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Brood Year 2002 Cooperative Report

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Idaho Supplementation Studies
Brood Year 2002 Cooperative Report

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ABSTRACT

The Idaho Supplementation Studies project (ISS) was initiated in 1992 to evaluate the benefits and risks of using hatchery supplementation to increase natural production of spring/summer Chinook salmon *Oncorhynchus tshawytscha*. This report documents ISS research tasks completed by the four cooperating agencies (Idaho Department of Fish and Game, Nez Perce Tribe, Shoshone-Bannock Tribes, and U.S. Fish and Wildlife Service), and represents a new report format where data from all four agencies are compiled in a single document. This report contains information on brood year 2002 activities and includes data on the number of adults that returned to collection facilities (escapement), supplementation adults passed onto spawning grounds (adult treatments), redd counts, and carcass information. The report then follows the resulting juveniles through migration and includes juvenile treatments, natural production estimates, and survival and passage timing to Lower Granite Dam. Total adult escapement in the Clearwater River basin in 2002 ranged from 36 in Crooked Fork Creek to 1,335 in the Crooked River. Escapement in the Salmon River streams was generally higher and ranged from 1,120 in the Pahsimeroi River to 8,603 in the South Fork Salmon River. Adult treatments in the two basins also followed this trend with 4 to 38 supplementation adults passed at weirs in the Clearwater River basin and from 142 to 747 adults passed at weirs in the Salmon River subbasin. In addition to passing ISS adults for volitional spawning, a portion of these fish was used to create the final ISS supplementation juveniles. Redd counts were conducted on all ISS study streams. Ground surveys were used to count redds in all streams except White Cap Creek, Alturas Lake Creek, and the Upper Salmon River, which were surveyed aerially, and the Lemhi River, which received both aerial and ground counts. Redd density in survey transects in the Clearwater River subbasin streams ranged from 0.1 redds/km in Eldorado Creek to 7.8 redds/km in Crooked Fork Creek. Transects in the Salmon River subbasin streams generally had higher densities of redds and ranged from 0.9 redds/km in Alturas Lake Creek to 33.7 redds/km in the South Fork Salmon River. Carcass data were collected concurrently with redd counts. A high level of prespawn mortality was observed in some streams, which may affect estimates of successful spawning. Prespawn mortality may be greatly underestimated if large numbers of adults are dying prior to our first redd count. Alternatively, the small number of carcasses collected in some streams may lead to an overestimation of prespawn mortality based on the chance collection of a single such individual. Brood year 2002 juvenile treatments were made at or near prescribed levels and included presmolt releases in 2003 and smolt releases in 2004. The smolt releases represent the final juvenile treatments made by the ISS program. Rotary screw traps were operated on 18 ISS streams to estimate the number and seasonal migration timing of naturally produced juveniles. Migration estimates (based on the recapture of PIT-tagged individuals) totaled 4,038,306 brood year 2002 juveniles and included 2,208,529 from the Clearwater River basin and 1,829,777 juveniles from the Salmon River basin. However, a large number of subtaggable sized juveniles migrated from the study streams, and our preliminary work indicates this may result in a substantial underestimation of the number of juveniles that migrate. Based on this, we recommend that when sufficient numbers of juveniles large enough to be PIT tagged are not present in the daily catch to ensure adequate recaptures to estimate migration, a subsample of the catch be stained with Bismarck Brown dye and released upstream to provide these estimates. However, due to the important information on survival and migration rate provided by PIT tags, they should be used as soon as practical. Supplementation juveniles marked with PIT tags generally passed Lower Granite Dam in a manner similar to naturally produced juveniles of the same life stage. It was noted that juveniles tagged as presmolts consistently passed the dam earlier than did those tagged as smolts.

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INTRODUCTION

Background

Salmon Supplementation Studies in Idaho Rivers (ISS) was developed to address critical uncertainties associated with hatchery supplementation of Chinook salmon *Oncorhynchus tshawytscha* populations in Idaho (Bowles and Leitzinger 1991). The ISS program was designed to address questions identified in the Supplementation Technical Work Group Five Year Work Plan (STWG 1988), define the potential role of supplementation in managing Idaho's anadromous fisheries, and be utilized as a recovery tool for salmon populations in the Snake River basin (Bowles and Leitzinger 1991).

Two goals of ISS were initially identified: 1) assess the use of hatchery Chinook salmon to increase natural populations in the Salmon River and Clearwater River subbasins, and 2) evaluate the genetic and ecological impacts of hatchery Chinook salmon on naturally reproducing Chinook salmon populations. In response to these goals, four objectives were developed: 1) monitor and evaluate the effects of supplementation on presmolt and smolt numbers and spawning escapement of naturally produced Chinook salmon; 2) monitor and evaluate changes in natural productivity and genetic composition of target and adjacent populations following supplementation activities; 3) determine which supplementation strategies (broodstock and release stage) provide the most rapid and successful response in natural production without adverse effects on productivity; and 4) develop supplementation recommendations (Bowles and Leitzinger 1991).

The ISS program was designed as a three-phase research project. Phase I, completed in 1991, involved collection of baseline data and development of an extensive experimental design. Phase II, the implementation phase, began in 1992 and continued until 2002 with the final adult broodstock being collected for parr and presmolt treatment releases in 2003 and smolt treatment releases in 2004. Phase III began in 2003 and involves monitoring and evaluating the treatment effect of supplementation on natural production in treatment and control streams. Phase III will continue for one full generation after the final marked ISS supplementation adults return to treatment and control streams and will end in 2012.

The ISS program was developed as a cooperative research project involving the Idaho Department of Fish and Game (IDFG), the Nez Perce Tribe (NPT), the Shoshone-Bannock Tribes (SBT), and the United States Fish and Wildlife Service (USFWS). Funding is provided by the Bonneville Power Administration (BPA). Treatment and control streams across the Clearwater River and Salmon River subbasins were partitioned among each of the four agencies, with each agency being responsible for data collection following the original study design established in Bowles and Leitzinger (1991). These estimates of escapement include natural and supplementation adults, juvenile production in treatment and control streams, juvenile passive integrated transponder (PIT) tag interrogations at detection facilities throughout the Columbia River basin, and supplementation in treatment streams.

This document summarizes activities conducted by the cooperating agencies and data collected for brood year 2002 and represents a change in ISS reporting. Cooperating agencies will now produce a single report based on brood year activities instead of individual agency reports covering either brood or calendar years. This will serve as a template for future annual brood year reports.

Study Area

The ISS program incorporates treatment and control streams in the Clearwater and Salmon River subbasins. Currently, there are 16 treatment and 14 control streams included in ISS. The Clearwater River basin contains 10 treatment and five control streams. The Salmon River subbasin includes six treatment and nine control streams (Figure 1).

During the course of the study, changes have been made to several study streams, including changes in names and treatment classifications. Streams that either have had their names changed or are in the process of being changed include White Sands Creek now Colt Killed Creek, Squaw Creek proposed for change to Fishing Creek, and Papoose Creek proposed for change to Legendary Bear Creek. Throughout the remainder of the report, these streams will be referred to by their new or proposed names. Additionally, due to logistical and biological reasons, some streams have changed classification from the original study design (Bowles and Leitzinger 1991). The American River, Crooked Fork Creek, Slate Creek, and the Lemhi River were scheduled for treatment but were changed to control streams because runs were inadequate to provide for broodstock collection. Johnson Creek was changed to a treatment stream after the inception of the Johnson Creek Artificial Propagation Evaluation Program (BPA Project Number 1996-043-00). Alturas Lake Creek has never been treated, and lacks monitoring facilities for juvenile production, and will likely be excluded in the final analysis.

Fish communities are similar across all 30 ISS study streams. Anadromous species in all streams include wild/natural and hatchery Chinook salmon and summer steelhead *O. mykiss*. Sockeye salmon *O. nerka* are also present in the upper Salmon River subbasin. Resident fish communities for the Clearwater River and Salmon River subbasins include bull trout *Salvelinus confluentus*, westslope cutthroat trout *O. clarkii*, mountain whitefish *Prosopium williamsoni*, redside shiner *Richardsonius balteatus*, northern pikeminnow *Ptychocheilus oregonensis*, sculpin *Cottus* spp., dace *Rhinichthys* spp., suckers *Catostomus* spp., resident rainbow trout *O. mykiss* and eastern brook trout *S. fontinalis* (Bowles and Leitzinger 1991). However, not all resident species are found in all streams.

METHODS

Adult Escapement

Weirs

Escapement weirs to capture, enumerate, and manage adult Chinook salmon were operated in the South Fork Salmon River, Pahsimeroi River, upper Salmon River, Crooked River, Red River, Crooked Fork Creek, Clear Creek, Lolo Creek, Newsome Creek, and Johnson Creek (Figure 1; sites 20, 28, 25, 12, 14, 7, 3, 1, 11, and 19). Trapped adults were retained in a hatchery and spawned as broodstock, culled, or passed upstream to spawn naturally. In addition to adult enumeration, biological characteristics measurable with nonlethal methods (fork length [FL], sex, external tags, marks, or fin clips) were recorded for fish passed above weirs.

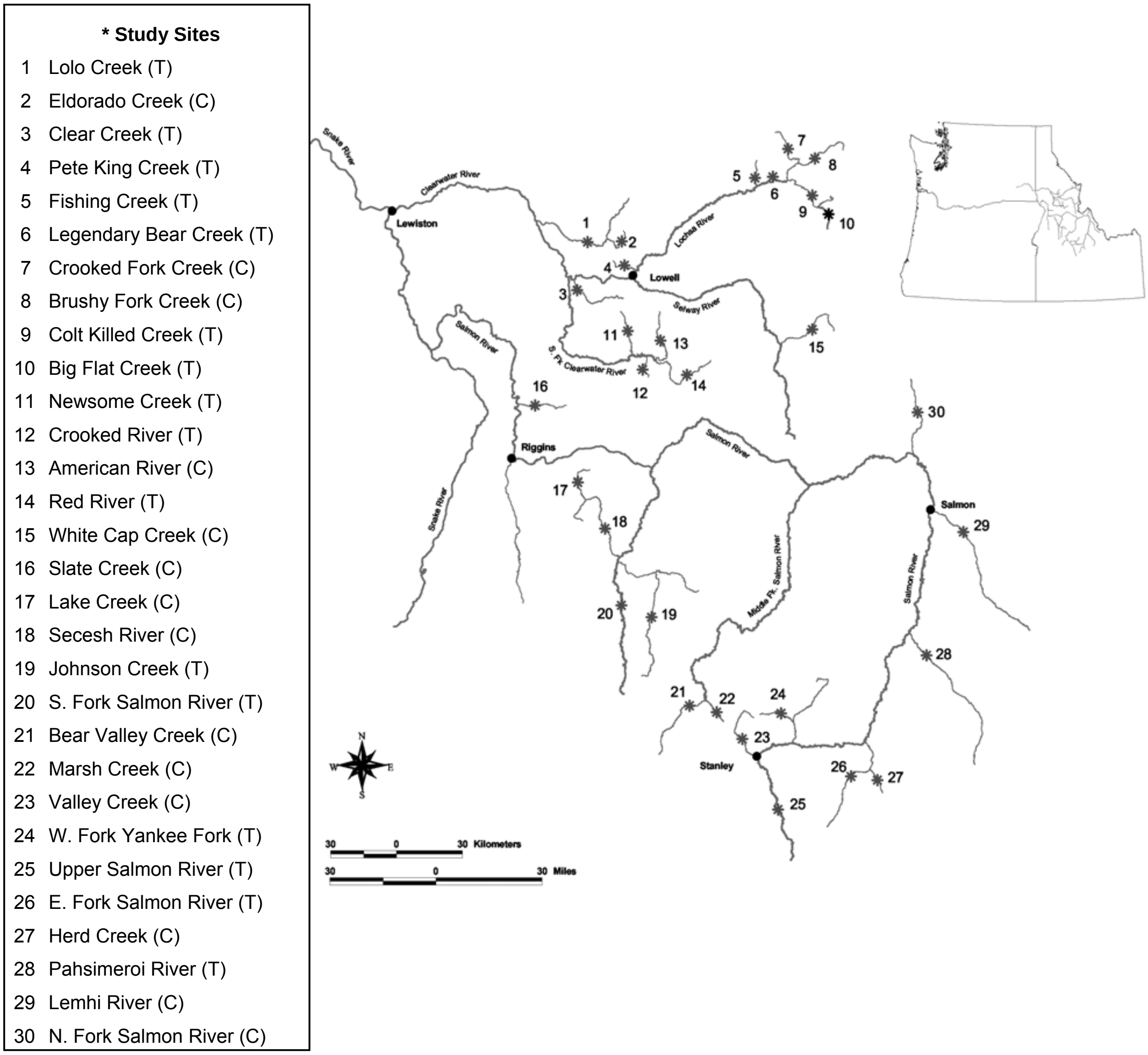

Figure 1. Current treatment and control streams in the Salmon River and Clearwater River basins included in the Idaho Supplementation Studies. Streams are monitored by personnel from the Idaho Department of Fish and Game, Nez Perce Tribe, Shoshone-Bannock Tribe, and the U.S. Fish and Wildlife Service. Not all treatment streams received juvenile treatments each year.

Escapement protocols and criteria for ISS treatment were applied to treatment streams with escapement weirs. Naturally produced adults were either passed above weirs to spawn naturally or were spawned in the hatchery as broodstock. In most cases, supplementation origin adults were released upstream in numbers that did not exceed the wild/natural component. A proportion of the ISS adults were retained and spawned to create ISS supplementation juveniles. In most cases, general production hatchery Chinook salmon intercepted at weirs were transported to the hatchery or recycled into an ongoing salmon fishery within the same drainage downstream from the ISS evaluation reaches.

The Chinook Salmon Adult Abundance Monitoring Project (BPA Project No. 199703000) operated a video weir near the mouth of Lake Creek. This weir was designed to allow fish to pass the weir without delay, but the only route through the weir was by the video camera. Fish passage was recorded in both directions and the video footage provided a census of fish that moved into Lake Creek (Figure 1; site 17). Fish passing the weir were enumerated, identified to species, and examined for fin clips or other marks. Fish in the 1.1 age group (i.e., jacks) were also identified based on size.

Not all ISS streams have adult escapement weirs on them. Four treatment streams in the Clearwater River basin do not have weirs including Colt Killed, Pete King, Fishing, and Legendary Bear creeks (Figure 1; sites 9, 4, 5, and 6). In the Salmon River basin, the West Fork Yankee Fork Salmon River does not have an adult weir, and the weir on the East Fork Salmon River (Figure 1; sites 24, and 26) was not operated for Chinook salmon during this report period. Evaluation of escapement in these streams is limited to spawning surveys and carcass recoveries.

Redd Counts

Chinook salmon redds were counted annually in each study stream from mid-August through October, to estimate spawning escapement. Since precise measures of production are critical to ISS evaluation, we maintained index reaches as reported in Walters et al. (1999), and surveyed most of these index reaches two or three times with ground counts following procedures outlined in IDFG's Redd Count Manual (Hassemer 1993). Multiple ground counts allowed crews to be on streams either during redd construction or shortly thereafter, thus aiding in redd identification. Multiple counts also increased the number of adult Chinook salmon carcasses recovered. Exceptions included Big Flat and Colt Killed Creek, which are remote streams without easy access. These streams were surveyed once using a single pass ground count that was believed to coincide with peak spawning activity. Alturas Lake Creek, White Cap Creek, and the Upper Salmon River were surveyed once with an aerial count. A combination of aerial and ground counts were used for redd surveys on the Lemhi River.

Redds observed during ground surveys were flagged, assigned a unique number to avoid duplicate counts, recorded using a global positioning system, and described as complete or in progress. For streams with multiple ground surveys, the final redd counts were the sum of all new redds observed in each pass. Adult Chinook salmon on or near redds were also recorded. Flagging was removed during the last ground count.

Carcass Recoveries

Data were collected from Chinook salmon carcasses to determine origin (hatchery or natural) and ocean age. Measurements collected included FL and mid-eye to hypural plate length to the nearest centimeter, sex, estimated percent spawned, and carcasses were checked for fin clips, marks, tags, or radio transmitters. In most cases, carcasses were tested for coded-wire tags either by collecting snouts for laboratory analysis or by scanning fish with detectors in the field. Visceral cavities were inspected visually to determine the prevalence of prespawn mortality (based on the condition of reproductive organs) and to estimate egg retention in females that spawned. Observers either looked for PIT tags while assessing the condition of the viscera or scanned the carcass with a PIT tag detector. Several structures were collected for age (dorsal fin rays, and/or scales) and DNA analysis (fin tissue) for ISS and other Chinook salmon research programs using methods outlined in Kiefer et al. (2002). Structures collected varied by stream, and not all structures were collected from all carcasses.

In 2003, we increased carcass recovery efforts in response to Independent Scientific Review Panel (ISRP) concerns regarding hatchery strays. These fish have either an adipose fin clip or those without external marks but containing a coded-wire tag (CWT). To address these concerns, we used portable CWT scanners to interrogate carcasses recovered in ISS study streams. In those cases where scanners were not available, snouts were collected for later interrogation. Summarized information regarding CWT interrogations within ISS study streams will be available in the brood year 2003 report.

Supplementation Treatments

The ISS study uses both juvenile and adult life stages to provide supplementation for treatment streams. Juveniles from locally collected broodstocks were uniquely marked and released into ISS treatment streams at different life stages at prescribed levels. As these fish returned to their natal streams as adults, they were intercepted at weirs, identified, and passed upstream to supplement natural spawning. In this report, three biologically distinct life stages for juvenile treatment are defined: 1) age-0 summer parr that are released in July and August 2) age-0 presmolts that are released during September and October, and 3) age-1 smolts that are released the following spring (March through April). Both juvenile and adult ISS treatments are documented in this report. Juvenile treatments included releases of parr (in 2003) and smolts (in 2004) from ISS spawning activities associated with adults maturing in 2002. Adult treatments include supplementation adults passed above weirs for natural spawning in 2002. Preliminary data on adult returns in 2003 are also presented as available, but will be completely summarized in the next brood year report.

As prescribed in Bowles and Leitzinger (1991), hatchery adults returning from F_1 and F_2 supplementation releases have been spawned with naturally produced fish since 1995. As in past years, broodstock management in 2002 utilized both hatchery origin and naturally produced adults to produce supplementation juveniles. Supplementation broodstocks to create brood year 2002 juvenile treatments were developed as follows:

Salmon River Subbasin
- McCall Fish Hatchery—South Fork Salmon River
- Pahsimeroi Fish Hatchery—Pahsimeroi River
- Sawtooth Fish Hatchery—Upper Salmon River
- Johnson Creek—Johnson Creek Wild Stock

Clearwater River Subbasin
- Clearwater Fish Hatchery—Red River, Crooked River, Newsome Creek
- Powell Satellite Facility—Colt Killed Creek, Lolo Creek, Legendary Bear, Fishing Creek, Pete King Creek
- Kooskia NFH—Clear Creek

Hatchery methods used for capturing and spawning adult Chinook salmon and rearing juveniles for the ISS study followed standard practices (see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; Bromage and Roberts 1995; McDaniel et al. 1994; Pennell and Barton

1996). As the lead agency for ISS, IDFG coordinated directly with hatchery and culture facilities to manage broodstock production and release supplementation juveniles.

In treatment streams with weirs, escapement was used to determine how many natural origin adults were retained for supplementation broodstocks. The study design established criteria for releasing a minimum of two-thirds of the returning natural adults to spawn naturally. As such, no more than 33% of the natural component of the return was retained in the hatchery. Natural and supplementation origin adults were spawned in the hatcheries to produce stream specific juvenile supplementation groups. The number of juveniles in these groups approximated the number of juveniles expected from natural production in that stream for that brood year. Thus, assuming that survival in naturally produced fish was equal to or greater than supplementation fish, hatchery supplementation origin adults returning to treatment streams would not exceed the naturally produced component.

The South Fork Salmon River continued to receive a portion of the prescribed brood year 2002 juvenile treatment as parr that were allowed to migrate volitionally from Stolle Pond. This alternate treatment began with brood year 1996 juveniles to expand the current range of the spawning aggregate in the South Fork Salmon River by rearing and releasing juveniles upstream of and within suspected historic spawning areas (Sankovich and Hassemer 1999).

Juvenile Production Estimates

For analysis, life stages used in production estimates were based on age, biological development, and arbitrary seasonal trapping dates. Spring/summer Chinook salmon “fry” were newly emerged young-of-the-year (YOY) captured prior to July 1 (spring trapping season). Fry became “parr” as they entered their first summer and included age-0 fish collected between July 1 and August 31 (summer trapping season) as they migrated from natal streams. Presmolts were juvenile fish that were collected moving downstream between September 1 and trap removal at ice-up (fall trapping season). Although juveniles in the act of migration before September 1 were defined as parr in this report, they also may be considered presmolts. Migrating presmolts did not show typical smolt characteristics (e.g., silvery color and the tendency to lose their scales easily). Smolts were age-1 migrants captured between the start of trapping and June 30.

Rotary Screw Trap Estimates

Rotary screw traps were operated on 18 streams to collect migrating juvenile Chinook salmon. Traps were positioned in the thalweg of each stream to maximize capture efficiency. A portion of the fish collected were marked with PIT tags to estimate the number of spring, summer, and fall emigrants, and to estimate minimum survival rates to Lower Granite Dam. Trap data also provided additional life history information, such as size during migration and migration timing. Traps were deployed as early in the spring as possible, depending on ice conditions, and were fished continuously until ice-up in the fall. However, high flows, debris, and ice prevented trap operation on some days. Traps were checked and fish processed at least once daily between 0700 hours and 1830 hours. However, when problems were anticipated (e.g., high water, ice, or debris) or unusually high numbers of juveniles were passing (generally immediately following hatchery releases) the trap was checked several times throughout the day and night as necessary. When a trap day was missed, migration for that day was interpolated by averaging migration estimates from the previous and subsequent day or via linear regression for longer periods.

Each day, captured fish were anesthetized in buffered Tricaine Methanesulfonate (MS-222), scanned for PIT tags, weighed (to nearest 0.1 g), and measured to the nearest 1 mm FL. To reduce retention time in the anesthetic, no more than 30 juvenile fish were anesthetized at one time. A subsample of fish was marked with PIT tags for trap efficiency and survival studies. In some streams, a large percentage of juveniles were too small to be PIT tagged. In these streams juveniles may have been marked with Bismarck Brown dye (described below) or been given a caudal fin clip to estimate trap efficiency. Fish needed to be ≥60 mm FL to be PIT tagged or ≥35 mm FL to be fin clipped or dyed. PIT tagging protocols followed procedures described by Kiefer and Forster (1991) and the PIT Tag Steering Committee (1992). Tag needles and PIT tags were sterilized in a 70% ethanol solution for 10 min prior to use and between uses. After fish were tagged, they were held in the stream in live boxes, which were large, lidded plastic boxes with numerous holes in them to allow water to flow through freely. To provide an estimate of trap efficiency, a subsample of marked fish was released approximately 0.4 km upstream of the trap or at least two riffles and a pool upstream of the trap. Sites were selected to maximize the probability that marked fish mixed with the general population prior to their arrival back at the trap. Efficiency releases were made daily, and the number of fish in these releases was based on a predetermined percentage of the daily catch designed to distribute PIT tags proportionally over the entire migration period. All other fish were held in separate live boxes and released downstream of the trap. Fish from both groups were released when they appeared to have recovered from the anesthetic. In streams with a high abundance of potential predators, fish were released after dusk. All efforts were done to hold fish no longer than necessary due to their need to keep migrating.

To calculate seasonal and brood year specific migration (or population) estimates from rotary screw trap operations, we utilized a computer program developed by the University of Idaho (Steinhorst et al. 2004). Gauss (Aptech Systems, Inc., Maple Valley, Washington) is a structured programming language where the basic variables are matrices rather than scalars. We divided each trap season into periods of varying length to minimize environmental variation within the periods. This results in a relative decrease in variation of trap efficiencies within a given period. In order to calculate an estimate of population size, Gauss needs three parameters, including the number of fish marked and released upstream of the trap, the number of marked fish recaptured, and finally, the number of unmarked fish captured with the marked recaptures. The number of marked and unmarked fish provides an initial estimate of recaptures/marks released (p_1). The number of unmarked fish provides an initial N. This information is entered into the Gauss program, which iteratively maximizes the log likelihood, $\ln L(N,p_1)$ until the estimate does not change significantly (stabilization). Since the estimators do not have a finite expectation, the Bailey (1951) modified estimator ($N^B_{simple\ h} = c_h \text{ X } (m_h+1)/(r_h+1)$ is used to determine N (Steinhorst et al. 2004). The maximum likelihood estimates of N and the corresponding confidence intervals require minimal assumptions: 1) fish are captured independently with probability “p,” and 2) marked fish thoroughly mix with unmarked fish. Young-of-the-year Chinook salmon fry were not included in smolt estimates for the spring season. Likewise, precocial Chinook salmon caught in traps in the summer, fall, or spring were not included in parr, presmolt, or smolt emigrant estimates for the brood year being studied.

