchery released 293,522 spring chinook salmon smolts (no supplementation fish) into Walton Creek at the Powell satellite facility in 2000 (Table 2; Appendix A Table 1). Green-egg-to-smolt (release) survival of brood year 1998 spring chinook salmon reared at Clearwater Fish Hatchery was 77.20% (Table 8).

2000 Adult Return—1,602 adult spring chinook salmon were trapped at the Powell satellite facility in 2000, which included 789 females, 469 males, 304 jacks, and 40 of unknown sex (Table 9). Male returns included 304 three-year-olds, 262 four-year-olds, 70 five-year-olds, 70 that were transferred to the South Fork Clearwater satellites to be spawned, and 67 of unknown age (Table 10). Female returns included 1 three-year-old, 626 four-year-olds, 22 five-year-olds, 60 that were transferred to the South Fork Clearwater satellites for production, and 80 of unknown age (Table 10). Included in the total were 59 wild- or natural-origin or supplementation fish (14 three-year-olds, 38 four-year-olds, and 7 five-year-olds).

Adult Releases—59 wild- or natural-origin or supplementation adult chinook salmon were released into the Lochsa River and Crooked Fork Creek above the Powell satellite weirs including 14 three-year-olds, 38 four-year-olds, and 7 five-year-old adult spring chinook salmon. No downstream releases occurred in 2000.

Brood Year 2000 Spawning Protocol—At ponding, adult chinook salmon were injected with erythromycin 200 (Gallimycin) into the peritoneal cavity posterior to the pelvic fins at a rate of 20 mg/kg body weight as a preventive measure for BKD. Additionally, all ponded fish were treated three times per week in a one-hour 120 ppm formalin flush.

There were 274 prespawning mortalities, including 70 females and 204 males. There were 551 females spawned (all were marked). The eggs from each female were fertilized with milt from one male; some males were used more than once. Approximately one minute after milt from the first male had been in contact with the eggs, milt from a second male was introduced as a safety measure to offset the possibility of the first male being nonviable. A total of 335 adult males including jacks were used. Eggs were water hardened in a 100 ppm Argentyne solution for one hour, rinsed, chilled, and placed in egg trays.

The green egg take was 2,035,086. These green eggs yielded 1,791,464 eyed-eggs for an 88.00% eye-up survival. Average fecundity based on the green egg count was 4,006 eggs per female (Table 9; George 2000).

Disease sampling included collecting kidney samples from all females and 60 ovarian and 20 head wedge samples. Eggs from 43 females were culled because BKD ELISA values exceeded brood year 2000 spawn management criteria (George 2000).

Mark/Tag Recovery—Personnel from IDFG recovered 1,145 CWTs from fish returning to the Powell satellite weir and 11 from sport fisheries in 2000. All CWT recoveries came from fish that were reared at Clearwater Fish Hatchery and released at the Powell Satellite weir. Coded-wire tag releases that contributed to recoveries in 2000 included zero from brood year 1995, 214,680 from brood year 1996, and 418,452 from brood year 1997. Coded-wire tag recoveries at the weir included zero from brood year 1995, 894 from brood year 1996, and 251 from brood year 1997. Coded-wire tag recoveries from sport fisheries included zero from brood year 1995, nine fish from brood year 1996, and two fish from brood year 1997. All CWT recoveries were from adipose-clipped fish (Appendix B, C, D; Table 1).

Three-year-old fish ranged from 50 to 55 cm fork length with a median of 52 cm (n = 113). Four-year-old fish ranged from 71 to 76 cm with a median of 73 cm (n = 11). Zero five-year-old fish were collected with CWT or PIT tags.

Other tags detected at the weir included 13 PIT-tagged fish and two radio-tagged fish.

Brood Year 1995 Smolt-to-Adult Return Rate—We estimated 104 spring chinook salmon of hatchery origin returned to the rack from a release of 3,513 brood year 1995 smolts (Table 11). The PIT tag detections at LGR from brood year 1995 included zero Powell satellite fish yielding an SAR of 0.00% (release to adult detection at LGR; Appendix D Table 1).

Consumptive Releases—Fish were distributed to the Kamiah food bank (21) and the Nez Perce Tribe (29).

Dworshak National Fish Hatchery

Information pertaining to the LSRCP program at Dworshak National Fish Hatchery is reported under separate cover (Idaho Fishery Resource Office 2000). We include selected information in this report for comparative purposes.

2000 Juvenile Releases—Dworshak National Fish Hatchery released 1,017,873 spring chinook salmon smolts into the North Fork of the Clearwater River in 2000 (Table 8); an additional 50,000 supplementation fish were released into Clear Creek Spring. Green-egg-to-smolt (release) survival of brood year 1998 spring chinook salmon reared at Dworshak National Fish Hatchery was 80.70%.

2000 Adult Return—3,202 adult spring chinook salmon of wild-, natural-, or hatchery-origin were trapped at the Dworshak National Fish Hatchery in 2000, which included 221 jacks and 2,981 adults. Total returns included 221 three-year-olds, 2,827 four-year-olds, 104 five-year-olds, and 50 of unknown age.

Mark/Tag Recovery—Dworshak National Fish Hatchery personnel recovered 1,040 CWTs from both Dworshak and Kooskia national fish hatcheries.

Brood Year 1995 Smolt-to-Adult Return Rate—Dworshak National Fish Hatchery estimated 4,798 spring chinook salmon of hatchery origin returned to the rack from a release of 1,311,445 brood year 1995 smolts (Table 11).

Brood Year 1995 Progeny:Parent Ratios

Female progeny:parent ratios for brood year 1995 LSRCP hatchery chinook salmon (for which we could provide estimates) ranged from 9.58:1 for McCall Fish Hatchery to 78.0:1 for the Powell satellite facility (Clearwater Fish Hatchery; Table 11).

Juvenile Out-migration Conditions

Mean daily flows at LGR in 2000 (emigration year for brood year 1998 chinook salmon) averaged 100.3 kcfs during the "peak" (April 15 to May 5) and 88.7 kcfs during the "extended" (April 20 to May 30) out-migration periods (Table 12). Daily flows throughout the 2000 emigration period are shown in Figure 3.

Out-migration Timing and Juvenile Survival for 2000 Emigration

General

The following discussion of PIT tag data refers to groups of Idaho-LSRCP and IPC hatchery-reared chinook salmon smolts that migrated in 2000. The PIT tag detection rates at the lower Snake River dams for chinook salmon smolts ranged from 21.8% for fish released into Johnson Creek (South Fork Salmon River tributary) to 51.6% for fish released from the Rapid River Fish Hatchery (Appendix E). No PIT-tagged parr or presmolt releases occurred in 2000. In migration year (MY) 1997 and 1998, detection rates were inversely related to the distance from release site to LGR, likely due to timing of the runoff, explained by the R^2 values of 0.0209 and 0.036, respectively. In MY 1999 and 2000, detection rates were related to the distance from release site to LGR, likely due to timing of the runoff, explained by the R^2 values of 0.4037 and 0.3486, respectively.

Spill at the lower Snake River dams during the 2000 emigration period may have affected detection rates, because fish passing the projects via spill were not subjected to detection equipment. Spill occurred at Snake River dams as follows: Lower Granite, March 30 to June 20; Little Goose, March 6 to June 20; Lower Monumental, April 4 to June 20; and Ice Harbor, April 4 to August 31.

Median travel times from release site to LGR for hatchery-reared chinook salmon smolts (excluding Dworshak/Kooskia fish) ranged from 22.1 from Sawtooth Fish Hatchery to 48.9 days from Rapid River Fish Hatchery (Appendix E). Median arrival dates at LGR for all groups of PIT-tagged smolts ranged from April 5 to July 28 (Figures 5-11). First dates of arrival for smolts varied from April 3 to April 23. Last dates of arrival for smolts varied from May 22 to July 28.

Median travel time to LGR was not influenced by release location for PIT-tagged hatchery-reared chinook salmon smolts in 2000 (R^2 = 0.0059; Figure 12). Cumulative percent detection at LGR also was not influenced by release distance from LGR for PIT-tagged hatchery-reared chinook salmon smolts in 2000 (R^2 = 0.3486; Figure 4). However, median travel time to LGR was influenced by release date for PIT-tagged hatchery-reared chinook salmon smolts in 2000 (R^2 = 0.9037; Figure 13). Similar to past years, water flow appears to influence travel time and cumulative percent detection more than distance and release date (Hassemer 2000).

McCall Fish Hatchery

Smolts reared at the McCall Fish Hatchery were released at Knox Bridge and at Johnson Creek (Appendix E Table 2). Smolts released at Knox Bridge survived at a minimum of 40.72% to LGR (based on cumulative unique interrogations of PIT tag detections). The median arrival date at LGR for these fish was May 8 to May 9. The first fish arrived on April 16 and the last on July 28. Smolts released at Johnson Creek survived at a minimum of 21.80% to LGR (based on cumulative unique interrogations of PIT tag detections). The median arrival date at LGR for these fish was May 14. The first fish arrived on April 15 and the last on August 9 (Figure 5).

Red River Satellite

Smolts reared at the Clearwater Fish Hatchery and released from the Red River Satellite facility survived at a minimum of 51.33% to LGR (based on cumulative unique interrogations of PIT tag detections; Appendix E Table 1). The median arrival date at LGR for these fish was May 5. The first fish arrived on April 22 and the last on May 31 (Figure 6).

Crooked River Satellite

Smolts reared at the Clearwater Fish Hatchery and released from the Crooked River Satellite facility survived at a minimum of 45.00% to LGR (based on cumulative unique interrogations of PIT tag detections; Appendix E Table 1). The median arrival date at LGR for these fish was May 6. The first fish arrived on April 17 and the last on May 31 (Figure 7).

Powell Satellite

Smolts reared at the Clearwater Fish Hatchery and released from the Powell satellite facility survived at a minimum of 46.84% to LGR (based on cumulative unique interrogations of PIT tag detections; Appendix E Table 1). The median arrival date at LGR for these fish was May 5. The first fish arrived on April 17 and the last on May 31 (Figure 8).

Rapid River Hatchery

Smolts reared and released at the Rapid River Fish Hatchery (IPC) survived at a minimum of 51.60% to LGR (based on cumulative unique interrogations of PIT tag detections; Appendix E Table 4). The median arrival date at LGR for these fish was May 7. The first fish arrived on April 5 and the last on May 31 (Figure 9).

Pahsimeroi Fish Hatchery

Smolts reared and released at the Pahsimeroi Fish Hatchery (IPC) survived at a minimum of 36.80% to LGR (based on cumulative unique interrogations of PIT tag detections; Appendix E Table 3). The median arrival date at LGR for these fish was May 2. The first fish arrived on April 21 and the last on May 22 (Figure 11).

Sawtooth Fish Hatchery

Two experimental groups of fish reared at Sawtooth Fish Hatchery were released into the Salmon River (NATURES treatment and control groups). Each experimental group contained two PIT tag groups, one from each raceway. Control groups survived at a minimum of 33.97% to LGR, while treatment groups survived at a minimum of 40.24% to LGR (based on cumulative unique interrogations of PIT tag detections; Appendix E Table 5). Median travel times ranged from 22.1 to 23.1 days for the control groups and 22.3 to 23.1 days for the treatment groups. The first fish from the control groups arrived on April 24 and the last on May 19. The first fish from the treatment groups arrived on April 23 and the last on May 20 (Figure 10).

Harvest

In the 2000 sport fishery, IDFG regional fisheries management staff estimated that 4,390 spring chinook salmon were harvested in the Clearwater Basin; an excess of 1,183 spring chinook salmon were also harvested in a tribal subsistence fishery. In the Little Salmon River, fisheries management staff estimated that 2,883 spring chinook salmon were harvested in the sport fishery, and an excess of 2,557 marked and 38 unmarked spring chinook salmon were harvested in a tribal subsistence fishery. In the South Fork Salmon River, fisheries management staff estimated that 668 summer chinook salmon were harvested in the sport fishery, and an excess of 1,577 summer chinook salmon were harvested in a tribal subsistence fishery.

SUMMARY

Returns of LSRCP hatchery-origin adult chinook salmon to Idaho in 2000 were less than LSRCP goals. The upper Snake River basin LSRCP annual return goal is 58,000 spring/summer adult chinook salmon above LGR; in 2000, there were an estimated 51,809 adult spring/summer chinook salmon of wild-, natural-, and hatchery-origin above LGR (Tables 3 and 4). Idaho-LSRCP goals are 21,200 adult spring chinook salmon to the Clearwater River and 27,232 adult spring/summer chinook salmon to the Salmon River.

In 2000, an estimated 13,430 wild-, natural-, and hatchery-origin adult spring chinook salmon (63.3% of the Idaho-LSRCP goal) returned to the Clearwater River. Adult spring chinook salmon returned as follows: Dworshak National Fish Hatchery (LSRCP; 3,202), Clearwater Fish Hatchery satellite facilities (LSRCP; 3,074), Kooskia National Fish Hatchery (USFWS; 1,581), sport harvest (4,390), and tribal harvest (1,183). Clearwater Fish Hatchery adult spring chinook salmon returns were 25.8% of their 11,915 project goal (Table 13); however, an unknown number of Clearwater Fish Hatchery adults were harvested in sport and tribal fisheries.

In 2000, an estimated 20,779 wild-, natural-, and hatchery-origin adult spring/summer chinook salmon (76.3% of the Idaho-LSRCP goal) returned to the Salmon River. Adult spring/summer chinook salmon returned as follows: McCall Fish Hatchery (LSRCP; 6,812), Sawtooth Fish Hatchery (LSRCP; 986), Rapid River Fish Hatchery (IPC; 4,799), Pahsimeroi Fish Hatchery (IPC; 459), sport harvest (3,551), and tribal harvest (4,172). McCall Fish Hatchery adult summer chinook salmon returns were 85.2% of their 8,000 project goal. However, the South Fork Salmon River fishery is a terminal fishery, and the 2,245 harvested hatchery-origin summer chinook were assumed to be returning to the McCall Fish Hatchery. Combining the sport and tribal harvest returns with the rack return of hatchery-origin summer chinook salmon, McCall Fish Hatchery surpassed their project goal. Sawtooth Fish Hatchery adult spring chinook salmon returns were 5.1% of their 19,445 project goal (Table 13); however, an unknown portion of Sawtooth Fish Hatchery adult spring chinook salmon were harvested in downstream sport and tribal fisheries.

Idaho-LSRCP hatcheries were originally designed to rear and release the number of juvenile spring/summer chinook salmon to meet adult return goals. In 2000, Clearwater Fish Hatchery and satellite facilities released 1.3 million smolts and 185,342 presmolts or 109.3% of their annual target of 1.3 million juvenile spring chinook salmon (Table 2). In 2000, McCall Fish Hatchery released 1.1 million smolts and 178,714 presmolts or 129.8% of their annual target of 1.0 million juvenile summer chinook salmon. In 2000, Sawtooth Fish Hatchery released 123,425 smolts or 18.6% of their annual target of 2.3 million juvenile spring chinook salmon.

Table 1. Length criteria (fork length in centimeters) used by Lower Snake River Compensation Plan Hatchery Evaluation Studies personnel and by hatchery personnel to age returning adult chinook salmon in 2000.

	Age (years)		
Hatchery	**3**	**4**	**5**
McCall Fish Hatchery	≤67	66-90	>89
Clearwater Fish Hatchery			
Powell	≤64	64-82	>83
Red River	≤64	64-82	>83
Crooked River	≤64	64-82	>83
Dworshak National Fish Hatchery	≤56	57-81	>81
Sawtooth Fish Hatchery	≤64	64-82	>82

Table 2. Numbers of hatchery-reared spring and summer chinook salmon juveniles released from Lower Snake River Compensation Plan hatcheries operated by the Idaho Department of Fish and Game. Only releases made between October 1, 1999 and September 30, 2000 are included. All smolt releases are from brood year 1998 production, and all parr and presmolt releases are from brood year 1999. Specific release location and numbers released are included in Appendix A. Total numbers include all fish reared at LSRCP facilities.

	Summer Chinook			Spring Chinook			
Hatchery	**Smolt**	**Presmolt**	**Parr**	**Smolt**	**Presmolt**	**Parr**	**Total**
McCall	1,118,880	178,714					**1,297,594**[a]
Clearwater				463,068			**463,068**[b]
South Fork (Red River/Crooked River)				555,061	185,342		**740,403**
Powell				293,522			**293,522**
Sawtooth				123,425			**123,425**
Total[c]	**1,118,880**	**178,714**	**0**	**1,435,076**	**185,342**	**0**	**2,918,012**

[a] Total number includes Johnson Creek releases.
[b] Total number includes Rapid River Fish Hatchery releases.
[c] Total number reflects fish tagged and does not include mortality before release.

Table 3. Total numbers of adult and jack spring and summer chinook salmon from wild-, natural- or hatchery-origin counted at Lower Granite Dam (LGR). Spring chinook are defined as crossing LGR March 1 to June 17 and summer chinook as crossing June 18 to August 17.

	Lower Granite Dam Count			
Return Year	Spring	Spring Jack	Summer	Summer Jack
2000	33,822	10,318	3,933	3,736
1999	3,296	2,507	3,260	1,584
1998	9,854	106	4,355	321
1997	33,855	84	10,708	118
1996	4,207	1,639	2,607	944
1995	1,105	373	694	157
1994	3,120	43	795	73
1993	21,035	183	7,889	130
1992	21,391	533	3,014	298
1991	6,023	980	3,809	1,179
1990	17,315	244	5,093	128
1989	12,955	1,549	3,169	902
1988	29,495	924	6,145	362
1987	28,835	946	5,891	660
1986	31,722	1,307	6,154	1,255
1985	25,207	2,530	5,062	1,577
1984	6,511	1,410	5,410	1,815
1983	9,517	509	3,885	767
1982	12,367	379	4,210	318
1981	13,115	527	3,326	479
1980	5,460	1,298	2,688	759
1979	6,839	786	2,712	858

Table 4. Lower Granite Dam total spring and summer chinook run reconstruction. Table taken from the U.S. Oregon Technical Advisory Committee, January 9, 2003.

	Spring			Summer			Total Run		
Year	Wild	Hatchery	Total	Wild	Hatchery	Total	Wild	Hatchery	Total
1979	2,573	4,266	6,839	2,714	0	2,714	5,287	4,266	9,553
1980	3,478	1,983	5,461	2,404	284	2,688	5,882	2,267	8,149
1981	7,941	5,174	13,115	2,739	567	3,306	10,680	5,741	16,421
1982	7,117	5,250	12,367	3,531	679	4,210	10,648	5,929	16,577
1983	6,181	3,336	9,517	3,219	676	3,895	9,400	4,012	13,412
1984	3,199	3,313	6,512	4,229	1,200	5,429	7,428	4,513	11,941
1985	5,245	19,963	25,208	2,696	2,366	5,062	7,941	22,329	30,270
1986	6,895	24,828	31,723	2,684	3,470	6,154	9,579	28,298	37,877
1987	7,883	20,953	28,836	1,855	4,036	5,891	9,738	24,989	34,727
1988	8,581	20,914	29,495	1,807	4,338	6,145	10,388	25,252	35,640
1989	3,029	9,926	12,955	2,299	870	3,169	5,328	10,796	16,124
1990	3,216	14,099	17,315	3,342	1,751	5,093	6,558	15,850	22,408
1991	2,206	4,418	6,624	2,967	842	3,809	5,173	5,260	10,433
1992	11,134	10,258	21,392	441	2,573	3,014	11,575	12,831	24,406
1993	5,871	15,164	21,035	4,082	3,807	7,889	9,953	18,971	28,924
1994	1,416	1,704	3,120	183	612	795	1,599	2,316	3,915
1995	745	360	1,105	343	349	692	1,088	709	1,797
1996	1,358	2,857	4,215	1,916	691	2,607	3,274	3,548	6,822
1997	2,126	31,729	33,855	5,137	5,572	10,709	7,263	37,301	44,564
1998	5,089	4,765	9,854	2,913	1,442	4,355	8,002	6,207	14,209
1999	1,104	2,192	3,296	1,584	1,676	3,260	2,688	3,868	6,556
2000	3,266	26,131	29,397	4,067	4,291	8,358	7,333	30,422	37,755

Table 5. Numbers of adult and jack spring chinook salmon returning to Idaho hatcheries, 1984-2000. (DNFH = Dworshak National Fish Hatchery, IPC = Idaho Power Company, EFSR = Sawtooth Fish Hatchery satellite facility on East Fork Salmon River, USFWS = United States Fish and Wildlife Service, LSRCP = Lower Snake River Compensation Plan). Powell, Red River, and Crooked River are satellite facilities of Clearwater Fish Hatchery. In 1997, Red River and Crooked River combined as South Fork. Numbers are listed under Crooked River for this report.

	LSRCP Facilities							USFWS	IPC			
Year	DNFH	Powell	Red R.	Crooked R.	Sawtooth	EFSR	Total LSRCP	Kooskia	Rapid R.	Oxbow	Total Other	Grand Total
2000	3,202	1,602	ND	1,472	986	0[a]	7,262	1,581	4,799	1,174	7,554	14,816
1999	800	188	ND	156	196	0[a]	1,340	157	885	79	1,121	2,461
1998	915	541	ND	367	153	0[a]	1,976	408	1,644	74	2,126	4,102
1997	3,150	718	ND	1,314	254	7	5,443	1,657	10,520	944	13,121	18,564
1996	963	186	62[b]	299	156	10	1,676	202	1,412	78	1,692	3,368
1995	125	14	4	6[c]	37	0[a]	186	40	129		169	355
1994	74	86	31	26	96	15	328	232	265	29	526	854
1993	823	500	139	402	587	90	2,541	1,180	4,468	431	6,079	8,620
1992	370	270	39	228	387	65	1,359	312	2,466	934	3,712	5,071
1991	165	33	18	20	566	62	864	467	1,913	69	2,449	3,313
1990	2,042	179	53[d]	29	1,488	145	3,936	1,141	2,606	30	3,777	7,713
1989	1,700	154	104[d]				1,958	973	2,800		3,773	5,731
1988	1,972		394[d]				2,366	595	3,780		4,375	6,741
1987	2,017		519				2,536	687	3,807		4,494	7,030
1986	516						516	283	6,900		7,183	7,699
1985	334						334	529			529	863
1984	82						82	341			341	423

[a] EFSR trap was not operated in 1995 or 1998-2000.
[b] Represents data from 3- and 4-year-old returns only.
[c] Represents data from 3-year-old returns only.
[d] Includes returns from fall releases.

Table 6. Numbers of hatchery-origin adult and jack spring chinook salmon returning to Idaho hatcheries, 1984-2000. (DNFH = Dworshak National Fish Hatchery, IPC = Idaho Power Company, EFSR = Sawtooth Fish Hatchery Satellite facility on East Fork Salmon River, USFWS = United States Fish and Wildlife Service, LSRCP = Lower Snake River Compensation Plan). Blank spaces indicate years when origin of adult fish was not documented. In 1997, Red River and Crooked River combined as South Fork. Numbers are listed under Crooked River for this report.

