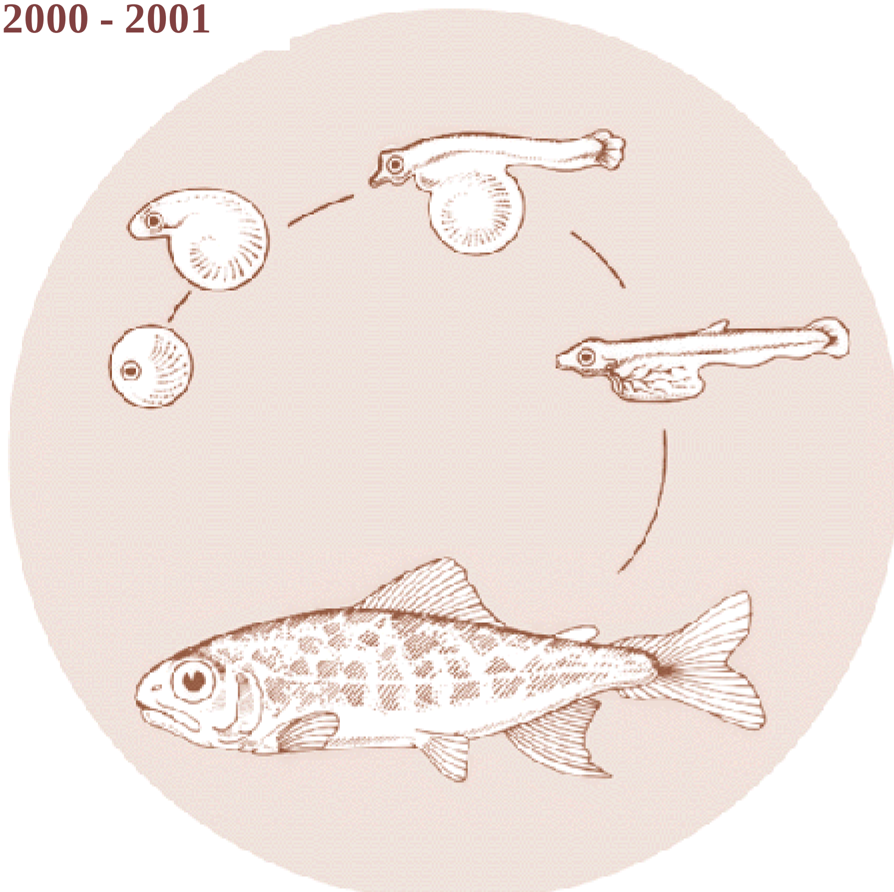
Salmon Supplementation Studies in Idaho Rivers

Idaho Supplementation Studies

Progress Report
2000 - 2001



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Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

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SALMON SUPPLEMENTATION STUDIES IN IDAHO RIVERS

2000-2001 Annual Report

Prepared by:

Chris Beasley
Jerry Lockhart
Toby Tabor
Ryan Kinzer

Nez Perce Tribe
Department of Fisheries Resources Management
P.O. Box 365
Lapwai, ID 83540

March 2003

SALMON SUPPLEMENTATION STUDIES IN IDAHO RIVERS

2000-2001 Annual Report (Brood Year 1999)
April 2000 through June 2001

Prepared by
Chris Beasley, ISS Project Leader
Jerry Lockhart, ISS Lead Fisheries Biologist
Toby Tabor, ISS Fisheries Biologist
and
Ryan Kinzer, ISS Lead Fisheries Technician

Nez Perce Tribe
Department of Fisheries Resources Management
PO Box 365
Lapwai, ID 83540

Prepared for:
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, Oregon 97208-3621

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ABSTRACT

This report summarizes brood year 1999 juvenile production and emigration data and adult return information for 2000 for streams studied by the Nez Perce Tribe for the cooperative Idaho Salmon Supplementation Studies in Idaho Rivers (ISS) project. In order to provide inclusive juvenile data for brood year 1999, we include data on parr, presmolt, smolt and yearling captures. Therefore, our reporting period includes juvenile data collected from April 2000 through June 2001 for parr, presmolts, and smolts and through June 2002 for brood year 1999 yearling emigrants. Data presented in this report include; fish outplant data for treatment streams, snorkel and screw trap estimates of juvenile fish abundance, juvenile emigration profiles, juvenile survival estimates to Lower Granite Dam (LGJ), redd counts, and carcass data. There were no brood year 1999 treatments in Legendary Bear or Fishing Creek. As in previous years, snorkeling methods provided highly variable population estimates. Alternatively, rotary screw traps operated in Lake Creek and the Secesh River provided more precise estimates of juvenile abundance by life history type. Juvenile fish emigration in Lake Creek and the Secesh River peaked during July and August. Juveniles produced in this watershed emigrated primarily at age zero, and apparently reared in downstream habitats before detection as age one or older fish at the Snake and Columbia River dams. Over the course of the ISS study, PIT tag data suggest that smolts typically exhibit the highest relative survival to Lower Granite Dam (LGJ) compared to presmolts and parr, although we observed the opposite trend for brood year 1999 juvenile emigrants from the Secesh River. SURPH2 survival estimates for brood year 1999 Lake Creek parr, presmolt, and smolt PIT tag groups to (LGJ) were 27%, 39%, and 49% respectively, and 14%, 12%, and 5% for the Secesh River. In 2000, we counted 41 redds in Legendary Bear Creek, 4 in Fishing Creek, 5 in Slate Creek, 153 in the Secesh River, and 180 in Lake Creek. We recovered 19 carcasses (11 natural 8 hatchery) in Legendary Bear Creek, one hatchery carcass in Fishing Creek, zero carcasses in Slate Creek, 82 carcasses (19 of unknown origin and 63 natural) in the Secesh River, and 178 carcasses (2 hatchery 176 natural) from Lake Creek. In 2000 the majority (82%) of carcasses were recovered in index spawning reaches. Preliminary analysis of brood year 1997 PIT tag return data for the Secesh River and Lake Creek yields LGJ to Lower Granite Dam (LGD) juvenile to adult survival rates of, 0.00% for parr, 0.20% for presmolts, and 3.13% for smolts. LGJ to LGD juvenile to adult return rates for brood year 1997 Legendary Bear Creek were 2.98% for naturally produced PIT tagged smolts and 0.89% for PIT tagged supplementation smolts. No adults were detected at LGD from brood year 1997 parr released in Fishing Creek.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACKNOWLEDGEMENTS

The Nez Perce Tribal Executive Committee authorized this research, with funding provided by the U.S. Department of Energy, Bonneville Power Administration (BPA). Many individuals and organizations contributed to this cooperative project, including the Nez Perce Tribe (NPT), Idaho Department of Fish and Game (IDFG), the United States Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and the United States Forest Service (USFS). Paul Kucera and Jay Hesse (NPT) provided technical review and comments for the report. Lake Creek and Secesh River summer parr PIT tag detections and survival estimates are based on individuals tagged by field crews working for Steve Achord (NMFS). Dave Faurot (NPT), Rob Hill (NPT), Mitch Daniel (NPT), Rick Orme (NPT), Kimberly Littlejohn (NPT), Jason Vogel (NPT), Jon Hansen (NPT), Jay Hesse (NPT), Karen Ketchu (USFS), and Kim Apperson (IDFG) assisted with redd count and snorkel surveys.

INTRODUCTION

This report summarizes Salmon Supplementation Studies in Idaho Rivers (ISS) research conducted during the spring of 2000 through the spring of 2002 by the Nez Perce Tribe (NPT). In order to provide complete data for juvenile production from an entire brood year, we combined calendar years into a single report. Specifically, brood year 1999 (BY99) young-of-the-year (YOY) chinook salmon (*Oncorhynchus* tshawytscha) were captured in the spring of calendar year 2000; BY99 parr, presmolts, and smolts were captured in summer 2000, fall 2000, and spring 2001 respectively; and BY99 yearlings were captured in summer and fall of 2001 and spring of 2002. Adult data such as redd counts and carcass recoveries are presented for return year 2000, and wherever possible adult return and survival data are presented by brood year.

Research goals for the ISS study as described in Bowles and Leitzinger (1991) are:

1) Assess the effectiveness of using of hatchery reared spring/summer chinook salmon to increase the abundance and productivity of natural populations of spring and summer chinook salmon in the Salmon and Clearwater River drainages.

2) Evaluate the genetic and ecological impacts of hatchery spring/summer chinook salmon on naturally reproducing spring/summer chinook salmon populations.

ISS streams studied by the NPT in the Clearwater River Subbasin include Legendary Bear Creek (formerly Papoose Creek) and Fishing Creek (formerly Squaw Creek). ISS streams studied by the NPT in the Salmon River Subbasin include Slate Creek, the Secesh River, and Lake Creek. Fishing Creek and Legendary Bear Creek are designated to receive parr and smolt treatments (T) respectively, while the Secesh River and Lake Creek are designated as non-supplemented control streams (C). Slate Creek was designated as a treatment stream but has not received any ISS treatments. Further detail regarding the experimental design and results of the first five years of the study can be found in Bowles and Leitzinger (1991) and Walters et al. (1999).

The NPT ISS project objectives are:

1) Monitor and evaluate the effects of supplementation on presmolt and smolt abundance and spawning escapements of naturally produced spring/summer chinook salmon.

2) Monitor and evaluate changes in natural productivity and genetic composition of target and adjacent populations following supplementation.

3) Determine which supplementation strategies (broodstock and release age) provide the quickest and most positive response in natural production without adverse effects on productivity.

4) Coordinate supplementation research planning and field evaluation program activities and management recommendations for the Nez Perce Tribe.

Products of this research include:

1) Estimates of juvenile abundance, by life history stage (YOY, parr, presmolt, smolt, and yearling) for chinook salmon in Lake Creek and the Secesh River.

2) Estimates and 95% confidence intervals for juvenile chinook salmon survival to the Lower Granite Dam (LGJ), by life history stage for emigrants from Lake Creek and the Secesh River.

3) Arrival and passage periods at LGJ, by life history stage for juvenile chinook salmon emigrants from Lake Creek and the Secesh River.

4) Chinook salmon parr abundance estimates from Legendary Bear Creek and Fishing Creek.

5) Juvenile chinook salmon survival estimates to LGJ for natural and outplanted (treatment) fish in Legendary Bear Creek and Fishing Creek.

6) Multiple pass redd count data for Lake Creek, the Secesh River, Slate Creek, Legendary Bear Creek, and Fishing Creek.

7) Carcass data including; age structure, origin (hatchery or natural), sex, length, and percent spawned for the Secesh River, Lake Creek, Slate Creek, Legendary Bear Creek, and Fishing Creek.

DESCRIPTION OF THE STUDY AREA

The NPT studies two streams located in the Clearwater River Subbasin and three streams in the Salmon River Subbasin (Figure 1). Legendary Bear Creek (Treatment; T) and Fishing Creek (T) are tributaries of the Lochsa River that, in turn, joins the Selway River to form the Middle Fork of the Clearwater River. Slate Creek (Control; C) is a tributary of the lower Salmon River. Secesh River (C) is a tributary of the South Fork of the Salmon River and Lake Creek (C) is a tributary of the Secesh River.