The mark-recapture procedure described above also allowed us to estimate seasonally weighted trapping efficiency. The season was divided into the same periods as used for migration estimates, and the trap efficiency was calculated for each period based upon the number of marked fish recaptured divided by the number of marked fish released in that period.

With this periodic trap efficiency, the migration estimate was calculated for each period by dividing the number of unmarked fish captured by the efficiency. The migration estimates for each period were then summed for the season and that sum was divided into the total number of unmarked fish captured during the season. To maintain robustness for analysis, we set a lower limit of seven mark recaptures for any period (Steinhorst et al. 2004). If a trap period did not contain a sufficient number of recaptures, that period was included with the previous or subsequent period depending on stream and trap conditions.

Bismarck Brown Stain Estimates

In some streams, a large portion of the juveniles collected in the screw traps was too small to be PIT tagged. In order to represent the entire population, we uniquely marked a subsample of all fish with a mark that can be applied to any size fish captured. The NPT (unpublished data) conducted evaluations of Bismarck Brown dye with juvenile hatchery Chinook salmon. They concluded that immersion staining with Bismarck Brown could be used to mark juveniles as small as 35 mm FL. Beginning in 2002, a subsample of our screw-trap collections in Lake Creek and the Secesh River were stained with Bismarck Brown dye to use for efficiencies and abundance estimates.

Twice a week, a subsample of 10% of the total trap catch was selected for staining. If the trap catch was greater than 3,000 fish, no more than 300 individuals were stained. Fish were held in dye (0.4g/16 L solution) for 1 hour. Four battery-powered aerators were used to maintain oxygen saturation in the dye solution, and the temperature was monitored constantly and controlled with ice packs. When properly stained the mark lasted 3–4 d, but could be adjusted by changing the dye concentration and/or exposure time. To evaluate possible delayed mortality and to reduce predation, stained fish were held in live boxes until dusk and released at the same time and at the same site as PIT-tagged fish.

Abundance or migration estimates were derived from Bismarck Brown stained fish using the same techniques as described for PIT-tagged fish, with the exception that marked fish were identified visually instead of via a scanner. Marks were observed as fish were removed from the trap box for enumeration. To better detect stained fish, trap tenders did not remove more than about 10 fish in any one net load from the trap box.

Snorkel Estimates

Due to a lack of available screw traps, access issues, and limited potential trap locations, we used underwater observations by snorkelers in a number of ISS study streams to estimate the abundance or density of juvenile Chinook salmon. Techniques and rationale for underwater observation to determine Chinook salmon parr abundance and density are described in Petrosky and Holubetz (1985), Hankin (1986), and Hankin and Reeves (1988).

Streams were first divided into sampling strata based on channel and habitat types and areas that Chinook salmon historically used for spawning and rearing. Channel types included confined, steep gradient reaches (Type B) and lower gradient, meandering reaches (Type C) (Rosgen 1985, 1994). Four habitat types were identified: pool, riffle, run, and pocket water. Pool, riffle, and run (glide) correspond to the definitions of Bisson et al. (1982). Pocket water was predominantly swift with numerous protruding boulders or other large obstructions, which create scour holes (pockets) or eddies (McCain et al. 1990). Multiple sample sites were established systematically in each stratum. Each site included one or more habitat types confined at both the upper and lower borders by a hydraulic control (Platts et al. 1983, McCain et al. 1990).

Sample sites were surveyed during July and August. To ensure adequate light, observations were made between 1000 and 1800 hours on non-overcast days. Counts were also limited to periods when water temperature was above 10°C (Thurow 1994) unless the stream did not routinely reach this temperature (e.g., the American River). Prior to snorkeling, visibility was measured to determine the most efficient distance between snorkelers for viewing fish. Enough snorkelers were then used to observe the entire stream width in one pass. All salmonids were identified, counted, and their total length estimated. The presence or absence of non-salmonids was noted. The length of each site snorkeled was measured along with at least three wetted stream widths.

Observed Chinook salmon parr density (number per 100 m^2) was calculated for each stream. The total number of parr observed in each stream was divided by the total area snorkeled, then multiplied by 100.

Migration and Survival

In streams with juvenile traps, Bowles and Leitzinger (1991) suggested that a minimum of 500 parr should be PIT tagged annually in ISS control streams. In addition, a minimum of 300 fall (presmolt) and 100 spring (smolt) migrants were to be tagged annually. Minimum tagging goals were formulated using assumed life history specific survival relationships to ensure a minimum of 35 PIT tag detections per life history group at Lower Granite Dam to provide a minimum acceptable level of statistical precision. However, the number of juveniles tagged has increased over time to better estimate juvenile and smolt to adult survival questions.

Juvenile Chinook salmon PIT tagged in study streams allowed us to estimate survival and migration timing of study stocks. These evaluation points were gathered through interrogations at dams on the Snake and Columbia rivers. Survival is an important indicator of overall stream and life stage productivity, and productivity is a critical variable in the evaluation of the effects of supplementation. Minimum survival is reported here and is defined as the total number of unique detections in the Snake and Columbia River systems divided by the number of tagged fish released. However, it is possible some tagged fish escaped detection during their journey to the Pacific Ocean. Migration timing was estimated using the temporal distribution of detections at Lower Granite Dam, and average travel time to this location was also calculated for fish from each life stage in each stream. Lemhi and Pahsimeroi river fish migrating as YOY were detected within the same year (age-0 smolts) as well as the next migration year (typical age-1 smolts). These fish were reported separately by year.

Summer Parr PIT tagging

When densities were high enough to make collection feasible, natural parr were collected and PIT tagged in all ISS streams. The migration timing and survival of these groups could then be compared with supplementation treatment groups or trap groups. A goal of 500–700 parr was targeted for PIT tagging (Bowles and Leitzinger 1991). Snorkelers generally were used to locate and capture fish with beach seines, but in some cases electrofishing was used. When these methods were ineffective or impossible, minnow traps may have been used to collect fish. To determine tag loss and mortality rates, PIT-tagged fish were held for 24 h before release.

RESULTS

Adult Escapement

Weirs

Adult Chinook salmon captured at ISS weirs were enumerated and identified as general production hatchery, supplementation hatchery, or wild/natural origin. The estimated number of adult Chinook salmon that escaped to weirs varied among study streams and ranged from 36 to 8,603 fish in 2002 (Table 1) and from 40 to 8,262 fish in 2003 (Table 2). Returns were lowest in Crooked Fork Creek and highest in the South Fork Salmon River in both years.

The video weir on Lake Creek was shown to be an effective method of enumerating Chinook salmon moving into the stream. In 2002, 410 adult Chinook salmon were counted at the video weir (Table 1), and in 2003, 490 adults were counted (Table 2). Considering the weir was functional 98% of the time in 2002 and experienced no downtime in 2003, we believe these estimates are both accurate and precise. There were 28 and 31 age-1.1 (jack) Chinook salmon counted moving into Lake Creek in 2002 and 2003, respectively (Faurot and Kucera 2004).

Redd Counts

Redds were counted in the majority of ISS study streams using according to standard methodologies, but several exceptions occurred. Fires within the Fishing Creek and Legendary Bear Creek drainages in 2003 precluded multiple pass surveys and only one pass was conducted. Additionally, White Cap Creek was not surveyed in 2003.

The number of redds/km varied between years and streams in 2002 and 2003, but redd densities were generally higher in streams in the Salmon River basin than in the Clearwater River basin. Redd densities in the Salmon River tributaries were 7.0 and 8.1 redds/km (no weighting) in 2002 and 2003, respectively. The South Fork Salmon River had the highest redd density in both years at ≈30 redd/km, while Alturas Lake Creek and the North Fork Salmon River were the lowest with only ≈1 redd/km (Table 3). The Clearwater River basin tributaries averaged 3.1 and 1.9 redds/km (no weighting) in 2002 and 2003, respectively. In 2002, redd density was highest in Crooked Fork Creek (7.8 redds/km) and lowest in Eldorado Creek (0.1 redds/km; Table 3). In 2003, redd density was highest in Newsome Creek (3.6 redds/km) and lowest in Eldorado Creek and Pete King Creek, where no redds were observed (Table 3).

Table 1. The number, rearing type, and sex (male-M, female-F, and undetermined-U) of adult Chinook salmon captured or counted at weirs on Idaho Supplementation Study (ISS) streams in 2002. Catch numbers are not expanded and do not represent total escapement. The East Fork Salmon River weir was not operated in 2002, so no data (ND) are available from this site.

	General Production			Supplementation			Wild/Natural			Undetermined			
Stream Name	**M**	**F**	**U**	**M**	**F**	**U**	**M**	**F**	**U**	**M**	**F**	**U**	**Total**
Clearwater River Subbasin													
Clear Creek	0	0	852 [a]	57	85	0	15	28	0	0	0	0	1,037
Crooked Fork Creek	56	58	0	10	2	0	24	12	0	0	0	0	36
Crooked River	470	652	0	22	18	0	97	71	0	3	2	0	1,335
Lolo Creek	28	32	0	1	5	0	25	20	0	0	0	0	111
Newsome Creek	28	27	0	4	0	0	90	69	0	0	0	1	219
Red River	206	285	0	11	20	0	55	47	0	0	0	0	624
Salmon River Subbasin													
East Fork Salmon River	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Johnson Creek	7	10	0	233	159	0	432	351	0	0	0	0	1,192
Lake Creek[b]	0	0	0	0	0	0	0	0	0	0	0	410	410
Pahsimeroi River	224	0	0	314	384	0	112	86	0	0	0	0	1,120
South Fork Salmon River	3,421	2,797	0	574	530	0	762	519	0	0	0	0	8,603
Upper Salmon River	11	101	0	357	454	0	516	347	0	0	0	0	1,786

[a] Unknown fish are unclipped with coded-wire tags; sexes were applied to all fish according to the percentages of ponded fish.
[b] Number based on estimates from a video weir. The 95% confidence interval on this estimate is ±4 fish.

Table 2. The number, rearing type, and sex (male-M, female-F, and undetermined-U) of adult Chinook salmon captured or counted at weirs on Idaho Supplementation Study (ISS) streams in 2003. Catch numbers are not expanded and do not represent total escapement. The East Fork Salmon River weir was not operated in 2003, so no data (ND) are available from this site.

	General Production			Supplementation			Wild/Natural			Undetermined			
Stream Name	**M**	**F**	**U**	**M**	**F**	**U**	**M**	**F**	**U**	**M**	**F**	**U**	**Total**
Clearwater River Subbasin													
Clear Creek	576	205	0	13	17	4	18	12	6	0	0	0	851
Crooked Fork Creek	41	11	0	10	5	0	24	16	0	0	0	0	40
Crooked River	473	455	0	40	48	0	96	123	0	38	87	0	1,360
Lolo Creek	26	11	0	11	2	0	36	34	0	0	0	1	121
Newsome Creek	8	7	0	29	41	0	134	132	0	0	0	4	355
Red River	118	113	0	15	11	0	14	23	0	2	2	0	298
Salmon River Subbasin													
East Fork Salmon River	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Johnson Creek	10	3	0	93	72	0	270	336	0	0	0	0	784
Lake Creek[a]	0	0	0	0	0	0	0	0	0	0	0	490	490
Pahsimeroi River	1165	430	0	400	423	0	158	171	0	0	0	0	2,747
South Fork Salmon River	3718	1980	0	533	372	0	844	651	0	0	0	0	8,262
Upper Salmon River	407	0	0	161	130	0	253	285	0	0	0	0	1,236

[a] Number based on estimates from a video weir, which operated continuously, and can be considered a census count.

Table 3. Number of Chinook salmon redds counted in survey transects within Idaho Supplementation Study (ISS) streams in 2002 and 2003 and summary information on transect length, number of passes, method of data collection, and when redd counting effort was stopped. Cases where no data are available are designated ND.

Stream	Year	Survey Length (km)	Redds	Redds per km	Passes	Last Pass	Survey Method
Clearwater Subbasin							
American R.	2002	34.6	199	5.8	3	9/27	Ground
American R.	2003	34.6	105	3.0	3	10/5	Ground
Big Flat Cr.	2002	4.8	5	1.0	1	9/3	Ground
Big Flat Cr.	2003	5.2	3	0.6	1	9/2	Ground
Brushy Fk. Cr.	2002	16.1	89	5.5	3	9/13	Ground
Brushy Fk. Cr.	2003	16.1	38	2.4	2	9/20	Ground
Clear Cr.	2002	20.2	69	3.4	5	9/20	Ground
Clear Cr.	2003	20.2	18	0.9	5	9/19	Ground
Colt Killed Cr.	2002	50.2	40	0.8	1	9/5	Ground
Colt Killed Cr.	2003	50.2	22	0.4	1	9/10	Ground
Crooked Fk. Cr.	2002	18.0	140	7.8	3	9/12	Ground
Crooked Fk. Cr.	2003	18.0	60	3.3	3	9/14	Ground
Crooked R.	2002	18.8	18	1.0	3	9/21	Ground
Crooked R.	2003	18.8	50	2.7	3	9/22	Ground
Eldorado Cr.	2002	17.1	1	0.1	3	9/11	Ground
Eldorado Cr.	2003	3.5	0	0.0	3	9/18	Ground
Fishing Cr.	2002	6.0	25	4.2	3	9/10	Ground
Fishing Cr.	2003	6.0	9	1.5	1	9/10	Ground
Legendary Bear Cr.	2002	6.8	42	6.2	3	9/11	Ground
Legendary Bear Cr.	2003	6.8	21	3.1	1	9/11	Ground
Lolo Cr.	2002	43.4	157	3.6	3	9/19	Ground
Lolo Cr.	2003	43.4	68	1.6	3	9/23	Ground
Newsome Cr.	2002	19.2	52	2.7	3	9/10	Ground
Newsome Cr.	2003	19.2	69	3.6	3	9/23	Ground
Pete King Cr.	2002	8.0	2	0.3	5	9/13	Ground
Pete King Cr.	2003	8.0	0	0.0	3	9/15	Ground
Red R.	2002	38.5	136	3.5	3	9/20	Ground
Red R.	2003	38.5	116	3.0	3	9/21	Ground
White Cap Cr.	2002	12.9	3	0.2	1	9/5	Aerial
White Cap Cr.	2003	ND	ND	ND	ND	ND	ND
Means	2002	21.0	65.2	3.1	2.9		
Means	2003	20.6	41.4	1.9	2.5		
Salmon Subbasin							
Alturas Lake Cr.	2002	14.0	13	0.9	1	9/3	Aerial
Alturas Lake Cr.	2003	14.0	15	1.1	1	9/2	Aerial
Bear Valley Cr.	2002	35.7	284	8.0	3	9/11	Ground
Bear Valley Cr.	2003	35.7	287	8.0	3	9/3	Ground
EF Salmon R.	2002	15.3	22	1.4	3	9/7	Ground
EF Salmon R.	2003	15.3	76	5.0	3	9/4	Ground
Herd Cr.	2002	16.4	59	3.6	3	10/3	Ground
Herd Cr.	2003	16.4	68	4.1	3	9/17	Ground
Johnson Cr.	2002	41.4	351	8.5	4	9/19	Ground
Johnson Cr.	2003	41.4	362	8.7	4	9/19	Ground
Lake Cr.	2002	20.8	200	9.6	3	9/5	Ground
Lake Cr.	2003	20.8	247	11.9	3	9/4	Ground

Table 3. Continued.

Stream	Year	Survey Length (km)	Redds	Redds per km	Passes	Last Pass	Survey Method
Lemhi R.	2002	51.7	122	2.4	3	9/11	Aerial/Ground
Lemhi R.	2003	51.7	71	1.4	3	9/10	Aerial/Ground
Marsh Cr.	2002	11.0	117	10.6	3	9/5	Ground
Marsh Cr.	2003	11.0	253	23.0	3	9/4	Ground
NF Salmon R.	2002	36.8	36	1.0	2	9/11	Ground
NF Salmon R.	2003	36.8	36	1.0	3	9/10	Ground
Pahsimeroi R.	2002	24.5	125	5.1	3	10/2	Ground
Pahsimeroi R.	2003	24.5	354	14.4	3	10/1	Ground
Secesh R.	2002	40.1	328	8.2	3	9/18	Ground
Secesh R.	2003	40.1	357	8.9	3	9/27	Ground
SF Salmon R.	2002	24.5	826	33.7	4	9/13	Ground
SF Salmon R.	2003	24.5	722	29.5	4	9/9	Ground
Slate Cr.	2002	6.6	33	5.0	3	9/19	Ground
Slate Cr.	2003	15.4	12	0.8	3	9/23	Ground
Upper Salmon R.	2002	59.0	378	6.4	1	9/3	Aerial
Upper Salmon R.	2003	59.0	267	4.5	1	9/2	Aerial
Valley Cr.	2002	33.2	123	3.7	3	9/17	Ground
Valley Cr.	2003	33.2	170	5.1	3	9/10	Ground
WF Yankee Fork S.R.[a]	2002	11.6	53	4.6	3	9/16	Ground
WF Yankee Fork S.R.	2003	11.6	24	2.1	3	9/15	Ground
Means	2002	27.7	191.9	7.0	2.8		
Means	2003	28.2	207.6	8.1	2.9		

[a] Total redd production in 2002 consisted of 20 redds constructed by wild/natural females and 33 redds constructed by females from the IDFG Captive Rearing Program. Females from the Captive Rearing Program were known to have spawned with both wild/natural and captive reared males.

Carcass Recoveries

Carcasses were collected from all ISS study streams where ground surveys were conducted. Chinook salmon carcass recovery data are summarized by stream, return year, sex, and origin (Appendix 1).

Carcasses that did not display evidence of having participated in spawning (generally females with intact ovaries) were identified as prespawn mortalities. In 2002, notable levels of prespawn mortality were detected in treatment adults in the South Fork Salmon River (34%), and Johnson Creek (17%; Appendix 2).

Assistance from the Lower Snake River Compensation Program (Hatchery Evaluation Studies) at the South Fork Salmon River adult trap enabled ISS to obtain carcass data throughout the run, and 87% of the prespawn mortality detected occurred in July, prior to the commencement of spawning. Of note is the relatively low level of prespawn mortality observed in general production females, all of which were strays that escaped upstream without being trapped.

Supplementation Treatment

Adult Chinook salmon of natural or supplementation origin not used for broodstock creation were passed above weirs on treatment streams to provide prescribed adult treatments. The number and rearing type of returning adults passed upstream of these weirs for spawning in 2002 are reported in Table 4. Table 5 contains the same preliminary data for adults passed in 2003. Because age-length criteria used to define ocean age differs among streams and facilities, all ocean ages have been combined here.

Table 4. Summary of adult Chinook salmon passed above weirs as adult treatments to Idaho Supplementation Study (ISS) streams in 2002. Treatments are broken down by rearing type, sex, and percent of adults passed over the weir by rearing type (Supplementation–adults derived from ISS broodstocks, Natural–wild/natural adults, Reserve–hatchery general production adults). Catch numbers are not expanded and do not represent total escapement.

	Supplementation			**Natural**			**Reserve**		
Stream	**Male**	**Female**	**%**	**Male**	**Female**	**%**	**Male**	**Female**	**%**
Clearwater Subbasin									
Clear Creek	10	17	48.2	10	19	51.8	0	0	0.0
Crooked River	22	16	18.4	96	72	81.6	0	0	0.0
Red River	10	21	25.0	50	43	75.0	0	0	0.0
Lolo Creek	1	5	5.4	25	20	40.5	28	32	54.1
Newsome Creek	4	0	1.8	90	69	71.3	28	32	26.9
Salmon Subbasin									
South Fork Salmon River	362	385	41.6	600	448	58.4	0	0	0.0
Pahsimeroi River	46	96	47.5	91	66	52.5	0	0	0.0
Upper Salmon River	236	310	40.7	480	314	59.3	0	0	0.0
Johnson Creek	233	159	36.1	372	305	62.4	7	9	1.5

Supplementation juveniles created from adult broodstock spawning in 2002 were used in the last juvenile treatments for this project. No adults were retained as broodstock in 2003. Treatments with brood year 2002 juveniles generally followed the original treatment schedule. Parr releases were made in Colt Killed Creek, Pete King Creek, Newsome Creek and Fishing Creek (Table 6). Presmolts were released in Crooked River and Red River, and smolts were released in Legendary Bear Creek, Lolo Creek, Clear Creek, Pahsimeroi River, South Fork Salmon River, and Upper Salmon River. A parr group was released into Stolle Pond South Fork Salmon River for summer rearing and subsequent volitional release beginning in September as presmolts (Table 6).

Table 5. Summary of adult Chinook salmon passed above weirs as adult treatments to Idaho Supplementation Study (ISS) streams in 2003. Treatments are broken down by rearing type, sex, and percent of adults passed over the weir by rearing type (Supplementation–adults derived from ISS broodstocks, Natural–wild/natural adults, Reserve–hatchery general production adults). Catch numbers are not expanded and do not represent total escapement.

	Supplementation			Natural			Reserve		
Stream	**Male**	**Female**	**%**	**Male**	**Female**	**%**	**Male**	**Female**	**%**
Clearwater Subbasin									
Clear Creek	13	17	50.0	18	12	50.0	0	0	0.0
Crooked River	40	48	28.7	96	123	71.3	0	0	0.0
Red River	15	11	41.3	14	23	58.7	0	0	0.0
Lolo Creek	7	0	26.9	12	4	61.5	3	0	11.5
Newsome Creek	25	37	21.0	120	111	78.3	2	0	0.7
Salmon Subbasin									
South Fork Salmon River	530	368	37.7	838	645	62.3	0	0	0.0
Pahsimeroi River	198	236	56.9	157	171	43.0	1	0	0.1
Upper Salmon River	99	94	26.3	253	287	73.7	0	0	0.0
Johnson Creek	93	72	23.9	232	294	76.1	0	0	0.0

Table 6. Brood year 2002 juvenile treatments by the Idaho Supplementation Studies (ISS). Marks include LV–left ventral clip, RV–right ventral clip, and CWT–coded-wire tag. Broodstocks were sourced from KSK–Clear Creek, POW–Colt Killed Creek, SFC–South Fork Clearwater, SFSR–South Fork Salmon River, PAR–Pahsimeroi River, SAL–Salmon River, and JC–Johnson Creek. Juvenile rearing facilities included KNFH–Kooskia National Hatchery, CAFH–Clearwater Anadromous Hatchery, NPT–Nez Perce Tribal Hatchery, MFH–McCall Hatchery, PFH–Pahsimeroi Hatchery, ST–Stolle Pond, and SFH–Sawtooth Hatchery.

Stream	**Release date**	**Number released**	**Life stage**	**Number tagged**	**Mark**	**Broodstock source**	**Rearing facility**
Clearwater River Subbasin							
Clear Creek	3/04	50,969	Smolt	750	LV	KSK	KNFH
Colt Killed Creek	7/03	122,152	Parr	700	LV	POW	CAFH
Crooked River	9/03	234,361	Presmolt	499	LV	SFC	CAFH
Fishing Creek	7/03	16,532	Parr	700	CWT	POW	CAFH
Legendary Bear Creek	4/04	56,174	Smolt	800	CWT	POW	CAFH
Lolo/Yoosa Creek	4/04	51,526	Smolt	1,998	CWT	SFC/POW	CAFH/NPT
Newsome Creek	9//03	68,917	Presmolt	3,002	CWT[a]	SFC/POW	CAFH/NPT
Pete King Creek	7/03	16,290	Parr	1,000	CWT	POW	CAFH
Red River	9/03	108,323	Presmolt	600	RV	SFC	CAFH
Salmon River Subbasin							
SFSR	3/04	174,750	Smolt	600	CWT	SFSR	MFH
SFSR (Stolle Pond)	7/03	80,340	Parr	1,217	CWT	SFSR	MFH/ST
Pahsimeroi River	3/04	124,185	Smolt	484	CWT	PAR	PFH
Upper Salmon River	4/04	187,961	Smolt	500	CWT	SAL	SFH
Johnson Creek	10/03	2,388	Presmolt	2,388	CWT	JC	MFH
Johnson Creek	3/04	112,870	Smolt	12,186	CWT	JC	MFH

[a] Ninety percent of the juveniles released in this group received a mark.