HATCHERY-ORIGIN FISH												
	LSRCP Facilities						Total	USFWS	IPC		Total	Grand
Year	DNFH	Powell	Red R.	Crooked R.	Sawtooth	EFSR	LSRCP	Kooskia	Rapid R.	Oxbow	Other	Total
2000		1,543	284	1,083	451	0	3,361		4,693	1,159	5,852	9,213
1999		180	ND	149	75	0	404		877	70	947	1,351
1998		519	ND	303	26	0	848		1,552	66	1,618	2,466
1997		713	ND	1,204	99	1	2,017		10,267	911	11,178	13,195
1996		181	46	254	51	1	533		1,323	60	1,383	1,916
1995									125			
1994									240			
1993									3,774			
1992									2,156			
1991									1,760			
1990									2,468	4	2,472	
1989									2,718			
1988												
1987												
1986												
1985												
1984												

Table 7. Numbers of adult and jack summer chinook salmon returning to McCall (South Fork Salmon River, Lower Snake River Compensation Plan) and Pahsimeroi (Idaho Power Company) fish hatcheries including total returns and hatchery-origin only returns, 1986-2000. Blank spaces indicated years when origin of adult fish was not documented.

	McCall Fish Hatchery		Pahsimeroi Fish Hatchery			
Return Year	Total	Hatchery Origin	Total	Hatchery Origin	Total	Total Hatchery Origin
2000	6,812	6,093	459	291	7,271	6,384
1999	1,961	1,670	377	296	2,338	1,966
1998	974	822	147	76	1,121	898
1997	3,659	3,371	127	39	3,786	3,410
1996	1,199	1,042	89	40	1,288	1,082
1995	307	269	80[a]	19	387	288
1994	519	222	36	28	555	250
1993	2,703	1,122	169		2,872	
1992	2,848		131		2,979	
1991	1,212		238		1,450	
1990	969		470		1,439	
1989	938		347		1,285	
1988	2,393		838		3,231	
1987	2,705		2,175		4,880	
1986	2,690		6,518		9,208	

[a] Represents data from 3- and 4-year-old returns only.

Table 8. Selected spawning and hatchery production data and in-hatchery survival estimates for brood year 1998 Idaho hatchery-reared spring and summer chinook salmon.

Facility	Females Used / (Spawn)[a]	Male Used / (Spawn)[a]	Green Eggs Taken	Eyed Eggs	Fry Produced	Egg-Fry Survival %	Parr on July 1	Presmolts Released	Smolts Released	Smolt Equivalents[b]	Egg-Smolt Survival %
Summer Chinook											
McCall											
South Fork	339 (299)	ND	1,433,237	1,158,056	1,152,265	80.4	0	0	1,039,930	1,039,930	72.6
Johnson Cr.	34 (32)	ND	155,870	56,251	55,069	35.3	0	0	78,950	78,950	50.7
Spring Chinook											
Clearwater									463,068	463,068	77.2[d]
Powell	245 (226)	253 (235)	897,993	723,985	723,985	80.6	0	0	293,522	293,522	77.2[d]
SF Clearwater[c]	113 (84)	139 (118)	330,054	282,082	282,082	85.5	0	164,280	555,061	702,913	77.2[d]
Dworshak	ND	ND	ND	ND	ND	ND	0	0	1,017,873	1,017,873	ND
Kooskia	ND	ND	ND	ND	ND	ND	0	0	449,454	449,454	ND
Sawtooth	30 (27)	31 (27)	139,469	129,593	127,064	91.1	0	0	123,425	123,425	88.5

[a] Used = spawned + prespawn mortalities + killed not spawned.
[b] Assumes 90% presmolt-smolt survival.
[c] South Fork Clearwater includes adults trapped at both Red River and Crooked River weirs.
[d] Average egg-smolt survival for all brood year 1998 spring chinook salmon reared at Clearwater Fish Hatchery.

Table 9. Total adult returns of spring and summer chinook salmon (wild-, natural-, or hatchery-origin) to Idaho hatchery racks in 2000.

	Returns					Spawned					Released			
	Adult					Adult					Adult			
Facility	Female	Male	Jack	Total	Sex Ratio M:F	Female	Male	Jack	Egg take	Fecundity	Female	Male	Jack	Total
Spring Chinook														
Rapid River[a]	1,406	1,127	1,540	4,799	2 :1	1,226		2	4,780,850[b]	3,900	NA	NA	NA	2,306[c]
Oxbow[d]	564	385	17	1,174	1 :1	ND	ND	ND	1,443,095[e]	ND	0	0	175	175
Dworshak	ND	ND	221	3,202	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Kooskia[f]	ND	ND	966	1,581	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Red River	0	0	0	315		0	0	0	0	0	0	0	0	33
Crooked River	0	0	0	1,157		0	0	0	0	0	0	0	0	678
South Fork C.R.	503	305	655	1,463[g]	2 :1	376	397	0	715,014	3,611	126	89	488	711[g]
Powell	789	469	304	1,562[h]	1 :1	551	335	0	2,035,086	4,006	108	123	0	231
Sawtooth	252	358	376	986	3 :1	89	81	84	417,709	4,693	159	275	91	525[i]
Total Spring Chinook				**16,239**					**9,391,754**					**4,659**
Summer Chinook														
McCall	1,771	1,625	3,416	6,812	3 :1	361		12	1,487,809	4,121	1,121	1,211	699	3,031
Johnson Cr.	16	25	32	73	4 :1	16	na	na	55,971	3,498	0	0	0	0
Pahsimeroi	194	177	88	459	1 :1	123	89	14	633,906	5,154	45	40	13	98
Total Summer Chinook				**7,344**					**2,177,686**					**3,129**

[a] Includes fish trapped at Rapid River and Oxbow hatcheries.
[b] Before 962,565 green eggs sent to Clearwater.
[c] Tribal supplementation releases, off-site into Clearwater drainage, food banks, and recycled back into fishery.
[d] Trucked to and spawned at Rapid River Hatchery.
[e] Included in the eggs listed for Rapid River Fish Hatchery; however, due to space limitations at Rapid River Fish Hatchery these eggs were reared at Oxbow Fish Hatchery.
[f] Fish trapped at Kooskia Fish Hatchery were trucked and spawned at Dworshak Fish Hatchery.
[g] Does not include nine of unknown sex.
[h] Does not include 40 of unknown sex.
[i] These releases only include fish released above the weir and do not include the 200 jacks and two females that were killed for food or disease testing.
[j] Total released = upstream + downstream + 200 fish taken to East Fork of the South Fork River to spawn naturally. Does not include fish trapped more than once and released downstream.

Table 10. Age and sex composition of 2000 spring and summer chinook salmon (wild-, natural-, or hatchery-origin) returns to Idaho hatchery racks. Summaries are taken from hatchery run reports except where noted.

	MALES							FEMALES							MALES AND FEMALES						
	3		4		5			3		4		5			3		4		5		
	No.	%	No.	%	No.	%	TOTAL	No.	%	No.	%	No.	%	TOTAL	No.	%	No.	%	No.	%	TOTAL
Summer Chinook																					
McCall FH																					
HES estimate[a]	3,416	50.1	1,582	23.2	43	0.6	5,041	0	0.0	1,724	25.3	47	0.7	1,771	3,416	50.1	3,306	48.5	90	1.3	**6,812**
Pahsimeroi FH	88	19.2	158	34.4	19	4.1	265	0	0.0	162	35.3	32	7.0	194	88	19.2	320	69.7	51	11.1	**459**
Spring Chinook																					
Rapid River FH[a]																					
HES estimate	1,498	37.8	1,090	27.5	4	0.1	2,592	0	0.0	1,370	34.5	5	0.1	1,375	1,498	37.8	2,460	62.0	9	0.2	**3,967**
Oxbow FH[b]																					
HES estimate	17	1.5	385	33.3	0.0	0.0	402	0	0.0	563	48.7	1.0	0.1	564	207	17.9	948	82.0	1	0.1	**1,156**[h]
Dworshak NFH		ND		ND		ND	ND		ND		ND		ND	ND	221	7.0	2,827	89.7	104	3.3	**3,152**
Kooskia NFH		ND		ND		ND	ND		ND		ND		ND	ND	966	61.1	604	38.2	11	0.7	**1,581**
Clearwater FH																					
Powell	304	23.7	262	20.4	70	5.4	773[c]	1	0.1	626	48.7	22	1.7	789[d]	305	23.7	888	69.1	92	7.2	**1,562**[d]
SF Clearwater[e]	655	45.2	284	19.6	19	1.3	960[f]	3	0.2	483	33.4	4	0.3	503[g]	658	45.4	767	53.0	23	1.6	**1,448**
Sawtooth FH	376	38.1	299	30.3	59	6.0	734	0	0.0	201	20.4	51	5.2	252	376	38.1	500	50.7	110	11.2	**986**

[a] Numbers estimated by Hatchery Evaluation Study biologist.
[b] Numbers of jacks do not reflect Snake River run size, because jacks were given away prior to enumeration; total only includes fish delivered to Rapid River to be spawned.
[c] Total includes 70 transfers and 67 of unknown age.
[d] Total includes 60 transfers and 80 of unknown age.
[e] SF Clearwater includes fish from both Red River and Crooked Fork River satellites.
[f] Total includes two fish of unknown age.
[g] Total includes 13 fish of unknown age.

Table 11. Female progeny:parent ratios (adult to adult survival) and hatchery production statistics for brood year 1995 hatchery-reared spring and summer chinook salmon. Numbers of males and females returned include some wild- or natural-origin fish unless otherwise noted.

Facility	Female (Used) / Spawned[a]	Male (Used) / Spawned)[a]	Green Eggs Taken	Fry Produced	Smolts Released	Smolt Equivalents	Females Returned[b]	Males Returned[b]	Total m/f	Parent: progeny
Summer Chinook										
McCall	(63) 57	(79) 79	238,344	219,239	238,647	0[c]	546	611	1,157	1: 9.58
Spring Chinook										
Clearwater										
South Fork (Red River/Crooked River)	(1) 1	(7) 6	4,376	ND	2,970	0	10	24	34	1: 10.00
Powell	(1) 1	(8) 8	5,259	ND	3,513	0	78	26	104	1: 78.00
Dworshak	27	ND	ND	ND	1,311,445	ND	ND	ND	4,798	ND
Kooskia	8	ND	ND	ND	16,598	ND	ND	ND	1,816	ND
Sawtooth	(2) 2	(15) 8	7,377	4,914	9,795	0	72	120	192	1: 36.00

[a] Used = spawned + prespawn mortalities + killed not spawned.
[b] Data is reported in the 1998, 1999, and 2000 run reports for each respective hatchery.
[c] Adult numbers were not separated by sex in all years; sex ratios were used to estimate numbers of each sex where only a total fish count was available.

Table 12. Snake River mean daily flow (kcfs) at Lower Granite Dam during the "peak" and "extended" chinook salmon smolt migration periods, 1977-2000. The migration periods are as defined by Petrosky (1991).

Year	"Peak" (04/15-05/05)	"Extended" (04/20-05/30)
1977	39.1	40.2
1978	85.4	95.8
1979	64.8	89.9
1980	87.5	102.9
1981	76.2	86.7
1982	116.8	131.6
1983	85.6	111.3
1984	121.9	146.1
1985	86.9	87.2
1986	93.4	105.7
1987	59	62.4
1988	55.1	64.2
1989	93.6	87.2
1990	63.8	66.4
1991	44	70.5
1992	54.2	57.3
1993	69.8	114
1994	64.1	77.5
1995	72.9	74.1
1996	112.8	124.4
1997	149.3	169.9
1998	81.4	123.9
1999	109.1	113.5
2000	100.3	88.7

Table 13. LSRCP mitigation accounting for fiscal year 2000 spring and summer chinook salmon total adult and jack returns (wild-, natural-, or hatchery-origin) and hatchery-reared juvenile releases that contributed to these returns.

	Adult Return 2000			Juvenile Releases[a]				
					Fiscal Year Releases Contributing to 2000 Return[b]			
	Goal	Actual	% of Goal	Annual Target	1997	1998	1999[c]	% of Target[d]
Summer Chinook								
McCall Fish Hatchery	8,000	6,812	85.2%	1,000,000	651,262	1,595,225	1,182,610	114.3%
Spring Chinook								
Sawtooth Fish Hatchery	19,445	986	5.1%	2,300,000	52,956	266,554	223,393	7.9%
Clearwater Fish Hatchery	11,915	3,074	25.8%	1,369,500	823,021	3,626,900	2,824,231	177.1%
TOTAL	**39,360[e]**	**10,872**	**27.6%**	**4,669,500**	**1,527,239**	**5,488,679**	**4,230,234**	**80.3%**

[a] Release numbers are smolt equivalents. Parr and presmolt releases were converted to smolt equivalents by multiplying by 0.75 and 0.90, respectively.

[b] Release numbers may include off-site releases.

[c] Fiscal year 1999 releases only include fish from brood year 1997.

[d] (1997 fiscal year + 1998 fiscal year + 1999 fiscal year)/(annual target * 3)

[e] The LSRCP total mitigation goal = 58,700 spring and summer chinook above Lower Granite Dam, including 21,200 spring chinook to the Clearwater River (Dworshak and Clearwater fish hatcheries) and 27,232 spring/summer chinook to the Salmon River (McCall and Sawtooth fish hatcheries). Difference due to rounding errors and conversion of hatchery-reared juvenile production capacities to adult return. Dworshak National Fish Hatchery not included in table.

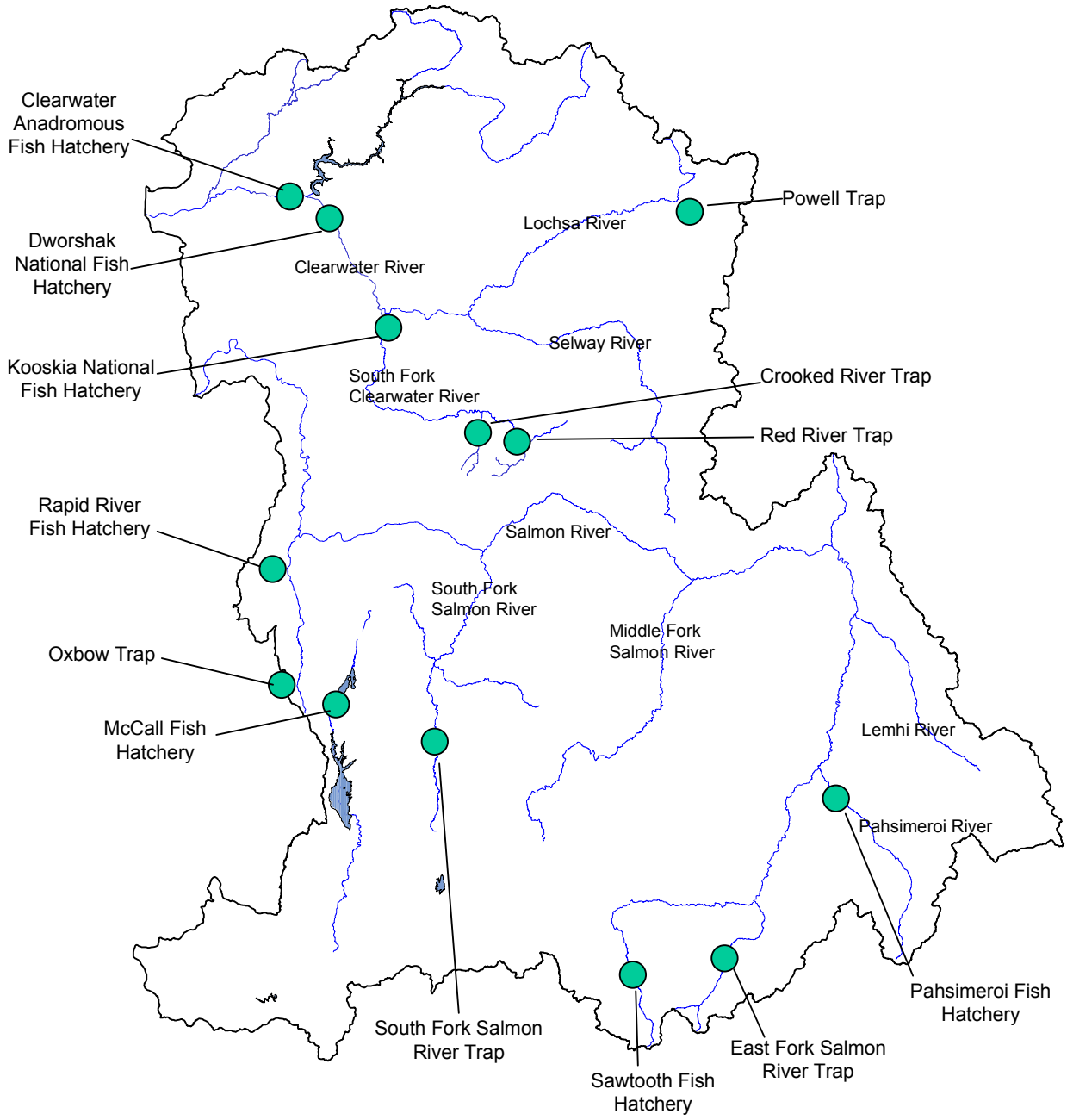


Figure 1. Locations of chinook salmon fish hatcheries and trapping facilities in Idaho.

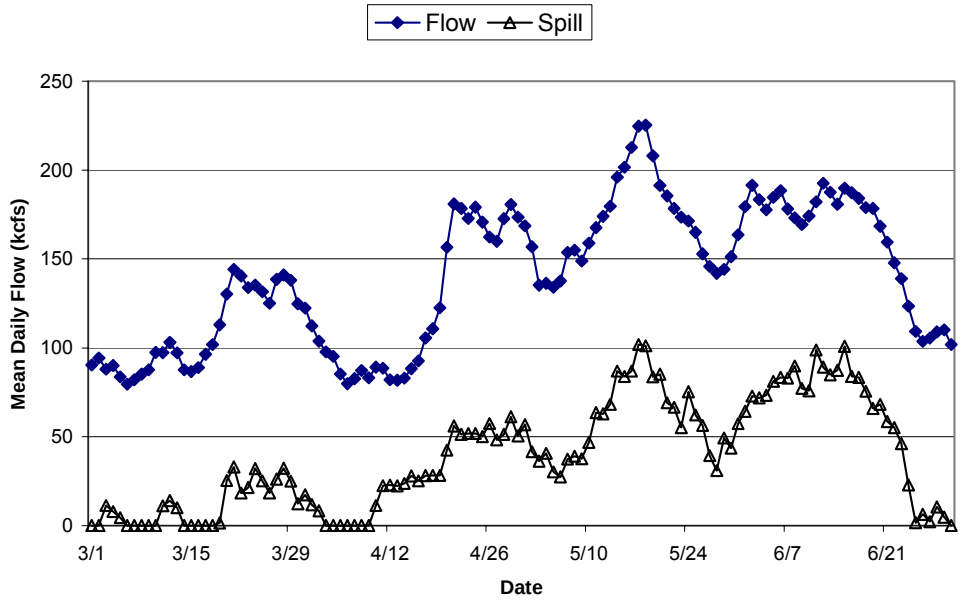


Figure 2. Daily flows and spill (kcfs) measured at Lower Granite Dam during the 1997 smolt emigration period.

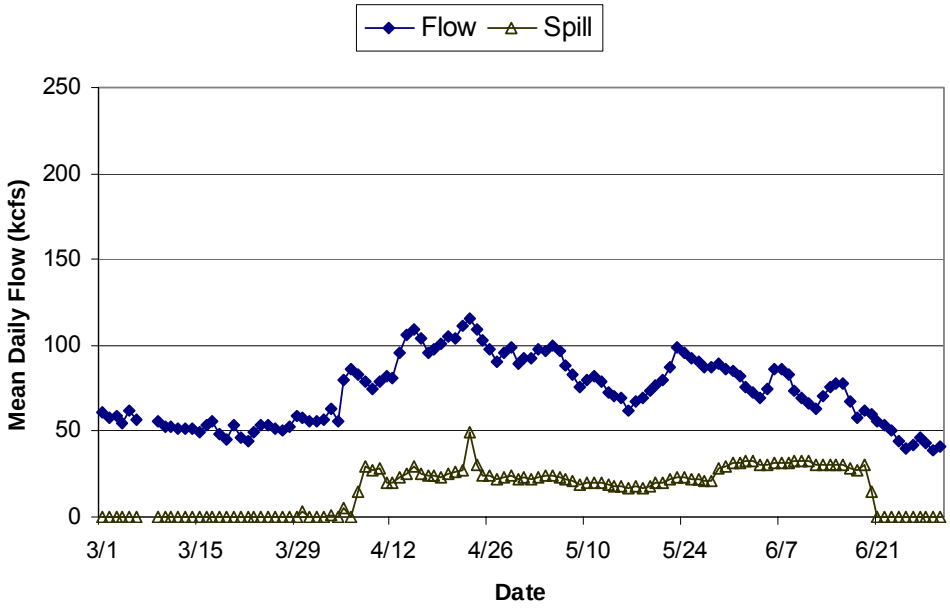
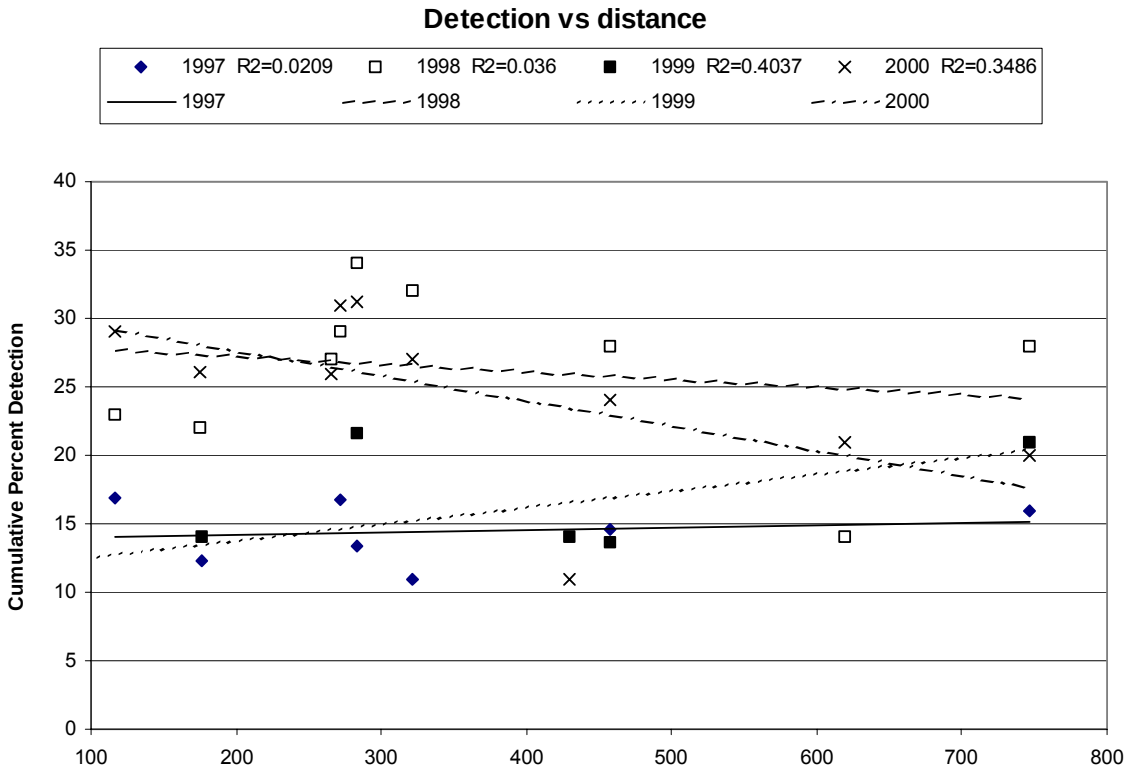


Figure 3. Daily flows and spill (kcfs) measured at Lower Granite Dam during the 2000 smolt emigration period. Data was not available for March 7-8.