The study streams are subject to typical land use activities that occur in the intermountain region such as grazing, road building, logging, housing development and mining activities. Despite localized impacts, the study streams remain relatively pristine (Bowles and Leitzinger 1991).

Fish communities in the study streams consist of hatchery, wild, or naturally produced spring or summer chinook salmon, bulltrout (*Salvelinus confluentus*), cuttroat trout (*O. clarki*), mountain whitefish (*Prosopium williamsoni*), northern pike minnow (*Ptychocheilus oregonensis*), red sided shiner (*Richardsonius balteatus*), sculpins (*Cottus sp*.), dace (*Rhinichthys sp*.), suckers (*Catostomus sp*.), rainbow trout (*O. mykiss*) and brook trout (*S. fontinalis*) (Bowles and Leitzinger 1991).

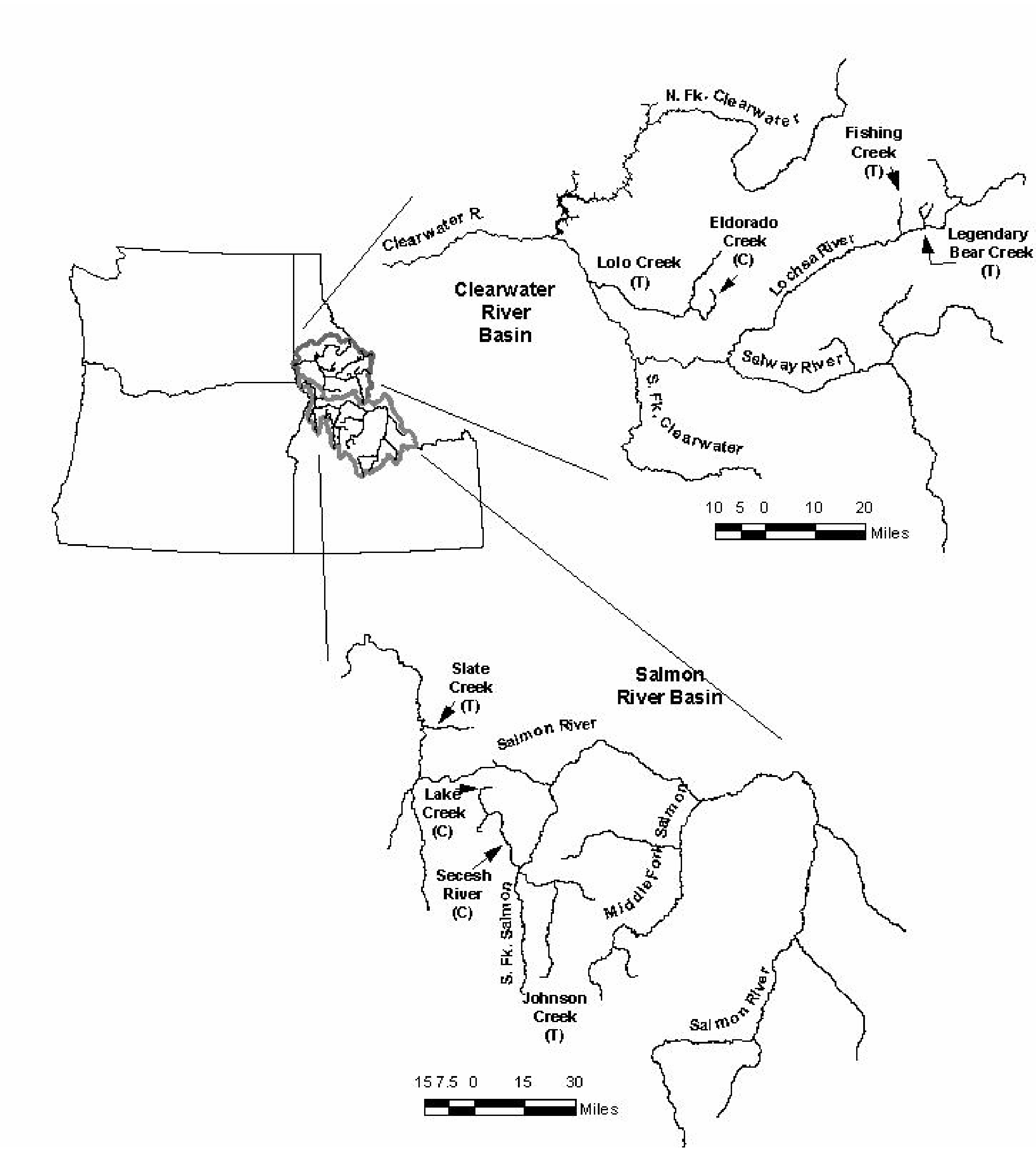


Figure 1. ISS streams studied by the Nez Perce Tribe include Slate Creek, Lake Creek, the Secesh River, Fishing Creek, and Legendary Bear Creek.

METHODS

General methods used for all ISS streams are described in Bowles and Leitzinger (1991). More detailed methodologies are described in the ISS cooperators five-year report (Walters et al. 1999). Specific methodologies used for the NPT ISS project are described in this section.