Juvenile Production Estimates

Rotary Screw Trap Estimates

Screw traps were operated to collect brood year 2002 juvenile Chinook salmon on 18 ISS study streams in 2003 and 2004 for 4,535 trap days. Initial spring trap installation dates ranged from February 24 through April 16, with the majority of traps operational by mid-March. Removal dates ranged from October 25 through December 16, with the majority of the traps operational until mid-November (Appendix 3). Between March 1, 2003 and June 30, 2004, there were 487 possible trap days to collect brood year 2002 juveniles at each trap. At most trap sites, winter conditions prevented trap operations for approximately 90 days. This left about 397 possible days for trap operation. Due to icing conditions, most traps were not operated after the middle of November 2003. The exceptions were traps in the spring-fed Lemhi and Pahsimeroi rivers, which operated until mid-December at the latest. Seven of the traps operated from 296 to 390 days (mean = 329 d or 82.9% of possible), seven operated from 201 to 282 days (mean = 249 d or 62.7% of possible), and four traps operated from 56 to 164 days (mean = 118 d or 29.7% of possible; Appendix 3). High spring runoff or torrential precipitation events were responsible for most lost trap days. The trap on the East Fork Salmon River was damaged during the spring flows and could not be replaced for the remainder of the trap year, and the West Fork Yankee Fork Salmon River trap had to be removed due to incidental captures of adult Chinook salmon.

Data from PIT-tagged fish recaptured at screw traps were used to estimate the number of brood year 2002 juveniles that migrated from ISS study streams in 2003 and 2004. A total of 377,431 brood year 2002 juvenile Chinook salmon were collected and 67,479 were PIT tagged for release above the traps to estimate individual trap efficiency and migration estimates. A total of 15,352 PIT-tagged juveniles (released above the trap) were later recaptured (Table 7). Summing the migration estimates for all the traps yielded a total brood year 2002 migration estimate of 4,038,306 juvenile Chinook salmon from ISS study streams (Table 7; see Appendix 4 for the seasonal migration data used in the overall estimate).

Bismarck Brown Staining

In the spring of 2003, brood year 2002 juvenile Chinook salmon (≈35 mm FL) began moving past our traps as early as March in some streams. Since PIT tag recoveries are used to evaluate trap efficiencies, the earlier PIT tagging began, the earlier a trap's efficiency could be evaluated and reliable migration estimates produced. However, PIT tagging protocols required juveniles to be ≥60 mm FL. A large proportion of our streams did not have juvenile salmon this size until well into July or August (Table 8), but because juvenile growth was not consistent among streams, juveniles in some locations could be tagged earlier than others. When juvenile size and migration timing (Appendix 5) resulted in few or no PIT-taggable fish until well into the season, our trap efficiency evaluation began after a large number of fish had passed the trap.

Table 7. Overall migration estimates of brood year 2002 juvenile Chinook salmon and corresponding lower (L) and upper (U) 95% confidence intervals (CI) from 18 Idaho Supplementation Study (ISS) streams with rotary screw traps. Estimates are based on the total catch and the seasonal trap efficiency (Eff.) based on the number of PIT-tagged (Mark) fish recaptured (RC). In several streams either insufficient numbers of fish were collected or the trap was not functional for a long enough period to estimate meaningful confidence intervals and are denoted ND.

Stream	Catch	Mark	RC	Eff.	Estimate	L CI	U CI
Clearwater River subbasin							
Lolo Creek	16,346	5,594	917	0.153	106,568	95,467	122,212
Crooked River	1,456	1,120	449	0.302	4,814	4,133	5,772
Red River	10,767	4,218	556	0.131	82,258	74,941	90,831
Newsome Creek	16,671	3,576	1,199	0.177	94,232	81,096	114,495
American River	22,221	4,472	641	0.133	166,758	153,235	185,059
Clear Creek	255	195	36	0.189	1,236	ND	ND
Colt Killed Creek	1,173	586	55	0.081	14,487	10,162	23,325
Crooked Fork Creek	6,794	2,703	688	0.172	39,571	31,906	53,244
Totals	75,683	22,464	4,541		509,924		
Salmon River subbasin							
Marsh Creek	39,958	6,130	1,813	0.189	211,630	184,399	244,645
Johnson Creek	25,065	8,101	3,211	0.124	195,591	146,935	294,911
Secesh River	80,205	6,132	894	0.146	1,027,917	782,196	1,457,878
Lake Creek[a]	62,604	5,078	1028	0.093	670,688	547,959	837,169
South Fork Salmon River	107,941	4,255	1,119	0.265	894,322	734,898	1,129,809
West Fork Yankee Fork	180	130	9	0.076	1,476	ND	ND
East Fork Salmon River	1,605	237	23	0.097	3,016	1,972	4,663
Lemhi River	4,194	4,066	921	0.209	19,834	ND	ND
Pahsimeroi River	12,524	9,059	1,950	0.176	71,127	66,144	77,616
Upper Salmon River	30,076	6,905	871	0.069	432,781	341,980	599,955
Totals	364,352	50,093	11,839		3,528,382		

[a] Lake Creek is a tributary to Secesh River; therefore, we consider only trap estimates from the Secesh River trap in overall abundance estimates.

During the summer and fall of 2003, juvenile migrants in Lake Creek were stained or PIT tagged to better evaluate juvenile production (Figure 2). In Lake Creek, we were able to stain fish as early as June 23, while we were unable to PIT tag until July 26. When the recapture rates of the two marking types were compared, PIT-tagged fish were recaptured at a higher rate than those stained with Bismarck Brown (Figure 2). This resulted in an underestimation of the number of migrants when only the PIT tag recapture efficiency was used to estimate the entire population. Prior to June 23, 421 juvenile Chinook salmon were captured in the trap and prior to July 26, 48,269 fish were captured in the trap. Based upon PIT tag recapture efficiency, when expanded to the nontaggable portion of the captures, the juvenile abundance estimate was 362,182 (CI 211,213–631,650 or -41.7% and +74.4%; $\alpha = 0.05$). When the stained fish efficiency was applied to captures, the juvenile abundance estimate was 670,688 (CI 547,959–837,169 or -18.3% and +24.82%; $\alpha = 0.05$). This represents almost a twofold difference in the juvenile abundance estimation based on mark type.

Table 8. Percentage of brood year 2002 juvenile Chinook salmon collected prior to June and monthly thereafter in rotary screw traps in select ISS study streams that were too small to be PIT tagged (<60 mm fork length). ND indicates that no data are available for that period.

Stream	Jan-Jun (%)	Jul (%)	Aug (%)	Sep (%)	Oct (%)
Clearwater River Basin					
American River	100	100	99	97	75
Colt Killed Creek	100	100	100	49	8
Crooked Fork Creek	100	95	65	24	4
Crooked River	100	81	64	ND	ND
Lolo Creek	ND	ND	ND	ND	69
Newsome Creek	ND	ND	ND	86	42
Red River	100	98	91	54	21
Salmon River Basin					
Johnson Creek	100	97	67	20	2
Lake Creek	100	99	94	49	12
Lemhi River	8	0	0	0	0
Marsh Creek	69	28	33	26	10
Pahsimeroi River	4	0	1	0	0
Secesh River	100	99	96	62	23
South Fork Salmon River	100	99	96	66	35
Upper Salmon River	83	10	2	0	0

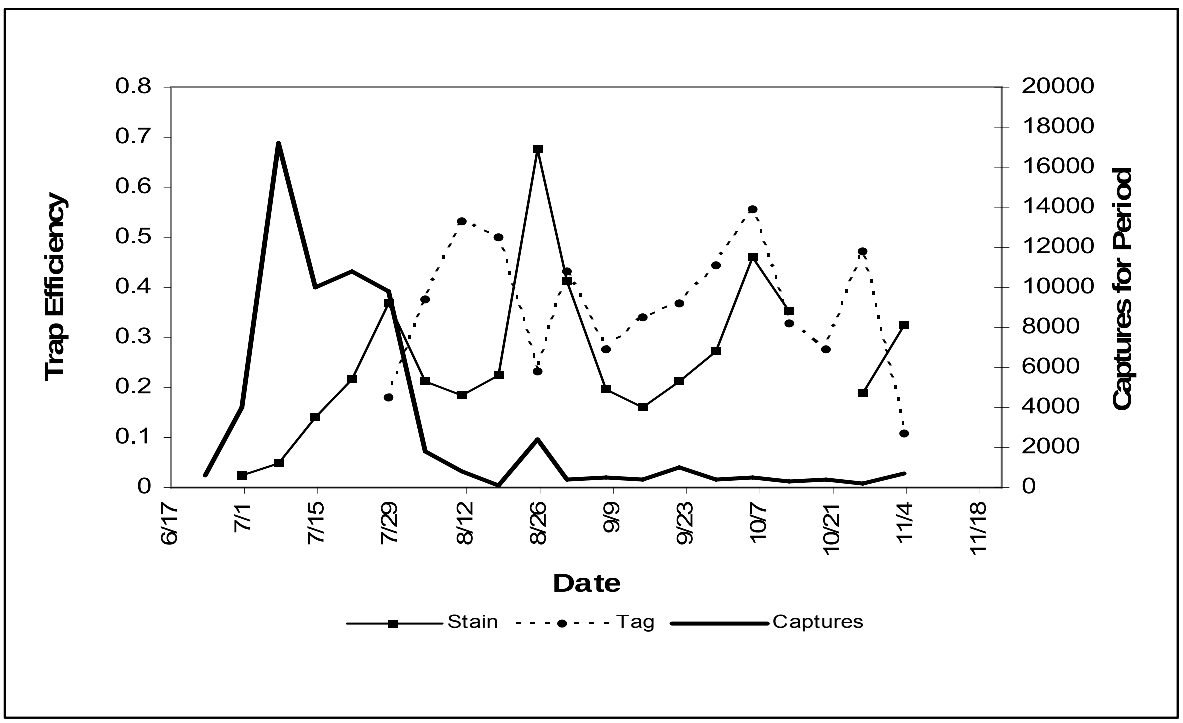

Figure 2. Total captures of juvenile Chinook salmon and periodic trap efficiency based on the recapture of PIT-tagged and Bismarck Brown stained fish in Lake Creek, June–November 2003.

Snorkel Estimates

Underwater observations were used to estimate juvenile Chinook salmon densities in 11 ISS study streams. The observed densities were highly variable and ranged from 0.2 to 94 fish/100 m^2 (Table 9). Juvenile density observed in the one Salmon River subbasin tributary we snorkeled was intermediate to that observed in the Clearwater River tributaries.

Migration and Survival

Brood year 2002 juvenile Chinook salmon displayed similar patterns of migration in most ISS study streams. Peak migration generally occurred between June and October with a second, smaller peak in the following spring (smolt) trapping period (Appendix 5). However, the smolt migration was substantial in Clear Creek, Crooked River and the spring-fed Lemhi and Pahsimeroi rivers (Appendix 5). During the brood year 2002 trapping seasons, the West Fork Yankee Fork, East Fork Salmon River, Clear Creek, and Lolo Creek traps were not operated during the entire trap season. Although the other traps were operated for the majority of the period, estimates of spring and/or summer movement were not always calculated for individual seasons due to low trap efficiency or low numbers of juveniles collected, but may have been combined with the fall to get estimates for that portion of the trap year (Table 10). This analysis also suggests that the largest portion of the migration in ISS study streams tended to be in the first spring and summer (Table 10, Appendix 5). The majority of the streams (9 of 14) had less than 11% smolt (spring 2) migration and results were consistent between treatment and control streams (Table 10). However, in three treatment streams (Crooked, Red, and Pahsimeroi rivers) the smolt (spring 2) migrations accounted for between 30% and 46% of the total estimated migration (Table 10). Supplementation parr reared in Stolle Pond (South Fork Salmon River) and allowed to migrate volitionally beginning in September as presmolts emigrated from the pond throughout the fall and early winter (monitored with a remote PIT tag detector). No fish were detected leaving the pond after December 13, though pond-reared smolts were prevalent in the South Fork Salmon River juvenile trap throughout the following spring (Appendix 5).

Table 9. Densities of brood year 2002 juvenile Chinook salmon calculated from direct underwater observations in Idaho Supplementation Study (ISS) streams during 2003.

Stream	Density (No./100 m^2)
Clearwater River Subbasin	
American River	67.7
Clear Creek	4.8
Crooked River	4.1
Eldorado Creek	18.2
Fishing Creek	11.5
Legendary Bear Creek	41.3
Lolo Creek	38.4
Newsome Creek	19.5
Pete King Creek	0.2
Red River	93.9
Salmon River Subbasin	
Slate Creek	11.6

Survival, migration rate, and passage timing were estimated from the PIT tag detections of the various groups of brood year 2002 Chinook salmon tagged and released in ISS study streams (Appendix 6). These analyses were aided by sufficient adult spawning escapement in 2002 to provide adequate numbers of juveniles from each life stage for PIT tagging in most study streams. Supplementation juveniles had similar detection rates as naturally produced fish of the same life stage. Detection rates were higher for groups of fish that migrated as smolts from the study streams and ranged from approximately 31% to 66% in the Clearwater River tributaries and 28% to 59% in the Salmon River study streams. One exception to this was the smolt group from the West Fork Yankee Fork Salmon River, which had only one detection, but there were only 46 fish tagged in this group. Detection rates of presmolts and parr were lower (<20%) in both subbasins than smolt groups and were similar among streams (Appendix 6).

Table 10. Seasonal breakdown of brood year 2002 juvenile Chinook salmon migration from Idaho Supplementation Study (ISS) streams. Seasons where traps were not operated or catches were insufficient to produce reliable estimates are noted as ND.

			Percent of Estimate by Season			
Stream	**Type**	**Estimate**	**First Spring**	**Summer**	**Fall**	**Second Spring**
Clearwater River basin						
American River	Control	166,758	7.0	50.7	36.6	5.6
Clear Creek[a]	Treatment	1,236	ND	ND	1.2	ND
Colt Killed Creek[b]	Treatment	14,487	ND	3.9	85.3	10.8
Crooked Fork Creek[b]	Control	39,571	ND	47.7	42.8	9.5
Crooked River[c]	Treatment	4,814	ND	ND	53.6	46.4
Lolo Creek[d]	Treatment	106,568	ND	ND	69.2	ND
Newsome Creek[b]	Treatment	94,232	ND	18.6	79.3	2.1
Red River	Treatment	82,258	16.7	16.1	37.5	29.7
Salmon River basin						
East Fork Salmon River[e]	Treatment	3,016	0.0	ND	ND	ND
Johnson Creek[b]	Treatment	195,591	ND	89.7	5.0	5.3
Lake Creek	Control	670,688	23.9	73.3	2.5	0.3
Lemhi River[f]	Control	19,834	ND	ND	89.9	10.1
Marsh Creek	Control	211,630	28.2	58.2	10.8	2.8
Pahsimeroi River	Treatment	71,127	14.0	8.6	33.1	44.3
Secesh River	Control	1,027,917	46.3	49.7	3.4	0.6
South Fork Salmon River	Treatment	894,322	0.2	88.7	10.6	0.6
Upper Salmon River	Treatment	432,781	48.7	16.8	26.8	7.8
West Fork Yankee Fork[e]	Treatment	1,476	90.5	ND	ND	ND

[a] Trap not operated in spring 1 or summer. No estimate during fall due to few captures.
[b] Trap was operated but no estimate from spring 1.
[c] Trap was operated and spring 1, summer, and fall estimate combined.
[d] Trap not operated in spring 1 or summer.
[e] Trap only operated during spring 1 and spring 2.
[f] Trap was operated but no spring 1 estimate. Summer and fall estimate combined.

Cumulative passage timing of the brood year 2002 juveniles at Lower Granite Dam was comparable among streams. Most fish were interrogated at Lower Granite during the April through July time period, and fish tagged as parr and presmolts typically arrived at the dam earlier in the year than those tagged as smolts (Appendix 7). Passage of supplementation groups was generally consistent with wild/natural groups of the same life stage. However, notable exceptions included the Newsome Creek presmolt and smolt groups, which had similar passage at Lower Granite Dam, and the Lolo Creek supplementation smolt group, which was intermediate between natural parr/presmolts and smolts (Appendix 7).

Summer Parr Tagging

A total of 10,267 brood year 2002 juvenile Chinook salmon were PIT tagged as summer parr in ISS study streams. Of these, 1,272 were tagged in the Clearwater River subbasin and 8,995 were tagged in the Salmon River subbasin (Table 11). This tagging effort was conducted by ISS personnel through a cooperative effort with NOAA Fisheries (BPA Project Number 1991-028-00).

Table 11. Number of brood year 2002 juvenile Chinook salmon PIT tagged as summer parr in Idaho Supplementation Study (ISS) streams during 2003.

Stream	Number PIT Tagged
Clearwater River Subbasin	
Fishing Creek	731
Legendary Bear Creek	541
Total	1,272
Salmon River Subbasin	
Herd Creek	968
Lake Creek	664
Lemhi River	699
Marsh Creek	1,534
Secesh River	1,142
South Fork Salmon River	1,490
Valley Creek	2,498
Total	8,995

DISCUSSION

Adult Escapement

Measurement of the relative escapement of all rearing types of adults (natural, supplementation, and general production) to ISS streams is critical to evaluate production and productivity between treatments and controls. Straying and prespawn mortality vary among years and streams. As the program transitions to Phase III, cooperators will assess survey needs for each stream to determine adequate survey intensity and timing needed to obtain sufficient carcass data to address these issues.

Weirs

In 2003, a combined video and acoustic imaging (dual frequency identification sonar or DIDSON) weir was installed on the Secesh River. Fish that pass through the video weir are used to verify the accuracy of the DIDSON camera. Data to date indicate that the use of both the video camera and the acoustic camera provide an accurate census of the number of Chinook salmon that pass into the Secesh River and Lake Creek spawning areas. The addition of these facilities also provides the ISS program with valuable escapement information on two control streams.

Carcass Recoveries

If maintained, the level of prespawning mortality observed in some ISS study streams in 2002 could have profound effects on both production and productivity (as measured by smolts per spawner or redds per female) in study streams. Additionally, if ISS streams are representative of spawning streams throughout the Salmon River subbasin, prespawn mortality may prove to be a serious issue in recovering these stocks. However, estimates in this report could be negatively or positively biased since estimates of prespawn mortality are subject to large measurement error. If adults were dying shortly after entering the spawning tributaries, many of these carcasses would have been lost to decomposition or scavenging before the first redd survey, and estimates could be negatively biased. Conversely, the number of carcasses recovered were low in many streams; therefore, a chance recovery of only one or two individuals that died before spawning could introduce a large positive bias to these estimates. Populations in the South Fork Salmon River and Johnson Creek experienced the largest percentages of prespawn mortality, the majority of which occurred within 1.6 km upstream from the weirs. The majority of prespawn mortality observed above the South Fork Salmon River weir was in fish that had been handled at the adult traps (as opposed to those that entered the area before the weir was operational or got through the weir). However, a high level of prespawn mortality was also observed in Chinook salmon below this facility. Levels of prespawn mortality observed in at least some streams in 2002 may have been an aberration that will not repeat itself in the future. We recommend that prespawn mortality be documented in all study streams, and all carcasses that appear to have died prior to spawning be noted as a prespawn mortality. We also recommend that, where feasible, one or two carcass surveys should be conducted prior to redd counts. This additional effort will improve estimates of prespawn mortality and will also improve the accuracy of spawner abundance and productivity estimates.

Supplementation Treatments

When the ISS study design was implemented, it was assumed there would be adequate numbers of returning wild adult Chinook salmon to produce localized broodstocks for use in treatment streams. Unfortunately, this was not the case, and, as a result, many of the treatment streams did not receive their prescribed level of juvenile treatments or were only partially treated (Lutch et al. 2003).

Recently, the Independent Scientific Review Panel raised concerns regarding the ISS program. One concern was that deviations from the original study design had occurred and that it was likely that these deviations had compromised the statistical integrity of the study (Lutch et al. 2003). In response to this concern, it was decided that Phase II of the program design would be extended through brood year 2002. By extending Phase II, we were able to increase the number of fully treated streams from 33% to 80% of the original design. No additional juvenile treatments will be administered beyond brood year 2002 (Lutch et al. 2003).

In 2002, the West Fork Yankee Fork Salmon River received maturing Chinook salmon from the IDFG Chinook captive rearing program (BPA project number 1997-00-100). Adults from this program were released for volitional spawning and were known to have successfully contributed to eyed-egg production in this stream (Venditti et al. 2003). Captive reared females produced 33 redds (Table 3) and were known to have spawned with both captive reared and wild/natural males. This represents an additional treatment that will need to be accounted for when these data are analyzed.

Juvenile Production Estimates

Rotary Screw Trap Estimates

Although not all traps were operated throughout the trap year in all steams, some patterns could be inferred from the trap migration estimates. Screw trap data provided abundance estimates with narrow confidence limits, but these did not include winter migrants or fish that moved during other periods when traps could not be deployed. Despite these limitations, it appeared that 85% of the brood year 2002 production in ISS study stream was in the Salmon River tributaries (63% in the South Fork Salmon River drainage, 16% above the Middle Fork Salmon River, and 6% in the Middle Fork Salmon River tributaries). The remaining 15% of the production from ISS study streams was in the Clearwater River tributaries, with 10% coming from the South Fork Clearwater River tributaries, 3% in lower Clearwater River tributaries, and 2% in the upper Clearwater River tributaries.

Bismarck Brown Staining

Traditionally in the ISS project, some of the juvenile fish that were marked with PIT tags are released above the trap and their recapture rates were used for trap efficiency evaluations. Juvenile migrant abundances were calculated using the number of juveniles collected and these efficiency estimates. Since protocol requires that juvenile Chinook salmon must be ≥60 mm FL to be PIT tagged, a large proportion of the population may have migrated from a stream prior to reaching a taggable length. Additionally, our abundance estimates only represented those fish of taggable size and may not have reflected a true representation of the entire migrant population. In response to this, cooperators decided to evaluate alternative methods that could be used to evaluate trap efficiencies. In some streams, this was important since subtaggable fish comprised a significant portion of the catch early in the migration year and in some streams (e.g., Lake Creek, Marsh Cr., Secesh River, Colt Killed Cr.) remained the dominant size class collected throughout the season (Table 8).

Biologists with the NPT computed paired migration estimates based on the recapture of Bismarck Brown stained and PIT-tagged juvenile Chinook salmon from Lake Creek in 2003. This study showed that trap efficiencies based solely on PIT tag recoveries could underestimate migrant abundance when compared to those utilizing stained groups that include the entire size range of fish moving past the traps, and demonstrated the potential importance of marking all size classes of fish during the migration period. One concern with this technique that should be investigated is the possible predation bias toward stained fish.

We then expanded our comparison of population estimates derived from PIT tag and Bismarck Brown recaptures to other years and streams. These analyses indicated that, when both techniques were used concurrently, estimates produced from the recapture of PIT-tagged juveniles ≥60 mm FL and stained fish ≥35 mm FL did not differ. One of the original goals of this work was to determine the maximum percentage of subtaggable juveniles in the catch that would allow accurate migration estimation with PIT tags alone. However, the data suggest that as long as a sufficient number of juveniles ≥60 mm FL are present in the catch to ensure adequate recaptures (at least seven per period), PIT tagging alone will suffice. However, Bismarck Brown marking still has utility and should be implemented at traps where large numbers of small juveniles pass prior to PIT-taggable conspecifics.

Based on the expanded comparison of estimates from the two marking techniques and on the assumption that there is no increased level of predation mortality upon stained fish, we recommend that when PIT-taggable sized Chinook salmon are not present in sufficient numbers to compute trap efficiency estimates, staining be used for these purposes. When PIT-taggable fish are present in sufficient number to provide reliable estimates (i.e., at least seven recaptures), PIT tags should be used to provide trap efficiency, juvenile survival estimates to Lower Granite Dam, and adult return estimates. Additionally, we recommend that PIT tagging and staining be conducted concurrently for the 2005 field season to verify the comparability of population estimates produced by the two techniques.