Hatchery	Km	Hatchery	Km
DNFH	116	POWP	321
KNFH	176	JOHNSC	429
CROOKP	265	KNOXB	457
REDP	272	PAHP	619
RAPH	283	SAWT	747

Figure 4. Detection rates versus distance (Km) of release from Lower Granite Dam for hatchery-reared PIT-tagged spring and summer chinook salmon released from Idaho fish hatcheries, 1997-2000. DNFH = Dworshak National Fish Hatchery, KNFH = Kooskia National Fish Hatchery, CROOKP = Crooked River Satellite (Clearwater), REDP = Red River Satellite (Clearwater), RAPH = Rapid River Fish Hatchery, POWP = Powell Satellite (Clearwater), JOHNSC = Johnson Creek (McCall), KNOXB = Knox Bridge (McCall), PAHP = Pahsimeroi Fish Hatchery, SAWT = Sawtooth Fish Hatchery. McCall and Pahsimeroi hatcheries produce summer chinook salmon; all others produce spring chinook salmon.

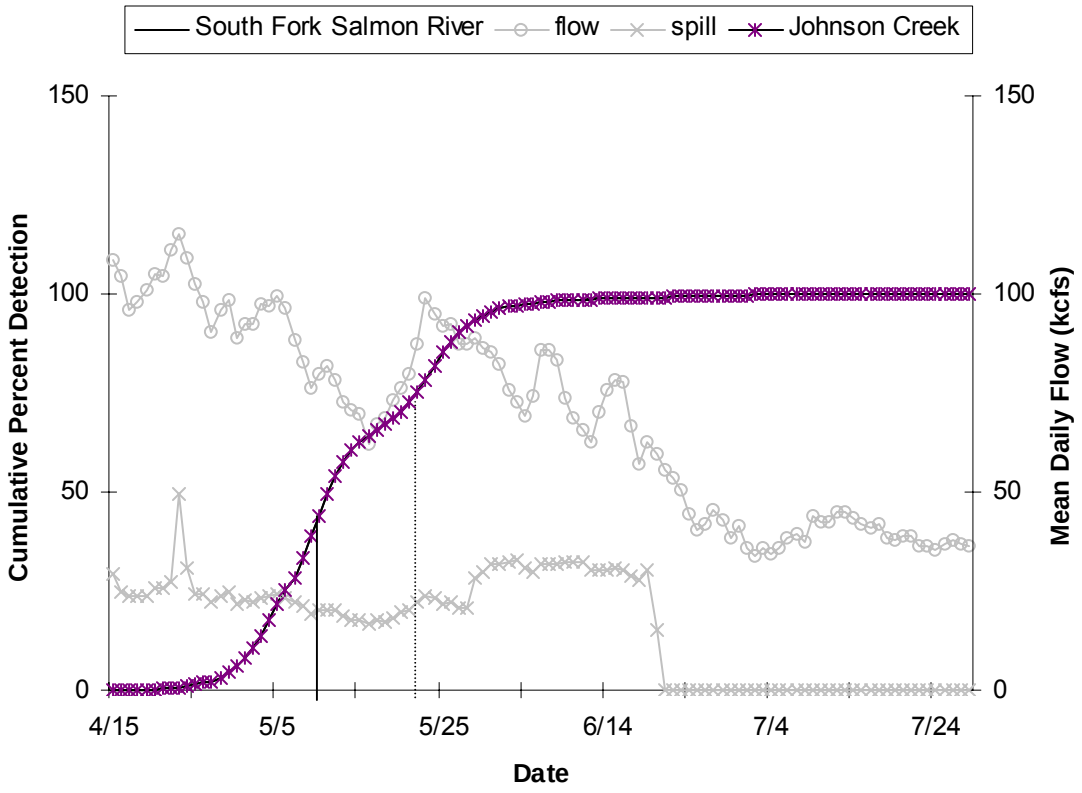


Figure 5. Migration year 2000 arrival timing and detection rates for PIT-tagged juvenile summer chinook salmon reared at McCall Fish Hatchery and released on the South Fork Salmon River, Idaho near Knox Bridge (SFSR) and Johnson Creek, Idaho (JOHNSC). Vertical lines indicate median arrival dates (SFSR = 5/9/00 and JOHNSC = 5/14/00). Release dates were 4/3 to 4/6. Daily flows and spill (kcfs) measured at Lower Granite Dam during the 2000 smolt emigration period. Travel times and arrival dates are based on PIT tag detections at only Lower Granite Dam. SFSR and JOHNSC detections are so close that the line appears to only show JOHNSC.

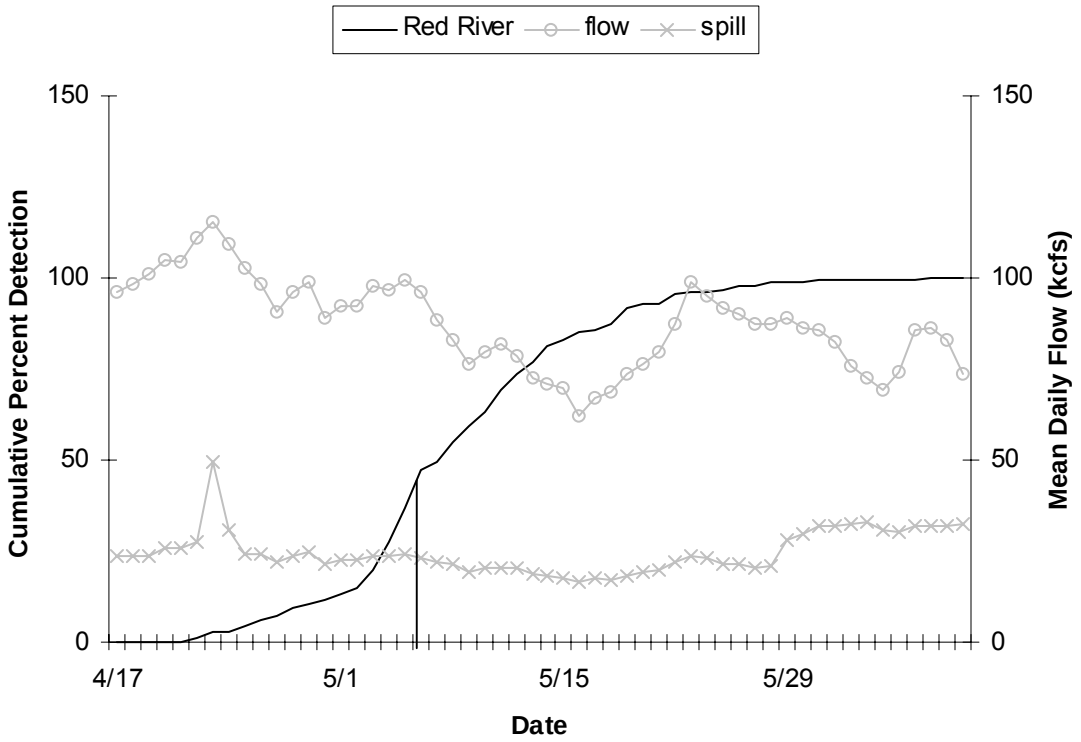


Figure 6. Migration year 2000 arrival timing and detection rates for PIT-tagged juvenile spring chinook salmon reared at Clearwater Fish Hatchery and released in the Red River, Idaho. Vertical line indicates median arrival date. Release date was 3/17. Daily flows and spill (kcfs) measured at Lower Granite Dam during the 2000 smolt emigration period. Travel times and arrival dates are based on PIT tag detections at only Lower Granite Dam.

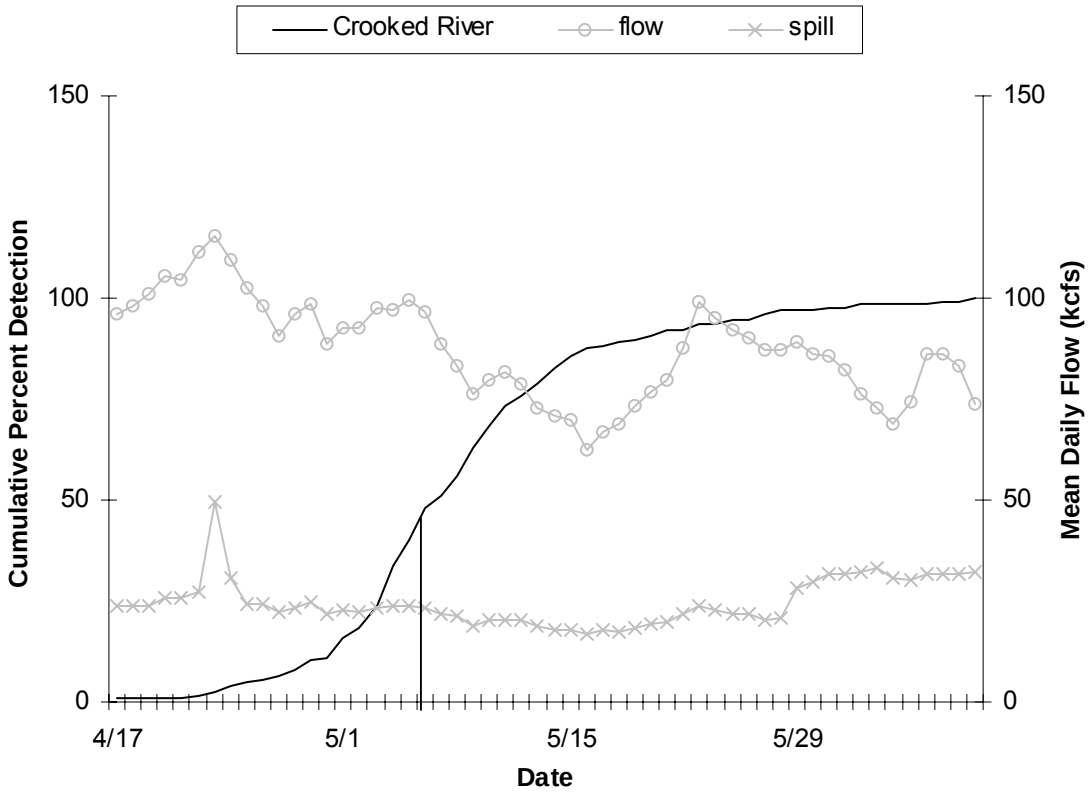


Figure 7. Migration year 2000 arrival timing and detection rates for PIT-tagged juvenile spring chinook salmon reared at Clearwater Fish Hatchery and released in the Crooked River, Idaho. Vertical line indicates median arrival date. Release date was 4/10. Daily flows and spill (kcfs) measured at Lower Granite Dam during the 2000 smolt emigration period. Travel times and arrival dates are based on PIT tag detections at only Lower Granite Dam.

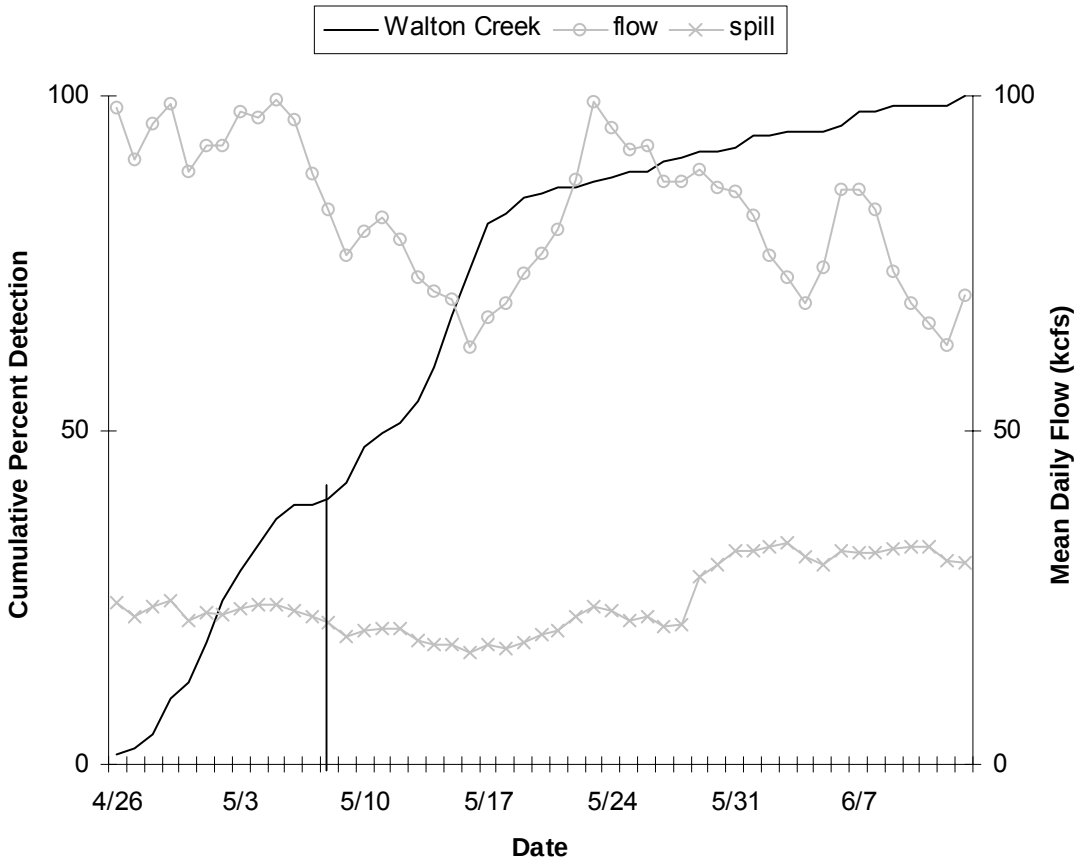


Figure 8. Migration year 2000 arrival timing and detection rates for PIT-tagged juvenile spring chinook salmon reared at Clearwater Fish Hatchery and released in Walton Creek, Idaho. Vertical line indicates median arrival date. Release date was 4/10. Daily flows and spill (kcfs) measured at Lower Granite Dam during the 2000 smolt emigration period. Travel times and arrival dates are based on PIT tag detections at only Lower Granite Dam.

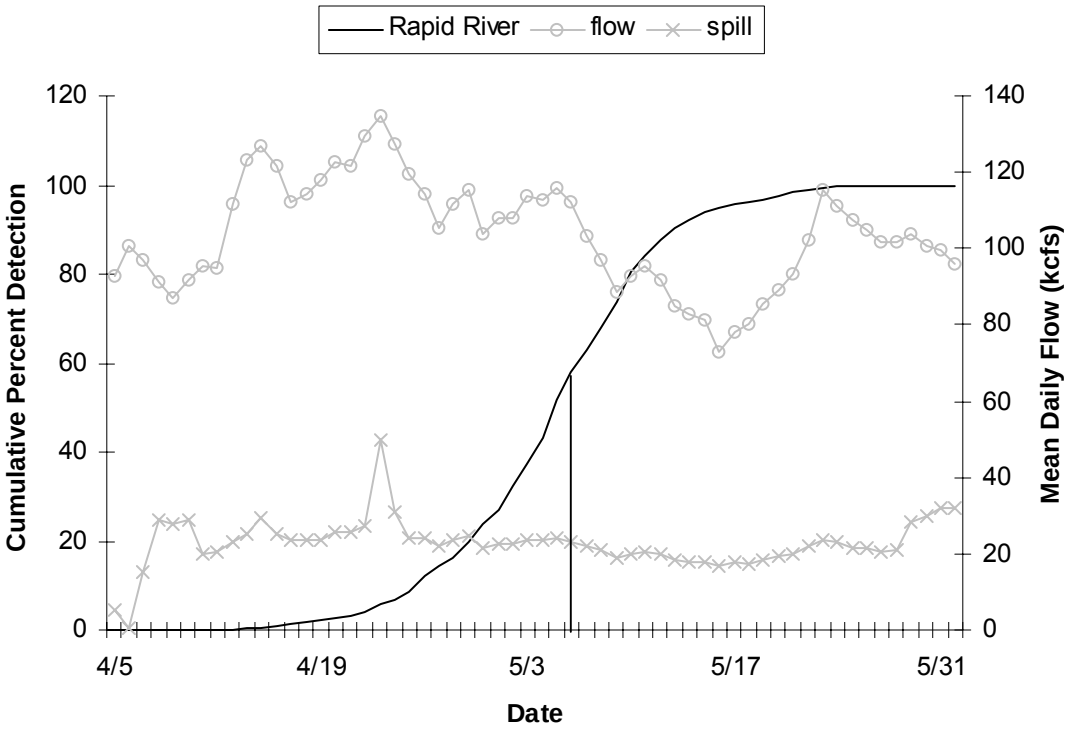


Figure 9. Migration year 2000 arrival timing and detection rates for PIT-tagged juvenile spring chinook salmon reared at Clearwater Fish Hatchery and released from the Rapid River Fish Hatchery. Vertical line indicates median arrival date. Release date was 3/17. Daily flows and spill (kcfs) measured at Lower Granite Dam during the 2000 smolt emigration period. Travel times and arrival dates are based on PIT tag detections at only Lower Granite Dam.

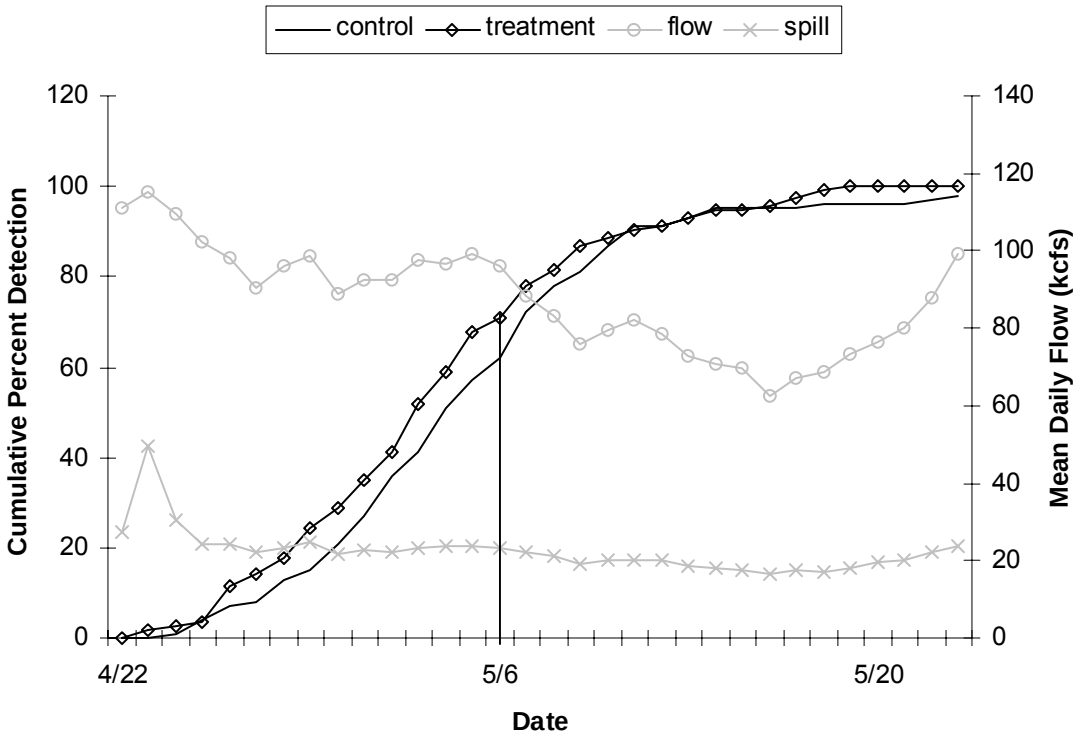


Figure 10. Migration year 2000 arrival timing and detection rates for PIT-tagged juvenile spring chinook salmon reared at Sawtooth Fish Hatchery and released in the upper Salmon River, Idaho. All fish released from Sawtooth in 2000 were part of the Natural Rearing Enhancement System (NATURES) rearing experiment. Vertical lines indicate median arrival dates. (Median arrival date was similar for both groups.) Release date was 4/12. Daily flows and spill (kcfs) measured at Lower Granite Dam during the 2000 smolt emigration period. Travel times and arrival dates are based on PIT tag detections at only Lower Granite Dam.