Life Stages

For analysis, we define life stages based on age, biological development, and arbitrary seasonal trapping dates. Spring/summer chinook salmon "young of the year (YOY)" are newly emerged fish that are captured prior to July 1 (spring trapping season). Spring/summer chinook salmon "parr" are fish entering their first summer in fresh water that are collected between July 1 and August 31 (summer trapping season) as they emigrate from natal streams. Spring/summer chinook salmon "summer parr" are juvenile fish that are collected between July 1 and August 31 by a one time capture event (seining, electro-fishing, etc.). Summer parr may or may not be actively emigrating at capture (some leave in the summer, fall, or spring of the following year). Although spring/summer chinook salmon parr in the act of emigration before September 1 are defined as parr, they also may be considered presmolts. Spring/summer chinook salmon "presmolts" are actively emigrating juvenile fish greater than one year of age but less than eighteen months of age between September 1 and December 31 (fall trapping season). Presmolts in the act of emigration do not show typical smolt characteristics (e.g., silvery color and the tendency to easily lose their scales). Spring/summer chinook salmon "smolts" are actively emigrating juvenile fish greater than one year old captured between January 1 and June 30. Spring/summer chinook salmon "yearlings" are in their second summer or fall, or third spring. Spring/summer chinook salmon "precocial yearlings" are yearlings that release milt when handled. Type 1 yearlings are those that leave the natal stream shortly after emergence and rear in downstream locations. Type 2 yearlings are those that rear in the natal stream a second summer. Spring/summer chinook salmon "adults" are fish that have emigrated to the ocean and returned to fresh water to spawn.

Following Bowles and Leitzinger (1991), we define "wild" fish as those chinook salmon lacking hatchery ancestry that result from in-stream production, "natural" fish refers to chinook salmon resulting from in-stream production involving at least one parent or ancestor of hatchery origin, "hatchery" fish refers to chinook salmon that were reared in a hatchery for some portion of their life.

Treatments

Juvenile chinook salmon are stocked in different streams at different life history stages. The ISS experimental design designated parr releases for Fishing Creek and smolt releases for Legendary Bear Creek. These releases were scheduled for calendar years 1993 to 1997 (BY92 to BY95). Supplementation fish for Fishing Creek and Legendary Bear Creek are reared at Clearwater Anadromous Fish Hatchery (CAFH) or Dworshak National Fish Hatchery (DNFH). Broodstock at the CAFH were originally derived from a combination of adults collected from the Middle Fork Salmon River, Lookinglass Hatchery, Rapid River Hatchery, and the Powell satellite collection facility. DNFH broodstock were originally derived from the Little White Salmon River Hatchery, Leavenworth Hatchery, Rapid River Hatchery, and Carson Hatchery.

Treatment fish are marked using a combination of coded wire tags (CWT) and fin clips (ventral and/or adipose) to enable identification of adults when they return to streams and to ensure differentiation between hatchery and natural adults for broodstock management and analysis purposes. Passive Integrated Transponder tags (PIT tags) are also inserted into a portion of treatment fish to evaluate survival to Lower Granite Dam (LGJ) and potentially juvenile to adult survival from LGJ to Lower Granite Dam (LGD). Bowles and Leitzinger (1991) recommend between 300 and 700 PIT tags for each release group of supplementation fish. Parr and smolts are typically released into treatment streams during July and August and March and April respectively. Fish are trucked to all release sites.

Population Estimates of Juvenile Fish based on Snorkeling

To estimate parr abundance in Legendary Bear Creek and Fishing Creek, we use underwater observations by snorkelers. Sites in Legendary Bear Creek, Fishing Creek, the Secesh River and Lake Creek are snorkeled to update the General Parr Monitoring (GPM) database maintained by the Idaho Department of Fish and Game (IDFG; BPA 1983-007-00). Techniques and rationale for estimating parr abundance using underwater observation are described in Petrosky and Holubetz (1985), Hankin (1986), and Hankin and Reeves (1988).

Upper and lower boundaries were established on Lake Creek, the Secesh River, Fishing Creek, and Legendary Bear Creek that encompass all spawning and rearing areas typically used by chinook salmon (Table 1). Streams are divided into strata with multiple sample units based on channel and habitat types. Each unit includes 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). Channel types include confined, steep gradient reaches (Type B), and lower gradient, meandering reaches (Type C) (Rosgen 1985, 1994). Four habitat types are used: pool, riffle, run, and pocket water.

Table 1. Downstream and upstream boundaries snorkeled for parr population estimates, 1992-2000.

Basin **Stream**	**Downstream Boundary**	**Upstream Boundary**
Clearwater		
Fishing Creek	Mouth	Culvert 0.8 km upstream from confluence of W. Fk. Fishing Creek
Legendary Bear Creek	Mouth	Confluence of E. Fork and W. Fork Legendary Bear Creek
Salmon		
Secesh River	Confluence of Alex Creek [a]	Confluence of Lake Creek and Summit Creek
Lake Creek	Mouth	Confluence of Corduroy Creek [b]

[a] Prior to 1997, the boundary was the Chinook Campground.
[b] Prior to 1997, the boundary was the bridge at Forest Route 318.

Pool, riffle, and run units correspond to the definitions of Bisson et al. (1982). Pocket water is predominantly swift with numerous protruding boulders or other large obstructions that create scour holes (pockets) or eddies (McCain et al. 1990).

In 2000, snorkel surveys in Legendary Bear Creek occurred on 19 and 20 July, 20 and 21 July in Fishing Creek, 27 July in the Secesh River, and 27 July in Lake Creek. To ensure adequate light observations are limited to non-overcast days between 10:00 hours and 18:00 hours. Unless the stream is normally a colder water stream, counts are limited to periods when water temperatures are above 10^{o} C (Thurow 1994). Visibilities are measured to determine the most efficient fish viewing distance between snorkelers. To measure visibility, a Secchi disk or similar object is placed in the water. A submerged snorkeler observes the object while drifting downstream until he no longer observes the Secchi disk or object. The distance between the Secchi disk or object and the last point it is observed is measured as the visibility. Snorkelers are then arranged across the entire stream at distances appropriate for visibility conditions. All salmonids are identified, counted, and length estimates are recorded. Presence or absence of non-salmonids is noted. The length and width of sample sites are measured to determine the sample area. Observed chinook salmon parr densities (number per $100m^2$) and parr population estimates are calculated for each stratum as described in Nemeth et al. (1996), wherein:

Total area of stratum = (Total length of stratum) x (Mean width of reaches snorkeled)

Number of possible reaches within the stratum =
(Total length of stratum)/(Mean length of reaches snorkeled)

Average area of all possible reaches = (Total area)/(Number of possible reaches within stratum)

Adjusted number of parr for individual reaches snorkeled =
(Number of parr observed) x (Average area of possible reaches)/(Area of snorkeled reaches)

Population estimate for stratum =
Population estimate ± (t-value$_{(n-1df)}$) x (Standard deviation of parr between reaches)/Square root of the number of reaches

Parr population estimate = Sum of all strata

Population Estimates of Juvenile Fish based on Rotary Screw Trapping

Juvenile fish traps are five-foot diameter rotary-screw traps manufactured by EG Solutions, Corvallis, Oregon. The Lake Creek trap (1841 m elevation; river kilometer (rkm) 522.303.215.059.045.001;1 km above the mouth) and Secesh River trap (1731 m elevation; rkm 522.303.215.059.030; 30 km above the mouth) are deployed as soon as conditions permit after March 1 and are fished until early November, when ice formation forces us to remove them. For analysis purposes, we arbitrarily define trapping seasons as follows: 1) spring season - trap installation through June 30; 2) summer trapping season - July 1 through August 31 and; 3) fall trapping season - September 1 through trap removal.

Traps are checked at least once daily between 0700 hours and 1830 hours or more frequently when problems are anticipated (e.g. when high water or ice conditions exist). Our definition of a "trap day" consists of two periods from 1800 hours to 0600 hours and from 0600 hours until 1800 hours. Our observations of fish movement suggest that there is a strong diurnal pattern to emigration, with the majority of fish emigrating between 2200 and 0400 hours. High water and debris cause the screw traps to be inoperable for short durations in the spring and early summer seasons. When a trap can only be operated between 1800 to 0600 hours we use the term "half day," and those data are included in analyses. However, if a trap is inoperable from 1800 to 0600 hours, we assume that the bulk of the daily emigration has been missed, and data from the entire trap day are excluded from analyses. When a trap day is missed, we interpolate emigration for that day by averaging emigration estimates from the previous and subsequent days.

In order to estimate juvenile survival to LGJ, Bowles and Leitzinger (1991) suggested that a minimum of 500 parr should be PIT tagged annually in ISS control streams. In addition, in streams with juvenile traps, a minimum of 300 fall (presmolt) and 100 spring (smolt) emigrants 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 LGJ. Given the uncertainty associated with original survival assumptions, annual NPT PIT tag goals are 500 smolts, 500 presmolts, and 500 parr in both the Secesh River and Lake Creek. In order to disperse PIT tags throughout each trapping period, we set daily PIT tag goals by dividing 500 PIT tags by the number of trapping days in each trap season. When daily (or seasonal) PIT tag goals cannot be met, excess tags are deployed in subsequent days or seasons.

Each day, captured fish are anesthetized in buffered Tricaine Methanesulfonate (MS222), scanned for PIT tags, weighed (to nearest 0.1g), and measured (fork length to nearest mm). To reduce retention time in the anesthetic, no more than 20 juvenile fish are anesthetized at one time. A sub-sample of fish is marked with PIT-tags for survival studies, and another subsample is marked with caudal fin clips or Bismark-Brown dye for trap efficiency estimates. Fish must be greater than 59 mm to be PIT-tagged or greater than 39 mm to be fin clipped or dyed. Each season, a separate group of yearlings are PIT-tagged for evaluation as precocial or non-precocial yearlings. PIT-tag protocols follow procedures described by Kiefer and Forster (1991) and the PIT Tag Steering Committee (1992). Tag needles and PIT-tags are sterilized in a 70% ethanol solution for ten minutes prior to use and between uses. After marking, fish are held in the stream in live boxes. Live boxes are large plastic shipping boxes with lids and numerous holes drilled into the sides or ends of the boxes. Fish are released after 12 hours, usually at dusk, when they appear to be totally recovered from the anesthetic. To provide trap efficiency evaluation data, a sub-sample of marked fish is released approximately 0.4 km upstream of the trap or at least two riffles and a pool upstream of the trap. All other fish are held in separate live boxes and released below hydraulic controls downstream of the trap.

To calculate seasonal and brood year specific emigration estimates from rotary screw trap operations we utilize a Gauss program developed by the University of Idaho (Steinhorst 2000). Gauss (Aptech Systems, Maple Valley, Washington) is a structured programming language where the basic variables are matrices rather than scalars. We divide the trap seasons into periods, typically 7 to 10 days in length. The length of periods is selected to minimize environmental variation within each period, which presumably translates to a relative decrease in variation of trap efficiencies within a given period. Fish are marked and released upstream of the trap. The recaptured portion of the marked fish provides an initial calculated p_1 and the number of unmarked fish provides an initial N. This information is inserted 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 ($N^B_{simple\ h} = c_h$ X $(m_h+1)/(r_h+1)$) is used to determine N (Steinhorst 2000). 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 emigrating fish. Our release sites are selected to maximize the probability that marked fish will mix with the general population prior to arriving at the trap.

Young-of-the-year chinook salmon fry are not included in smolt estimates for the spring season but are included in the summer parr estimate. Yearling or precocial chinook salmon caught in traps during summer, fall, or spring are likewise not included in parr, pre-smolt, or smolt emigrant estimates for the brood year being studied.