Snorkel Estimates

Throughout the history of the ISS project, snorkel counts have consistently produced juvenile abundance estimates with large confidence intervals. Efforts to increase the size and number of sampled reaches and the use of alternate sampling methods failed to significantly improve precision (Nemeth et al. 1996). Wide confidence intervals associated with snorkel counts may have been attributed to low fish densities, migration, poor visibility, temperature, misidentification of fish, recording errors, a narrow time period when data were collected, and a lack of updated habitat data. No measure or calibration of snorkel data bias has been conducted using other sampling methods, and ISS snorkel surveys have been routinely conducted only once per site per year.

Although a decision was made in 1997 to discontinue the use of snorkel counts to produce abundance estimates in most locations (Walters et al. 1999), the NPT continues to snorkel some streams because it is the only practical technique available to provide juvenile abundance indices in those locations. The degree to which these estimates accurately reflect juvenile production is unknown, owing to the likelihood of fish migration prior to surveys. Juvenile abundance estimates are critical, because they provide a measure of productivity (e.g., parr per redd) that will contribute to Phase III ISS statistical analyses. Although the abundance numbers may have lacked precision, the observed densities could be compared to redd production to provide a productivity index, though one with large statistical bounds.

Migration and Survival

Most juvenile Chinook salmon left their natal streams prior to the second spring trapping season. The streams that had the largest second spring migration estimates tended to be low elevation streams (Lolo Creek and Clear Creek) and spring-fed streams (Pahsimeroi River and Red River). This may reflect the fact that winter rearing areas were limited in most of our study streams, and juveniles preferred to congregate in more suitable winter habitats downriver of natal streams. Arrival timing at Lower Granite Dam indicated that fish that passed the traps as parr overwintered in downstream areas and then tended to pass the dam at both the same time and well in advance of juveniles that had left their natal streams the following spring as smolts.

Bowles and Leitzinger (1991) indicated a need for 500 PIT-tagged parr in ISS streams to determine survival. This number was based on assumed survival to obtain 35 detections at Lower Granite Dam. The goal was met for brood year 2002 wild summer parr in all nine streams where they were tagged. In response to the low number of juveniles due to low spawning escapement in the mid 1990s, effort to tag this group of fish has been dropped from a number of ISS study streams. Recently, escapement has been sufficient to provide adequate juvenile production to renew the effort to tag these fish. We recommend an assessment by the cooperating agencies to determine if resuming an intensive effort to PIT tag summer parr will provide a statistically adequate dataset to compare survival between control and treatment streams.

The “minimum” survival estimates used by the ISS program have serious limitations, and future estimates of survival should be made using a more quantitatively powerful method. Computing survival by the minimum survival method precludes meaningful, statistical comparisons between groups or over time. We recommend using SURPH2 model for future survival estimates. We also recommend that all cooperators use this model with historic ISS PIT tag detection data to compute adjusted survival estimates and facilitate future analyses.

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APPENDICES

Appendix 1. Number, rearing type, and sex of adult Chinook salmon carcasses collected during 2002 and 2003 spawning ground surveys on Idaho Supplementation Study (ISS) streams. Streams where no data were collected (e.g., redds counted via aerial surveys) are designated ND.

Stream	Run Year	Sex	Unknown	Natural	General Production	ISS Supplementation
Clearwater Subbasin						
American R.	2002	Male	0	6	14	0
		Female	0	12	21	0
		Unknown	0	0	0	0
		Total	0	18	35	0
American R.	2003	Males	0	9	5	0
		Females	0	9	4	0
		Unknown	7	3	5	0
		Total	7	21	14	0
Big Flat Cr.	2002	Males	0	0	0	0
		Females	0	2	0	0
		Unknown	0	0	0	0
		Total	0	2	0	0
Big Flat Cr.	2003	Males	0	0	0	0
		Females	0	0	0	0
		Unknown	0	0	0	0
		Total	0	0	0	0
Brushy Fk. Cr.	2002	Males	0	8	2	0
		Females	0	20	10	0
		Unknown	0	0	0	0
		Total	0	28	12	0
Brushy Fk. Cr.	2003	Males	0	3	0	0
		Females	0	0	0	0
		Unknown	0	0	0	0
		Total	0	3	0	0
Clear Cr.	2002	Males	2	4	25	4
		Females	0	10	39	4
		Unknown	0	0	1	1
		Total	0	14	65	9
Clear Cr.	2003	Males	0	1	6	3
		Females	0	1	3	0
		Unknown	0	0	0	0
		Total	0	2	9	3
Colt Killed Cr.	2002	Males	0	0	2	0
		Females	0	6	5	0
		Unknown	0	0	0	0
		Total	0	6	7	0
Colt Killed Cr.	2003	Males	0	1	1	0
		Females	0	2	0	0
		Unknown	0	0	0	0
		Total	0	3	1	0
Crooked Fk. Cr.	2002	Males	0	16	7	0
		Females	1	17	17	0
		Unknown	0	0	0	0
		Total	1	33	24	0
Crooked Fk. Cr.	2003	Males	0	1	0	0
		Females	0	7	0	1
		Unknown	0	0	0	0
		Total	0	8	0	1

Appendix 1. Continued.

Stream	Run Year	Sex	Unknown	Natural	General Production	ISS Supplementation
Clearwater Subbasin						
Crooked R.	2002	Males	0	3	2	0
		Females	0	0	1	0
		Unknown	0	0	0	0
		Total	0	3	3	0
Crooked R.	2003	Males	0	13	0	0
		Females	2	13	3	1
		Unknown	10	21	1	1
		Total	12	47	4	2
Eldorado Cr.	2002	Males	0	1	0	0
		Females	0	1	0	0
		Unknown	0	0	0	0
		Total	0	2	0	0
Eldorado Cr.	2003	Males	0	0	0	0
		Females	0	0	0	0
		Unknown	0	0	0	0
		Total	0	0	0	0
Fishing Cr.	2002	Males	1	4	0	0
		Females	0	10	2	0
		Unknown	1	0	0	0
		Total	2	14	2	0
Fishing Cr.	2003	Males	0	0	0	0
		Females	0	2	0	0
		Unknown	1	0	0	0
		Total	1	2	0	0
Legendary Bear Cr.	2002	Males	3	6	5	0
		Females	2	9	8	0
		Unknown	11	0	1	0
		Total	16	15	14	0
Legendary Bear Cr.	2003	Males	0	2	1	0
		Females	0	1	2	0
		Unknown	0	0	0	0
		Total	0	3	3	0
Lolo Cr.	2002	Males	11	43	8	4
		Females	6	41	9	4
		Unknown	21	0	0	0
		Total	38	84	17	8
Lolo Cr.	2003	Males	3	24	0	3
		Females	3	29	0	8
		Unknown	7	0	0	0
		Total	13	53	0	11
Newsome Cr.	2002	Males	1	24	6	0
		Females	2	11	7	0
		Unknown	8	0	0	0
		Total	11	35	13	0
Newsome Cr.	2003	Males	3	17	1	9
		Females	3	20	2	20
		Unknown	5	0	0	0
		Total	11	37	3	29
Pete King Cr.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Unknown	0	0	0	0
		Total	0	0	0	0

Appendix 1. Continued.

Stream	Run Year	Sex	Unknown	Natural	General Production	ISS Supplementation
Pete King Cr.	2003	Males	0	0	0	0
		Females	0	0	0	0
		Unknown	0	0	0	0
		Total	0	0	0	0
Red R.	2002	Males	0	14	28	1
		Females	0	13	23	1
		Unknown	0	0	0	0
		Total	0	27	51	2
Red R.	2003	Males	0	7	6	1
		Females	0	12	3	0
		Unknown	10	2	66	1
		Total	10	21	75	2
White Cap Cr.	2002	Males	ND	ND	ND	ND
		Females	ND	ND	ND	ND
		Unknown	ND	ND	ND	ND
		Total	ND	ND	ND	ND
White Cap Cr.	2003	Males	ND	ND	ND	ND
		Females	ND	ND	ND	ND
		Unknown	ND	ND	ND	ND
		Total	ND	ND	ND	ND
Salmon Subbasin						
Alturas Lake Cr.	2002	Males	ND	ND	ND	ND
		Females	ND	ND	ND	ND
		Unknown	ND	ND	ND	ND
		Total	ND	ND	ND	ND
Alturas Lake Cr.	2003	Males	ND	ND	ND	ND
		Females	ND	ND	ND	ND
		Unknown	ND	ND	ND	ND
		Total	ND	ND	ND	ND
Bear Valley Cr.	2002	Males	0	95	0	0
		Females	0	61	0	0
		Unknown	0	0	0	0
		Total	0	156	0	0
Bear Valley Cr.	2003	Males	0	156	0	0
		Females	0	162	0	0
		Unknown	0	0	0	0
		Total	0	318	0	0
EF Salmon R.	2002	Males	0	5	0	0
		Females	0	13	0	0
		Unknown	0	0	0	0
		Total	0	18	0	0
EF Salmon R.[a]	2003	Males	0	8	0	0
		Females	0	9	0	0
		Unknown	0	0	0	0
		Total	0	17	0	0
Herd Cr.	2002	Males	0	7	0	0
		Females	0	5	0	0
		Unknown	0	0	0	0
		Total	0	12	0	0
Herd Cr.	2003	Males	0	13	0	0
		Females	0	12	0	0
		Unknown	0	0	0	0
		Total	0	25	0	0

Appendix 1. Continued.

Stream	Run Year	Sex	Unknown	Natural	General Production	ISS Supplementation
Johnson Cr.	2002	Males	1	194	13	47
		Females	1	270	4	5
		Unknown	6	1	0	0
		Total	8	465	17	52
Johnson Cr.	2003	Males	1	248	1	108
		Females	0	209	4	77
		Unknown	1	2	0	1
		Total	2	459	5	186
Lake Cr.	2002	Males	4	91	1	0
		Females	2	89	6	0
		Unknown	2	0	0	0
		Total	8	180	7	0
Lake Cr.	2003	Males	8	124	0	0
		Females	4	134	0	0
		Unknown	3	0	0	0
		Total	15	258	0	0
Lemhi R.	2002	Males	0	4	0	0
		Females	0	12	0	0
		Unknown	0	0	0	0
		Total	0	16	0	0
Lemhi R.	2003	Males	0	4	0	0
		Females	0	5	0	0
		Unknown	0	0	0	0
		Total	0	9	0	0
Marsh Cr.	2002	Males	0	50	0	0
		Females	0	53	0	0
		Unknown	0	0	0	0
		Total	0	103	0	0
Marsh Cr.	2003	Males	0	95	0	0
		Females	0	154	0	0
		Unknown	0	0	0	0
		Total	0	249	0	0
NF Salmon R.	2002	Males	0	4	0	0
		Females	0	3	0	0
		Unknown	0	1	0	0
		Total	0	8	0	0
NF Salmon R.	2003	Males	0	3	0	0
		Females	0	6	0	0
		Unknown	0	0	0	0
		Total	0	9	0	0
Pahsimeroi R.	2002	Males	0	6	2	2
		Females	0	8	7	8
		Unknown	0	0	0	0
		Total	0	14	9	10
Pahsimeroi R.	2003	Males	1	27	14	12
		Females	1	46	17	40
		Unknown	0	0	0	0
		Total	2	73	31	52
Secesh R.	2002	Males	8	122	9	2
		Females	4	114	11	0
		Unknown	1	1	0	0
		Total	13	237	20	2

Appendix 1. Continued.

Stream	Run Year	Sex	Unknown	Natural	General Production	ISS Supplementation
Secesh R.	2003	Males	6	131	3	0
		Females	4	164	0	0
		Unknown	3	1	0	0
		Total	13	296	3	0
SF Salmon R.	2002	Males	6	212	64	140
		Females	2	197	33	180
		Unknown	12	0	0	0
		Total	20	409	97	320
SF Salmon R.	2003	Males	13	421	58	258
		Females	11	427	19	248
		Unknown	14	1	0	1
		Total	38	849	77	507
Slate Cr.	2002	Males	0	9	1	0
		Females	1	9	1	0
		Unknown	0	0	0	0
		Total	1	18	2	0
Slate Cr.	2003	Males	0	0	1	0
		Females	0	1	0	0
		Unknown	0	0	0	0
		Total	0	1	1	0
Upper Salmon R.	2002	Males	2	215	0	93
		Females	2	134	0	140
		Unknown	3	0	0	0
		Total	7	349	0	233
Upper Salmon R.	2003	Males	0	63	0	19
		Females	0	77	0	27
		Unknown	0	0	0	0
		Total	0	140	0	46
Valley Cr.	2002	Males	0	5	0	0
		Females	0	6	0	0
		Unknown	0	0	0	0
		Total	0	11	0	0
Valley Cr.[a]	2003	Males	0	45	0	0
		Females	0	64	0	0
		Unknown	0	0	0	0
		Total	0	109	0	0
WF Yankee Fork S.R.	2002	Males	0	3	0	0
		Females	0	8	0	0
		Unknown	0	0	0	0
		Total	0	11	0	0
WF Yankee Fork S.R.[a]	2003	Males	0	15	0	0
		Females	0	19	0	0
		Unknown	0	0	0	0
		Total	0	34	0	0

[a] Data preliminary–pending coded-wire tag results

Appendix 2. Percentage of prespawn mortality observed in Idaho Supplementation Studies (ISS) streams during 2002 spawning ground surveys. Streams where no data are available are designated ND. Additionally, in some instances prespawn mortality data were not recorded for males due to the difficulty of determining if they had spawned.

			Percentage by Rearing Type			
Stream	Year	Sex	Unknown	Natural	General Production	ISS Supplementation
Clearwater Subbasin						
American R.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
Big Flat Cr.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
Brushy Fk. Cr.	2002	Males	0	0	0	0
		Females	0	5	0	0
		Total	0	5	0	0
Clear Cr.	2002	Males	1	0	4	1
		Females	0	3	9	1
		Total	0	3	13	2
Colt Killed Cr.	2002	Males	0	0	0	0
		Females	0	66	20	0
		Total	0	66	20	0
Crooked Fk. Cr.	2002	Males	0	0	0	0
		Females	0	26	41	0
		Total	0	26	41	0
Crooked R.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
Eldorado Cr.	2002	Males	ND	ND	ND	ND
		Females	0	0	0	0
		Total	0	0	0	0
Fishing Cr.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
Legendary Bear Cr.	2002	Males	0	0	0	0
		Females	0	13	13	0
		Total	0	9	9	0
Lolo Cr.	2002	Males	ND	ND	ND	ND
		Females	0	13	2	0
		Total	0	13	2	0
Newsome Cr.	2002	Males	ND	ND	ND	ND
		Females	0	33	17	0
		Total	0	33	17	0
Pete King Cr.	2002	Males				
		Females				
		Total				
Red R.	2002	Males	0	0	0	0
		Females	0	23	4	0
		Total	0	15	2	0
White Cap Cr.	2002	Males				
		Females				
		Total				

Appendix 2. Continued.

Stream	Year	Sex	Percentage by Rearing Type: Unknown	Natural	General Production	ISS Supplementation
Salmon Subbasin						
Alturas Lake Cr.	2002	Males	ND	ND	ND	ND
		Females	ND	ND	ND	ND
		Total	ND	ND	ND	ND
Bear Valley Cr.	2002	Males				
		Females				
		Total				
EF Salmon R.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
Herd Cr.	2002	Males				
		Females				
		Total				
Johnson Cr.	2002	Males	0	27	0	13
		Females	0	29	100	22
		Total	0	28	100	17
Lake Cr.	2002	Males	0	1	0	0
		Females	0	2	0	0
		Total	0	2	0	0
Lemhi R.	2002	Males				
		Females				
		Total				
Marsh Cr.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
NF Salmon R.	2002	Males				
		Females				
		Total				
Pahsimeroi R.	2002	Males	0	0	0	0
		Females	0	0	0	14
		Total	0	0	0	0
Secesh R.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
SF Salmon R.	2002	Males	8	13	19	23
		Females	9	25	0	45
		Total	8	19	14	34
Slate Cr.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
Upper Salmon R.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
Valley Cr.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0
WF Yankee Fork S.R.	2002	Males	0	0	0	0
		Females	0	0	0	0
		Total	0	0	0	0

[a] Data preliminary—pending coded-wire tag results

Appendix 3. Rotary screw trap operations to collect BY02 spring/summer Chinook salmon in Idaho Supplementation Study (ISS) streams. The spring trapping season extends from trap deployment in the spring to June 30. The summer season extends from July 1 to August 31, and the fall season runs from September 1 to trap removal.

Stream	Season and Calendar Year	Start Date	End Date	Total Days Trapped
Clearwater River Subbasin				
American River	Spring 2003	3/28/03	6/30/03	86
	Summer 2003	7/1/23	8/31/03	55.5
	Fall 2003	9/1/23	10/31/03	48
	Spring 2004	3/26/04	6/30/04	78
	Total	3/28/03	6/30/04	267.5
Clear Creek	Spring 2004	3/12/04	6/13/04	56
Crooked River	Spring 2003	3/27/03	6/30/03	80
	Summer 2003	7/1/03	8/31/04	40
	Fall 2003	9/1/03	10/31/03	0.5
	Spring 2004	3/20/04	6/30/04	81
	Total	3/27/03	6/30/04	201.5
Lolo Creek	Fall 2003	9/30/03	12/16/03	72
	Spring 2004	3/23/04	6/26/04	92
	Total	9/30/03	6/26/04	164
Newsome Creek	Summer 2003	7/1/03	9/2/03	63
	Fall 2003	9/2/03	11/12/03	61
	Spring 2004	3/30/04	6/30/04	92
	Total	7/1/03	6/30/04	216
Red River	Spring 2003	3/26/03	6/30/03	80.5
	Summer 2003	7/1/03	8/31/03	55
	Fall 2003	9/1/03	10/30/03	21.5
	Spring 2004	3/26/04	6/30/04	82
	Total	3/26/03	6/30/04	239
Crooked Fork Creek	Spring 2003	3/20/03	6/30/03	87
	Summer 2003	7/1/03	8/31/03	62
	Fall 2003	9/1/03	11/04/03	61
	Spring 2004	3/18/03	6/30/04	86
	Total	3/20/03	6/30/04	296
Colt Killed Creek	Spring 2003	3/20/03	6/30/03	88
	Summer 2003	7/1/03	8/31/03	62
	Fall 2003	9/1/03	11/04/03	61
	Spring 2004	3/18/03	6/30/04	85
	Total	3/20/03	6/30/04	296
Salmon River Subbasin				
Johnson Creek	Spring 2003	3/6/03	6/30/03	85.5
	Summer 2003	7/1/03	8/31/03	62
	Fall 2003	9/1/03	11/21/03	74
	Spring 2004	2/24/03	6/30/04	123.5
	Total	3/24/03	6/30/04	345
Lake Creek	Spring 2003	4/01/03	6/30/03	77.5
	Summer 2003	7/01/03	8/31/03	62
	Fall 2003	9/01/03	11/03/03	63.5
	Spring 2004	3/22/04	6/30/04	96.5
	Total	6/09/03	6/30/04	243

Appendix 3. Continued.

Stream	Season and Calendar Year	Start Date	End Date	Total Days Trapped
Secesh River	Spring 2003	4/16/03	6/30/03	57.5
	Summer 2003	07/01/03	08/31/03	62
	Fall 2003	09/01/03	11/03/03	63.5
	Spring 2004	03/31/04	06/30/04	87.5
	Total	06/13/03	06/30/04	230
South Fork Salmon River	Spring 2003	03/06/03	6/30/03	81
	Summer 2003	07/01/03	08/31/03	60
	Fall 2003	09/01/03	10/25/03	55
	Spring 2004	03/03/04	06/30/04	86
	Total	03/06/03	06/30/04	282
Marsh Creek	Spring 2003	3/18/03	6/30/03	105
	Summer 2003	7/1/03	8/31/03	62
	Fall 2003	9/1/03	11/11/03	67
	Spring 2004	3/17/04	6/30/04	106
	Total	3/18/03	6/30/04	340
Upper Salmon River	Spring 2003	3/6/03	6/30/03	96
	Summer 2003	7/1/03	8/31/03	62
	Fall 2003	9/1/03	11/11/03	73
	Spring 2004	3/17/04	6/30/04	106
	Total	3/6/03	6/30/04	337
Pahsimeroi River	Spring 2003	3/4/03	6/30/03	119
	Summer 2003	7/1/03	8/31/03	62
	Fall 2003	9/1/03	12/6/03	97
	Spring 2004	2/26/04	6/30/04	112
	Total	3/24/03	6/30/04	390
Lemhi River	Spring 2003	3/7/03	6/30/03	114
	Summer 2003	7/1/03	8/31/03	59.5
	Fall 2003	9/1/03	12/11/03	93.5
	Spring 2004	3/9/04	6/30/04	112
	Total	3/7/03	6/30/04	379
East Fork Salmon River	Spring 2003	3/10/03	5/23/03[a]	75
	Spring 2004	3/16/04	5/3/04[a]	48
	Total	3/10/03	5/3/04	123
WF Yankee Fork Salmon River	Spring 2003	3/10/03	5/23/03[b]	47
	Spring 2004	4/7/04	6/30/04	83
	Total	3/10/03	6/30/04	130

[a] East Fork Salmon River screw trap pulled due to high flows. Significant damage from debris impaired further trapping efforts.

[b] West Fork Yankee Fork Salmon River screw trap pulled due to high flows. Subsequently, adult Chinook salmon were repeatedly caught in trap when replaced. Due to section 10 permit requirements, the trap was pulled immediately.

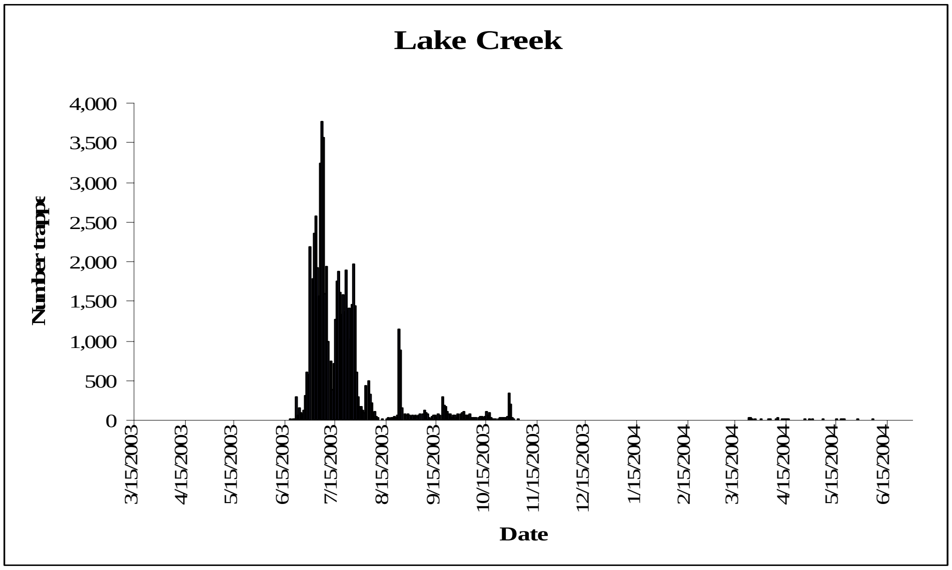
Appendix 4. Seasonal migration estimates of brood year 2002 juvenile Chinook salmon and corresponding lower (L) and upper (U) 95% confidence intervals (CI) from 18 Idaho Supplementation Study (ISS) streams with rotary screw traps. Estimates are based on the total catch and the seasonal trap efficiency (Eff.) based on the number of PIT-tagged (Mark) fish released upstream and recaptured (RC).