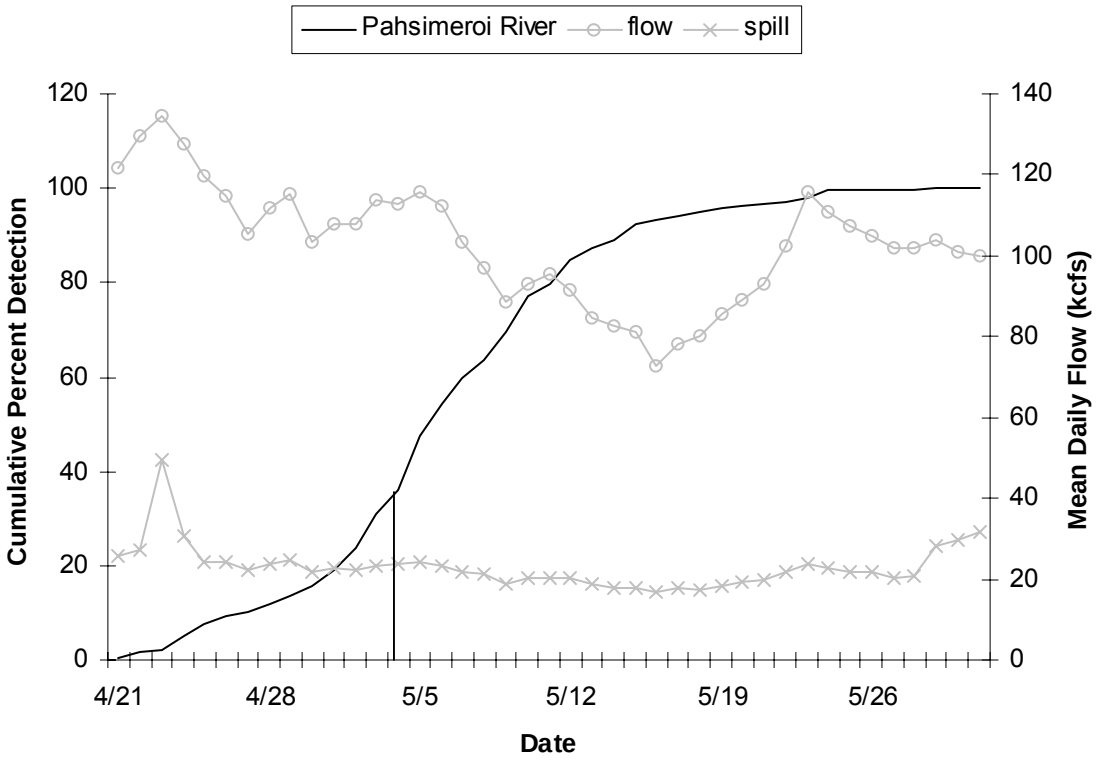
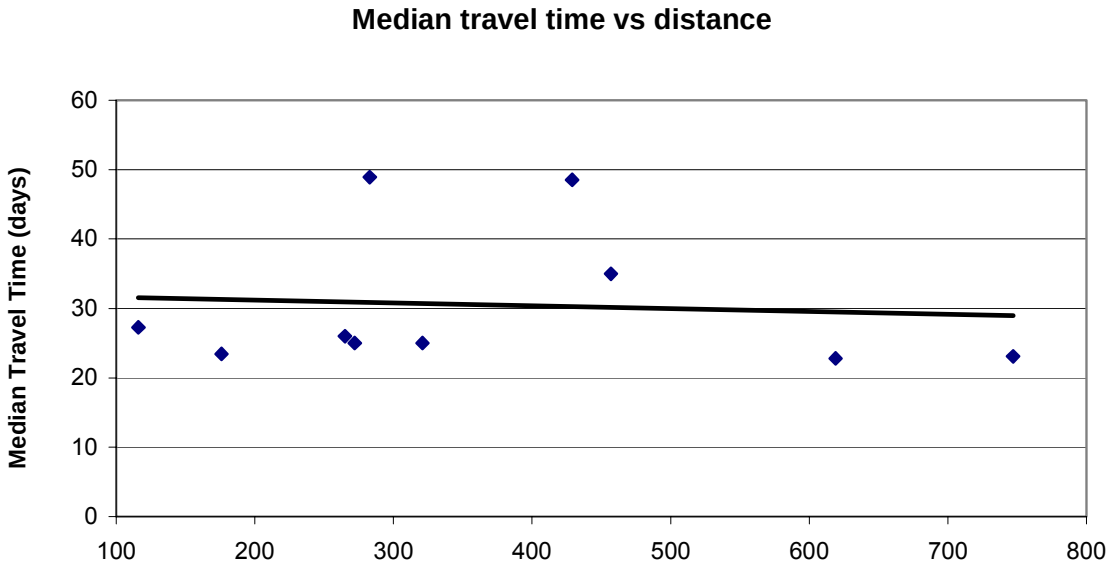
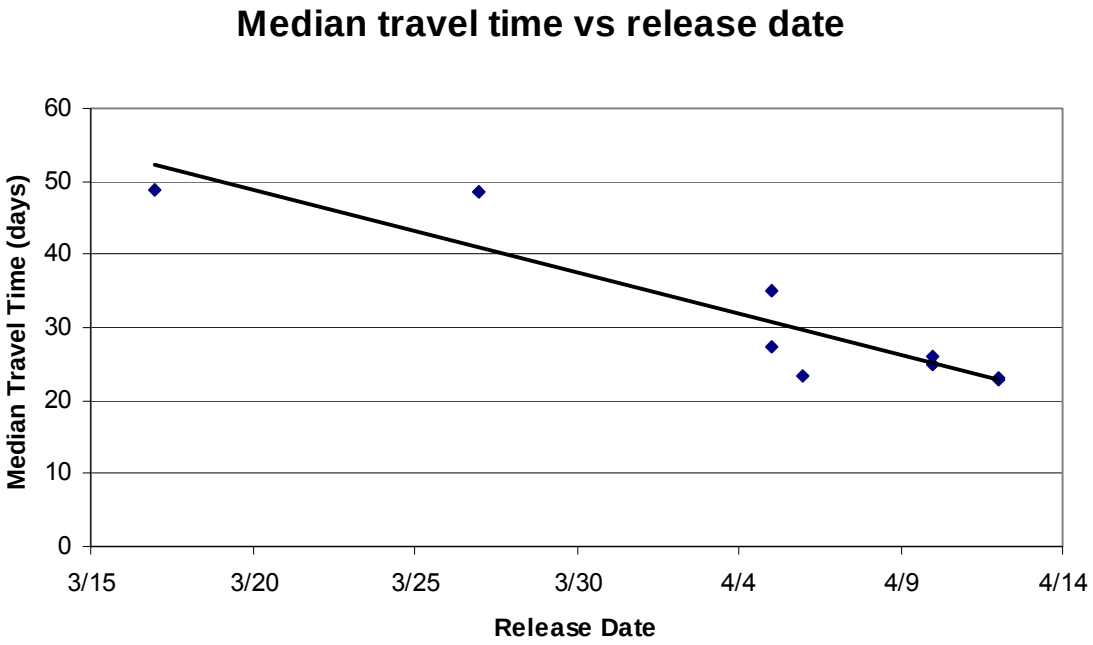


Figure 11. Migration year 2000 arrival timing and detection rates for PIT-tagged juvenile spring chinook salmon reared in the Pahsimeroi Fish Hatchery and released at Pahsimeroi River, Idaho. Vertical line indicates median arrival date. Release date was 4/12. Daily flows and spill (kcfs) measured at Lower Granite Dam during the 2000 smolt emigration period. Travel times and arrival dates are based on PIT tag detections at only Lower Granite Dam.



Hatchery	Km	Hatchery	Km
DNFH	116	POWP	321
KNFH	176	JOHNSC	429
CROOKP	265	KNOXB	457
REDP	272	PAHP	619
RAPH	283	SAWT	747

Figure 12. Median travel time (days) to Lower Granite Dam (LGR) versus migration distance (km) to LGR for PIT-tagged spring and summer chinook salmon smolts released from Idaho hatcheries that emigrated in 2000 (R^2 = 0.0059). Median travel times are based on unique PIT tag detections at LGR. DNFH = Dworshak National Fish Hatchery, KNFH = Kooskia National Fish Hatchery, POWP = Powell Satellite (Clearwater), CROOKP = Crooked River Satellite (Clearwater), RAPH = Rapid River Fish Hatchery, KNOXB = Knox Bridge (McCall), JOHNSC = Johnson Creek (McCall), PAHP = Pahsimeroi Fish Hatchery, SAWT = Sawtooth Fish Hatchery, REDP = Red River Satellite (Clearwater). Knox Bridge (McCall), Johnson Creek (McCall), and Pahsimeroi Fish Hatchery releases are summer chinook; all others are spring chinook.



Hatchery	Rel. Date	Hatchery	Rel. Date
RAPH	3/17	CROOKP	4/10
JOHNSC	3/27	POWP	4/10
DNFH	4/5	REDP	4/10
KNOXB	4/5	PAHS	4/12
KNFH	4/6	SAWT	4/12

Figure 13. Median travel time (days) to Lower Granite Dam (LGR) versus release date for PIT-tagged spring and summer chinook salmon smolts released from Idaho hatcheries that emigrated in 2000 (R^2 = 0.9037). Median travel times are based on unique PIT tag detections at only LGR. DNFH = Dworshak National Fish Hatchery, KNFH = Kooskia National Fish Hatchery, POWP = Powell Satellite (Clearwater), CROOKP = Crooked River Satellite (Clearwater), RAPH = Rapid River Fish Hatchery, KNOXB = Knox Bridge (McCall), JOHNSC = Johnson Creek (McCall), PAHP = Pahsimeroi Fish Hatchery, SAWT = Sawtooth Fish Hatchery, REDP = Red River Satellite (Clearwater). Knox Bridge (McCall), Johnson Creek (McCall), and Pahsimeroi Fish Hatchery releases are summer chinook; all others are spring chinook.

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APPENDICES

Appendix A. Table 1. Release data for Clearwater Fish Hatchery reared spring chinook salmon released in year 2000. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R06A	44,456	CWT, Ad CWT, Ad, PIT CWT, Ad CWT, Ad, PIT Ad	104642 104642 104641 104641	10,927 154 10,341 146 22,888	48	Crooked R LSRCP
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R06B	16,221	Ad		16,221	48	Crooked R LSRCP
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R07A	44,650	Ad		44,650	48	Crooked R LSRCP
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R07B	44,555	Ad		44,555	48	Crooked R LSRCP
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R09A	39,682	Ad		39,682	41	Crooked R LSRCP
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R09B	41,349	Ad		41,349	41	Crooked R LSRCP
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R10A	34,690	Ad		34,690	41	Crooked R LSRCP
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R10B	30,607	Ad		30,607	41	Crooked R LSRCP
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R11A	34,722	Ad		34,722	41	Crooked R LSRCP
Crooked R Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R11B	34,790	Ad		34,790	41	Crooked R LSRCP
					Total CWT Release:		**21,568**		
					Total Non-CWT Release:		**344,154**		
					Total Group Release:		**365,722**		

Appendix A. Table 1, continued.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
Red River Rearing Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R04B	39,753	Ad		39,753	40	Red River
Red River Rearing Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R05A	38,533	CWT, Ad CWT, Ad, PIT CWT, Ad CWT, Ad, PIT Ad	104640 104640 104639 104639	10,630 153 10,279 147 17,324	40	Red River
Red River Rearing Ponds 4/10/00-4/14/00	1998	S Fk Clearwater	R05B	1,202	Ad		1,202	40	Red River
					Total CWT Release:		**21,209**		
					Total Non-CWT Release:		**58,279**		
					Total Group Release:		**79,488**		
Red River Rearing Ponds 4/10/00-4/13/00	1998	Powell	R01A	48,907	CWT, Ad CWT, Ad Ad	105418 105407	37,524 9,861 1,522	18	Powell Large
Red River Rearing Ponds 4/10/00	1998	Powell	R01B	49,326	CWT, Ad Ad	105410	47,807 1,519	34	Powell Large
Red River Rearing Ponds 4/10/00-4/13/00	1998	Powell	R02A	49,469	CWT, Ad Ad	105409	47,985 1,484	34	Powell Large
Red River Rearing Ponds 4/10/00	1998	Powell	R02B	47,880	CWT, Ad Ad	105407	46,387 1,493	18	Powell Large
Red River Rearing Ponds 4/10/00-4/13/00	1998	Powell	R03A	49,197	CWT, Ad CWT, Ad, PIT Ad	105412 105412	47,531 150 1,516	18	Powell Large
Red River Rearing Ponds 4/10/00	1998	Powell	R03B	48,743	CWT, Ad Ad	105411	47,195 1,548	34	Powell Large
					Total CWT Release:		**284,440**		
					Total Non-CWT Release:		**9,082**		
					Total Group Release:		**293,522**		

Appendix A. Table 1, continued.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
Red River Rearing Ponds 4/10/00	1998	Powell	R01B	49,286	CWT, Ad Ad	105410	47,807 1,479	34	Powell Small
Red River Rearing Ponds 4/10/00-4/13/00	1998	Powell	R02A	49,469	CWT, Ad Ad	105409	47,834 1,484	34	Powell Small
Red River Rearing Ponds 4/10/00	1998	Powell	R03B	48,655	CWT, Ad Ad	105411	47,195 1,460	34	Powell Small
					Total CWT Release:		**142,836**		
					Total Non-CWT Release:		**4,423**		
					Total Group Release:		**147,259**		
Red River Rearing Ponds 4/10/00-4/14/00	1998	Powell	R04A	39,824	Ad		39,824	40	Red River Powell Stock
Red River Rearing Ponds 4/10/00-4/14/00	1998	Powell	R05A	1,200	Ad		1,200	40	Red River Powell Stock
Red River Rearing Ponds 4/10/00-4/14/00	1998	Powell	R05B	38,539	Ad		38,539	40	Red River Powell Stock
					Total CWT Release:		**0**		
					Total Non-CWT Release:		**79,563**		
					Total Group Release:		**79,563**		
Crooked R Ponds 4/10/00-4/12/00	1998	Powell	R06B	30,288	Ad		30,288	48	Crooked R Powell Stock
					Total CWT Release:		**0**		
					Total Non-CWT Release:		**30,288**		
					Total Group Release:		**30,288**		
Rapid River Hatchery 3/6/00-3/10/00	1998	Rapid River	R08E	77,265	Ad		77,265	33	Rapid R Release
Rapid River Hatchery 3/6/00-3/10/00	1998	Rapid River	R08W	77,266	Ad		77,266	33	Rapid R Release
Rapid River Hatchery 3/6/00-3/10/00	1998	Rapid River	R09E	77,673	Ad		77,673	33	Rapid R Release

Appendix A. Table 1, continued.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
Rapid River Hatchery 3/6/00-3/10/00	1998	Rapid River	R09W	77,673	Ad		77,673	33	Rapid R Release
Rapid River Hatchery 3/6/00-3/10/00	1998	Rapid River	R10E	76,595	Ad		76,595	33	Rapid R Release
Rapid River Hatchery 3/6/00-3/10/00	1998	Rapid River	R10W	76,596	Ad		76,596	33	Rapid R Release
					Total CWT Release:		**0**		
					Total Non-CWT Release:		**463,068**		
					Total Group Release:		**463,068**		
Red River Rearing Ponds 9/28/2000	1999	Rapid River	R09A	39,937	Lv		39,937	48	Red River Release
Red River Rearing Ponds 9/28/2000	1999	Rapid River	R09B	39,798	Lv		40,298	48	Red River Release
					Total CWT Release:		**0**		
					Total Non-CWT Release:		**80,235**		
					Total Group Release:		**80,235**		
Crooked R Ponds 9/28/2000	1999	Rapid River	R10A	52,814	Rv		53,013	46	Crooked River Release
Crooked R Ponds 9/28/2000	1999	Rapid River	R10B	52,793	Rv		52,793	46	Crooked River Release
					Total CWT Release:		**0**		
					Total Non-CWT Release:		**105,806**		
					Total Group Release:		**105,806**		

Total S Fk Clearwater Stock CWT Release	**42,777**
Total S Fk Clearwater Stock Non-CWT Release	**402,433**
Total S Fk Clearwater Stock Release	**445,210**
Total Powell Stock CWT Release	**427,276**
Total Powell Stock Non-CWT Release	**123,356**
Total Powell Stock Release	**550,632**

Appendix A. Table 1, continued.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
				Total Rapid River Stock CWT Release		**0**			
				Total Rapid River Stock Non-CWT Release		**649,109**			
				Total Rapid River Stock Release		**649,109**			
				Total CWT Release For Clearwater Hatchery		**470,053**			
				Total Non-CWT Release For Clearwater Hatchery		**1,174,898**			
				Total PIT Tag Release For Clearwater Hatchery		**750**			
				Total Clearwater Hatchery Release		**1,644,951**			

Appendix A. Table 2. Release data for McCall Fish Hatchery reared summer chinook salmon released in year 2000. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
E Fk Of S Fk Sal @ Johnson Ck 3/27/00-3/30/00	1998	S Fk Salmon	V03	78,950	CWT, Elas CWT, Elas, PIT Elas	611710 611710	68,539 8,043 2,368	63	NPT Johnson Ck.
					Total CWT Release:		**76,582**		
					Total Non-CWT Release:		**2,368**		
					Total Group Release:		**78,950**		
S Fk Salmon R @ Knox Bridge 4/3/2000-4/6/2000	1998	S Fk Salmon	P01	485,500	Ad Ad, PIT		438,004 47,709	48	U.S. Canada
S Fk Salmon R @ Knox Bridge 4/3/00-4/6/00	1998	S Fk Salmon	P02	359,744	CWT, Ad CWT, Ad CWT, Ad CWT, Ad CWT, Ad Ad	105510 105509 105508 105507 105506	65,601 64,928 64,229 65,093 63,779 36,114	51	U.S. Canada
					Total CWT Release:		**323,630**		
					Total Non-CWT Release:		**521,827**		
					Total Group Release:		**845,457**		
S Fk Salmon R @ Knox Bridge 4/3/00-4/6/00	1998	S Fk Salmon	P02	194,686	RV RV/PIT		194,086 600	51	ISS
					Total CWT Release:		**0**		
					Total Non-CWT Release:		**194,686**		
					Total Group Release:		**194,686**		
S Fk Salmon R 9/26/2000	1999	S Fk Salmon	V03	29,788	CWT, Ad Ad	104970	28,894 894	102	Excess SFSR reserve SU release by NPT

Appendix A. Table 2, continued.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
S Fk Salmon R 9/26/00-9/30/00	1999	S Fk Salmon	V04	29,889	CWT, Ad CWT, Ad Ad	105070 104970	5,172 23,820 897	94	Excess SFSR reserve SU release by NPT
S Fk Salmon R 9/26/00-9/30/00	1999	S Fk Salmon	V05	30,901	CWT, Ad CWT, Ad Ad	105070 104970	15,157 14,817 927	91	Excess SFSR reserve SU release by NPT
S Fk Salmon R 9/26/2000	1999	S Fk Salmon	V06	33,902	CWT, Ad AD	105070	32,885 1,017	98	Excess SFSR reserve SU release by NPT
					Total CWT Release:		**120,745**		
					Total Non-CWT Release:		**3,735**		
					Total Group Release:		**124,480**		
S Fk Salmon R @ Stolle Meadows 9/7/00-11/2/00	1999	S Fk Salmon	V01	52,607	CWT	105416	52,607	138	Supplementation Stolle Pond
					Total CWT Release:		**52,607**		
					Total Non-CWT Release:		**1,627**		
					Total Group Release:		**54,234**		
							Total S Fk Salmon Stock CWT Release		**573,564**
							Total S Fk Salmon Stock Non-CWT Release		**724,243**
							Total S FK Salmon Stock Release		**1,297,807**
							Total CWT Release for McCall Hatchery		**573,564**
							Total Non-CWT Release for McCall Hatchery		**724,243**
							Total PIT Tag Release for McCall Hatchery		**56,352**
							Total McCall Hatchery Release		**1,287,807**

Appendix A. Table 3. Release data for Pahsimeroi Fish Hatchery reared summer chinook salmon released in year 2000. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
Pahsimeroi Ponds 4/12/2000	1998	PAH CH-2	P02	53,837	Ad Ad, PIT		53,337 500	10.9	ISS/IPC
					Total CWT Release:		**0**		
					Total Non-CWT Release:		**53,837**		
					Total Group Release:		**53,837**		
					Total PAH CH-2 Stock CWT Release				**0**
					Total PAH CH-2 Stock Non-CWT Release				**53,837**
					Total PAH CH-2 Stock Release				**53,837**
					Total CWT Release for Pahsimeroi Hatchery				**0**
					Total Non-CWT Release for Pahsimeroi Hatchery				**53,837**
					Total PIT Tag Release for Pahsimeroi Hatchery				**500**
					Total Pahsimeroi Hatchery Release				**53,837**

Appendix A. Table 4. Release data for Rapid River Fish Hatchery reared spring chinook salmon released in year 2000. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P01A	3,997	Ad		3,997	42	U.S. Canada
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P01B	3,996	CWT, Ad CWT, Ad CWT, Ad CWT, Ad CWT, Ad Ad	105505 105504 105503 105502 105501	651 662 655 656 660 712	40	U.S. Canada
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P02A	3,982	Ad		3,982	43	U.S. Canada
Rapid River Hatchery 4/17/2000	1998	Rapid River	P02B	4,003	Ad		3,526	43	U.S. Canada
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P02C	3,997	Ad		3,997	36	U.S. Canada
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P02D	4,649	Ad		4,649	50	U.S. Canada
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P01A	395,660	Ad		395,660	43	U.S. Canada
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P01B	395,644	CWT, Ad CWT, Ad CWT, Ad CWT, Ad CWT, Ad Ad	105505 105504 105503 105502 105501	64,436 65,538 64,801 64,881 65,352 70,636	40	U.S. Canada
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P02A	394,175	Ad		394,175	43	U.S. Canada
Rapid River Hatchery 3/16/2000	1998	Rapid River	P02B	396,290	Ad Ad, PIT		349,114 47,478	43	U.S. Canada

Appendix A. Table 4, continued.

Release Site / Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPK)	Marking Purpose
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P02C	395,661	Ad		395,661	36	U.S. Canada
Rapid River Hatchery 3/15/00-4/25/00	1998	Rapid River	P02D	460,300	Ad		460,300	50	U.S. Canada
						Total CWT Release:	**328,292**		
						Total Non-CWT Release:	**2,133,887**		
						Total Group Release:	**2,462,179**		
								Total Rapid River Stock CWT Release	**328,292**
								Total Rapid River Stock Non-CWT Release	**2,133,887**
								Total Rapid River-Stock Release	**2,462,179**
								Total CWT Release for Rapid River Hatchery	**328,292**
								Total Non-CWT Release for Rapid River Hatchery	**2,133,887**
								Total PIT Tag Release for Rapid River Hatchery	**47,478**
								Total Rapid River Hatchery Release	**2,462,179**

Appendix A. Table 5. Release data for Sawtooth Fish Hatchery reared spring chinook salmon released in year 2000. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site/Date	Brood Year	Stock Name	Raceway Number	Raceway Total	Mark Type	CWT Code	Release Number	Size (FPP)	Marking Purpose
Sawtooth Hatchery 4/12/2000	1998	Salmon R	R01A	25,169	CWT	105422	24,907	35	ISS; Natural Rearing-Control
					CWT, PIT	105422	262		
Sawtooth Hatchery 4/12/2000	1998	Salmon R	R03A	30,323	CWT	105428	1,647	37	ISS; Natural Rearing-Control
					CWT, PIT	105428	14		
					CWT	105423	26,803		
					CWT, PIT	105423	223		
					CWT	105422	1,623		
					CWT, PIT	105422	13		
Sawtooth Hatchery 4/12/2000	1998	Salmon R	R05A	16,160	CWT	105429	7,833	38	ISS; Natural Rearing-Control
					CWT	105428	8,327		
				Total CWT Release:			**71,652**		
				Total Non-CWT Release:			**1,633**		
				Total Group Release:			**73,285**		
Sawtooth Hatchery 4/12/2000	1998	Salmon R	R02A	21,653	CWT	105420	21,403	31	ISS; Natural Rearing-Cammo
					CWT, PIT	105420	250		
Sawtooth Hatchery 4/12/2000	1998	Salmon R	R04A	27,596	CWT	105421	21,962	41	ISS; Natural Rearing-Cammo
					CWT, PIT	105421	201		
					CWT	105420	5,384		
					CWT, PIT	105420	49		
				Total CWT Release:			**49,249**		
				Total Non-CWT Release:			**891**		
				Total Group Release:			**50,140**		
					Total Salmon R Stock CWT Release				**120,901**
					Total Salmon R Stock Non-CWT Release				**2,524**
					Total Salmon R Stock Release				**123,425**
					Total CWT Release for Sawtooth Hatchery				**120,901**
					Total Non-CWT Release for Sawtooth Hatchery				**2,524**
					Total PIT Tag Release for Sawtooth Hatchery				**1,012**
					Total Sawtooth Hatchery Release				**123,425**

Appendix B. Table 1. Release and return data for Sawtooth Fish Hatchery reared spring chinook salmon brood year 1997. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site/Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Lt Salmon R @ Warm Springs Br 7/8/1998	1997	Powell	105229	19,252	NONE	NPTH Parr Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Lt Salmon R @ Warm Springs Br 7/8/1998	1997	Powell	Untagged	595	NONE	NPTH Parr Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
			Totals:	**19,847**				**0**	**0**	**0**	
Lochsa R @ Squaw Creek 7/29/1998	1997	Powell	100000	1,819	NONE	ISS Parr Release	1 2 3	0 ND ND	8 ND ND	8 ND ND	
Lochsa R @ Squaw Creek 7/29/1998	1997	Powell	104616	9,628	NONE	ISS Parr Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Lochsa R @ Squaw Creek 7/29/1998	1997	Powell	Untagged	385	NONE	ISS Parr Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Squaw Creek Total	1997	No. PIT Tags:	995				1 2 3				0 ND ND
			Totals:	**12,827**				**0**	**8**	**8**	
Colt Killed Cr: Trib To Lochsa 7/15/98-8/5/98	1997	Powell No. PIT Tags:	Untagged 1,906	297,173	AD. PIT	Contribution	1 2 3	0 ND ND	0 ND ND	0 ND ND	0 ND ND
			Totals:	**299,079**				**0**	**0**	**0**	
Lochsa R @ Boulder Ck 7/7/98-7/8/98	1997	Powell	Untagged	83,748	AD	Parr Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
			Totals:	**83,748**				**0**	**0**	**0**	

Appendix B. Table 1, continued.