Summer Parr PIT Tagging

When densities are great enough to make collection feasible, natural parr are PIT tagged in treatment streams (Legendary Bear Creek and Fishing Creek). A minimum goal of 500 -700 parr are targeted for PIT tagging (Bowles and Leitzinger 1991). Snorkelers are used to locate and capture fish with common beach seines. When seining is ineffective or impossible, minnow traps are used to collect fish. PIT tagged fish are held for 24 hours to determine tag loss and mortality rates before release. Since the National Marine Fisheries Service (NMFS) collects and PIT tags summer parr in both the Secesh River and Lake Creek (BPA Project Number 93-029-00), we do not collect summer parr for our project in those streams. For analysis purposes, we include detection data from those fish in our reports.

Arrival Timing and Survival

During emigration, some juvenile fish pass through PIT tag interrogation facilities located in Snake and Columbia River dams. PIT tag interrogation efficiencies differ by dam as a result of differences in design or by changes in operation (e.g., spill). The PIT tag detections recorded at these facilities are stored and disseminated from the PIT Tag Information System (PTAGIS) database (PSMFC 1998; WWW.ptagis.org). We utilize PIT tag detections at mainstem dams to estimate the number of juveniles arriving at LGJ, and the survival of individual PIT tag groups to LGJ.

The PTAGIS database is queried for information on the cumulative number of fish from each PIT tag group that are detected at all Snake and Columbia River interrogation sites. Queries include PIT tag numbers, dates of detections, and travel times. Detections of yearlings that were PIT tagged as parr are separated from these queries and evaluated as individual groups.

We define passage as the length of time each PIT tagged group takes to pass LGJ. For this report, we describe passage of PIT tagged juvenile fish at LGJ in terms of the maximum range of days (referred to as passage days) required to detect the first arrival, 10%, 50%, 90%, and 100% of tagged fish by brood year and basin. The date for 100% detection is the date of the last detection for each individual PIT tag group.

The Survival Under Proportional Hazards (SURPH2) model (Lady et al.2001), is used to calculate survival and detection probabilities of PIT tagged fish to LGJ. We use SURPH2 information to compare performances among and between the different life stages of tagged juvenile salmon.

Life History

Juvenile life history data are derived from yearly trap collections, stream collections by other methods (seines, minnow traps, etc.), and PIT tag detections at various stream sites and the Snake and Columbia River hydroprojects. Timing and relative abundance of juvenile fish runs are determined by plotting the number of juvenile fish captured each day at the traps from July 1 through June 30. Downstream relocation of fish is determined by recapture of fish marked in Lake Creek at the Secesh River screw trap. Delayed emigration of juvenile chinook salmon that spend a second year in fresh water is determined from PIT tag detections at the Snake and Columbia River hydroproject interrogation and trap sites. We measure the condition factor of emigrating chinook salmon for different time periods with the formula:

$$K = (w/l^3)(10^4)$$

where K is the condition factor, w is the weight in grams (g), and l is the length in millimeters (Everhart and Youngs 1992).

Adult Escapement

Adult life history data are derived from PIT tag detections, spawning ground surveys, and underwater video data. Redd counts and carcass recoveries are used to measure adult escapement to Slate Creek, the Secesh River, Lake Creek, Fishing Creek, and Legendary Bear Creek. To help monitor adult escapement in Lake Creek, the NPT also operates an underwater video counting station (Faurot and Kucera 2001; BPA Project Number 1997-030-00). Returning adults are classified as hatchery or natural origin based on fin clips. Carcass ages are inferred based on regional length data (Beamesderfer et al.1997). We use the European Notation method to describe the age of adult fish. Multiple redd counts are conducted in Slate Creek, the Secesh River, Lake Creek, Fishing Creek, and Legendary Bear Creek during the months of August and September following methods described in Hassemer (1993). Consistency among years is maintained by surveying an index area of known length. Expanded areas are surveyed in order to include all probable spring/summer chinook salmon spawning areas (Table 2).

Table 2. Stream section boundaries and lengths surveyed for chinook salmon redds and carcasses, 1992-2000. Italicized text indicates changes from original ISS redd survey reaches. Year begun indicates the year in which the reach was first surveyed for the ISS project.

Stream		**Survey Reach**	**Description**	**Year Begun**
Lake Creek	Original ISS (1992) Mouth to Willow Creek (13.6km)	1	Mouth to Three Mile Creek	1992
		2	Three Mile Creek to Willow Creek	1992
	Added to the project after the original transects were established	*3*	*Willow Creek to Corduroy Creek*	1997
		Three Mile Creek	*2km upstream*	1997
		Willow Creek	*2km upstream (Durden Mine)*	1997
Secesh River	Original ISS (1992) Alex Creek to Grouse Creek Junction Bridge (FS325) (10.3km)	1	Alex Creek to Chinook campground (Not included in emigration estimates now because it is below trap at Chinook Campground)	1992
		2	Chinook campground to meadow bridge (Long Gulch)	1992
		3	Meadow bridge (Long Gulch) to Piah Creek (Perfect's)	1992
		4	Piah Creek (Perfect's) to Grouse junction bridge	1992
	Added to the project after the original transects were established	*5*	*Grouse junction bridge to Lake Creek*	1996
		Loon	*Area around mouth of Loon Creek*	1997
		Grouse Creek	*3km upstream*	1997
		Summit Creek 1	*Mouth to Lake Rock bridge (upper)*	1996
		Summit Creek 2	*Lake Rock bridge to sharp curve (BM6324)*	1998
		Lick Creek	*4.5km upstream*	1997
Slate Creek	Original ISS (1992) Willow Creek to foot	5	Willow Creek to Trough Creek (2.5km)	1992