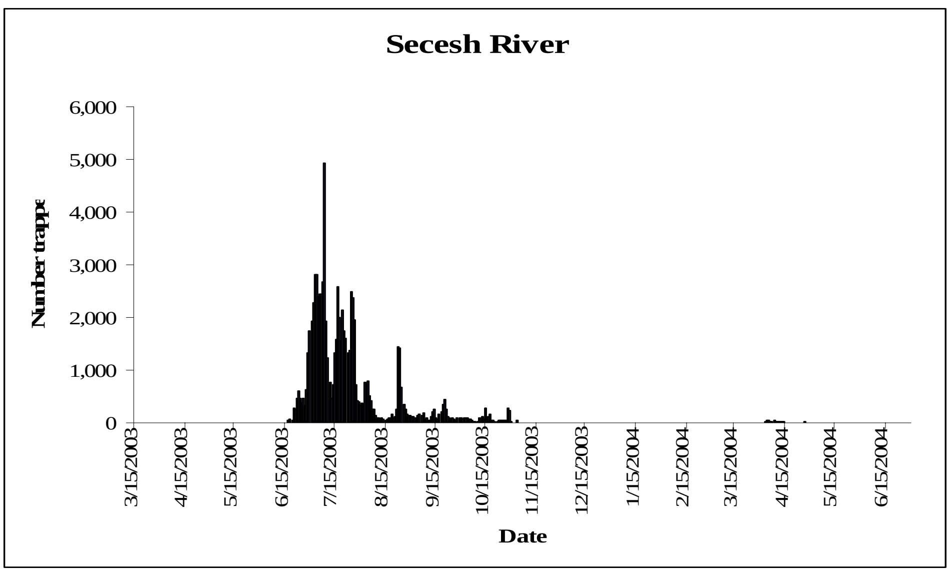
Stream	Trapping Season	Catch	Mark	RC	Eff.	Estimate	L CI	U CI
Lemhi River	Spring 2003	53	0	NA	NA	NA	NA	NA
West Fork Yankee Fork	Spring 2003	128	84	8	0.106	1,335	751	3,423
South Fork Salmon River	Spring 2003	1,475	0	NA	NA	NA	NA	NA
Pahsimeroi River	Spring 2003	2,050	1,820	375	0.206	9,928	9,002	10,936
American River	Spring 2003	958	244	20	0.086	11,663	7,848	19,297
Red River	Spring 2003	1,263	456	41	0.092	13,743	10,370	18,929
Marsh Creek	Spring 2003	6,926	335	38	0.116	59,670	44,399	79,632
Lake Creek	Spring 2003	4,564	385	10	0.028	160,155	95,632	300,694
Upper Salmon River	Spring 2003	5,868	358	9	0.028	210,661	122,240	375,753
Secesh River	Spring 2003	7,121	734	10	0.015	475,812	250,950	893,209
East Fork Salmon River	Spring 2003	1,291	0	NA	NA	NA	NA	NA
Crooked Fork Creek	Spring/Summer 2003	1,335	392	45	0.117	18,878	11,415	37,004
Johnson Creek	Spring/Summer 2003	17,485	3,100	894	0.289	175,424	123,309	285,989
Clear Creek	Spring/Summer/Fall 2003	15	0	NA	NA	NA	NA	NA
Crooked River	Spring/Summer/Fall 2003	331	303	38	0.128	2580	1940	3521
Colt Killed Creek	Summer 2003	122	50	10	0.216	566	328	1020
Pahsimeroi River	Summer 2003	313	312	15	0.051	6,123	4,915	7,739
Red River	Summer 2003	1,838	841	116	0.139	13,227	10,557	16,366
Newsome Creek	Summer 2003	2,412	57	7	0.138	17,487	9,338	39,479
Upper Salmon River	Summer 2003	10,973	1,196	180	0.151	72,567	56,821	92,143
American River	Summer 2003	9,509	1,362	153	0.113	84,617	61,487	126,971
Marsh Creek	Summer 2003	26,002	1,143	284	0.249	123,038	104,067	149,987
Lake Creek	Summer 2003	53,223	3,161	622	0.197	491,855	407,321	615,435
Secesh River	Summer 2003	65,539	3,559	484	0.136	510,603	461,674	569,693
South Fork Salmon River	Summer 2003	80,166	633	63	0.101	794,144	632,669	1,003,609
Lemhi River	Summer/Fall 2003	3,550	3,505	757	0.216	17,781	16,267	19,939
Johnson Creek	Fall 2003	5,121	3,176	1,690	0.532	9,785	9,372	10,216
Colt Killed Creek	Fall 2003	946	448	40	0.091	12,363	8,336	21,760
Lake Creek	Fall 2003	4,329	1,066	288	0.271	16,682	14,673	19,237
Crooked Fork Creek	Fall 2003	5,161	2,048	623	0.305	16,947	13,574	21,258
Marsh Creek	Fall 2003	4,530	2,440	483	0.198	22,762	20,549	25,199
Pahsimeroi River	Fall 2003	2,476	2,456	271	0.111	23,552	20,469	28,324
Red River	Fall 2003	5,846	1,593	301	0.189	30,856	25,728	36,912
Secesh River	Fall 2003	6,919	1,276	345	0.271	35,016	28,874	45,706

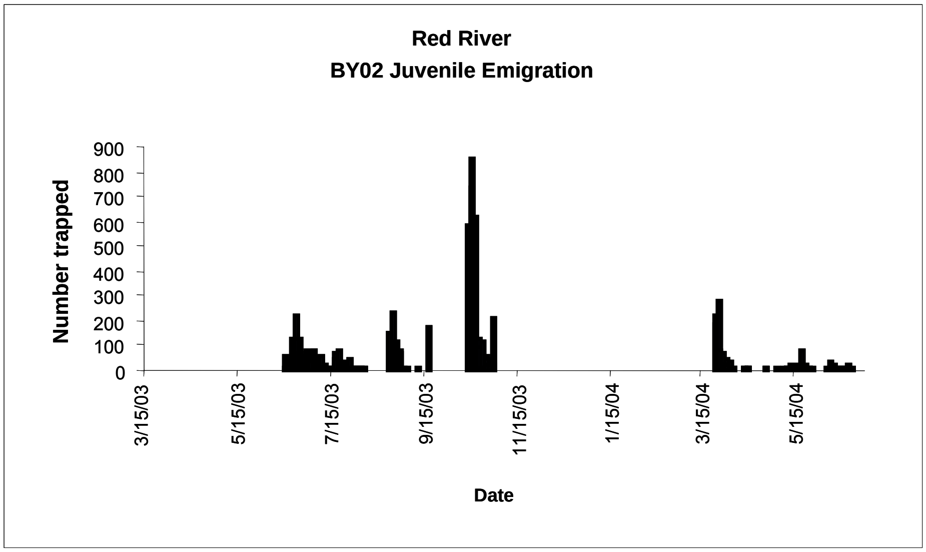
Appendix 4. Continued.

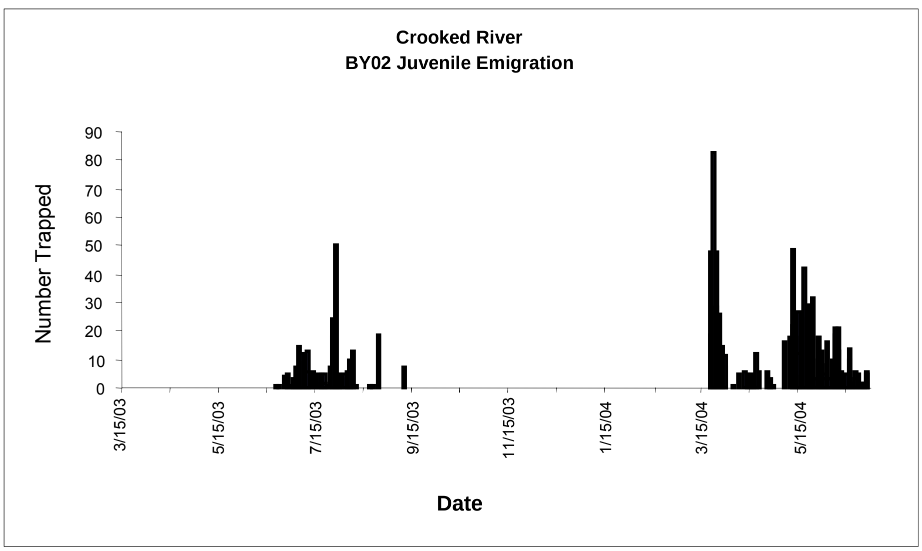
Stream	Trapping Season	Catch	Mark	RC	Eff.	Estimate	L CI	U CI
American River	Fall 2003	10,309	1,837	310	0.169	61,072	47,338	81,525
Lolo Creek	Fall 2003	14,527	4,003	812	0.203	73,754	67,558	80,942
Newsome Creek	Fall 2003	13,975	3,246	1,149	0.354	74,745	65,940	85,331
South Fork Salmon River	Fall 2003	24,576	2,250	580	0.258	95,216	83,573	108,628
Upper Salmon River	Fall 2003	6,634	2,638	150	0.057	115,941	79,316	175,679
Clear Creek	Spring 2004	240	195	36	0.189	1,221	814	1,802
Colt Killed Creek	Spring 2004	105	88	5	0.067	1,558	599	2,652
Lake Creek	Spring 2004	488	466	108	0.233	1,996	1,659	2,455
Newsome Creek	Spring 2004	284	273	43	0.161	2,000	1,399	3,031
Lemhi River	Spring 2004	591	561	164	0.294	2,000	1,727	2,322
Crooked River	Spring 2004	1,125	817	411	0.504	2,234	1,986	2,513
East Fork Salmon River	Spring 2004	314	237	23	0.097	3,016	1,972	4,663
Crooked Fork Creek	Spring 2004	298	263	20	0.08	3,746	2,307	6,271
South Fork Salmon River	Spring 2004	1,724	1,372	476	0.347	4,962	4,449	5,606
Marsh Creek	Spring 2004	2,500	2,212	1,008	0.456	5,890	5,497	6,326
Secesh River	Spring 2004	626	563	55	0.099	6,486	4,699	9,139
American River	Spring 2004	1,445	1,029	158	0.154	9,406	7,264	13,261
Johnson Creek	Spring 2004	2,459	1,825	627	0.344	10,382	8,751	12,473
Red River	Spring 2004	1,820	1,328	98	0.074	24,432	17,525	34,794
Pahsimeroi River	Spring 2004	7,685	4,471	1,289	0.288	31,524	29,101	34,591
Lolo Creek	Spring 2004	1,819	1,591	105	0.067	32,814	24,303	47,990
Upper Salmon River	Spring 2004	6,601	2,713	532	0.196	33,612	27,078	42,465
West Fork Yankee Fork	Spring 2004	52	46	1	0.043	NA	NA	NA

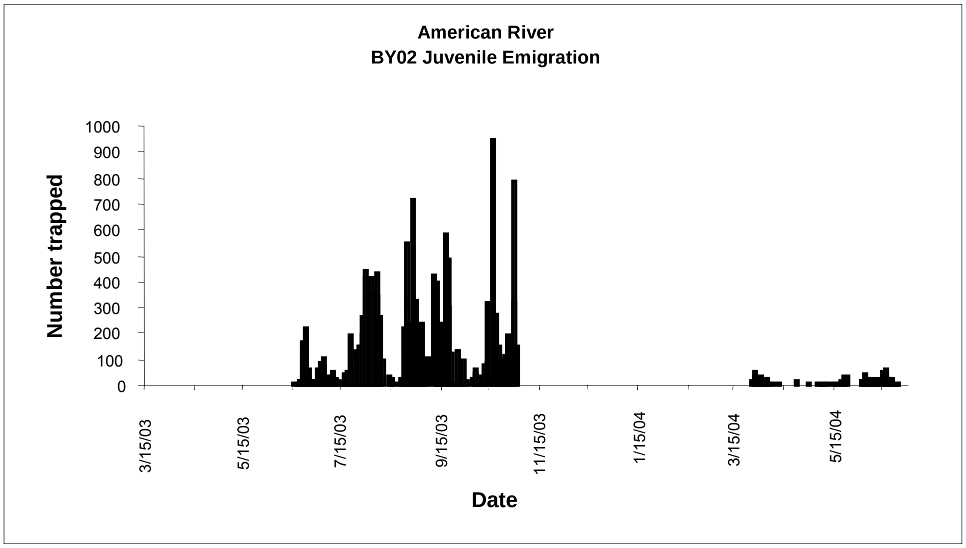
Appendix 5. Daily trap catch of brood year 2002 juvenile Chinook salmon at screw traps operated on Idaho Supplementation Study (ISS) streams. Areas of no catch between November and March indicate periods traps were removed for the winter.

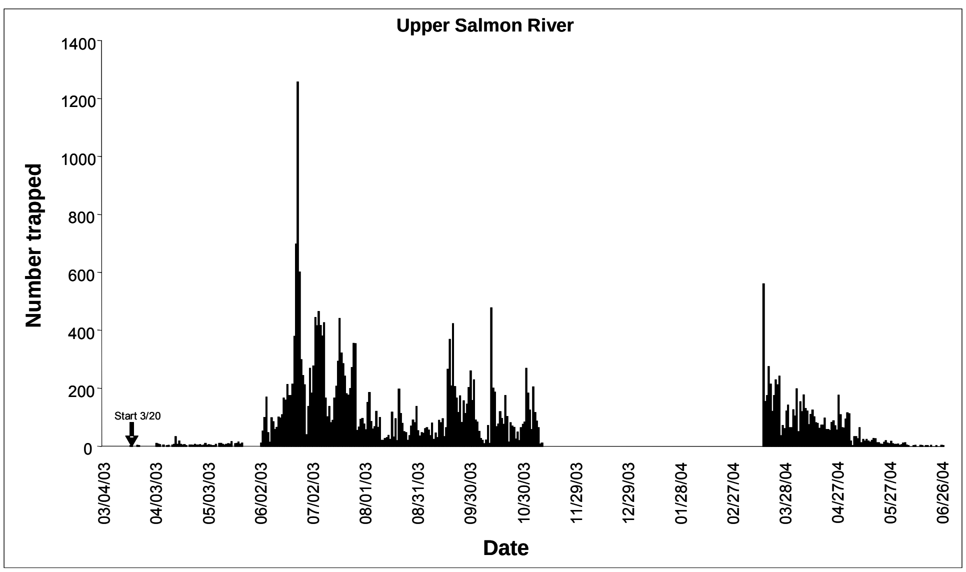




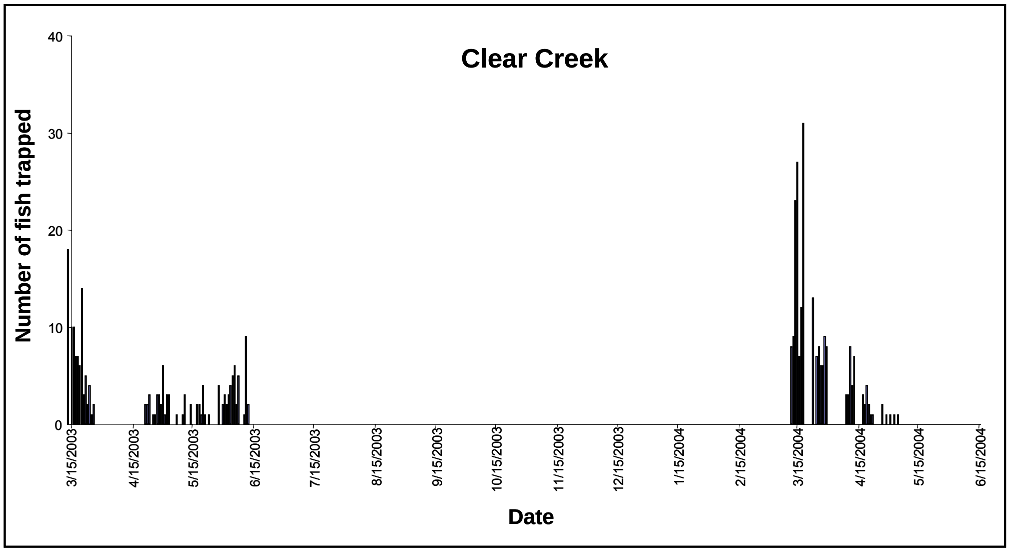

Red River
BY02 Juvenile Emigration
Number trapped
900
800
700
600
500
400
300
200
100
0
3/15/03
5/15/03
7/15/03
9/15/03
11/15/03
1/15/04
3/15/04
5/15/04
Date

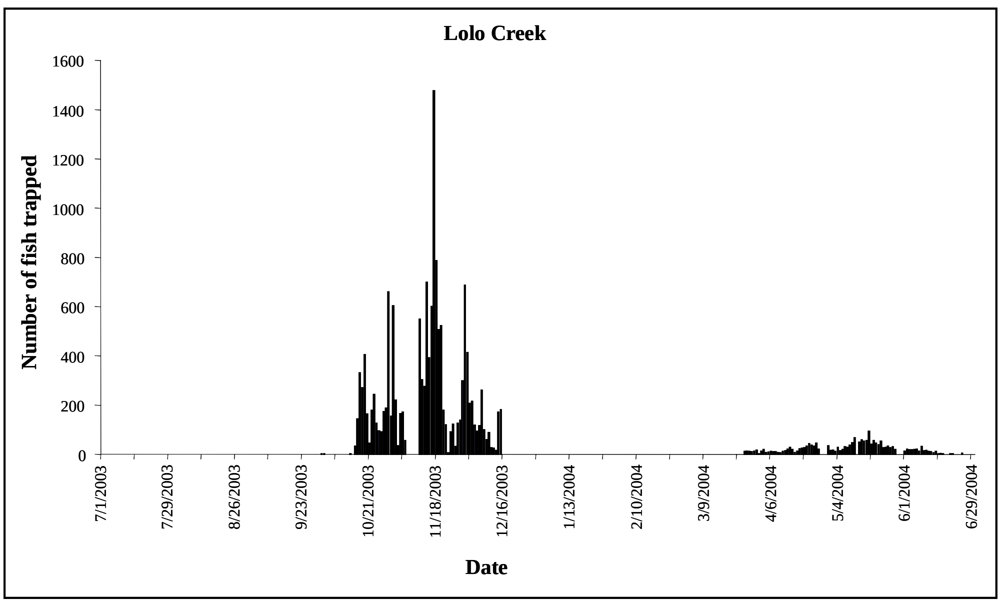

Crooked River
BY02 Juvenile Emigration
Number Trapped
90
80
70
60
50
40
30
20
10
0
3/15/03
5/15/03
7/15/03
9/15/03
11/15/03
1/15/04
3/15/04
5/15/04
Date

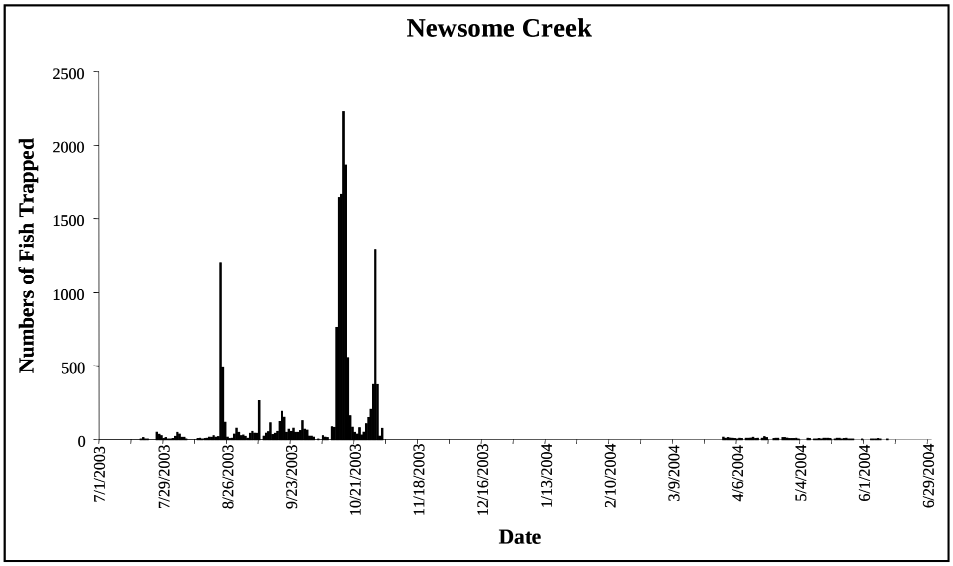

American River
BY02 Juvenile Emigration
Number trapped
1000
900
800
700
600
500
400
300
200
100
0
3/15/03
5/15/03
7/15/03
9/15/03
11/15/03
1/15/04
3/15/04
5/15/04
Date

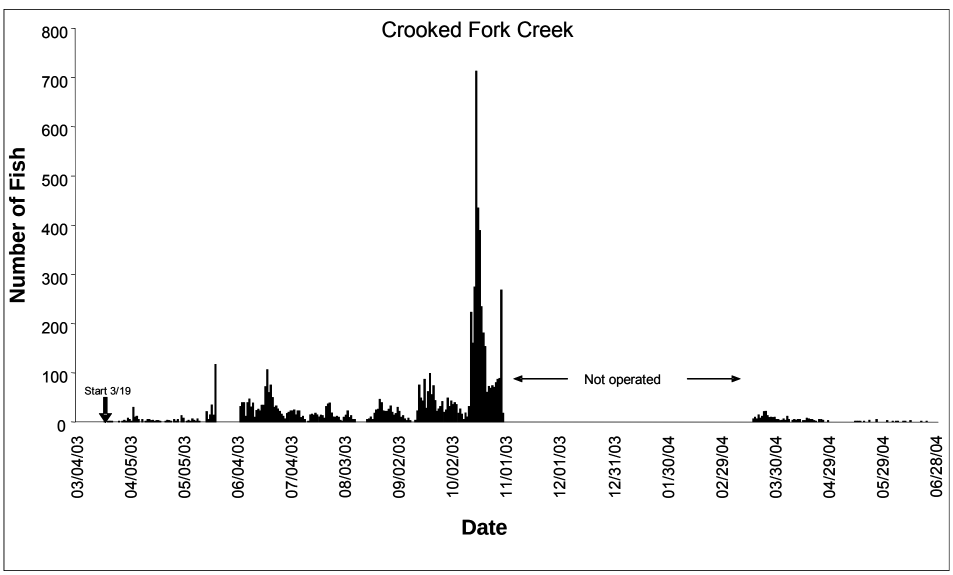

Upper Salmon River
Number trapped
1400
1200
1000
800
600
400
200
0
Start 3/20
03/04/03
04/03/03
05/03/03
06/02/03
07/02/03
08/01/03
08/31/03
09/30/03
10/30/03
11/29/03
12/29/03
01/28/04
02/27/04
03/28/04
04/27/04
05/27/04
06/26/04
Date

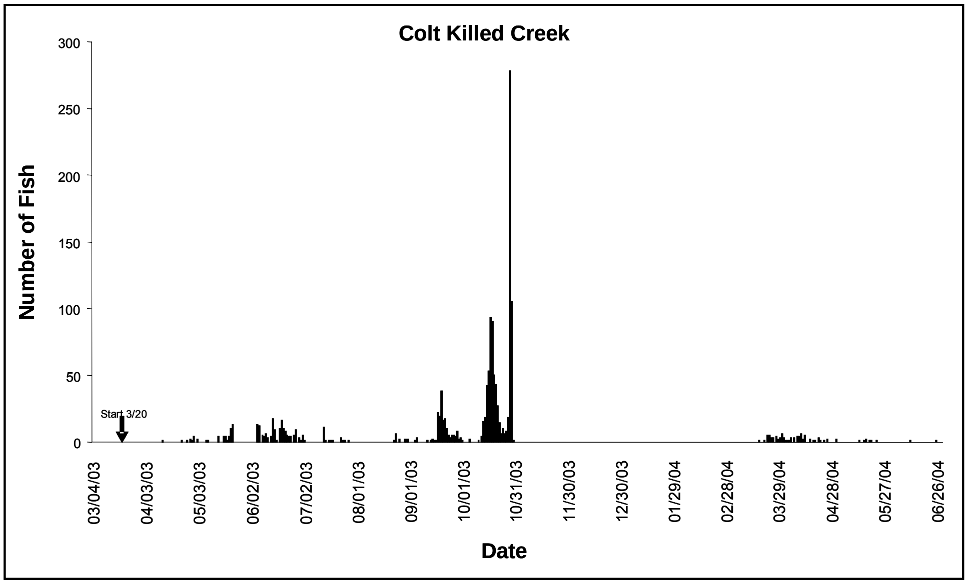
Appendix 5. Continued.