Release Site/Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Walton Ck Trib to Lochsa 9/23/1998	1997	Powell	105136	51,398	AD	Contribution	1 2 3	0 ND ND	2 ND ND	2 ND ND	
Walton Ck Trib to Lochsa 9/23/1998	1997	Powell	105135	51,404	AD	Contribution	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Walton Ck Trib to Lochsa 9/23/1998	1997	Powell No. PIT Tags:	Untagged 716	227,753	AD,LV, PIT	Contribution	1 2 3	0 ND ND	0 ND ND	0 ND ND	0 ND ND
			Totals:	**331,271**				**0**	**2**	**2**	
Magruder Corridor Selway River 9/29/1998	1997	Selway No. PIT Tags:	Untagged 596	5,116	PIT	Parr Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	0 ND ND
			Totals:	**5,712**				**0**	**0**	**0**	
Red River Rearing Ponds 10/5/1998	1997	S Fk Clearwater No. PIT Tags:	Untagged 704	65,410	LV, PIT	Parr Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	0 ND ND
			Totals:	**66,114**				**0**	**0**	**0**	
Crooked R: S Fk Clwtr 9/24/1998	1997	S Fk Clearwater	Untagged	162,119	RV, PIT	Parr Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
			Totals:	**162,119**				**0**	**0**	**0**	
S Fk Clwtr R @ Mill Ck 3/19/1999	1997	S Fk Clearwater	105116	38,451	NONE	NPTH Mill Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
S Fk Clwtr R @ Mill Ck 3/19/1999	1997	S Fk Clearwater	Untagged	1,189	NONE	NPTH Mill Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
			Totals:	**39,640**				**0**	**0**	**0**	
Lolo Ck 3/31/99-4/2/99	1997	S Fk Clearwater	105303	10,909	NONE	NPTH Lolo Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	

Appendix B. Table 1, continued.

Release Site/Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Lolo Ck 3/31/99-4/2/99	1997	S Fk Clearwater	105112	24,657	NONE	NPTH Lolo Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Lolo Ck 3/31/99-4/2/99	1997	S Fk Clearwater	105131	53,487	NONE	NPTH Lolo Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Lolo Ck 3/31/99-4/2/99	1997	S Fk Clearwater	105134	53,476	NONE	NPTH Lolo Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Lolo Ck 3/31/99-4/2/99	1997	S Fk Clearwater No. PIT Tags:	Untagged 1007	4,439	PIT	NPTH Lolo Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	2 ND ND
			Totals:	**147,975**				**0**	**0**	**0**	
Walton Ck Trib to Lochsa 4/12/99-4/15/99	1997	Rapid River	105142	53,109	AD	LSRCP Powell Pond	1 2 3	0 ND ND	30 ND ND	30 ND ND	
Walton Ck Trib to Lochsa 4/12/99-4/15/99	1997	Rapid River	105137	52,079	AD	LSRCP Powell Pond	1 2 3	0 ND ND	44 ND ND	44 ND ND	
Walton Ck Trib to Lochsa 4/12/99-4/15/99	1997	Rapid River	105138	52,471	AD	LSRCP Powell Pond	1 2 3	0 ND ND	40 ND ND	40 ND ND	
Walton Ck Trib to Lochsa 4/12/99-4/15/99	1997	Rapid River	105139	52,706	AD	LSRCP Powell Pond	1 2 3	0 ND ND	42 ND ND	42 ND ND	
Walton Ck Trib to Lochsa 4/12/99-4/15/99	1997	Rapid River	105140	52,569	AD	LSRCP Powell Pond	1 2 3	0 ND ND	41 ND ND	41 ND ND	
Walton Ck Trib to Lochsa 4/12/99-4/15/99	1997	Rapid River	105141	52,716	AD	LSRCP Powell Pond	1 2 3	2 ND ND	52 ND ND	54 ND ND	
Walton Ck Trib to Lochsa 4/12/99-4/15/99	1997	Rapid River No. PIT Tags:	Untagged 1000	17,827	AD	LSRCP Powell Pond	1 2 3	0 ND ND	0 ND ND	0 ND ND	0 ND ND
			Totals:	**334,477**				**2**	**249**	**251**	

Appendix B. Table 1, continued.

Release Site/Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Papoose Ck: Lochsa R 4/7/1999	1997	Powell No. PIT Tags:	103210 1498	44,558	NONE	NPTH Papoose Ck.	1 2 3	0 ND ND	1 ND ND	1 ND ND	0 ND ND
Papoose Ck: Lochsa R 4/7/1999	1997	Powell	Untagged	1,894	AD	ISS Papoose Ck.	1 2 3	0 ND ND	0 ND ND	0 ND ND	
			Totals:	**47,950**				**0**	**1**	**1**	
Newsome Ck: S Fk Clwtr R 3/19/1999	1997	Rapid River	105304	18,968	NONE	NPTH Newsome Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Newsome Ck: S Fk Clwtr R 3/19/1999	1997	Rapid River	105132	51,919	NONE	NPTH Newsome Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Newsome Ck: S Fk Clwtr R 3/19/1999	1997	Rapid River No. PIT Tags:	Untagged 999	2,223	PIT	NPTH Newsome Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	0 ND ND
			Totals:	**74,109**				**0**	**0**	**0**	
Meadow Ck: Selway R 3/22/99-3/29/99	1997	Rapid River No. PIT Tags:	Untagged 999	284,574	AD, PIT	NPTH Meadow Ck Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	1 ND ND
			Totals:	**285,573**				**0**	**0**	**0**	
Crooked R: S Fk Clwtr 4/12/99-4/15/99	1997	Rapid River	Untagged	246,978	AD	Contribution	1 2 3	0 ND ND	0 ND ND	0 ND ND	
			Totals:	**246,978**				**0**	**0**	**0**	
Red River: S Fk Clwtr 4/12/99-4/15/99	1997	S Fk Clearwater No. PIT Tags:	Untagged 500	360,483	AD,PIT	Contribution	1 2 3	0 ND ND	0 ND ND	0 ND ND	0 ND ND
			Totals:	**360,983**				**0**	**0**	**0**	
Crooked R: S Fk Clwtr 4/12/99-4/15/99	1997	S Fk Clearwater No. PIT Tags:	Untagged 500	353,503	AD	Contribution	1 2 3	0 ND ND	0 ND ND	0 ND ND	1 ND ND
			Totals:	**354,003**				**0**	**0**	**0**	

Appendix B. Table 1, continued.

Release Site/Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Lochsa R @ Pete King Creek 7/20/1998	1997	Powell	Untagged	12,889	BWT	Pete King Release	1 2 3	0 ND ND	0 ND ND	0 ND ND	
			Totals:	**12,889**				**0**	**0**	**0**	
Lochsa R @ Boulder Ck 4/5/99-4/7/99	1997	Powell	105117	38,536	NONE	Nez Perce Tribal release.	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Lochsa R @ Boulder Ck 4/5/99-4/7/99	1997	Powell	105118	35,373	NONE	Nez Perce Tribal release.	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Lochsa R @ Boulder Ck 4/5/99-4/7/99	1997	Powell	105149	18,837	NONE	Nez Perce Tribal release.	1 2 3	0 ND ND	1 ND ND	1 ND ND	
Lochsa R @ Boulder Ck 4/5/99-4/7/99	1997	Powell	Untagged	2,869	NONE	Nez Perce Tribal release.	1 2 3	0 ND ND	0 ND ND	0 ND ND	
			Totals:	**95,615**				**0**	**1**	**1**	

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**263**	**4**
Total 2-Ocean:	**ND**	**ND**
Total 3-Ocean:	**ND**	**ND**
Total Harvest Recoveries:	**2**	
Total Hatchery Recoveries:	**261**	
Total PIT Tag Detections:	**—**	**4**
Total PIT Tag Releases:	**11,420**	
Total Releases:	**2,980,909**	
Total Recoveries:	**263**	

Appendix B. Table 2. Release and return data for McCall Fish Hatchery reared summer chinook salmon brood year 1997. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon	105129	34,953	AD	Contribution	1	5	22	27	
							2	ND	ND	ND	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon	104944	53,744	AD	Contribution	1	10	20	30	
							2	ND	ND	ND	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon	104945	54,863	AD	Contribution	1	6	30	36	
							2	ND	ND	ND	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon	105119	42,440	AD	Contribution	1	14	27	41	
							2	ND	ND	ND	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon	105128	53,374	AD	Contribution	1	10	48	58	
							2	ND	ND	ND	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon	105130	51,027	AD	Contribution	1	8	49	57	
							2	ND	ND	ND	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon No. PIT Tags:	Untagged 47,174	678,571	AD	Contribution	1	0	0	0	119
							2	ND	ND	ND	ND
							3	ND	ND	ND	ND
			Totals:	**1,016,145**				**53**	**96**	**249**	
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon	105122	38,341	NONE	NPT Release	1	0	8	8	
							2	ND	ND	ND	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon	Untagged	1,186	NONE	NPT Release	1	0	0	0	
							2	ND	ND	ND	
							3	ND	ND	ND	
			Totals:	**39,527**				**8**	**0**	**8**	

Appendix B. Table 2, continued.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
S Fk Salmon R @ Knox Bridge 4/5/99-4/8/99	1997	S Fk Salmon No. PIT Tags:	Untagged 593	126,344	LV	Supplementation	1 2 3	0 ND ND	0 ND ND	0 ND ND	2 ND ND
			Totals:	**126,937**				**0**	**0**	**0**	
Buckhorn Ck: S Fk Salmon 10/7/98-10/8/98	1997	S Fk Salmon	105230	18,561	NONE	NPT fall release SFSR	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Buckhorn Ck: S Fk Salmon 10/7/98-10/8/98	1997	S Fk Salmon	105123	38,121	NONE	NPT fall release SFSR	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Buckhorn Ck: S Fk Salmon 10/7/98-10/8/98	1997	S Fk Salmon	105124	34,807	NONE	NPT fall release SFSR	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Buckhorn Ck: S Fk Salmon 10/7/98-10/8/98	1997	S Fk Salmon No. PIT Tags:	105143 2,001	52,810	NONE	NPT fall release SFSR	1 2 3	0 ND ND	0 ND ND	0 ND ND	0 ND ND
Buckhorn Ck: S Fk Salmon 10/7/98-10/8/98	1997	S Fk Salmon	Untagged	4,525	NONE	NPT fall release SFSR	1 2 3	0 ND ND	0 ND ND	0 ND ND	
			Totals:	**150,825**				**0**	**2**	**2**	
S Fk Salmon R @ Stolle Meadows 8/3/98-8/19/98	1997	S Fk Salmon	105121	41,988	NONE	Research release @ Stolle Meadows	1 2 3	0 ND ND	0 ND ND	0 ND ND	
S Fk Salmon R @ Stolle Meadows 8/3/98-8/19/98	1997	S Fk Salmon	104617	6,388	NONE	Research release @ Stolle Meadows	1 2 3	0 ND ND	0 ND ND	0 ND ND	
S Fk Salmon R @ Stolle Meadows 8/3/98-8/19/98	1997	S Fk Salmon	Untagged	1,496	NONE	Research release @ Stolle Meadows	1 2 3	0 ND ND	0 ND ND	0 ND ND	
Stolle Pond 10/10/98	1997		PIT	971			1 2 3				1 ND ND
			Totals:	**51,814**				**0**	**0**	**0**	

Appendix B. Table 2, continued.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Buckhorn Ck: S Fk Salmon 8/5/98	1997	S Fk Salmon	105231	21,086	NONE	NPT summer release @ Buckhorn Ck.	1	0	0	0	
							2	ND	ND	ND	
							3	ND	ND	ND	
Buckhorn Ck: S Fk Salmon 8/5/98	1997	S Fk Salmon	105114	22,520	NONE	NPT summer release @ Buckhorn Ck.	1	0	0	0	
							2	ND	ND	ND	
							3	ND	ND	ND	
Buckhorn Ck: S Fk Salmon 8/5/98	1997	S Fk Salmon	Untagged	1,349	NONE	NPT summer release @ Buckhorn Ck.	1	0	0	0	
							2	ND	ND	ND	
							3	ND	ND	ND	
			Totals:	**44,955**				**0**	**0**	**0**	

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**257**	**122**
Total 2-Ocean:	**ND**	**ND**
Total 3-Ocean:	**ND**	**ND**
Total Harvest Recoveries:	**53**	
Total Hatchery Recoveries:	**204**	
Total PIT Tag Detections:	**—**	**122**
Total PIT Tag Releases:	**50,739**	
Total Releases:	**1,430,201**	
Total Recoveries:	**257**	

Appendix B. Table 3. Release and return data for Pahsimeroi Fish Hatchery reared summer chinook salmon brood year 1997. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Pahsimeroi Ponds 4/14/99-4/19/99	1997	PAH CH-2 No. PIT Tags:	Untagged 500	135,169	AD	Pahsimeroi IPC	1 2 3	0 ND ND	0 ND ND	0 ND ND	0 ND ND
			Totals:	135,669				0	0	0	

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**0**	**0**
Total 2-Ocean:	**ND**	**ND**
Total 3-Ocean:	**ND**	**ND**
Total Harvest Recoveries:	**0**	
Total Hatchery Recoveries:	**0**	
Total PIT Tag Detections:	**—**	**0**
Total PIT Tag Releases:	**500**	
Total Releases:	**135,669**	
Total Recoveries:	**0**	

Appendix B. Table 4. Release and return data for Rapid River Fish Hatchery reared spring chinook salmon brood year 1997. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Rapid River Hatchery	1997	Rapid River	105133	52,439	AD	Contribution	1	2	21	23	
3/18/99-4/26/99							2	ND	ND	ND	
							3	ND	ND	ND	
Rapid River Hatchery	1997	Rapid River	103219	52,751	AD	Contribution	1	4	22	26	
3/18/99-4/26/99							2	ND	ND	ND	
							3	ND	ND	ND	
Rapid River Hatchery	1997	Rapid River	103522	54,067	AD	Contribution	1	1	19	20	
3/18/99-4/26/99							2	ND	ND	ND	
							3	ND	ND	ND	
Rapid River Hatchery	1997	Rapid River	103523	55,139	AD	Contribution	1	2	30	32	
3/18/99-4/26/99							2	ND	ND	ND	
							3	ND	ND	ND	
Rapid River Hatchery	1997	Rapid River	103524	53,915	AD	Contribution	1	4	14	18	
3/18/99-4/26/99							2	ND	ND	ND	
							3	ND	ND	ND	
Rapid River Hatchery	1997	Rapid River	103533	55,020	AD	Contribution	1	2	35	37	
3/18/99-4/26/99							2	ND	ND	ND	
							3	ND	ND	ND	
Rapid River Hatchery	1997	Rapid River	Untagged	2,476,105	AD	Contribution	1	0	0	0	53
3/18/99-4/26/99		No. PIT Tags:	47,848				2	ND	ND	ND	ND
							3	ND	ND	ND	ND
			Totals:	**2,847,284**				**15**	**141**	**156**	
Snake R @ Hells Canyon Dam	1997	Rapid River	Untagged	300,000	AD	Contribution	1	0	0	0	
3/18/99-3/19/99							2	ND	ND	ND	
							3	ND	ND	ND	
			Totals:	**300,000**				**0**	**0**	**0**	

Appendix B. Table 4, continued.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Lt Salmon R @ Stinky Springs 3/17/1999	1997	Rapid River	Untagged	200,000	AD	Contribution	1	0	0	0	
							2	ND	ND	ND	
							3	ND	ND	ND	
			Totals:	**200,000**				**0**	**0**	**0**	

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**156**	**53**
Total 2-Ocean:	**ND**	**ND**
Total 3-Ocean:	**ND**	**ND**
Total Harvest Recoveries:	**15**	
Total Hatchery Recoveries:	**141**	
Total PIT Tag Detections:	**—**	**53**
Total PIT Tag Releases:	**47,848**	
Total Releases:	**3,347,284**	
Total Recoveries:	**156**	

Appendix B. Table 5. Release and return data for Sawtooth Fish Hatchery reared spring chinook salmon brood year 1997. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Sawtooth Hatchery	1997	Salmon R	105262	21,194	NONE	Supplementation	1	0	29	29	
4/16/1999							2	ND	ND	ND	
							3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	104618	10,855	NONE	Supplementation	1	0	4	4	
4/16/1999							2	ND	ND	ND	
							3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	104620	6,938	NONE	Supplementation	1	0	3	3	
4/16/1999							2	ND	ND	ND	
							3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	104631	9,838	NONE	Supplementation	1	0	9	9	
4/16/1999							2	ND	ND	ND	
							3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	104632	7,885	NONE	Supplementation	1	0	9	9	
4/16/1999							2	ND	ND	ND	
							3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	104633	4,518	NONE	Supplementation	1	0	2	2	
4/16/1999							2	ND	ND	ND	
							3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	105238	21,133	NONE	Supplementation	1	0	15	15	
4/16/1999							2	ND	ND	ND	
							3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	105240	21,964	NONE	Supplementation	1	0	7	7	
4/16/1999							2	ND	ND	ND	
		No PIT Tags:	498				3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	Untagged	1,128	NONE	Supplementation	1	0	0	0	
4/16/1999							2	ND	ND	ND	
							3	ND	ND	ND	
			Totals:	**105,951**				**0**	**78**	**78**	

Appendix B. Table 5. Continued.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Sawtooth Hatchery	1997	Salmon R	105239	21,129	AD	Reserve	1	0	30	30	
							2	ND	ND	ND	
4/16/1999							3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	102021	40,759	AD	Reserve	1	0	60	60	
							2	ND	ND	ND	
4/16/1999		No PIT Tags:	995				3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	104619	7,909	AD	Reserve	1	0	11	11	
							2	ND	ND	ND	
4/16/1999		No PIT Tags:	996				3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	105125	40,227	AD	Reserve	1	0	71	71	
							2	ND	ND	ND	
4/16/1999		No PIT Tags:	500				3	ND	ND	ND	
Sawtooth Hatchery	1997	Salmon R	Untagged	4,927	AD	Reserve	1	0	0	0	
							2	ND	ND	ND	
4/16/1999							3	ND	ND	ND	
			Totals:	**117,442**				**0**	**172**	**172**	
Sawtooth Hatchery Total		No. PIT Tags:	2,989				1				0
							2				ND
							3				ND

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**250**	**0**
Total 2-Ocean:	**ND**	**ND**
Total 3-Ocean:	**ND**	**ND**
Total Harvest Recoveries:	**0**	
Total Hatchery Recoveries:	**250**	
Total PIT Tag Detections:	**—**	**0**
Total PIT Tag Releases:	**2989**	
Total Releases:	**223,393**	
Total Recoveries:	**250**	

Appendix C. Table 1. Release and return data for Clearwater Fish Hatchery reared spring chinook salmon brood year 1996. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Powell Rearing Ponds	1996	Powell	104627	54,569	AD,PIT	Powell	1	1	13	14	
4/6/98-4/8/98		No. PIT Tags:	501			Contribution	2	1	198	199	
						Normal Size	3	ND	ND	ND	
Powell Rearing Ponds	1996	Powell	104626	53,545	AD,PIT	Powell	1	0	14	14	
4/6/98-4/8/98		No. PIT Tags:	469			Contribution	2	2	218	220	
						Normal Size	3	ND	ND	ND	
Powell Rearing Ponds	1996	Powell	Untagged	12,117	AD,PIT	Powell	1	0	0	0	
4/6/98-4/8/98		No. PIT Tags:	35			Contribution	2	0	0	0	
						Normal Size	3	ND	ND	ND	
			Totals:	**121,236**				**4**	**443**	**447**	
Powell Rearing Ponds	1996	Powell	104624	52,940	AD,PIT	Powell	1	1	13	14	
4/6/98-4/8/98		No. PIT Tags:	479			Contribution	2	3	161	164	
						Large Size	3	ND	ND	ND	
Powell Rearing Ponds	1996	Powell	104625	53,626	AD,PIT	Powell	1	0	36	36	
4/6/98-4/8/98		No. PIT Tags:	468			Contribution	2	1	241	242	
						Large Size	3	ND	ND	ND	
Powell Rearing Ponds	1996	Powell	Untagged	10,121	AD	Powell	1	0	0	0	
4/6/98-4/8/98		No. PIT Tags:	58			Contribution	2	0	0	0	
						Large Size	3	ND	ND	ND	
			Totals:	**117,692**				**5**	**451**	**456**	
Powell Rearing Ponds	1996	Powell	Untagged	5,919	AD, PIT	Walton Ck.	1	0	0	0	
4/6/98-4/9/98						Smolt Release	2	0	0	0	
							3	ND	ND	ND	
			Totals:	**5,919**				**0**	**0**	**0**	
Powell Ponds Total		No. PIT Tags:	2010				1				0
							2				11
							3				ND