	bridge 0.7km up Little Slate Creek (5.5 km)	*6*	Trough Creek to end of road 2038 (1.65km up Little Slate Creek) (3.0km)	1992
	Added to the project after the original transects were established	*1*	*Forest Boundary to mp6 (2.4km)*	1997
		2	*Mp6 to Slide Creek (2.76km)*	1997
		3	*Slide Creek to North Fork (2.5km)*	1997
		4	*North Fork to Willow Creek (0.9km)*	1997
		7	*End of road 2038 to Van Buren Creek (12km)*	1997
		8	*Van Buren Creek to junction 221 road and 2002 (6km)*	1997
Legendary Bear Creek	Original ISS (1992) Mouth to mouth of East and West Forks (3.0km)	1	Mouth to forks (Creek splits into two forks) (3km)	1992
	Added to the project after the original transects were established	*2*	*.8km up East Fork and 3km up West Fork*	1997
Fishing Creek	Original ISS (1992) Mouth to mouth of East and West Forks (6.0km)	1	Mouth to sharp curve (3.6km)	1992
		2	Sharp curve to West Fork (2.4km)	1992

Redd counts are conducted once every ten days. The date to conduct the first count is based on historic redd survey data. Counts are conducted a minimum of three times per year on main streams (e.g., the Secesh River mainstem) and once on any smaller tributary stream that contain probable spawning habitat or for which historic spawning has been documented (e.g., Grouse Creek tributary to the Secesh River). Multiple ground counts allow survey crews to view redds at the time of construction or shortly thereafter, and aid in carcass recovery.

On the first survey, all redds are recorded, marked with flagging and noted on 7.5 minute scale USGS topographic maps. On subsequent surveys, previously detected redds are noted and new redds are recorded and marked on maps. Redds that are still under construction or too small to be a completed or fully developed redd are noted. Additional notes are taken on which adults are associated with redd construction.

Carcass surveys are conducted simultaneously with redd counts. Data collected from carcasses include fork length (nearest 0.5 cm), mid-eye to hypural plate length (MEHP), sex, percent spawned, and presence of tags or marks. In addition, scale, fin, and muscle samples are collected for age evaluation, DNA analysis, and nutrient evaluation studies. Snouts are collected from all fish and later scanned for the presence of coded wire tags (CWT). To prevent double counting, we sever the caudal peduncle of sampled carcasses.

RESULTS

Treatments

There were no BY99 treatments in Fishing Creek or Legendary Bear Creek. Appendix A summarizes treatments in Fishing Creek and Legendary Bear Creek from BY91 through BY99.

Population Estimates of Juvenile Fish Based on Snorkeling (Brood Year 1999)

In 2000, we snorkeled 11 sites in Fishing Creek, nine sites in Legendary Bear Creek, three sites in the Secesh River, and two sites in Lake Creek. The observed density of juvenile chinook salmon in Fishing Creek was $3.85/100m^2$ versus $12.07/100m^2$ in Legendary Bear Creek. The observed density of juvenile chinook salmon for Lake Creek and the Secesh River were $4.00/100m^2$ and $3.19/100m^2$ respectively. Population estimates for Fishing Creek and Legendary Bear Creek were 2,341 (±2,567) and 2,602 (±1,048) respectively. Since Lake Creek and the Secesh River were snorkeled only for the IDFG GPM database, we do not report population estimates for these locations based on snorkel surveys. During snorkel surveys we noted the presence of several other fish species (Table 3). Appendix B summarizes population estimates and observed densities of juvenile chinook salmon based on underwater observation for BY91 to BY99.

Population Estimates of Juvenile Fish Based on Rotary Screw Trapping (Brood Year 1999)

Over the period of trap operation for BY 99 parr presmolts, and smolts (April 2000 through June 2001), the Secesh River trap was operated for a total of 250.5 out of 254 possible days. Trap efficiencies for the Secesh River ranged from 9.5% for young of the year (YOY) to 33.9% for presmolts (Table 4). The Lake Creek trap was operated for 262.5 out of 287 possible days. Trap efficiencies ranged from 33% for YOY to 54.9% for presmolts (Table 4).

BY 99 juvenile captures are summarized by life stage in table four, and mortalities associated with trapping operations are listed in table five. In order to comprehensively report BY99 juvenile chinook captures, table four includes BY99 yearling chinook salmon captured in the summer and fall trapping seasons of 2001, and spring trapping season of 2002. During this period, the Secesh River trap was operated for a total of 190 out of 201 possible days. In Lake Creek, no yearlings were captured in the spring of 2002, however we did capture yearlings in the summer and fall trapping seasons of 2001. Over this period, the Lake Creek trap was operated for a total of 132.5 out of 133 possible days. We were unable to calculate trap efficiencies for yearling chinook salmon due to a paucity of recaptures.

We estimate that 30,670 and 68,339 BY99 juvenile chinook salmon emigrated from Lake Creek and the Secesh River respectively (Table 6). Secesh River estimates include Lake Creek fish. Yearling abundance could not be estimated due to a paucity of recaptures. Appendix C summarizes BY95 through BY99 trapping and tagging activities and Appendix D summarizes the Lake Creek and Secesh River emigration estimates for BY95 through BY99.

Table 3. Fish species observed during snorkel surveys in the Secesh River, Lake Creek, Legendary Bear Creek, and Fishing Creek.