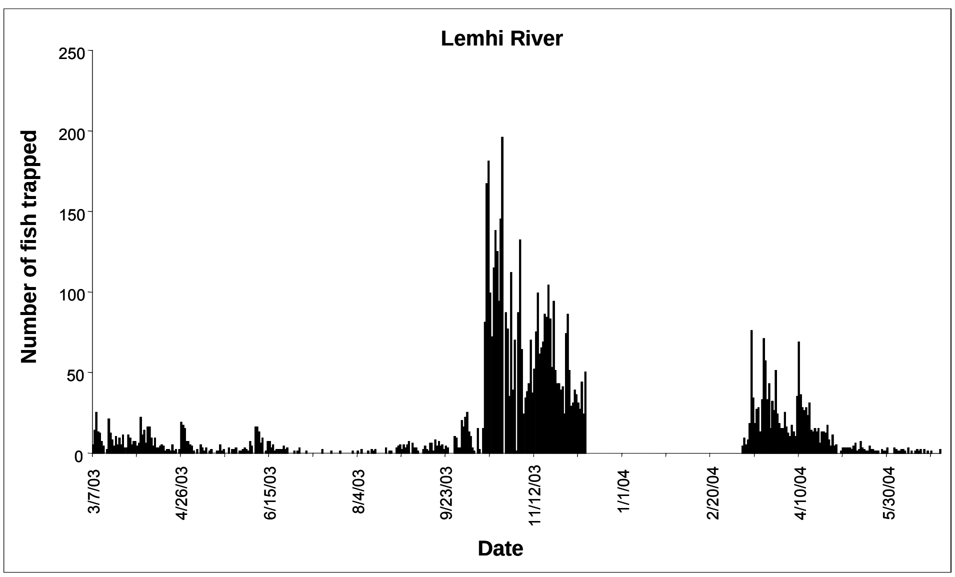




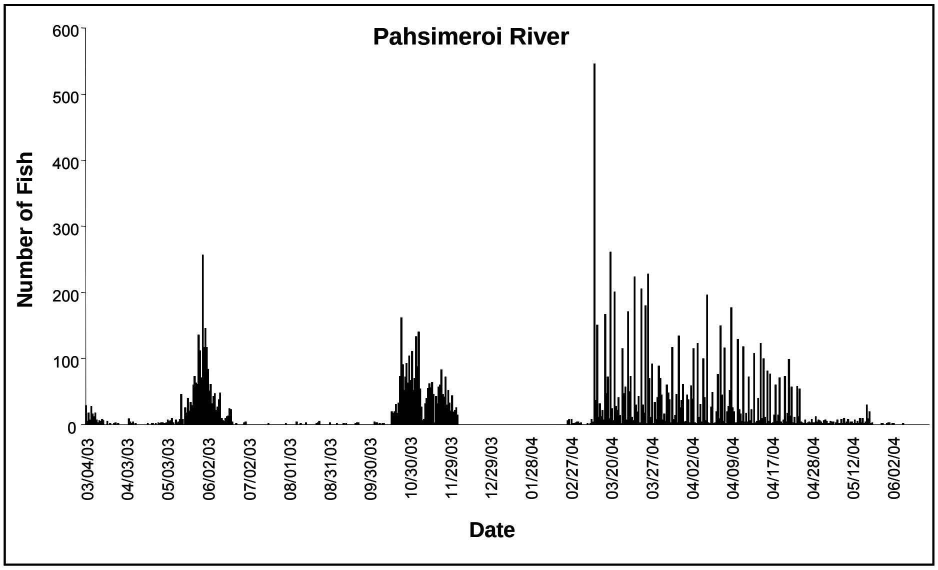

Newsome Creek
Numbers of Fish Trapped
2500
2000
1500
1000
500
0
7/1/2003
7/29/2003
8/26/2003
9/23/2003
10/21/2003
11/18/2003
12/16/2003
1/13/2004
2/10/2004
3/9/2004
4/6/2004
5/4/2004
6/1/2004
6/29/2004
Date

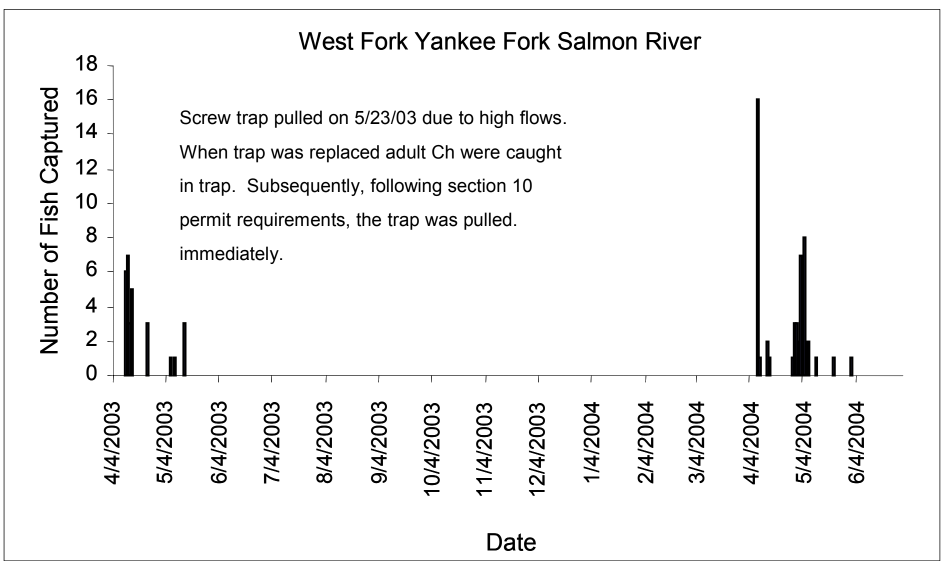

Crooked Fork Creek
Number of Fish
800
700
600
500
400
300
200
100
0
Start 3/19
Not operated
03/04/03
04/05/03
05/05/03
06/04/03
07/04/03
08/03/03
09/02/03
10/02/03
11/01/03
12/01/03
12/31/03
01/30/04
02/29/04
03/30/04
04/29/04
05/29/04
06/28/04
Date


Colt Killed Creek
Number of Fish
300
250
200
150
100
50
0
Start 3/20
03/04/03
04/03/03
05/03/03
06/02/03
07/02/03
08/01/03
09/01/03
10/01/03
10/31/03
11/30/03
12/30/03
01/29/04
02/28/04
03/29/04
04/28/04
05/27/04
06/26/04
Date

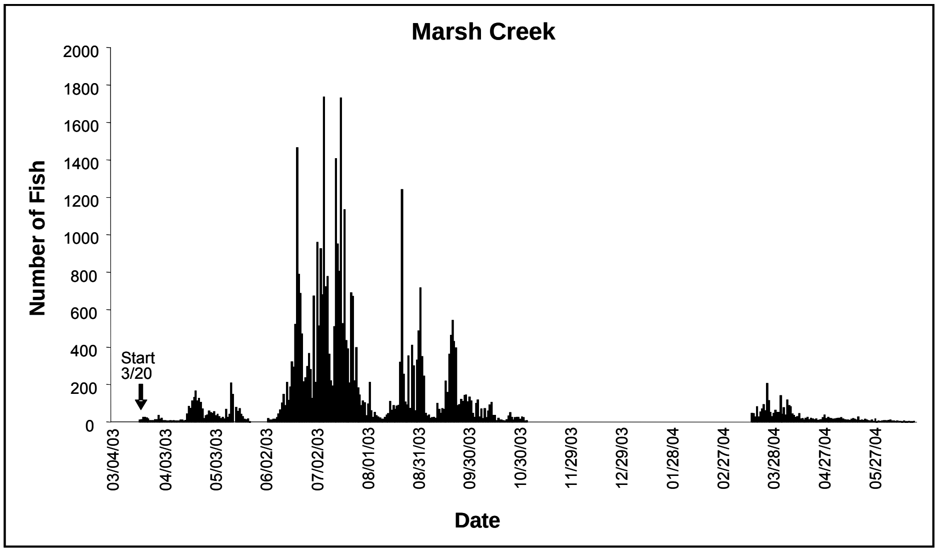

Lemhi River
Number of fish trapped
250
200
150
100
50
0
3/7/03
4/26/03
6/15/03
8/4/03
9/23/03
11/12/03
1/1/04
2/20/04
4/10/04
5/30/04
Date

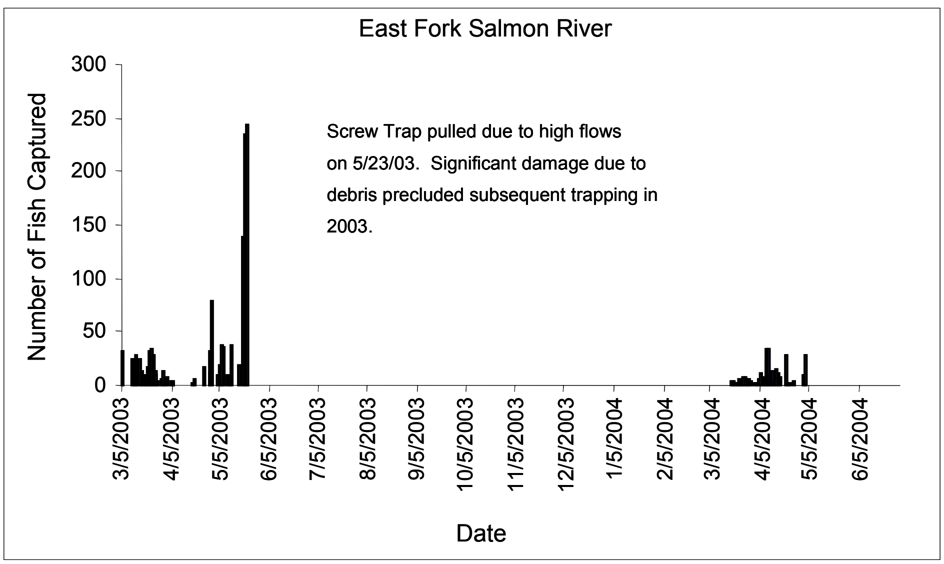
Appendix 5. Continued.

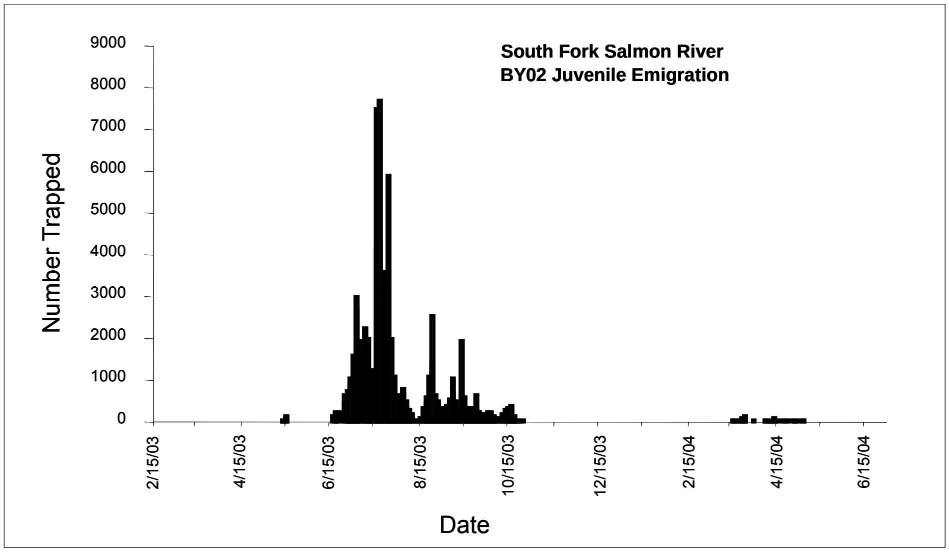


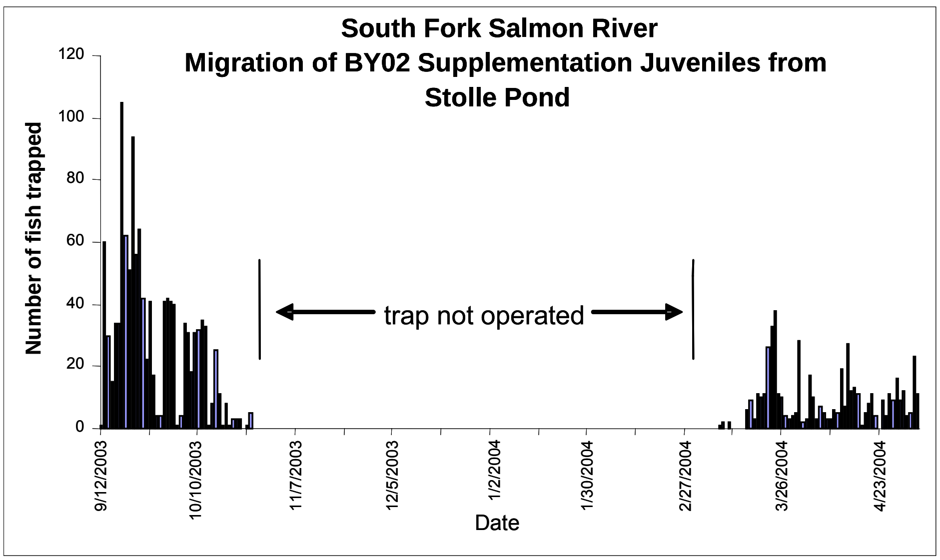


Appendix 5. Continued.






South Fork Salmon River
BY02 Juvenile Emigration
Number Trapped
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
2/15/03
4/15/03
6/15/03
8/15/03
10/15/03
12/15/03
2/15/04
4/15/04
6/15/04
Date


South Fork Salmon River
Migration of BY02 Supplementation Juveniles from
Stolle Pond
Number of fish trapped
120
100
80
60
40
20
0
trap not operated
9/12/2003
10/10/2003
11/7/2003
12/5/2003
1/2/2004
1/30/2004
2/27/2004
3/26/2004
4/23/2004
Date

Appendix 6. Numbers and passage characteristics at Lower Granite Dam (LGR) of various groups of brood year 2002 juvenile Chinook salmon PIT tagged in ISS study streams. Abbreviations used throughout the table include Su–summer, Sp–spring, S–smolt, P-S–presmolt, P–parr, Hatch–hatchery, Det.–detections.

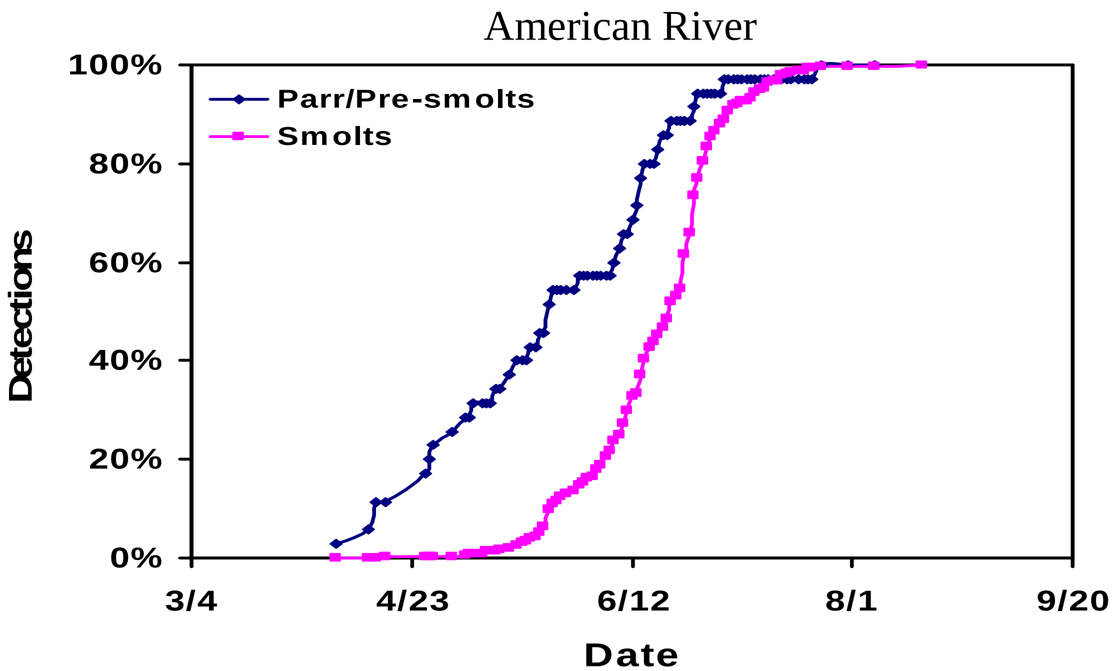
Trapping Stream	Season	Life Stage	Number Tagged	Detection Year	Unique Det.	LGR Det.	Mean Travel Time (d)	Travel Time SE (d)	First Arrival	10%	50%	90%	Last Arrival
Clearwater Subbasin													
American River	Su 03	Wild P	51	2004	0	0							
American River	Fall 03	Wild P-S	1,450	2004	45	35	225.0	4.5	4/6	4/15	5/24	6/26	7/25
American River	Sp 04	Wild S	1047	2004	521	420	23.2	1.1	4/17	5/24	6/21	7/4	8/17
Clear Creek	Sp 04	Wild S	205	2004	93	13	32.3	25.3	4/12	4/12	5/5	5/24	7/21
Clear Creek	Sp 04	Hatch S	750	2004	474	88	31.2	9.2	4/7	4/15	5/1	5/10	5/26
Colt Killed Creek	Fall 03	Wild P-S	500	2004	61	46	216.6	2.7	4/12	5/1	5/21	6/5	6/24
Colt Killed Creek	Sp 04	Wild S	88	2004	32	29	57.4	4.0	4/26	5/8	6/11	7/1	7/19
Colt Killed Creek		Hatch P	708	2004	3	2	306.0	13.2	5/17		5/17		6/12
Crooked Fork Creek	Su 03	Wild P	134	2004	14	11	258.1	2.4	4/25	4/27	5/6	5/22	5/26
Crooked Fork Creek	Fall 03	Wild P-S	2,332	2004	417	312	209.1	1.0	4/6	4/22	5/7	5/25	6/27
Crooked Fork Creek	Sp 04	Wild S	261	2004	81	66	48.8	2.1	4/24	5/4	5/23	6/18	7/5
Crooked River	Su 03	Wild P	92	2004	2	2	304.4	14.7	5/12	5/12	5/12	5/21	5/21
Crooked River	Fall 03	Wild P-S	0	2004	0	0							
Crooked River	Sp 04	Wild S	928	2004	364	266	35.4	1.5	5/10	5/26	6/15	7/3	7/28
Crooked River		Hatch P-S	499	2004	4	4	281.2	8.7	5/24	5/24	6/24	7/2	7/2
Lolo Creek	Fall 03	Wild P-S	3,017	2004	381	258	186.2	1.0	3/29	4/14	5/1	5/20	6/10
Lolo Creek	Sp 04	Wild S	1,139	2004	753	567	24.7	0.6	4/25	5/11	5/24	6/8	7/4
Lolo Creek		Hatch P-S	1,998	2004	166	113	236.1	1.7	4/2	4/14	5/11	6/1	6/23
Newsome Creek	Su 03	Wild P	35	2004	0	0							
Newsome Creek	Fall 03	Wild P-S	2,985	2004	292	211	216.6	1.3	4/1	4/25	5/10	5/30	7/19
Newsome Creek	Sp 04	Wild S	250	2004	116	92	40.8	2.0	5/4	5/13	6/9	6/29	7/17
Newsome Creek		Hatch P-S	3,025	2004	60	45	275.6	3.0	4/20	5/17	6/15	7/5	7/16
Papoose Creek	Su 03	Wild Su P	557	2004	35	30	288.9	2.6	4/6	4/29	5/19	5/25	6/17
Papoose Creek		Hatch S	801	2004	292	211	27.8	0.4	4/19	5/1	5/5	5/11	5/30
Red River	Su 03	Wild P	104	2004	10	8	279.8	10.1	4/6	4/6	5/19	6/12	6/12
Red River	Fall 03	Wild P-S	1,548	2004	112	82	211.6	2.2	4/11	4/25	5/11	6/15	7/4
Red River	Sp 04	Wild S	1,326	2004	564	429	46.3	1.3	5/3	5/23	6/12	7/2	7/31
Red River		Hatch P-S	496	2004	32	28	237.1	4.1	3/31	4/12	5/21	6/14	6/27
Squaw Creek	Su 03	Wild Su P	736	2004	95	66	287.7	1.6	4/6	4/29	5/15	5/28	6/24
Squaw Creek		Hatch P	797	2004	8	7	295.3	5.4	4/27	4/27	5/15	5/31	6/1
Salmon Subbasin													
Johnson Creek	Su 03	Wild P	1,971	2004	237	190	265.5	1.2	4/2	4/22	5/5	5/23	6/25
Johnson Creek	Fall 03	Wild P-S	5,015	2004	777	607	185.9	3.0	4/2	4/23	5/5	5/23	6/30
Johnson Creek	Sp 04	Wild S	2,408	2004	936	770	55.4	0.6	4/15	5/2	5/16	6/10	7/6
Johnson Creek		Hatch P-S	2,388	2004	201	200	173.1	3.8	4/15	5/1	5/9	5/28	6/26
Lake Creek	Su 03	Wild P	395	2004	22	15	253.4	5.6	3/31	4/11	4/28	5/23	6/10
Lake Creek	Fall 03	Wild P-S	1,176	2004	105	72	214.1	2.6	4/4	4/15	5/1	5/26	7/18
Lake Creek	Sp 04	Wild S	457	2004	153	115	42.6	1.5	4/29	5/10	5/28	6/20	7/17
Lake Creek	Su/Fall 03	Yearlings	365	2004	21	14	250.6	19.9	4/15	4/24	5/2	5/21	5/30
Lake Creek		Wild Su P	664	2004	33	26	250.7	3.6	4/9	4/15	5/4	5/28	6/16

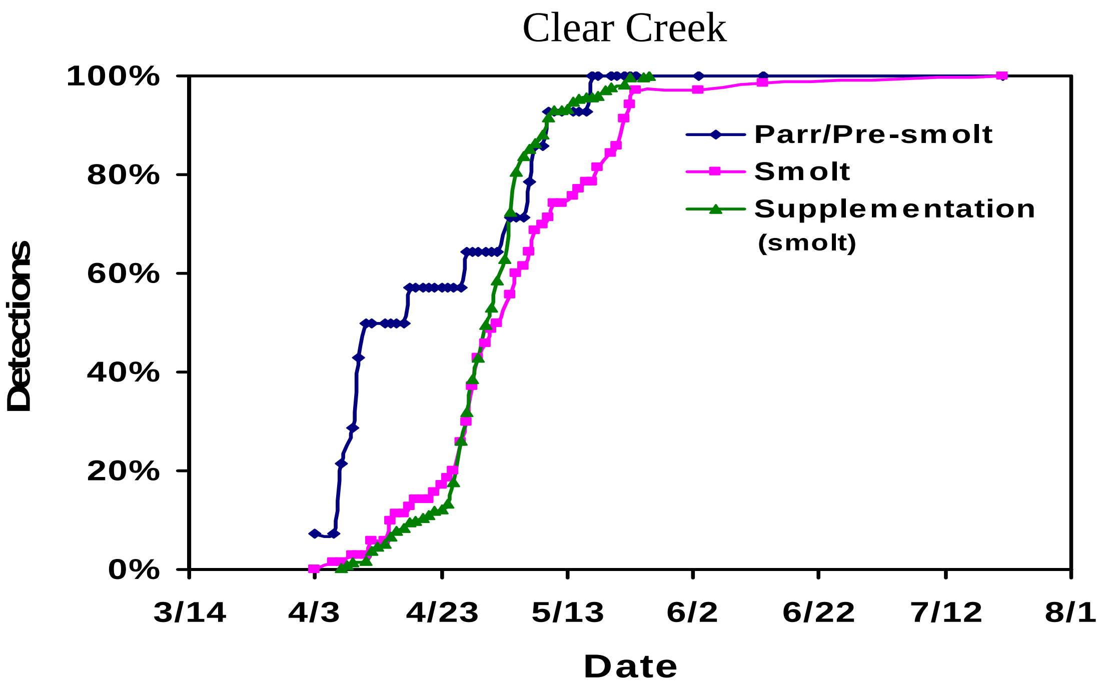
Appendix 6. Continued.