Appendix C. Table 1, continued.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Crooked R: S Fk Clwtr	1996	Crooked R	Untagged	205,407	AD,PIT	Contribution	1	0	0	0	0
4/7/98-4/9/98							2	0	0	0	1
		No. PIT Tags:	499				3	ND	ND	ND	ND
			Totals:	**205,906**				**0**	**0**	**0**	
Snake R @ Hells Canyon Dam	1996	Rapid River	Untagged	304,100	AD	Contribution	1	0	0	0	
3/16/98-3/18/98							2	0	0	0	
							3	ND	ND	ND	
			Totals:	**304,100**				**0**	**0**	**0**	
Red River Rearing Ponds	1996	Red River	Untagged	21,123	LV, PIT	Red River LVs	1	0	0	0	
4/7/98-4/9/98							2	0	0	0	
		No. PIT Tags:	500				3	ND	ND	ND	
			Totals:	**21,623**				**0**	**0**	**0**	
Red River Rearing Ponds	1996	S Fk Clearwater	Untagged	29,085	RV, PIT	Red River RVs	1	0	0	0	
4/13/1998							2	0	0	0	
		No. PIT Tags:	500				3	ND	ND	ND	
			Totals:	**29,585**				**0**	**0**	**0**	
Red River Total		No. PIT Tags:	1,000				1				0
							2				0
							3				ND
Magruder Corridor @ Selway R.	1996	Selway	Untagged	8,592	AD, PIT	NPT Helicopter	1	0	0	0	0
4/21/98-4/22/98		No. PIT Tags:	300			Smolt Plant.	2	0	0	0	0
							3	ND	ND	ND	ND
			Totals:	**8,892**				**0**	**0**	**0**	

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**78**	**0**
Total 2-Ocean:	**825**	**12**
Total 3-Ocean:	**ND**	**ND**
Total Harvest Recoveries:	**9**	
Total Hatchery Recoveries:	**894**	
Total PIT Tag Detections:	**—**	**12**
Total PIT Tag Releases:	**3,809**	
Total Releases:	**814,953**	
Total Recoveries:	**903**	

Appendix C. Table 2. Release and return data for McCall Fish Hatchery reared summer chinook salmon brood year 1996. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
S Fk Salmon R @ Knox Bridge	1996	S Fk Salmon	105111	25,796	AD, PIT	U.S. Canada	1	0	25	25	
3/29/98-4/6/98						Release	2	14	11	25	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge	1996	S Fk Salmon	105126	51,931	AD, PIT	U.S. Canada	1	0	29	29	
3/29/98-4/6/98						Release	2	52	72	124	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge	1996	S Fk Salmon	105127	52,383	AD, PIT	U.S. Canada	1	0	59	59	
3/29/98-4/6/98						Release	2	33	64	97	
							3	ND	ND	ND	
S Fk Salmon R @ Knox Bridge	1996	S Fk Salmon	Untagged	193,281	AD	U.S. Canada	1	0	0	0	105
3/29/98-4/6/98		No. PIT Tags	47,499			Release	2	0	0	0	384
							3	ND	ND	ND	ND
			Totals:	**370,890**				**99**	**260**	**359**	
S Fk Salmon R @ Stolle Meadows	1996	S Fk Salmon	Untagged	24,990	RV	Supplementation	1	0	0	0	
7/7/98-7/10/98							2	0	0	0	
							3	ND	ND	ND	
			Totals:	**24,990**				**0**	**0**	**0**	
S Fk Salmon R @ Knox Bridge	1996	S Fk Salmon	Untagged	22,982	Elas	Supplementation	1	0	0	0	
3/29/98-4/6/98							2	0	0	0	
							3	ND	ND	ND	
			Totals:	**22,982**				**0**	**0**	**0**	

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**113**	**105**
Total 2-Ocean:	**246**	**384**
Total 3-Ocean:	**ND**	**ND**
Total Harvest Recoveries:	**99**	
Total Hatchery Recoveries:	**260**	
Total PIT Tag Detections:	**—**	**489**
Total PIT Tag Releases:	**47,499**	
Total Releases:	**418,862**	
Total Recoveries:	**359**	

Appendix C. Table 3. Release and return data for Pahsimeroi Fish Hatchery reared summer chinook salmon brood year 1996. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Pahsimeroi Ponds	1996	PAH CH-2	Untagged	64,655	AD,PIT	Pahsimeroi	1	0	0	0	0
4/15/98-4/18/98						Contribution	2	0	0	0	0
		No. PIT Tags:	993				3	ND	ND	ND	ND
			Totals:	**65,648**				**0**	**0**	**0**	

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**0**	**0**
Total 2-Ocean:	**0**	**0**
Total 3-Ocean:	**ND**	**0**
Total Harvest Recoveries:	**0**	
Total Hatchery Recoveries:	**0**	
Total PIT Tag Detections:	**—**	**0**
Total PIT Tag Releases:	**993**	
Total Releases:	**65,648**	
Total Recoveries:	**0**	

Appendix C. Table 4. Release and return data for Rapid River Fish Hatchery reared spring chinook salmon brood year 1996. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Rapid River Hatchery	1996	Rapid River	104905	308,531	AD	U.S.-Canada	1	0	191	191	31
3/16/98-4/28/98						Contribution.	2	104	687	791	384
		No. PIT Tags:	48,357				3	ND	ND	ND	ND
Rapid River Hatchery	1996	Rapid River	Untagged	539,282	AD	U.S.-Canada	1	0	0	0	
3/16/98-4/28/98						Contribution.	2	0	0	0	
							3	ND	ND	ND	
			Totals:	**896,170**				**104**	**878**	**982**	

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**191**	**31**
Total 2-Ocean:	**791**	**384**
Total 3-Ocean:	**ND**	**ND**
Total Harvest Recoveries:	**104**	
Total Hatchery Recoveries:	**878**	
Total PIT Tag Detections:	**—**	**415**
Total PIT Tag Releases:	**48,357**	
Total Releases:	**896,170**	
Total Recoveries:	**982**	

Appendix C. Table 5. Release and return data for Sawtooth Fish Hatchery reared spring chinook salmon brood year 1996. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam
Sawtooth Hatchery	1996	Salmon R	Untagged	42,662	AD	Sawtooth	1	0	0	0	0
						Contribution	2	0	0	0	2
4/21/1998		No. PIT Tags:	499				3	ND	ND	ND	ND
			Totals:	43,161				0	0	0	

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**0**	**0**
Total 2-Ocean:	**0**	**2**
Total 3-Ocean:	**ND**	**ND**
Total Harvest Recoveries:	**0**	
Total Hatchery Recoveries:	**0**	
Total PIT Tag Detections:	**—**	**2**
Total PIT Tag Releases:	**499**	
Total Releases:	**43,161**	
Total Recoveries:	**0**	

Appendix D. Table 1. Release and return data for Clearwater Fish Hatchery reared spring chinook salmon brood year 1995. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam	SAR (%)
Powell Rearing Ponds 4/15/1997	1995	Powell	Untagged	3,013	AD	Contribution	1	0	0	0	0	
							2	0	0	0	0	
		No. PIT Tags:	500				3	0	0	0	0	0
			Totals:	**3,513**				**0**	**0**	**0**		
Red River: S Fk Clwtr 4/14/1997-4/15/1997	1995	Red River	Untagged	2,470	AD	Contribution	1	0	0	0	0	
							2	0	0	0	0	
		No. PIT Tags:	500				3	0	0	0	0	0
			Totals:	**2,970**				**0**	**0**	**0**		
Magruder Corridor 4/11/1997	1995	Selway	Untagged	0	AD	Contribution	1	0	0	0	0	
							2	0	0	0	0	
		No. PIT Tags:	1,428				3	0	0	0	0	0
			Totals:	**1,428**				**0**	**0**	**0**		
Rapid River Hatchery 4/15/1997	1995	Rapid River	Untagged	11,947	AD	Contribution, Isolation	1	0	0	0	0	
							2	0	0	0	0	
		No. PIT Tags:	500			Group	3	0	0	0	0	0
			Totals:	**12,447**				**0**	**0**	**0**		

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**0**	**0**
Total 2-Ocean:	**0**	**0**
Total 3-Ocean:	**0**	**0**
Total Harvest Recoveries:	**0**	
Total Hatchery Recoveries:	**0**	
Total PIT Tag Detections:	**—**	**0**
Total PIT Tag Releases:	**2928**	
Total Releases:	**20,358**	
Total Recoveries:	**0**	

Appendix D. Table 2. Release and return data for McCall Fish Hatchery reared summer chinook salmon brood year 1995. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam	SAR (%)
S Fk Salmon R @ Knox Bridge 3/19/97-3/21/97	1995	S Fk Salmon	105144	62,235	AD	U.S. Canada Contribution	1	0	14	14		
							2	0	103	103		
							3	0	2	2		
S Fk Salmon R @ Knox Bridge 3/19/97-3/21/97	1995	S Fk Salmon No. PIT Tags	Untagged 52,701	60,356	AD	U.S. Canada Contribution	1	0	0	0	21	
							2	0	0	0	260	
							3	0	0	0	10	0.552
			Totals:	**175,292**				**0**	**119**	**119**		
S Fk Salmon R @ Knox Bridge 3/19/97-3/21/97	1995	S Fk Salmon	Untagged	63,355	Elas	Supplementation, Elastomer study	1	0	0	0		
							2	0	0	0		
							3	0	0	0		
			Totals:	**63,355**				**0**	**0**	**0**		

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**14**	**21**
Total 2-Ocean:	**103**	**260**
Total 3-Ocean:	**2**	**10**
Total Harvest Recoveries:	**0**	
Total Hatchery Recoveries:	**119**	
Total PIT Tag Detections:	**—**	**291**
Total PIT Tag Releases:	**52,701**	
Total Releases:	**238,647**	
Total Recoveries:	**119**	

Appendix D. Table 3. Release and return data for Pahsimeroi Fish Hatchery reared summer chinook salmon brood year 1995. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site / Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam	SAR (%)
Pahsimeroi Ponds	1995	PAH CH-2	Untagged	88,447	AD	Contribution	1	0	0	0	1	
4/7/1997							2	0	0	0	36	
		No. PIT Tags:	33,570				3	0	0	0	2	0.116
			Totals:	**122,017**				**0**	**0**	**0**		

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**0**	**1**
Total 2-Ocean:	**0**	**36**
Total 3-Ocean:	**0**	**2**
Total Harvest Recoveries:	**0**	
Total Hatchery Recoveries:	**0**	
Total PIT Tag Detections:	**—**	**39**
Total PIT Tag Releases:	**33,570**	
Total Releases:	**122,017**	
Total Recoveries:	**0**	

Appendix D. Table 4. Release and return data for Rapid River Fish Hatchery reared spring chinook salmon brood year 1995. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site/Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam	SAR (%)
Rapid River Hatchery 3/17/97-4/10/97	1995	Rapid River	Untagged	40,608	AD	Contribution	1	0	0	0	2	
							2	0	0	0	86	
		No. PIT Tags:	40,517				3	0	0	0	7	0.23
			Totals:	**85,838**				**0**	**0**	**0**		

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**0**	**2**
Total 2-Ocean:	**0**	**86**
Total 3-Ocean:	**0**	**7**
Total Harvest Recoveries:	**0**	
Total Hatchery Recoveries:	**0**	
Total PIT Tag Detections:	**—**	**95**
Total PIT Tag Releases:	**40,517**	
Total Releases:	**85,838**	
Total Recoveries:	**0**	

Appendix D. Table 5. Release and return data for Sawtooth Fish Hatchery reared spring chinook salmon brood year 1995. Return data includes coded-wire tag (CWT) recoveries at the hatchery and in the fishery (when applicable) and PIT tag detections at Lower Granite Dam. Smolt-to-adult ratios (SARs) to Lower Granite Dam are based on juvenile PIT tag releases and adult PIT tag detections. Release data in appendices is reported from IDFG fish marking database. Numbers based on estimates made at time of marking and may not match numbers reported in the text.

Release Site/Date	Brood Year	Stock Name	CWT Code	Tagged Release	Other Marks	Marking Purpose	Ocean Age	Harvest Returns	Hatchery Returns	Total Returns	Adult PIT Tag Detections at L. Granite Dam	SAR (%)
Sawtooth Hatchery	1995	Salmon R	Untagged	1,626	AD	Contribution	1	0	0	0	0	
4/17/1997							2	0	0	0	0	
		No. PIT Tags:	750				3	0	0	0	0	0
			Totals:	2,376				0	0	0		
U Salmon R @ Blaine Co. Br	1995	Salmon R	Untagged	1,524	AD	Contribution	1	0	0	0	0	
4/17/1997							2	0	0	0	0	
		No. PIT Tags:	750				3	0	0	0	0	0
			Totals:	2,274				0	0	0		
Pahsimeroi Hatchery	1995	Pah Ch-2	Untagged	5,145	AD	Pahsimeroi	1	0	0	0		
4/15/1997						Contribution	2	0	0	0		
							3	0	0	0		
			Totals:	5,145				0	0	0		

	Harvest / Hatchery Recoveries	Adult PIT Tag Detections at L. Granite Dam
Total 1-Ocean:	**0**	**0**
Total 2-Ocean:	**0**	**0**
Total 3-Ocean:	**0**	**0**
Total Harvest Recoveries:	**0**	
Total Hatchery Recoveries:	**0**	
Total PIT Tag Detections:	**—**	**0**
Total PIT Tag Releases:	**1,500**	
Total Releases:	**9,795**	
Total Recoveries:	**0**	

Appendix E. Table 1. Interrogations of PIT-tagged juvenile chinook salmon released from Idaho hatcheries and emigrating in spring 2000 from Clearwater Fish Hatchery. LGR = Lower Granite Dam, LGO = Little Goose Dam, LMN = Lower Monumental Dam, MCN = McNary, POWP = Powell Ponds, REDR = Red River, CROOKP = Crooked River.

File Name	Rel. Site	Rel. Date	No. Tag	No. Rel.	No./% Detected										Median Travel Time (Days)	Average Travel Time (Days)
					LGR		LGO		LMN		MCN		Total			
					No.	%	No.	%	No.	%	No.	%	No.	%		
SPRING CHINOOK																
Clearwater Fish Hatchery																
Production Releases																
Powell Satellite Hatchery																
KEP00074.C2A																
KEP00074.C3A																
Total	POWP	4/10/2000	301	301	81	26.91	36	11.96	18	5.98	6	1.99	141	46.84	26	27
Red River Satellite Hatchery																
KEP00074.C5A	REDR	4/10/2000	300	300	93	31.00	35	11.67	14	4.67	12	4.00	154	51.33	25	25
Crooked River Satellite Hatchery																
KEP00074.C6A	CROOKP	4/10/2000	300	300	77	25.67	33	11.00	15	5.00	10	3.33	135	45.00	26	26

Appendix E. Table 2. Interrogations of PIT-tagged juvenile chinook salmon released from Idaho hatcheries and emigrating in spring 2000 from McCall Fish Hatchery. LGR = Lower Granite Dam, LGO = Little Goose Dam, LMN = Lower Monumental Dam, MCN = McNary, KNOXB = Knox Bridge, JOHNSC = Johnson Creek.

File Name	Rel. Site	Rel Date	No. Tag	No. Rel.	No./% Detected LGR No.	LGR %	LGO No.	LGO %	LMN No.	LMN %	MCN No.	MCN %	Total No.	Total %	Median Travel Time (Days)	Average Travel Time (Days)
McCall Fish Hatchery			**SUMMER CHINOOK**													
Production releases																
LRB00069.M1M		* All groups reared together and released on the same day, except where noted. Total includes all mark groups.														
LRB00045.M51																
LRB00046.M51																
LRB00047.M51																
LRB00045.M41																
LRB00046.M41																
LRB00047.M41																
LRB00045.M11																
LRB00046.M11																
LRB00047.M11																
LRB00045.M21																
LRB00046.M21																
LRB00047.M21																
LRB00045.M31																
LRB00046.M31																
LRB00047.M31																
Total	**KNOXB**	**4/5/2000**	**44,721**	**44,721**	**11,325**	**25.32**	**3,884**	**8.68**	**1,260**	**2.82**	**1,740**	**3.89**	**18,209**	**40.72**	**34.11**	**35.21**
Idaho Supplementation Studies																
KAA99291.MCC	**KNOXB**	**4/3/2000**	**600**	**600**	**146**	**24.33**	**58**	**9.67**	**17**	**2.83**	**2.83**	**23**	**3.83**	**244**	**40.67**	**35.09**
University of Idaho Research																
JLC00047.M11	**KNOXB**	**4/5/2000**	**2,988**	**2,988**	**746**	**24.97**	**218**	**7.30**	**83**	**2.78**	**122**	**4.08**	**1,169**	**39.12**	**34.06**	**35.09**
Nez Perce Tribe																
JLV00045.JH1																
JLV00046.JH1																
JLV00047.JH1		* All groups reared together and released on the same day. Total includes all mark groups.														
JLV00045.JH2																
JLV00046.JH2																
JLV00047.JH2																
JLV00045.JH3																
JLV00046.JH3																
JLV00047.JH3																
JLV00045.JH4																
JLV00046.JH4																
JLV00045.JH5																
JLV00046.JH5																
JLV00045.JH6																
JLV00046.JH6																
Total	**JOHNSC**	**3/27/2000**	**8043**	**8043**	**877**	**10.90**	**481**	**5.98**	**127**	**1.58**	**268**	**3.33**	**1753**	**21.80**	**48.52**	**53.96**

Appendix E. Table 3. Interrogations of PIT-tagged juvenile chinook salmon released from Idaho hatcheries and emigrating in spring 2000 from Pahsimeroi Fish Hatchery. LGR = Lower Granite Dam, LGO = Little Goose Dam, LMN = Lower Monumental Dam, MCN = McNary, PAHP = Pahsimeroi.

File Name	Rel. Site	Rel. Date	No. Tag	No. Rel.	No./% Detected LGR No.	LGR %	LGO No.	LGO %	LMN No.	LMN %	MCN No.	MCN %	Total No.	Total %	Median Travel Time (Days)	Average Travel Time (Days)
Pahsimeroi Fish Hatchery			SPRING CHINOOK													
Idaho Supplementation Studies/Idaho Power Releases																
KEP00065.P03	PAHP	4/12/2000	500	500	107	21.4	53	10.6	16	3.2	8	1.6	184	36.8	22.8	24.66

Appendix E. Table 4. Interrogations of PIT-tagged juvenile chinook salmon released from Idaho hatcheries and emigrating in spring 2000 from Rapid River Fish Hatchery. LGR = Lower Granite Dam, LGO = Little Goose Dam, LMN = Lower Monumental Dam, MCN = McNary, RAPH = Rapid River Hatchery.

File Name	Rel. Site	Rel Date	No. Tag	No. Rel.	No./% Detected LGR No.	LGR %	LGO No.	LGO %	LMN No.	LMN %	MCN No.	MCN %	Total No.	Total %	Median Travel Time (Days)	Average Travel Time (Days)
Rapid River Fish Hatchery			SPRING CHINOOK													
Production Releases																
LRB00038.R11																
LRB00038.R21		* All groups reared together and released on the same day. Total includes all mark groups.														
LRB00038.R31																
LRB00038.R41																
LRB00038.R51																
LRB00039.R11																
LRB00039.R21																
LRB00039.R31																
LRB00039.R41																
LRB00039.R51																
LRB00040.R11																
LRB00040.R21																
LRB00040.R31																
LRB00040.R41																
LRB00040.R51																
LRB00041.R31																
LRB00041.R41																
LRB00041.R51																
LRB00041.R61																
Total	**RAPH**	**3/17/2000**	**44,479**	**44,479**	**13,868**	**31.18**	**5,780**	**12.99**	**1,586**	**3.57**	**1,719**	**3.86**	**22,953**	**51.60**	**48.92**	**48.72**
University of Idaho Research																
JLC00040.R21	RAPH	3/17/2000	2,999	2,999	932	31.08	367	12.24	121	4.03	107	3.57	1,527	50.92	48.92	48.48

Appendix E. Table 5. Interrogations of PIT-tagged juvenile chinook salmon released from Idaho hatcheries and emigrating in spring 2000 from Sawtooth Fish Hatchery. LGR = Lower Granite Dam, LGO = Little Goose Dam, LMN = Lower Monumental Dam, MCN = McNary, SAWTRP = Sawtooth Trap.

File Name	Rel. Site	Rel. Date	No. Tag	No. Rel.	No./% Detected										Median Travel Time (Days)	Average Travel Time (Days)
					LGR		LGO		LMN		MCN		Total			
					No.	%	No.	%	No.	%	No.	%	No.	%		
Sawtooth Fish Hatchery		SPRING CHINOOK														
Natures Rearing Experiment Control																
KEP00063.S01	SAWTRP	4/12/2000	262	262	52	19.85	19	7.25	9	3.44	9	3.44	89	33.97	23.10	24.10
KEP00063.S03	SAWTRP	4/12/2000	250	246	48	19.51	25	10.16	4	1.63	10	4.07	87	35.37	22.07	21.93
Natures Rearing Experiment Treatment																
KEP00063.S02	SAWTRP	4/12/2000	250	250	61	24.40	23	9.20	14	5.60	5	2.00	103	41.20	22.25	23.09
KEP00063.S04	SAWTRP	4/12/2000	250	246	53	21.54	31	12.60	8	3.25	7	2.85	99	40.24	23.10	22.65

Appendix F. Chinook salmon volitional release pilot study, Sawtooth Fish Hatchery brood years 1992 and 1993 and Crooked River satellite (Clearwater Fish Hatchery) brood year 1993.

ABSTRACT

A pilot study was designed by Hatchery Evaluation Studies personnel to examine the utility of using a volitional release strategy for juvenile hatchery-reared spring chinook salmon *Oncorhynchus tshawytscha* to increase juvenile out-migration survival and smolt-to-adult return rates (SARs). This report satisfies the reporting component most recently identified as Objective 1 Study 2 in the Idaho Department of Fish and Game Fiscal Year 2003 Lower Snake River Compensation Plan Statement of Work.

The original study plan included two years of work at the Sawtooth Fish Hatchery (brood years 1992 and 1993) and one year at the Crooked River satellite facility (Clearwater Fish Hatchery; brood year 1993). Work at the Sawtooth Fish Hatchery was cancelled both years due to disease outbreaks and a lack of available rearing space. Work at the Crooked River satellite facility compared a volitional release strategy to a traditional forced-emigration release strategy for the ability to increase juvenile out-migration survival and SARs. Smolts released from the Crooked River satellite facility were marked with passive integrated transponder tags to monitor juvenile out-migration survival and coded-wire tags to monitor SARs.

Juvenile out-migration survival of brood year 1993 volitional release groups was significantly greater than forced-emigration groups at the Crooked River satellite facility (χ^2 = 99.49, df = 1, P < 0.0001); however, SARs to the Crooked River satellite facility failed to show a difference between experimental groups (χ^2 = 0.962, df = 1, P = 0.327).

INTRODUCTION

The time at which juvenile anadromous salmonids migrate has been shown to affect survival and ultimately adult return rates (Wagner 1968; Bilton et al. 1982; Tiffan et al. 2000). Survival of out-migrating smolts is undoubtedly linked to a number of environmental and physiological conditions (Osterdahl 1969; Richardson and McCleave 1974; Hoar 1976; Fried et al. 1978; Youngson et al. 1983; Jonsson and Ruud-Hansen 1985; Rottiers and Redell 1993); however, the release of hatchery-reared anadromous smolts may not occur concurrently with the optimum conditions needed to maximize out-migration survival.