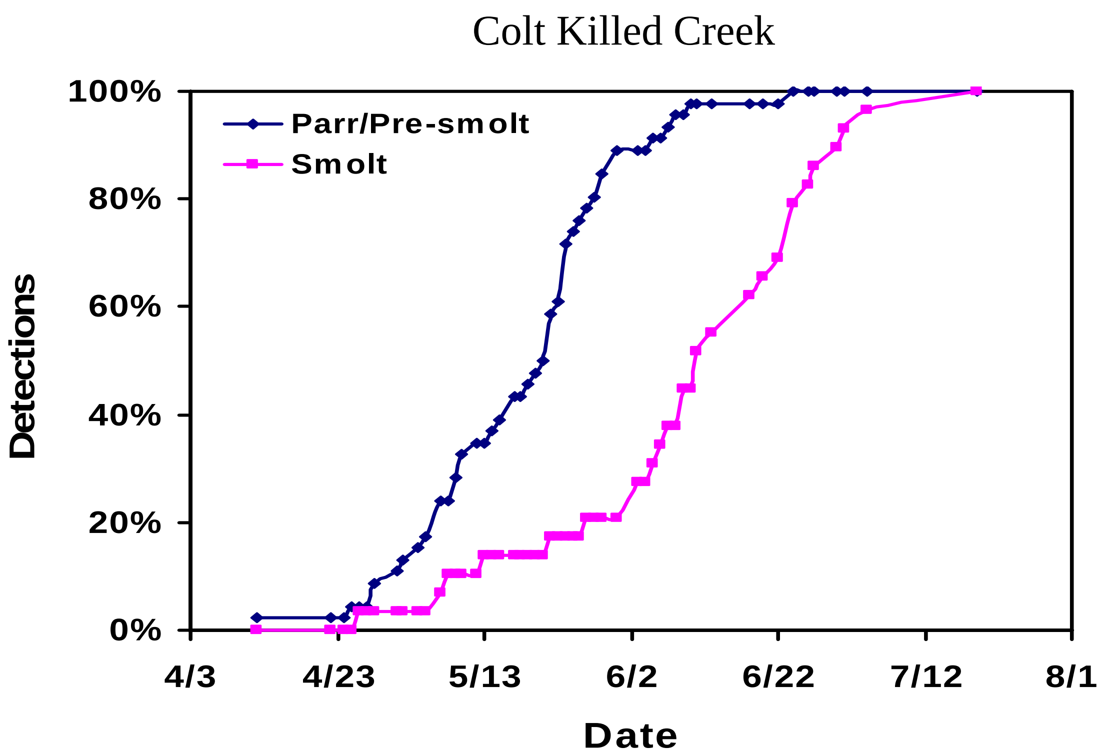
Trapping Stream	Season	Life Stage	Number Tagged	Detection Year	Unique Det.	LGR Det.	Mean Travel Time (d)	Travel Time SE (d)	First Arrival	10%	50%	90%	Last Arrival
				2003	26	21	24.1	2.6	6/12	6/22	7/4	7/16	7/18
Lemhi River[a]	Sp 03	Age 0	109	2004	6	5	305.0	1.9	4/2		4/17		5/8
Lemhi River	Su 03	P	14	2004	0	0							
Lemhi River	Fall 03	P-S	3,434	2004	880	450	166.3	0.9	3/29	4/7	4/23	5/5	6/15
Lemhi River	Sp 03	Seine P	699	2004	55	29	303.8	1.4	4/5	4/12	4/27	5/8	5/9
Lemhi River	Sp 04	S	585	2004	311	231	23.5	0.6	4/3	4/24	5/5	5/13	6/13
Marsh Creek	Su 03	Wild P	892	2004	77	51	273.7	3.2	3/31	4/15	4/26	5/9	5/23
Marsh Creek	Fall 03	Wild P-S	2,716	2004	468	362	216.4	0.8	4/3	4/23	5/4	5/18	6/25
Marsh Creek	Sp 04	Wild S	2,465	2004	692	567	43.9	0.7	4/15	5/4	5/23	6/22	7/20
Marsh Creek	Su/Fall 03	Yearlings	20	2004	2	2	291.1	8.8	4/27		4/27		5/7
Marsh Creek		Wild Su P	1,534	2004	114	84	276.1	1.1	4/3	4/20	5/2	5/12	5/30
				2003	712	399	21.0	0.6	5/28	5/29	6/21	7/8	10/1
Pahsimeroi River[a]	Sp 03	Age 0	1,963	2004	14	5	329.0	8.1	4/14		4/23		5/5
Pahsimeroi River	Su 03	Wild P	17	2004	1	1	300.3		4/27		4/27		4/27
Pahsimeroi River	Fall 03	Wild P-S	2,624	2004	505	261	165.7	1.0	4/1	4/13	4/25	5/5	5/14
Pahsimeroi River	Sp 04	Wild S	3,894	2004	1,162	851	22.5	0.3	4/6	4/26	6/15	6/29	7/19
Pahsimeroi River		Hatch S	970	2004	435	319	13.3	0.2	4/25	4/30	5/4	5/7	5/16
Sawtooth	Su 03	Wild P	914	2004	46	37	273.7	3.8	4/7	4/18	5/3	5/16	5/23
Sawtooth	Fall 03	Wild P-S	2,914	2004	354	260	213.2	1.1	4/4	4/22	5/5	5/15	5/23
Sawtooth	Sp 04	Wild S	3,039	2004	1,173	973	34.5	0.5	4/14	5/3	5/15	6/7	7/18
Secesh River	Su 03	Wild P	506	2004	39	27	252.9	4.0	4/4	4/7	4/26	5/13	6/20
Secesh River	Fall 03	Wild P-S	1,254	2004	137	84	212.6	2.3	4/3	4/11	4/29	5/24	6/20
Secesh River	Sp 04	Wild S	565	2004	123	97	47.3	1.8	5/4	5/14	6/9	6/27	7/19
Secesh River	Su/Fall 03	Yearlings	40	2004	3	2	143.6	125.6	4/18		4/18		6/15
Secesh River		Wild Su Pr	1,142	2004	46	30	252.8	3.3	4/1	4/15	5/2	5/28	6/13
South Fork Salmon River	Su 03	Hatch P	600	2004	22	17	253.4	8.7	4/28	5/2	5/9	5/25	5/27
South Fork Salmon River	Su/Fall 03	Wild P-S	3,440	2004	310	240	233.5	27.7	4/6	4/19	5/4	5/19	6/7
South Fork Salmon River	Su/Fall 03	Hatch P-S	617	2004	74	58	229.1	11.7	4/15	4/21	5/6	5/16	5/24
South Fork Salmon River	Sp 04	Hatch S	600	2004	353	274	41.7	5.0	4/23	4/28	5/5	5/10	5/25
South Fork Salmon River	Sp 04	Wild S	1,379	2004	507	400	45.9	17.8	4/21	5/4	5/23	6/12	7/23
East Fork Salmon River	Sp 04	Wild S	235	2004	126	106	32.4	9.1	4/21	4/30	5/10	5/20	6/11
West Fork Yankee Fork Salmon River	Sp 04	Wild S	46	2004	1	0	24.0		6/15				6/15

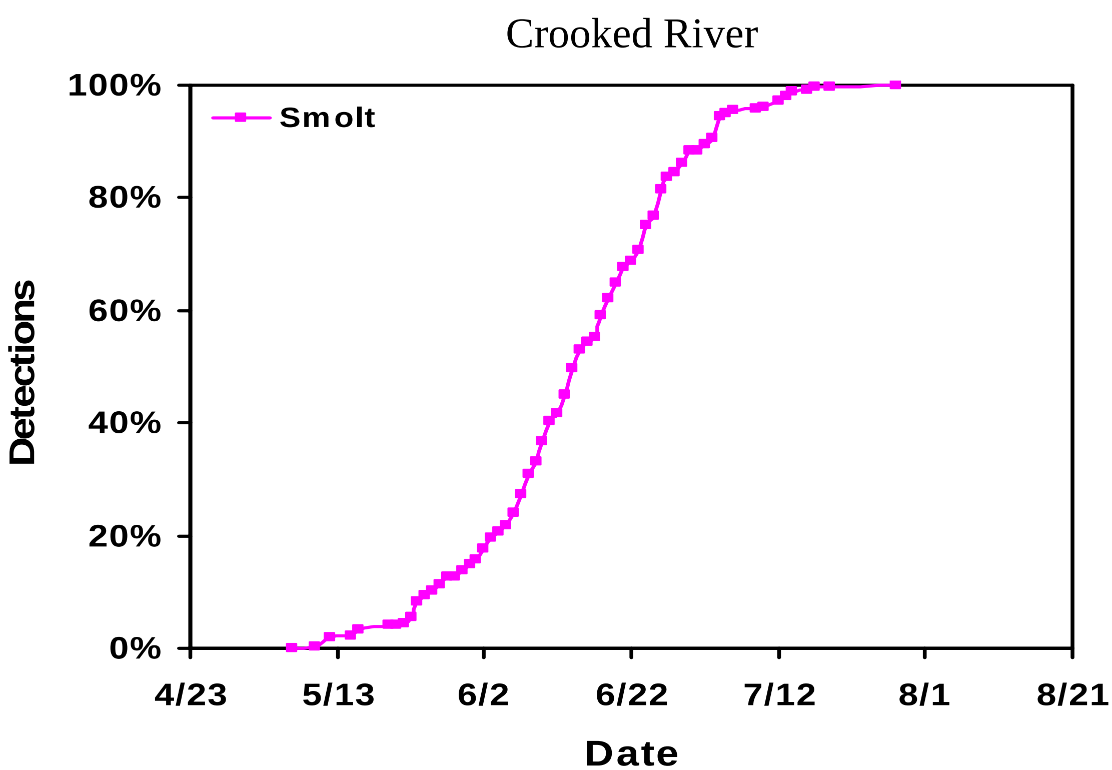
[a] Detections of these groups in both 2003 and 2004.

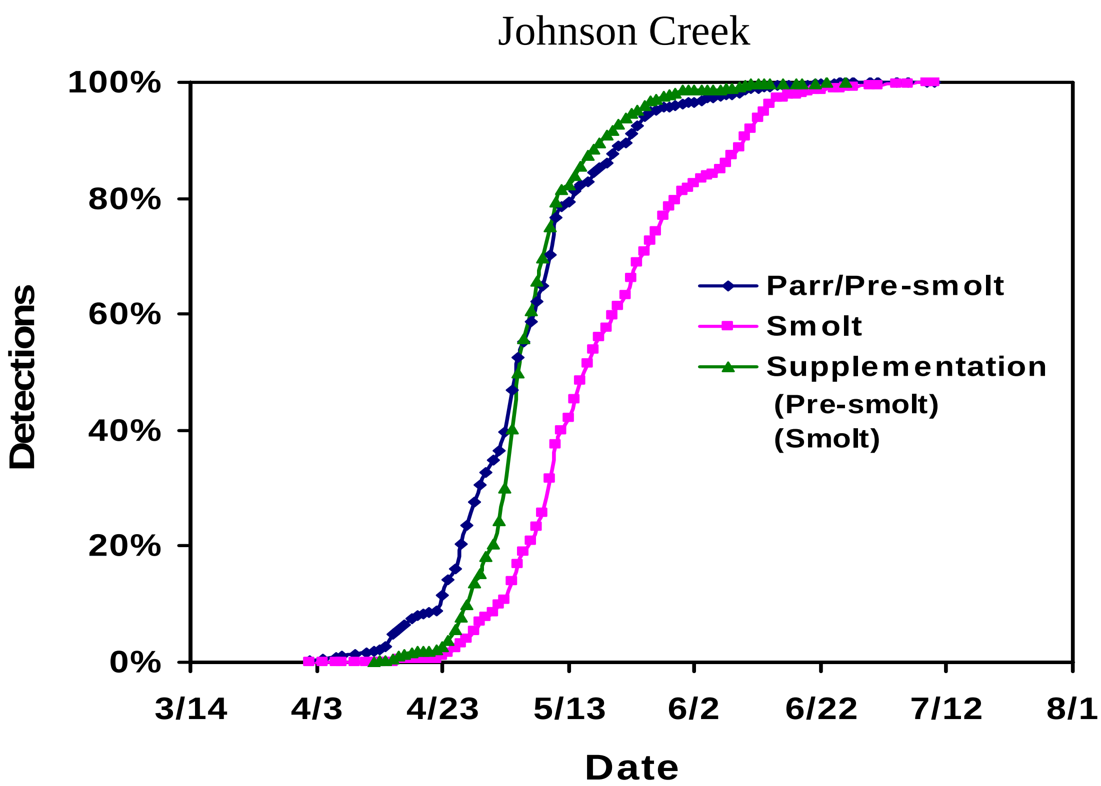
Appendix 7. Cumulative Lower Granite Dam passage for brood year 2002 juvenile Chinook salmon PIT tagged in Idaho Supplementation Study (ISS) streams. Separate passage curves are presented for the various life stages and study groups identified in the program (parr/presmolts, smolts, and supplementation).

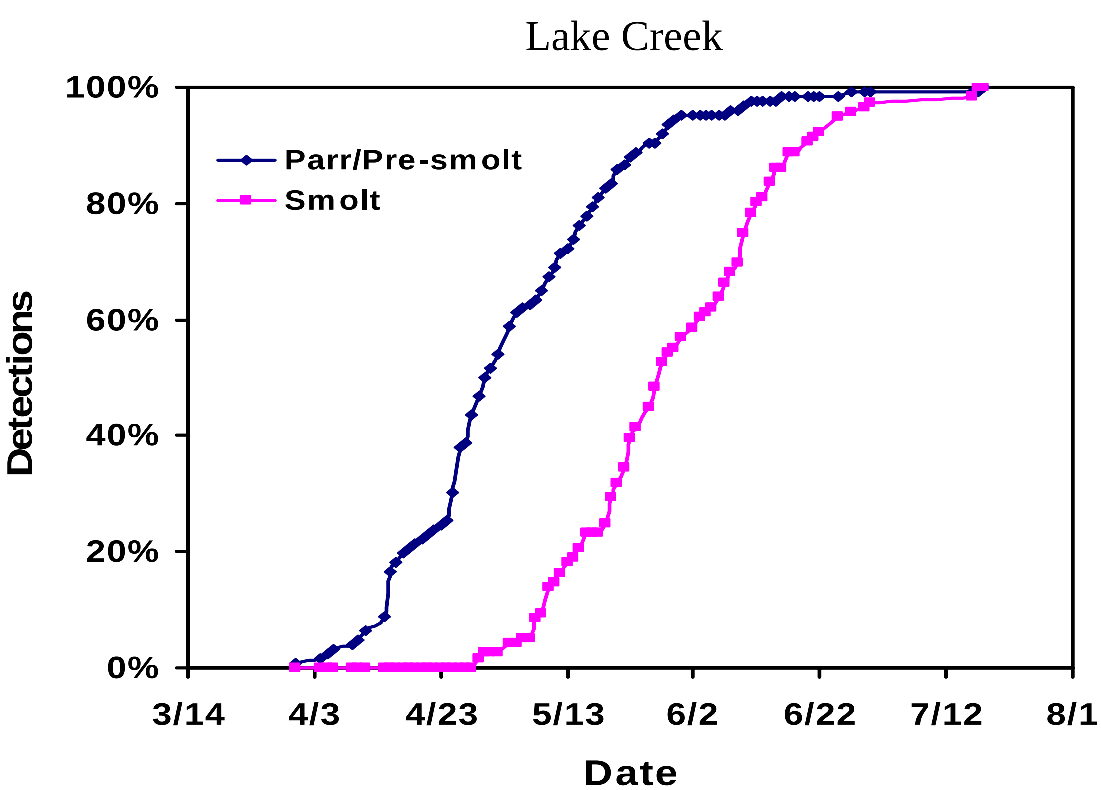


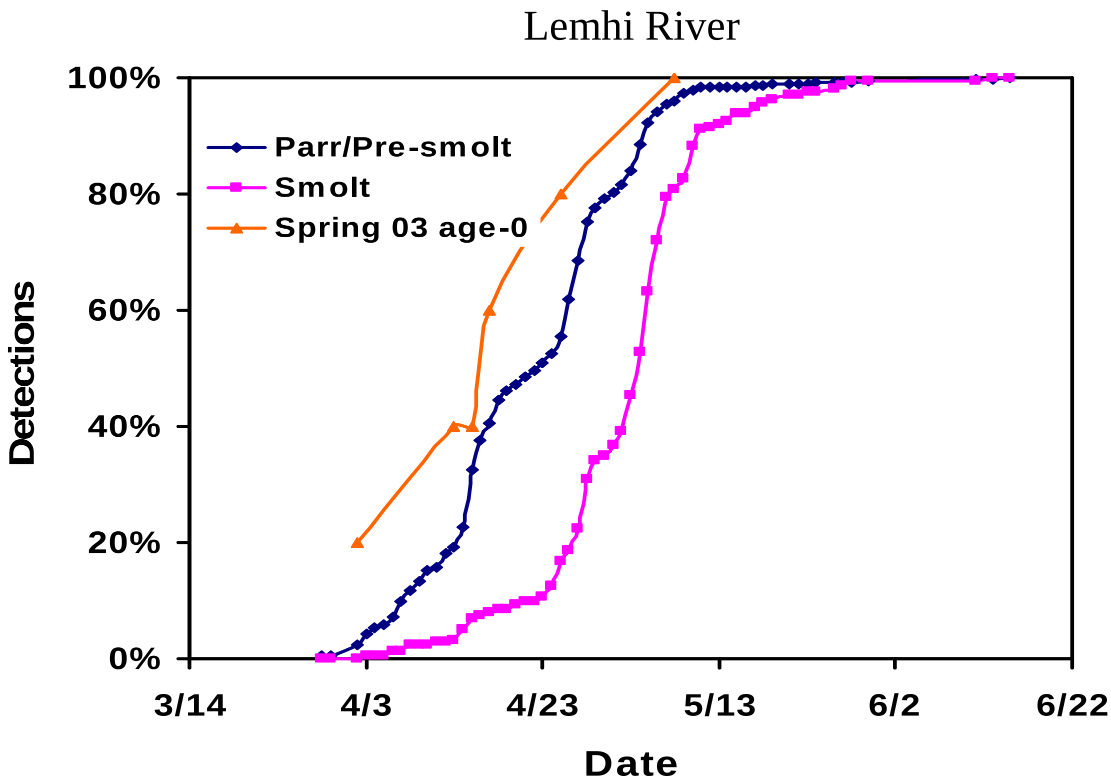


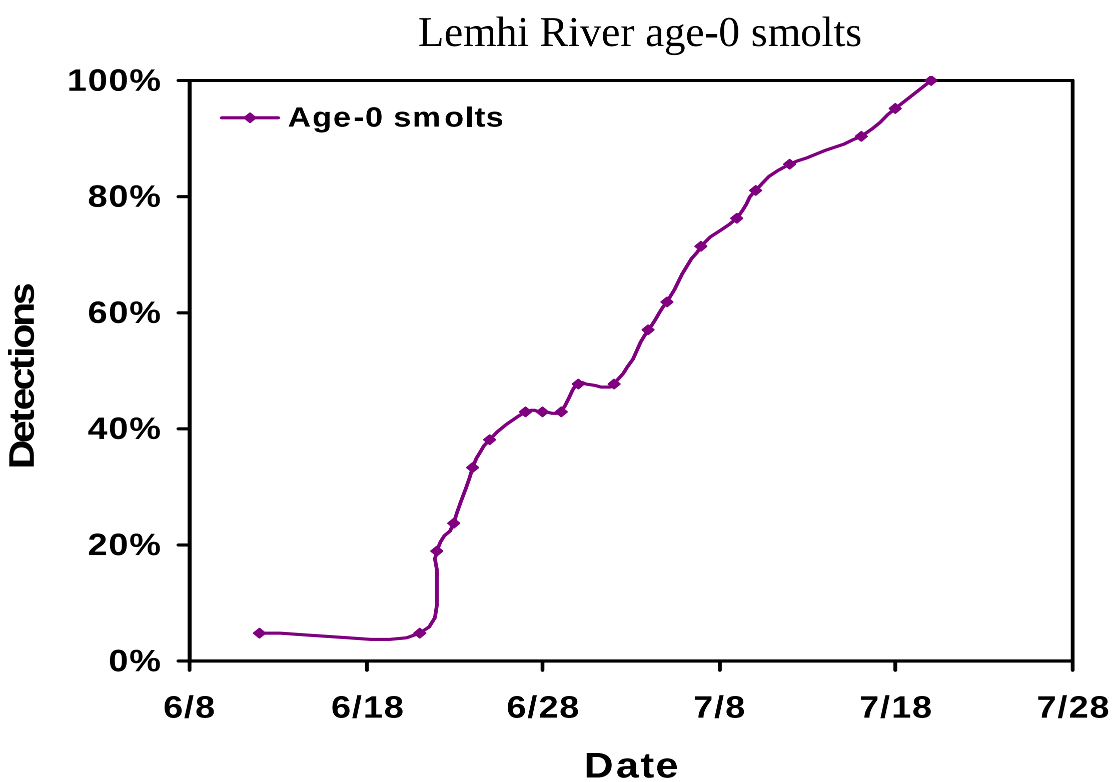

Colt Killed Creek
100%
80%
60%
40%
20%
0%
Detections
Parr/Pre-smolt
Smolt
4/3
4/23
5/13
6/2
6/22
7/12
8/1
Date

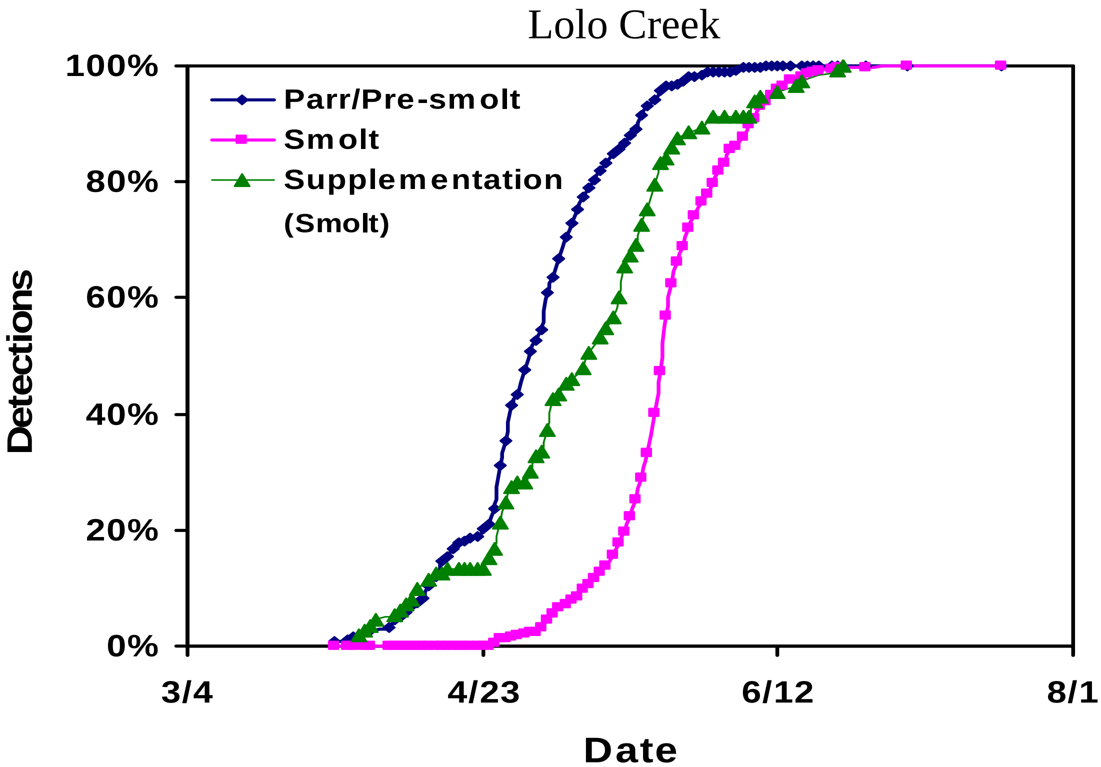

Crooked River
100%
80%
60%
40%
20%
0%
Detections
Smolt
4/23
5/13
6/2
6/22
7/12
8/1
8/21
Date

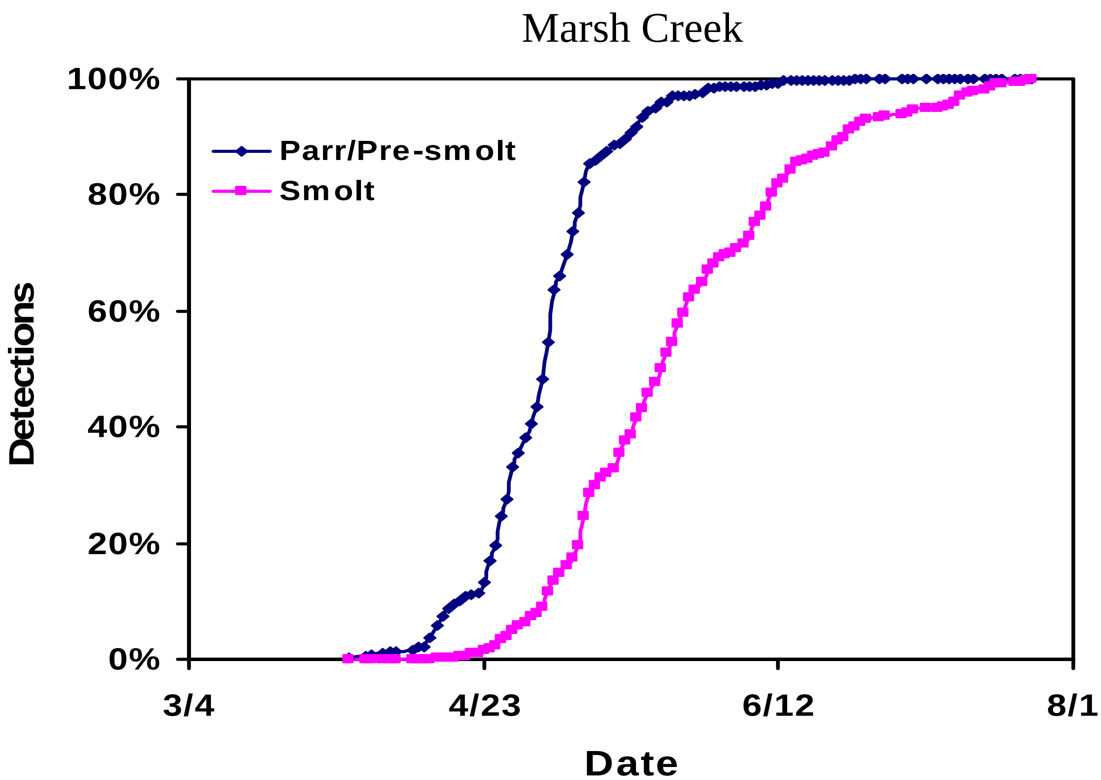

Johnson Creek
100%
80%
60%
40%
20%
0%
Detections
3/14
4/3
4/23
5/13
6/2
6/22
7/12
8/1
Date
Parr/Pre-smolt
Smolt
Supplementation
(Pre-smolt)
(Smolt)

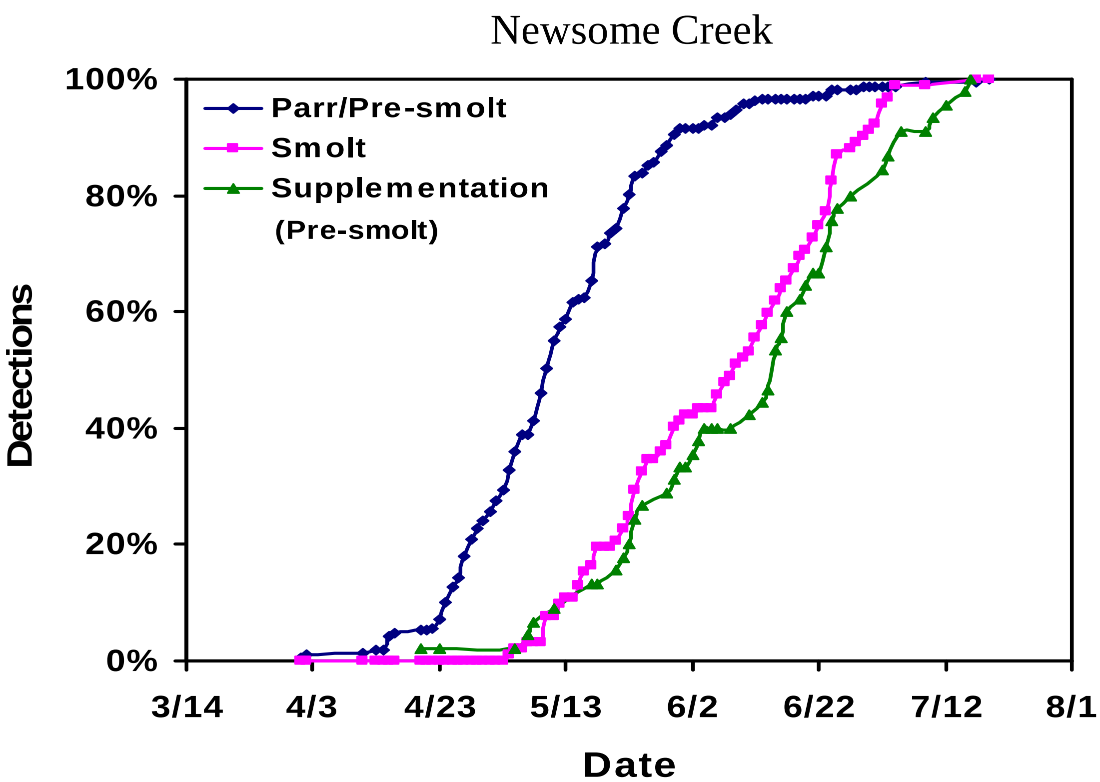

Lake Creek
100%
80%
60%
40%
20%
0%
Detections
3/14
4/3
4/23
5/13
6/2
6/22
7/12
8/1
Date
Parr/Pre-smolt
Smolt

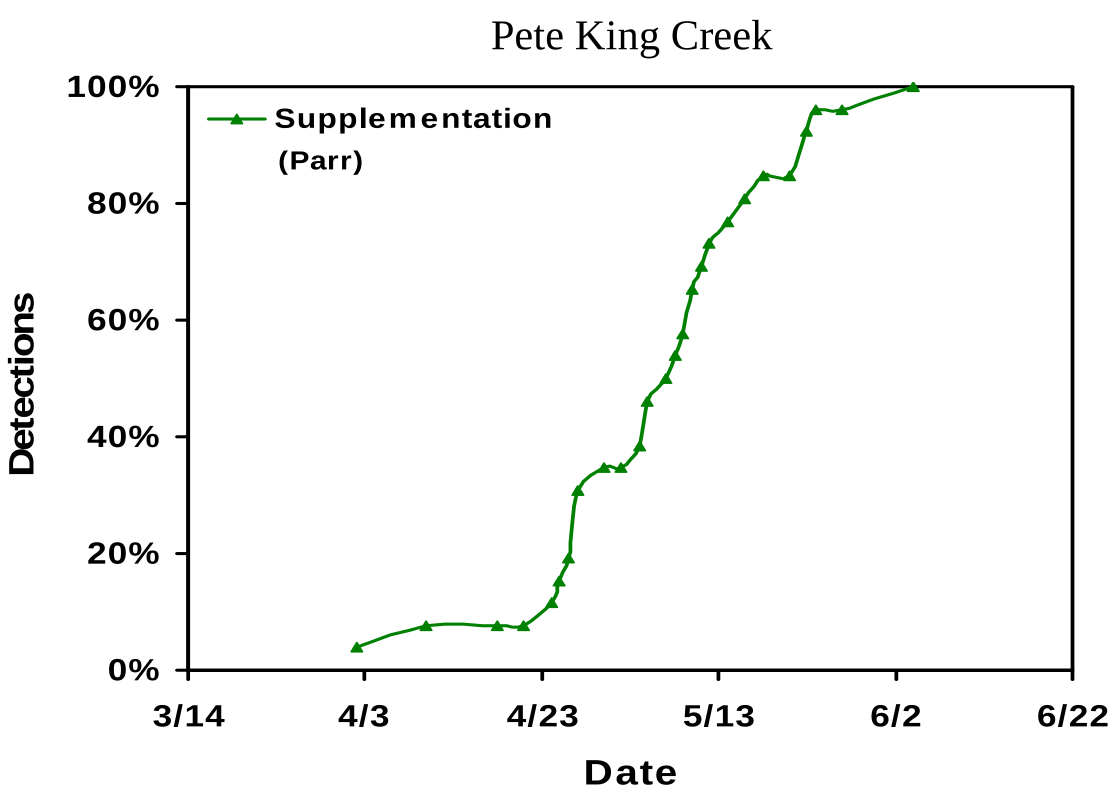

Lemhi River
Detections
100%
80%
60%
40%
20%
0%
Parr/Pre-smolt
Smolt
Spring 03 age-0
3/14
4/3
4/23
5/13
6/2
6/22
Date

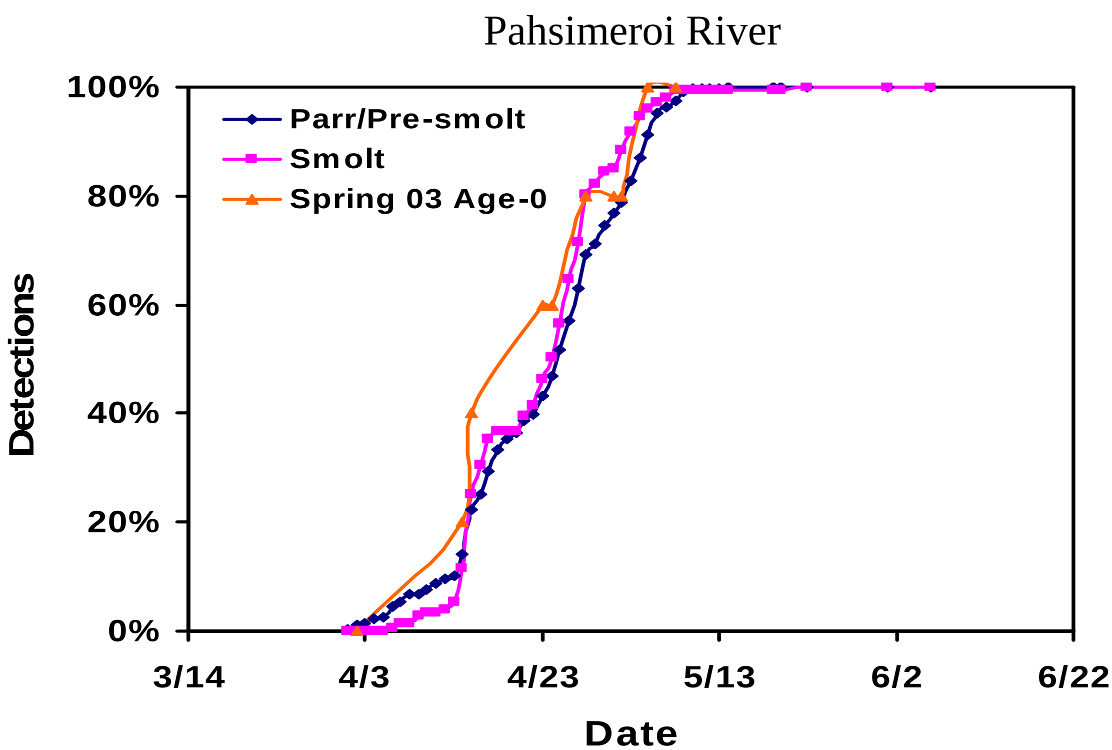

Lemhi River age-0 smolts
Detections
100%
80%
60%
40%
20%
0%
Age-0 smolts
6/8
6/18
6/28
7/8
7/18
7/28
Date

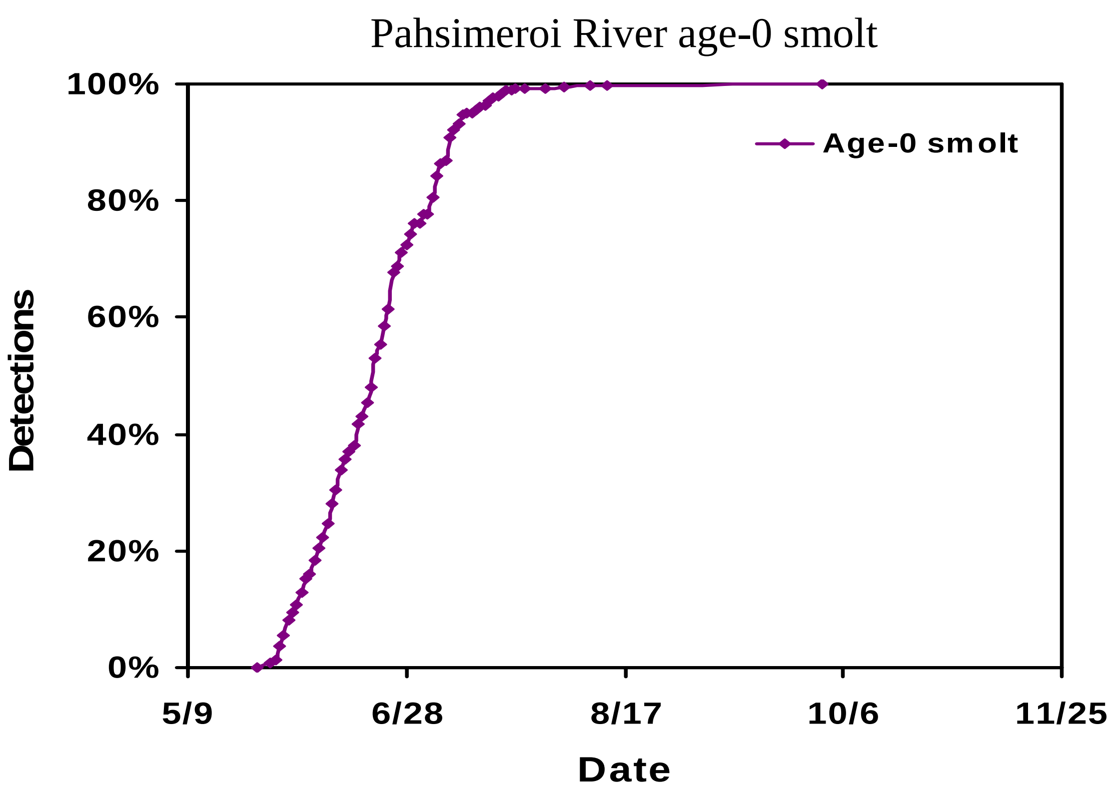

Lolo Creek
100%
80%
60%
40%
20%
0%
Detections
Parr/Pre-smolt
Smolt
Supplementation (Smolt)
3/4
4/23
6/12
8/1
Date

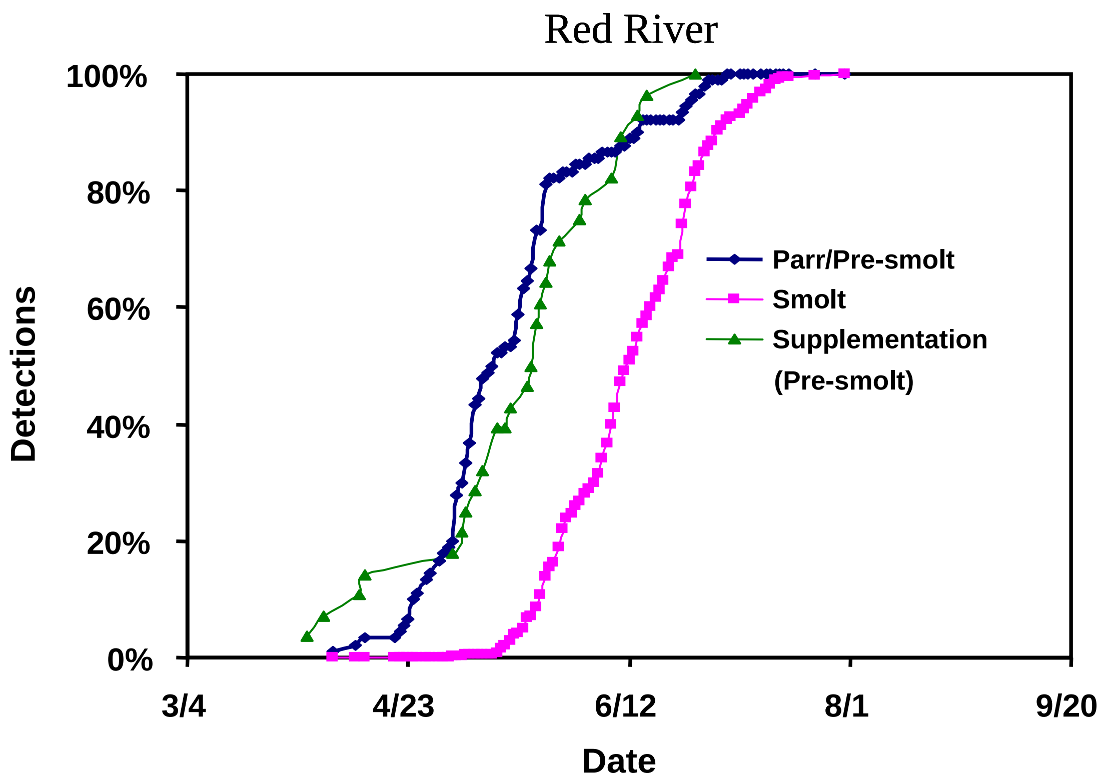

Marsh Creek
100%
80%
60%
40%
20%
0%
Detections
Parr/Pre-smolt
Smolt
3/4
4/23
6/12
8/1
Date

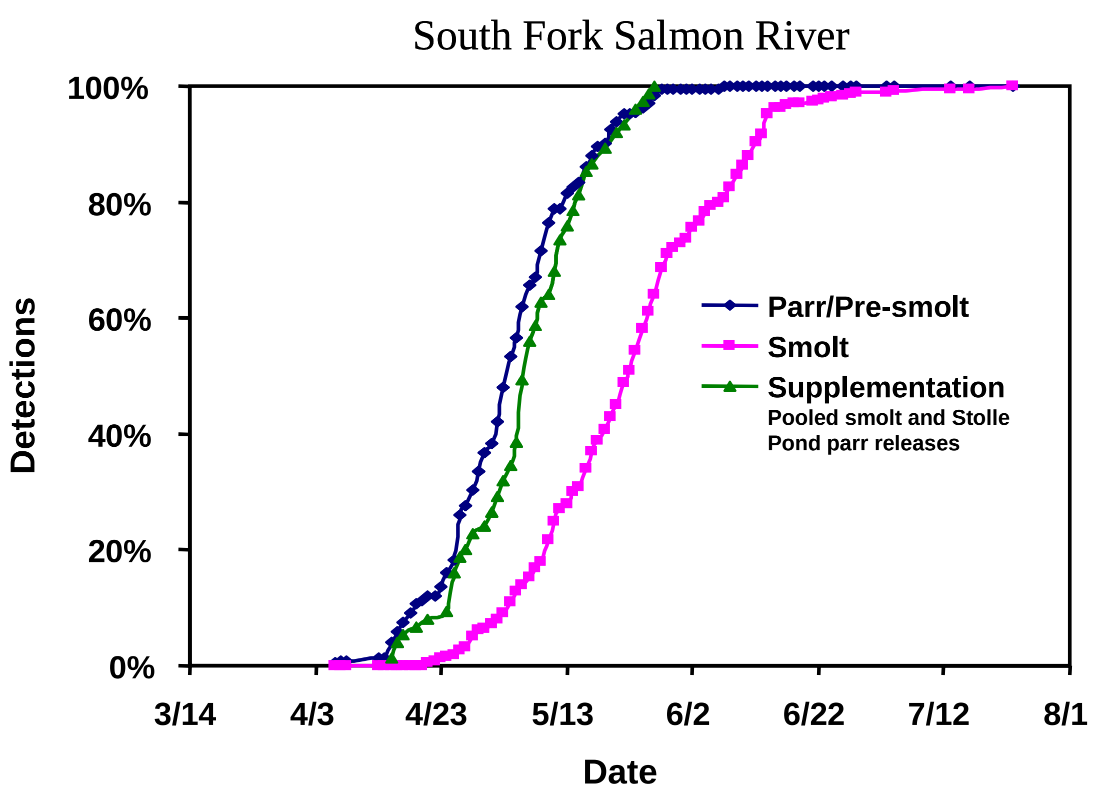

Newsome Creek
Parr/Pre-smolt
Smolt
Supplementation
(Pre-smolt)
Detections
0%
20%
40%
60%
80%
100%
3/14
4/3
4/23
5/13
6/2
6/22
7/12
8/1
Date

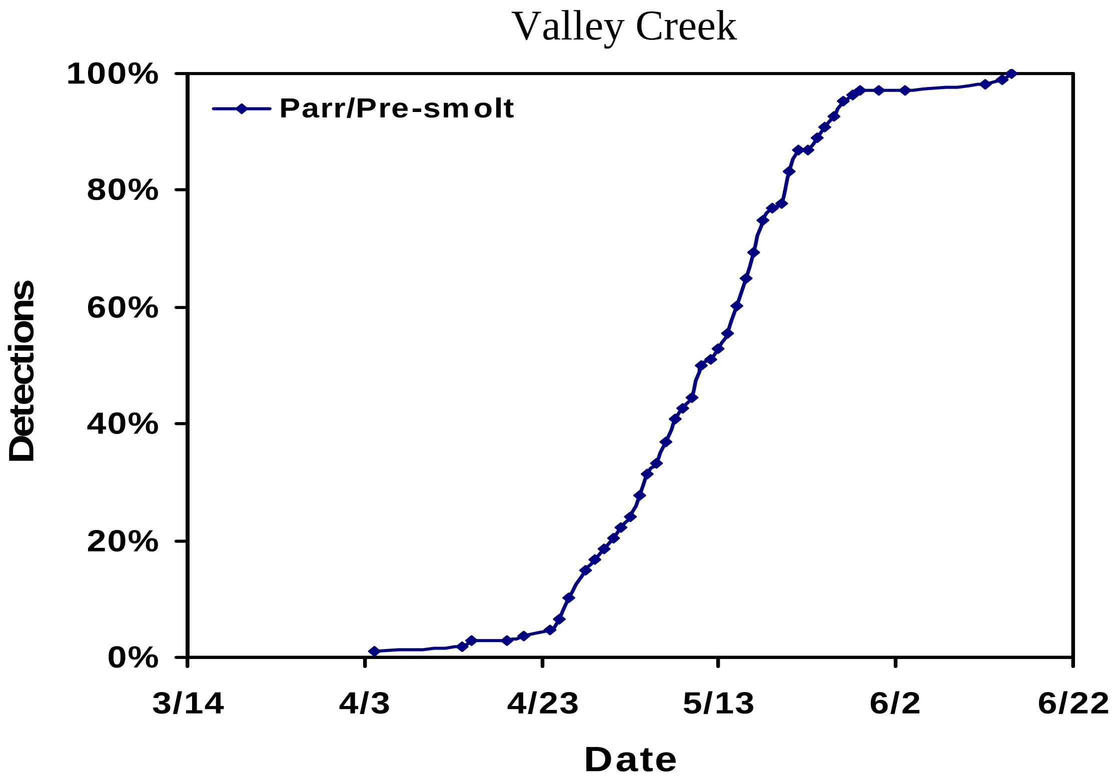

Pete King Creek
Supplementation
(Parr)
Detections
0%
20%
40%
60%
80%
100%
3/14
4/3
4/23
5/13
6/2
6/22
Date


Pahsimeroi River
100%
80%
60%
40%
20%
0%
Detections
Parr/Pre-smolt
Smolt
Spring 03 Age-0
3/14
4/3
4/23
5/13
6/2
6/22
Date


Pahsimeroi River age-0 smolt
100%
80%
60%
40%
20%
0%
Detections
Age-0 smolt
5/9
6/28
8/17
10/6
11/25
Date


Red River
100%
80%
60%
40%
20%
0%
Detections
3/4
4/23
6/12
8/1
9/20
Date
Parr/Pre-smolt
Smolt
Supplementation
(Pre-smolt)


South Fork Salmon River
100%
80%
60%
40%
20%
0%
Detections
3/14
4/3
4/23
5/13
6/2
6/22
7/12
8/1
Date
Parr/Pre-smolt
Smolt
Supplementation
Pooled smolt and Stolle
Pond parr releases


Valley Creek
Parr/Pre-smolt
100%
80%
60%
40%
20%
0%
Detections
3/14
4/3
4/23
5/13
6/2
6/22
Date

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