Migration timing, and possibly survival, for hatchery-reared anadromous salmonids are potentially affected by release strategy (e.g., volitional, forced-emigration, acclimation, etc) and by environmental conditions at the time of release. Volitional release strategies have shown a positive relationship to out-migration success over traditional forced-emigration releases (Evenson and Ewing 1992; Rottiers and Redell 1993; Viola and Shuck 1995). Environmental cues including flow, temperature, or release date have also shown a positive relationship to chinook salmon *Oncorhynchus tshawytscha* smolt out-migration survival (Wagner et al. 1963; Bjornn 1971; Raymond 1979; Berggren and Filardo 1993; Giorgi et al. 1997; Tiffan et al. 2000). However, stocking generally depends on scheduling personnel, driving conditions, and weather; furthermore, releases are often made directly into the receiving water forcing the smolts to migrate without acclimation.

The Idaho Department of Fish and Game's (IDFG) initial attempts to evaluate the potential for volitional releases to improve smolt-to-adult returns (SARs) came in response to a joint decision by management, research, and hatchery staff to allow juvenile spring chinook salmon to emigrate volitionally from the Sawtooth Fish Hatchery (upper Salmon River) and the Crooked River satellite ponds (South Fork Clearwater River).

The purpose of this study was to examine the effect of volitional and forced-emigration release methods on out-migration survival and SARs of hatchery-reared, juvenile spring chinook salmon. This project was considered a pilot study because release strategies varied during each year of the study.

STUDY SITES

The Sawtooth Fish Hatchery is located 8 km south of Stanley, Idaho. The facility's 29 ha border the Salmon River to the west, Highway 75 to the east, and Sawtooth National Forest (USFS) ground to the south and north. The Sawtooth Fish Hatchery weir is approximately 747 km from Lower Granite Dam (LGR) and 1,442 km from the mouth of the Columbia River (Snider and Schilling 2001).

Crooked River satellite facility consists of two separate sites. The first includes a weir, an adult fish trap, and a support cabin located 0.13 km upstream of the mouth of Crooked River and the South Fork Clearwater River. The second is located 6.0 km upstream from the adult trap on Crooked River and includes two raceways for rearing and acclimating smolts (Tighe 2001).

OBJECTIVE

1. Examine the utility of using a volitional release strategy instead of forced-emigration releases to increase juvenile out-migration survival and SARs of spring chinook salmon.

METHODS

Release Strategy

Sawtooth Fish Hatchery

Although no results were generated from the work at the Sawtooth Fish Hatchery, we felt it was important to document the original study design.

Spring chinook salmon intended for this experiment were progeny from adults that returned to the Sawtooth Fish Hatchery in 1992 and 1993. These fish were reared at the Sawtooth Fish Hatchery until their release.

At age one, juvenile chinook salmon were moved from indoor to outdoor raceways where they were reared until release. Raceways were 58.9 m long, 3.7 m wide, and 0.7 m deep. Raceways were constructed in a paired, flow-through series allowing water to flow through the upper section of the raceway before being re-used in the lower section of the raceways.

Screens were placed at the lower end of the upper raceway sections to prevent juvenile chinook salmon from entering the lower raceway sections prior to the experiment.

If the study had proceeded as intended, screens at the lower end of upper raceways would have been removed in the fall of 1993 and 1994 to allow chinook salmon presmolts to volitionally emigrate to the lower sections of these same raceways. (In natural conditions, a small portion of chinook salmon begin ocean migration as presmolts, so it is assumed that under hatchery conditions a similar portion may also be instinctually driven to out-migrate as presmolts.) Presmolts that emigrated to the lower raceway sections would have been considered fall migrants during this study. Five hundred of these were to be marked with passive integrated transponder (PIT) tags and released directly into the Salmon River that same year. The remaining fish would also be PIT tagged, then crowded back into the upper section of their respective raceway. This procedure, allowing volitional emigration within each raceway, would have been repeated in the spring of 1994 and 1995. Prior to the spring volitional emigration, PIT-tag detectors would be installed at the lower end of the upper raceways to record the behavior of those fish marked the previous fall. In the spring, smolt movement would be recorded based on the following behaviors: 1) fish that moved in the fall only, 2) fish that moved in the fall and spring, 3) fish that moved in spring only, and 4) fish that did not move at all. Once fish were assigned to a behavioral group, 500 fish from each group were to be randomly chosen to represent that group by being marked with PIT tags. After the raceway migration was complete, PIT-tag codes from fish marked the previous fall would be assigned to the appropriate experimental group with the newly tagged groups, excluding fish that moved in the spring only. All fish remaining after the fall release would be released as full-term smolts in the spring of 1994 and 1995.

Crooked River Satellite Facility (Clearwater Fish Hatchery)

Juvenile spring chinook salmon used in this experiment were progeny from adults that returned to the Crooked River and Red River satellite facilities and the Rapid River Fish Hatchery in 1993. These fish were reared at the Clearwater Fish Hatchery until being moved to the Crooked River satellite ponds. All releases were conducted with full-term smolts in the spring of 1995.

Juvenile spring chinook salmon were randomly selected to be part of volitional release (treatment) or the direct release (control) groups. Treatment group full-term smolts were moved from the Clearwater Fish Hatchery to the Crooked River satellite ponds, acclimated in the rearing ponds for two weeks, and then allowed to volitionally migrate from the ponds into Crooked River. Control group full-term smolts were moved from the Clearwater Fish Hatchery to the Crooked River satellite facility and released directly into Crooked River immediately below the rearing ponds (McGehee and Dredge 1996). An experimental number of the juvenile chinook salmon in each release group were PIT tagged to evaluate the potential benefit of volitional releases on emigration success and timing.

Out-migration Timing and Juvenile Survival

We retrieved PIT tag data from the PIT Tag Information System (PTAGIS) (http://www.psmfc.org/pittag/) database maintained by the Pacific States Marine Fisheries Commission in Gladstone, Oregon. These data were used to assess out-migration survival and arrival timing to LGR.

Using cumulative, unique PIT tag interrogation data, we compared the relative survival of fish from each experimental group arriving at lower Snake River dams with interrogation capabilities (Lower Granite, Little Goose, Lower Monumental, and McNary dams). Chi-square tests (α = 0.05) were used to make statistical comparisons between experimental groups. We restricted our comparisons to groups of fish released at similar times, because seasonally varying flow and spill conditions affect sampling rates, making comparisons of groups released at different times inappropriate.

The detection (interrogation) rate of PIT-tagged juvenile salmonids at lower Snake River dams serves as relative or minimum survival index. The index is considered relative or minimum because: 1) an unknown (but we believe small) number of PIT-tagged fish that die in the hatchery may go undetected, although we scan the dead fish; 2) not all fish pass through detectors; 3) approximately 0.3% of PIT tags fail (Kiefer and Lockhart 1994), or are lost between tagging and arrival at detection sites; 4) some fish arrive while detection gear is not being operated; and 5) mortality occurs between dams.

Smolt-to-Adult Return Rates

Coded-wire tags were administered to treatment and control spring chinook salmon reared at the Clearwater Fish Hatchery prior to juveniles being released to facilitate the identification of returning adults. In this report, SARs represent the survival of marked fish from juvenile release at the Crooked River satellite facility to adult return to the Crooked River satellite facility; calculated by dividing the number of marked adults that returned by the number of marked juveniles released. Smolt-to-adult return rates for marked fish are a commonly used estimator of performance and are assumed to represent overall SARs for unmarked fish. Smolt-to-adult return rates in this report represent a minimum estimate of survival from tagging to adult returns to the hatchery and are not expanded to include fish harvested or detected downstream.

RESULTS

Sawtooth Fish Hatchery

Brood Year 1992

A disease epizootic resulted in a 53.0% loss of brood year 1992 fish that were being used in the Volitional Release pilot study. To minimize potential for additional mortality, these fish were not PIT tagged or released according to the design of this pilot study (Snider and Coonts 1998). As such, no results were generated.

Brood Year 1993

A lack of available raceway space and a continued threat of disease outbreaks forced the Volitional Release pilot study to be cancelled with brood year 1993.

Crooked Fork Satellite (Clearwater Fish Hatchery)

Brood Year 1993

Out-migration Timing and Juvenile Survival—Treatment group smolts (n = 311,686) were released (volitionally) starting April 10, 1995 from the Crooked River satellite ponds; 2,400 of these smolts received PIT tags (Appendix F Tables 1 and 2). Control group smolts (n = 226,222) were released (forced-emigration) on April 12, 1995 into Crooked River; 1,200 of these smolts received PIT tags (Appendix F Tables 1 and 2). Treatment group smolts survived at a minimum of 54.38% to LGR (based on cumulative unique interrogations of PIT tag detections). The median arrival date at LGR for these fish was May 7, 1995. Control group smolts survived at a minimum of 36.75% to LGR (based on cumulative unique interrogations of PIT tag detections). The median arrival date at LGR for these fish was May 3, 1995 (Appendix F Figure 1). A significant difference was detected between the out-migration survival of fish in the control and treatment groups (χ^2 = 99.49, df = 1, P <0.0001). These data indicate that out-migration survival of spring chinook salmon from Crooked River to LGR in 1995 was not independent of release strategy.

Smolt-to-Adult Return Rates—Adults from treatment group releases returned to the Crooked River satellite facility in the following numbers: 25 age-3 fish, 430 age-4 fish, and 83 age-5 fish. Adults from control group releases returned in the following numbers: 1 age-3 fish, 88 age-4 fish, and 6 age-5 fish (Appendix F Table 2). No significant difference was detected between SARs for chinook salmon in control and treatment groups (χ^2 = 0.962, df = 1, P = 0.327). These data indicate that SARs of spring chinook salmon to the Crooked River satellite facility from brood year 1993 experimental groups were independent of release strategy.

DISCUSSION

Migration timing (as influenced by release strategy) can potentially influence out-migration survival and ultimately SARs. Volitional releases in some cases have been shown to increase the out-migration survival of steelhead up to 11.0% by eliminating the migration of residual fish (Viola et al. 1995). Although not synonymous with volitional releases, acclimation ponds are often used in conjunction with volitional release strategies. Acclimation ponds are used to allow fish to acclimate to the local water for a brief period before release and are often used in conjunction with volitional releases to spread out a large release over an extended period rather than a forced emigration release all at once. Similar to volitional releases, the use of acclimation ponds has, in some cases, been shown to increase out-migration survival over force-released steelhead smolts (Whitesel et al. 1994).

Although volitional releases may not show a consistent improvement in out-migration survival or SARs (Osborn and Rhine 1998, 1999, 2000; Hassemer et al. 2000; Newman 2002), they may be used to simply spread out large releases over time and to minimize potential negative impacts on sensitive or listed species that could occur from releasing a large number of hatchery-reared fish at one time.

Sawtooth Fish Hatchery

At the Sawtooth Fish Hatchery in 1993 and 1994, integrity of the brood year 1992 experiment was jeopardized by a disease epizootic accounting for a 53.0% loss of study fish precluding the time frame to safely mark the remaining fish for use in the experiment. Increases in mortality were noted after each stressful event. The commencement of mortality was

associated with spring adipose fin-clipping and the transfer of fish from inside vats (well water) to outside raceways (river water). Shortly after these events, the IDFG Eagle Fish Health Laboratory isolated two species of bacteria (*Aeromonas hydrophila* and *A. sobria*). Two antibiotic treatments were used in an attempt to stop or slow mortality. Initially, two applications of Oxytetracycline (OTC) were used to treat the bacteria; however, only *Aeromonas hydrophila* was susceptible to OTC. After the OTC treatment, erythromycin was used, and mortalities eventually dropped to near normal rates. However, with each subsequent stressful event, mortalities and the incidence of "fuzzy-tail" rose. Mortalities peaked in December 1993 and January 1994 (Snider and Coonts 1998).

Our attempts to evaluate the potential benefits of volitional releases within the scope of this pilot study failed at the Sawtooth Fish Hatchery. However, the literature lacks consistent data that show benefits to out-migration survival resulting from volitional releases of spring chinook salmon. Research, management, and hatchery staff at the IDFG continue to work within the limits of our production facilities to identify, evaluate, and implement practices to improve survival of hatchery-reared fishes.

Crooked Fork Satellite Facility

Although not part of the statistical analysis, arrival timing was also recorded for each release group (Appendix F Figure 1). Arrival timing was not used to make statistical inference about experimental groups because of inconsistent out-migration conditions between groups; however, arrival timing did not appear to differ substantially between the control group and the treatment group.

At the Crooked River satellite facility, statistical comparisons between treatment and control groups were potentially biased because treatment fish experienced different rearing environments from control fish (Natural Rearing Enhancement System; McGehee and Dredge 1996).

Although this pilot study lasted only one year, our findings suggest an improvement in out-migration survival for chinook salmon smolt releases using volitional release strategies over those released using forced emigration. Furthermore, although we did not test the effect of volitional releases in combination with other rearing or release strategies, volitional releases coupled with other innovative rearing or release practices (e.g. semi-natural rearing, acclimation facilities, etc.) may show more consistent improvements in out-migration survival and SARs than using volitional releases alone.

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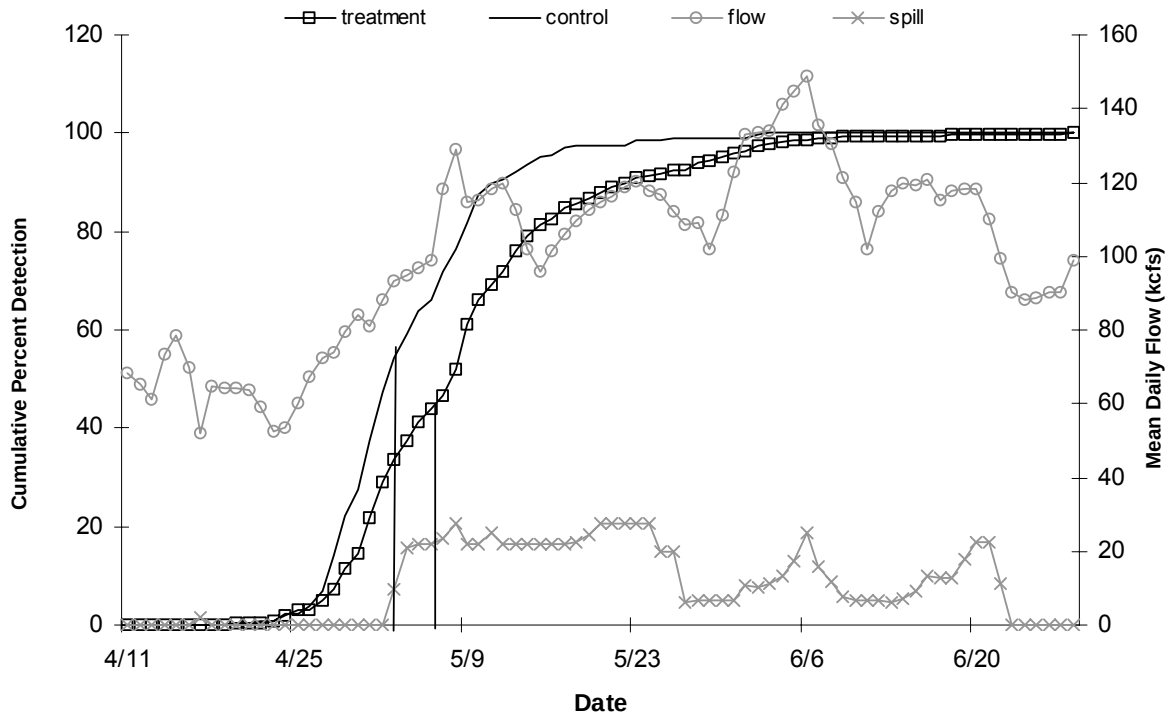
Appendix F. Table 1. Volitional release pilot study release groups and respective PIT-tag files showing number of marked fish in each group, release date, number of fish interrogated at each detection site and % survival, median travel time to Lower Granite Dam (LGR). All fish released from the Crooked River satellite facility into Crooked River, Idaho. Detection sites include: LGR, Little Goose Dam (LGO), Lower Monumental Dam (LMN) and McNary Dam (MCN).

Brood Year	Release Group	PIT tag file	# in group	Release Date	LGR		LGO		LMN		MCN		TOTAL		Median Travel Time (Days)
					No.	%	No.	%	No.	%	No.	%	No.	%	
1993	Treatment	DAC95046.4AC	400	04/10/95	99	24.75	64	16.00	47	11.75	8	0.00	218	54.50	29.57
1993	Treatment	DAC95046.C4B	400	04/10/95	107	26.75	59	14.75	52	13.00	11	0.00	229	57.25	29.61
1993	Treatment	DAC95048.C5A	400	04/10/95	96	24.00	60	15.00	39	9.75	8	0.00	203	50.75	32.73
1993	Treatment	DAC95048.C5B	400	04/10/95	90	22.50	62	15.50	39	9.75	8	0.00	199	49.75	23.45
1993	Treatment	DAC95048.C6A	400	04/10/95	115	28.75	62	15.50	37	9.25	11	0.00	225	56.25	22.38
1993	Treatment	DAC95048.C6B	400	04/10/95	118	29.50	61	15.25	42	10.50	10	0.00	231	57.75	27.61
	Treatment totals		**2,400**		**625**	**26.04**	**368**	**15.33**	**256**	**10.67**	**56**	**2.33**	**1,305**	**54.38**	**7-May**
1993	Control	DAC95052.C8A	400	04/12/95	64	16.00	47	11.75	19	4.75	10	0.00	140	35.00	23.56
1993	Control	DAC95053.C9A	400	04/12/95	41	10.25	32	8.00	11	2.75	9	0.00	93	23.25	21.82
1993	Control	DAC95054.11E	400	04/12/95	128	32.00	41	10.25	25	6.25	14	0.00	208	52.00	19.64
	Control Totals		**1,200**		**233**	**19.42**	**120**	**10.00**	**55**	**4.58**	**33**	**0.00**	**441**	**36.75**	**3-May**

Appendix F. Table 2. Volitional release pilot study experimental groups showing number of PIT tags, coded wire tag (CWT), marked fish, other marks, total number released, release site and smolt-to-adult survival (SAR). All fish released from the Crooked River satellite facility, all releases made with full-term spring chinook salmon smolts.

Brood Year	Experimental Group	# of PIT-tagged Fish Released	CWT Files	# of CWT Fish Released	# of untagged Fish Released	Other Marks	Total Release	Release Site	SAR (%)
1993	Treatment	2,400	103529 103528 103532 103531 103527 103530	308,554	3,132	ad-clip	311,686	Crooked Fork ponds	0.17 (538 adult fish returned)
1993	Control	1,200	104562 104651 104563	60,761	165,461	ad-clip	226,222	Crooked Fork ponds	0.16 (95 adult fish returned)



Appendix F. Figure 1. Migration year 1995 arrival timing and detection rates for PIT-tagged volitional release pilot study spring chinook salmon released in Crooked River, Idaho. Vertical lines indicate median arrival date. Release dates were April 10 (treatment group) and April 12 (control group). Daily flows and spill (kcfs) measured at Lower Granite Dam (LGR). Travel times and arrival dates are based on PIT-tag detections at only LGR.

Appendix G. Examination of variables affecting summer chinook salmon smolt out-migration.

ABSTRACT

This report summarizes the findings of a three-year pilot study designed to examine the effect of different release time scenarios and environmental conditions on out-migration survival of hatchery-reared, juvenile summer chinook salmon *Oncorhynchus tshawytscha*. This report satisfies the reporting component most recently identified as Objective 1 Study 3 in the Idaho Fish and Game Fiscal Year 2002 Lower Snake River Compensation Plan Statement of Work. Smolts tagged with passive integrated transponder tags were released in 1993, 1994, and 1995 over a range of release dates and during different environmental conditions to examine whether out-migration survival to Lower Granite Dam (LGR) could be positively affected. Fish were reared at the McCall Fish Hatchery and released at Knox Bridge on the South Fork Salmon River. Typical transportation and release protocols were followed.

Out-migration survival was compared for groups of fish released immediately following storm events and for fish released without regard to periods of precipitation (e.g., routine release schedule). In addition, we examined several environmental and physical variables at the time of release, including fish length, arrival timing at LGR, stream temperature, stream discharge, and moon phase and attempted to identify whether relationships existed between out-migration survival and the different variables tracked.

Smolts released immediately following storm events did not experience significantly different out-migration survival than smolts released without regard to periods of precipitation. Additionally, we identified no relationships between out-migration survival and the additional environmental and physical variables tracked during this study.

INTRODUCTION

Migration timing for juvenile anadromous salmonids can affect out-migration survival (Wagner 1968; Bilton et al. 1982; Tiffan et al. 2000) and may be responsible for lower post-release survival of hatchery-reared salmonids relative to their wild counterparts (Maynard et al. 1995). Survival of all out-migrating smolts is undoubtedly linked to a number of environmental and physiological conditions (Osterdahl 1969; Richardson and McCleave 1974; Hoar 1976; Fried et al. 1978; Youngson et al. 1983; Jonsson and Ruud-Hansen 1985; Rottiers and Redell 1993); however, the release of hatchery-reared anadromous smolts may not always occur concurrently with the optimum conditions needed to maximize out-migration survival.

Hatchery Evaluations Studies (HES) are mandated by the Lower Snake River Compensation Plan (LSRCP) Cooperative Agreement to “identify factors limiting hatchery success and recommend possible improvements based on existing knowledge and new experimentation” and, more specifically, to “develop experimental designs for controlled studies to further examine relationships identified above, and conduct studies as warranted to identify limitations that address LSRCP goals and objectives.”

In 1991, McCall Fish Hatchery and HES personnel identified an opportunity to potentially improve the out-migration survival of hatchery-reared summer chinook salmon smolts by releasing fish over a range of release dates and weather conditions.

The McCall Fish Hatchery has an annual production goal to release approximately one million summer chinook salmon *Oncorhynchus tshawytscha* smolts. Releases generally occur over the course of two to three days during the first two weeks of April at Knox Bridge on the South Fork Salmon River. Exact release dates depend on scheduling personnel, driving conditions, and weather. During this study, we released groups of fish at different times and weather conditions than the typical release protocols and examined the impact of release date, rainfall events, stream discharge, water temperature, fish length at release, and moon phase at release on smolt out-migration survival and arrival timing to Lower Granite Dam (LGR).

Physiological conditions (e.g., smoltification indices) were not examined in our work but have also been shown to influence travel time and out-migration survival (Berggren and Filardo 1993).

The purpose of this study was to examine the effect of different release time scenarios and environmental conditions on out-migration survival of hatchery-reared, juvenile summer chinook salmon. This project was considered a pilot study, because release strategies varied during each year of the study.

OBJECTIVE

1. Examine whether releasing summer chinook salmon smolts over varying release conditions affects juvenile out-migration survival at LGR.

STUDY AREA

Knox Bridge (South Fork Salmon River) is located on U.S. Forest Service Road 454 approximately 43.5 kilometers east of Cascade, Idaho. Knox Bridge has been the release location for McCall Fish Hatchery summer chinook salmon juveniles since the early 1980s (McPherson 1994; McPherson and Munson 1995a; McPherson and Munson 1995b).

METHODS

In this study, we tested the following hypothesis:

1. Out-migration survival of summer chinook salmon smolts to LGR does not vary as a function of release time or proximity of rainfall events (storm events) to release time.

In addition, we examined several environmental and physical variables at time of release, including fish length (fork length), water temperature, stream discharge, moon phase, and arrival timing at LGR and attempted to identify whether relationships existed between these variables and out-migration survival.

Summer chinook salmon used in this study were South Fork Salmon River summer chinook salmon smolts. Progeny from the 1991, 1992, and 1993 brood years were reared at the McCall Fish Hatchery and released as full-term smolts in the spring of 1993, 1994, and 1995, respectively.

EVALUATION

Multiple parameters were identified from the literature as potentially influencing out-migration survival. Based on these findings, the following parameters were recorded during each year of this pilot study: stream discharge in the South Fork Salmon River and at LGR, water temperature at release location, fish length at release (fork length), moon phase at release, and travel time from release location to LGR. Using these parameters, data were examined for patterns between release conditions and survival rates of each experimental group. In addition, a statistical analysis was performed on out-migration survival from release location to LGR (the first interrogation site these fish encounter 457 km downstream from the release location).

Chi-square tests ($\alpha = 0.05$) were used to test for independence between treatment and control groups. We restricted our comparisons to experimental groups within each release year because of seasonally varying water flow and spill at the dams. In addition, if a fish was detected at more than one Snake River dam, it was counted as a survivor to LGR.

We used graphic interpretation to determine if arrival-timing patterns were similar among release groups. Detection rates (survival) reflect the total number of first detections of individual fish at any of the Snake River detection sites: Lower Granite, Little Goose, Lower Monumental, or McNary dams. We present arrival-timing graphs for various PIT tag groups for comparative purposes. These graphs are constructed from detections at LGR only. For releases that occurred over an extended period, such as volitional releases, we used the middle date of the release period as the date from which to calculate travel times.

Release Strategies

Experimental groups were labeled control or treatment depending on the release strategy and consisted entirely of PIT-tagged fish. McCall Fish Hatchery's general release groups were not part of this study; however, experimental groups were sometimes released in conjunction with general release groups.

In 1993, releases were based on calendar date. One control group was released with the general release group, and one treatment group was released every two weeks thereafter, totaling four groups.

In 1994 and 1995, releases were made to coincide with rainfall events. One control group was released during two separate non-storm events, and one treatment group was released during two separate rainfall events. In both years, control group releases were combined and treated as one group for that year's analysis. Treatment groups were treated similarly.

In contrast to our experimental releases, typical releases for the "general production groups" reared at McCall Fish Hatchery depended on scheduling personnel, driving conditions, and weather, but generally occurred during the last week in March or the first week in April.

Handling/Tagging

All fish were reared, transported, marked, and in some cases released with the general production fish except for the treatment groups that were PIT tagged prior to release. All fish

were tagged as smolts by Idaho Department of Fish and Game (IDFG) staff using methods described by Prentice et al. (1990) and released as full-term summer chinook smolts.

RESULTS

Brood Year 1991

Control group smolts (n = 500) were released on April 3, 1993. Treatment group smolts were released on April 9 (n = 504), April 22 (n = 499), and May 5, 1993 (n = 509). No effort was made in 1993 to release fish in conjunction with storm events. Control group smolts were detected at 42.20%, while the treatment groups were detected at 38.89%, 43.49%, and 43.61%, respectively (Appendix G Table 1). No significant differences were detected between the individual treatment groups and control group (treatment group one: $\chi^2 = 1.14$, df = 1, P = 0.29; $\chi^2 = 0.15$, df = 1, P = 0.70; and treatment group two: $\chi^2 = 0.21$, df =1, P = 0.65). These data indicate that out-migration survival of summer chinook salmon to LGR in 1993 was independent of release date.

Brood Year 1992

Control group smolts were released during non-storm events on April 14 and April 28, 1994 (n = 400 each). Treatment group smolts were released during rainfall events on April 22 and April 12, 1994 (n = 400 each). No effort was made in 1994 to compare smolt out-migration survival to LGR with date of release. Combined interrogations for the control and treatment groups were 29.88% and 32.00%, respectively (Appendix G Table 1). No statistical difference was detected between the treatment and the control groups ($\chi^2 = 0.85$, df = 1, P = 0.36). These data indicate that out-migration survival of summer chinook salmon to LGR in 1994 was independent of the range of rainfall conditions that occurred at release for treatment and control groups.

Brood Year 1993

Control group smolts were released during non-storm events on April 12 and April 24, 1995 (n = 400 each). Treatment group smolts were released during rainfall events on April 7 and April 19, 1995 (n = 400 each). Combined interrogations for the control and treatment groups were 38.50% and 37.88%, respectively (Appendix G Table 1). No statistical difference was detected between the treatment and the control groups ($x^2 = 0.07$, df = 1, P = 0.80). These data indicate that out-migration survival of summer chinook salmon to LGR in 1995 was independent of the range of rainfall conditions that occurred at release for treatment and control groups.

DISCUSSION

Many variables are thought to influence anadromous smolt out-migration, including environmental cues (e.g., stream discharge, water temperature, day length, moon phase, etc.) and physiological conditions. During this pilot study, only time of release (1993) and rainfall events (1994, 1995) were examined for their effect on survival. Correlating releases with these variables did not produce significantly better survival during any year of this work. Consistent with these findings, other authors have observed very little consistency between these or other variables to influence out-migration success across multiple years (Wagner et al. 1963; Bjornn 1971; Raymond 1979; Berggren and Filardo 1993; Giorgi et al. 1997; Tiffan et al. 2000); this

suggests that other variables may influence out-migration survival in addition to those reported in the literature.

Although this study was not designed to directly test the effect of stream discharge at release location and at LGR, water temperature at release, length at release, and moon phase at time of release on juvenile out-migration survival, these variables were graphically represented to evaluate potential relationships (Appendix G Figures 1-3; Appendix G Table 1). This study was designed to examine the effect of time of release and rainfall events on out-migration survival and median travel time to LGR; however, there was no evidence to show a substantive response to any of the ancillary variables.

Although the variables we tracked failed to show an effect on out-migration survival or travel time from release to LGR, there is evidence in the literature that these variables can have an effect. Some authors argue that stream discharge has the greatest effect on travel time, but water temperature acts as the primary cue to initiate out-migration (Fried et al. 1978; Jonsson and Ruud-Hansen 1985; Rottiers and Redell 1993). Others suggest that fish respond primarily to increasing day length to initiate out-migration (Bjornn et al. 1968). Evenson and Ewing (1992) suggest that the timing of release should also be considered as an important out-migration cue. Other authors correlate photoperiod (Wagner 1974; Hoar 1976), light intensity (Richardson and McCleave 1974), moon phase (Grau et al. 1981), and moon phase coupled with elevated stream discharge (Youngson et al. 1983) to be the greatest influence on out-migration. Still others suggest that fish length at release may have the greatest influence on juvenile out-migration survival (Wagner et al. 1963; Tiffan et al. 2000).

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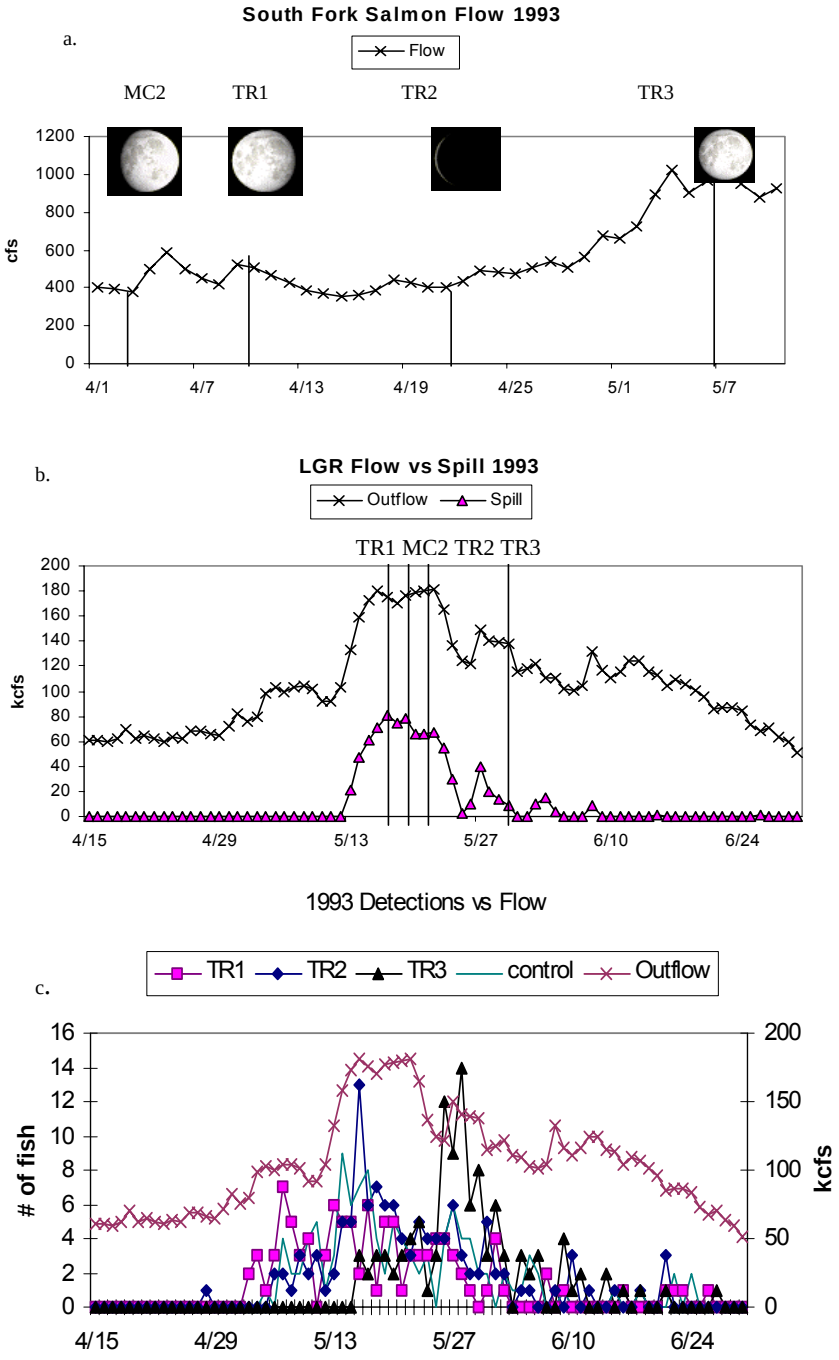
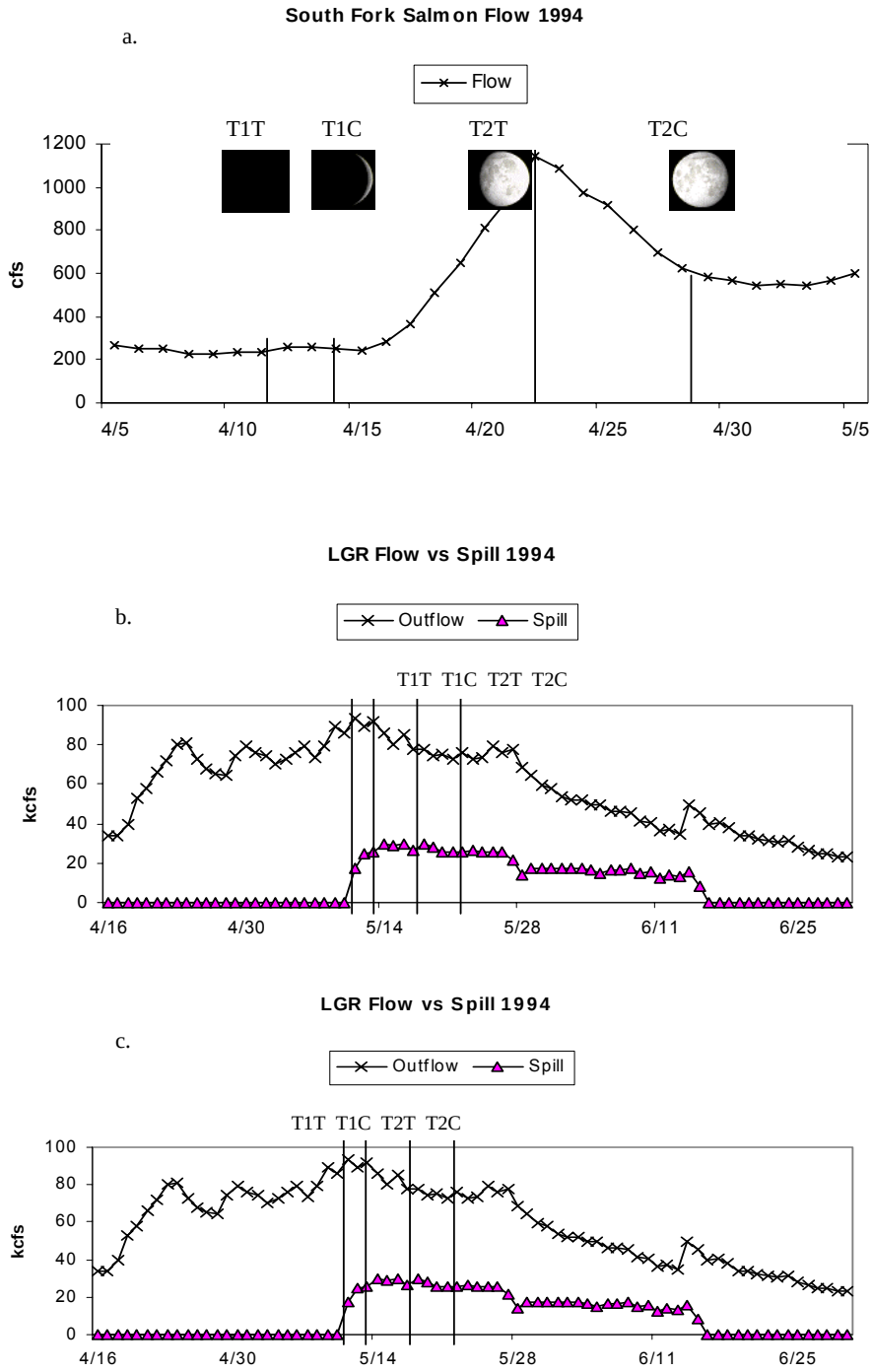
Appendix G. Table 1. Release groups and respective PIT tag files showing number of fish in each group, release date, release temperature °C (water), mean fork length (mm), survival to Lower Granite Dam (LGR), and median travel time to LGR. All fish released from Knox Bridge on the South Fork Salmon River, Idaho 1993-1995. LGR = Lower Granite Dam, LGO = Little Goose Dam, LMN = Lower Monumental Dam, MCN = McNary Dam.

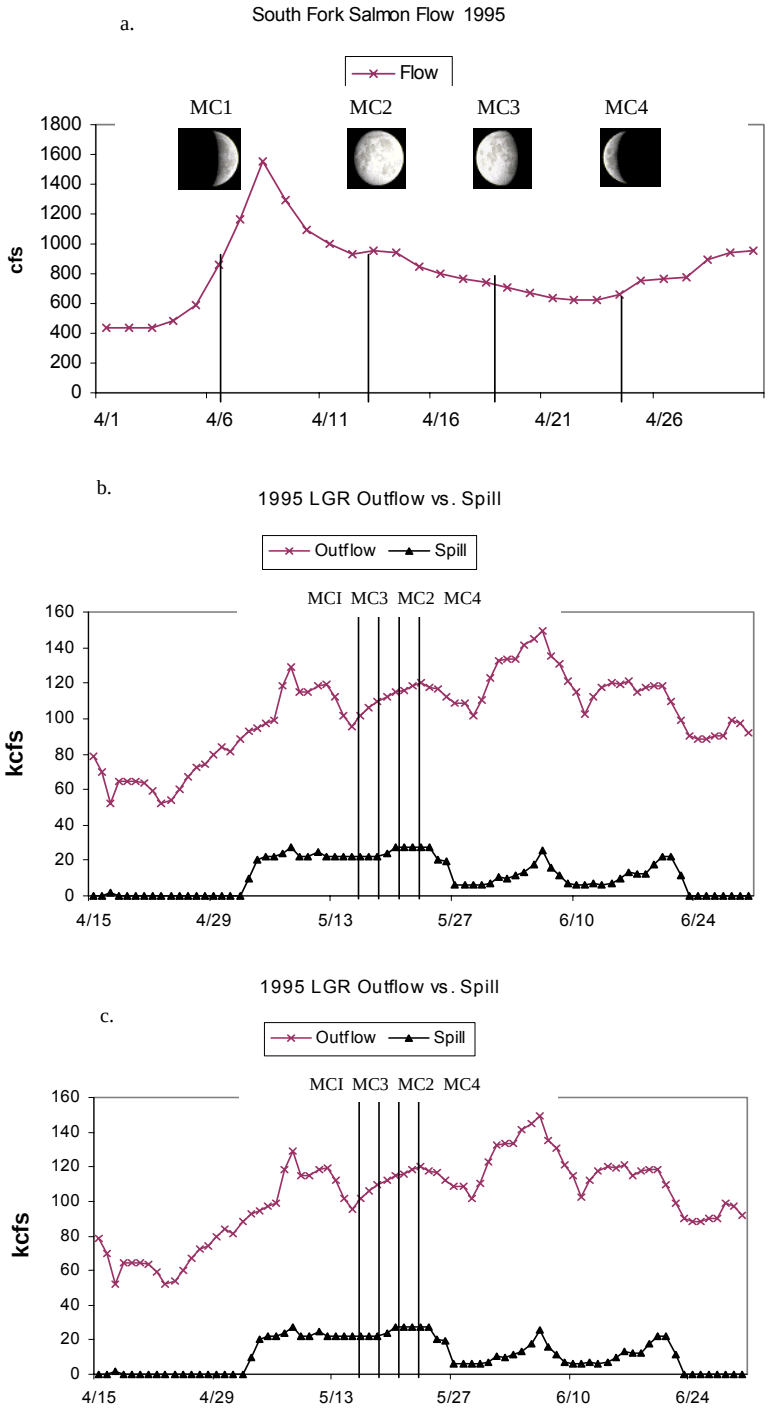
							LGR		LGO		LMN		MCN		TOTAL		
Release Year	Release Group	PIT Tag File	# In Group	Release Date	Release Temperature °C (Water)	Mean Fork Length (Mm)	No.	%	No.	%	No.	%	No.	%	No.	%	Median Travel Time (Days) To LGR
1993	Treatment #1	DAC93061.TR1	504	4/9	ND	122	104	20.63	44	8.73	32	6.35	16	3.17	196	38.89	40.68
	Treatment #2	DAC93061.TR2	499	4/22	ND	122	123	24.65	57	11.42	19	3.81	18	3.61	217	43.49	30.99
	Treatment #3	DAC93061.TR3	509	5/5	ND	122	113	22.20	64	12.57	32	6.29	13	2.55	222	43.61	24.40
1993	Control	DAC92280.MC2	500	4/3	ND	ND	113	22.60	46	9.20	33	6.60	19	3.80	211	42.20	50.40
1994	Storm event	DAC94069T1T	400	4/12	3.2	110	73	18.25	34	8.50	21	5.25	28	7.00	156	39.00	28.76
		DAC94070.T2T	400	4/22	3.9	107	38	9.50	26	6.50	13	3.25	23	5.75	100	25.00	27.20
	Treatment total		**800**		**3.55**	**108.5**	**111**	**13.88**	**60**	**7.50**	**34**	**4.25**	**51**	**6.38**	**256**	**32.00**	**27.98**
1994	Non-storm event	DAC94070.T1C	400	4/14	4.5	111	53	13.25	36	9.00	14	3.50	31	7.75	134	33.50	28.89
		DAC94070.T2C	400	4/28	4.4	108	46	11.50	30	7.50	17	4.25	12	3.00	105	26.25	24.04
	Control total		**800**		**4.45**	**109.5**	**99**	**12.38**	**66**	**8.25**	**31**	**3.88**	**43**	**5.38**	**239**	**29.88**	**26.46**
1994	General production	DAC94070.SPM	1000	4/9	3.6	107	84	16.87	36	7.23	18	3.61	40	8.03	178	17.80	31.16
1995	Storm event	DAC95048.MC1	400	4/7	2.1	120	85	21.25	41	10.25	33	8.25	13	3.25	172	43.00	37.25
		DAC95048.MC3	400	4/19	2.8	121	58	14.50	35	8.75	33	8.25	5	1.25	131	32.75	29.80
	Treatment total		**800**		**2.45**	**120.5**	**143**	**17.88**	**76**	**9.50**	**66**	**8.25**	**18**	**2.25**	**303**	**37.88**	**33.52**
1995	Non-storm event	DAC95048.MC2	400	4/12	3.1	120	71	17.75	50	12.50	33	8.25	4	1.00	158	39.50	38.54
		DAC95049.MC4	400	4/24	4.7	120	75	18.75	44	11.00	27	6.75	4	1.00	150	37.50	29.29
	Control total		**800**		**3.9**	**120**	**146**	**18.25**	**94**	**11.75**	**60**	**7.50**	**8**	**1.00**	**308**	**38.50**	**33.92**
1995	General production	LRB95047.MCH	1000	4/7	2.1	121	194	48.50	111	27.75	63	15.75	17	4.25	385	38.50	35.76



Appendix G. Figure 1. Relationships of juvenile out-migration to flow and date: a. Flow (cfs) in South Fork Salmon River and moon phase at time of release for each experimental group; b. Flow (kcfs) and spill at Lower Granite Dam (LGR) during migration and median arrival time for each experimental group (vertical lines correspond to individual release groups); and c. Daily flow at LGR and number of fish detected per day for treatment and control groups. Control group is represented by MC2, and the treatment groups are represented by TR1, TR2 and TR3.



Appendix G. Figure 2. Relationships of juvenile out-migration to flow and date; a. Flow (cfs) in South Fork Salmon River and moon phase at time of release for each experimental group; b. Flow (kcfs) and spill at Lower Granite Dam (LGR) during migration and median arrival time for each experimental group and (vertical lines correspond to individual release groups); c. Daily flow at LGR and number of fish detected per day for treatment and control groups. Control groups are represented by T1C and T2C. Treatment groups are represented by T1T and T2T.



Appendix G. Figure 3. Relationships of juvenile out-migration to flow and date: a. Flow (cfs) in South Fork Salmon River and moon phase at time of release for each experimental group; b. Flow (kcfs) and spill at Lower Granite Dam (LGR) during migration and median arrival time for each experimental group (vertical lines correspond to individual release groups); and c. Daily flow at LGR and number of fish detected per day for treatment and control groups. Control groups are represented by MC2 and MC4. Treatment groups are represented by MC1 and MC3.

Prepared by:

Dmitri Vidergar
Fisheries Research Biologist

Tracy Petering
Technical Records Specialist I

Paul Kline
Principal Fisheries Research Biologist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Virgil K. Moore, Chief
Bureau of Fisheries

Steve Yundt
Fisheries Research Manager