Basin	Stream	Fish Species Observed	
Salmon River	Secesh River	Chinook Salmon -	*Oncorhynchus tshawytcha*
		Steelhead -	*O. mykiss*
		Bull Trout -	*Salvelinus confluentes*
		Brook Trout -	*S. fontinalis*
		Mountain Whitefish -	*Prosopium williamsoni*
		Longnose Dace -	*Rhinichthys cataractae*
		Sculpin -	*Cottus* spp.
	Lake Creek	Chinook Salmon -	*O. tshawytcha*
		Steelhead -	*O. mykiss*
		Bull Trout -	*S. confluentes*
		Brook Trout -	*S. fontinalis*
		Mountain Whitefish -	*P. williamsoni*
		Sculpin -	*Cottus* spp.
Clearwater River			
		Chinook Salmon -	*O. tshawytcha*
	Legendary Bear (Papoose) Creek	Steelhead -	*O. mykiss*
		Cutthroat Trout -	*O. clarki*
		Bull Trout -	*S. confluentes*
		Sculpin -	*Cottus* spp.
		Chinook Salmon -	*O. tshawytcha*
	Fishing (Squaw) Creek	Steelhead -	*O. mykiss*
		Cutthroat Trout -	*O. clarki*
		Bull Trout -	*S. confluentes*
		Sculpin -	*Cottus* spp.

Life History - Emigration Characteristics

The pattern of juvenile fish emigration was similar for Lake Creek and the Secesh River, although the timing of peak emigration differed. Peak emigration occurred in late June through July for Lake Creek and September through October for the Secesh River. Secondary peaks occurred in September through October for Lake Creek and June through July for the Secesh River (Figure 2).

The majority of BY99 juvenile fish emigrated from natal streams as age zero parr during the first summer after emergence. In 2000, 48.6% of the total emigration from the Secesh River was composed of parr that emigrated before September first. In Lake Creek, parr composed 59.7% of

Table 4. Number of brood year 1999 juvenile chinook salmon captured in the Secesh River and Lake Creek. Trap efficiencies could not be calculated for yearling chinook salmon.

Basin / Stream / Brood Year	Season	Trap Start Date	Trap End Date	Number of Days Trapped (Missed)	Mean Trap Efficiency	Number Captured (Number PIT Tagged)				
						YOY	Parr	Presmolt	Smolt	Yearling
Salmon River										
Secesh River										
BY99	Spring	04/23/2002	06/30/2002	58.5 (10.5)	*					1 (1)
	Fall	09/01/2001	11/09/2001	69.5 (0.5)	*					12 (2)
	Summer	07/01/2001	08/31/2001	62 (0)	*					17 (15)
	Spring	04/10/2001	06/30/2001	81.5 (0.5)	0.289				704 (512)	
	Fall	09/01/2000	11/02/2000	62.5 (0.5)	0.339			7,560 (1,754)		
	Summer	07/01/2000	08/31/2000	61 (1)	0.253		5,929 (1,301)			
	Spring	05/15/2000	06/30/2000	45.5 (1.5)	0.095	1,965 (0)				
Lake Creek										
BY99	Fall	09/01/2001	11/10/2001	70.5 (0.5)	0.4					8 (4)
	Summer	07/01/2001	08/31/2001	62 (0)	*					17 (13)
	Spring	04/04/2001	06/30/2001	85.5 (2.5)	0.413				292 (206)	
	Fall	09/01/2000	11/01/2000	61 (1)	0.549			5,781 (1,547)		
	Summer	07/01/2000	08/31/2000	60.5 (1.5)	0.451		6,768 (792)			
	Spring	04/17/2000	06/30/2000	55.5 (19.5)	0.333	1,519 (0)				

Table 5. Mortalities by life stage resulting from brood year 1999 trapping activities. No brood year 1999 yearling mortalities were observed.

			Mortality			
Stream	**Trapping Season**	**Life Stage**	**Trap**	**Handling**	**Predation**	**Total (%)**
Secesh River	Spring 2000	YOY	1	0	1	2 (0.10)
	Summer 2000	Parr	3	6	3	12 (0.20)
	Fall 2000	Presmolt	15	0	0	15 (0.20)
	Spring 2001	Smolt	3	0	0	3 (0.43)
Lake Creek	Spring 2000	YOY	0	0	1	1 (0.07)
	Summer 2000	Parr	10	1	9	20 (0.29)
	Fall 2000	Presmolt	34	2	4	40 (0.69)
	Spring 2001	Smolt	1	0	0	1 (0.03)

Table 6. Summary of juvenile chinook salmon screw trap emigration estimates for the Secesh River and Lake Creek, brood year1999 (spring 2000 through spring 2001).

Stream	Life History Stage	Point Estimate	Lower 95% CI	Upper 95% CI
Lake Creek	YOY	4,557	3,195	6,647
	Parr	16,189	13,255	20,773
	Presmolt	9,388	8,754	10,062
	Smolt	536	394	623
	Total	30,670	27,354	35,522
Secesh River	YOY	20,742	11,566	36,119
	Parr	23,384	19,950	28,281
	Presmolt	22,155	19,704	25,082
	Smolt	2,058	1,679	2,362
	Total	68,339	57,253	88,856

the total emigration. In the Secesh River, presmolts composed 47.4% of the run and in Lake Creek they composed 38.2% of the run. The BY99 smolt emigration (spring of calendar year 2001) in the Secesh River was 4.0% versus 2.0% in Lake Creek.

Seven hundred seventy-eight (778) of 2,536 (30.68 %) of the PIT-tagged BY99 juvenile chinook salmon and 33 of 414 (7.97%) of the fin clipped BY99 juvenile chinook salmon from Lake Creek were recaptured at the Secesh River screw trap (Table 7).

It took an average of 28.2 days for PIT-tagged Lake Creek fish to travel the 16 km distance between the Lake Creek and Secesh River trap during the summer trapping period, 3.3 days during the fall trapping period, and 2.7 days during the spring trapping period (Table 8). For the migration year, the average travel time from the Lake Creek trap to the Secesh River trap was 9.46 days.

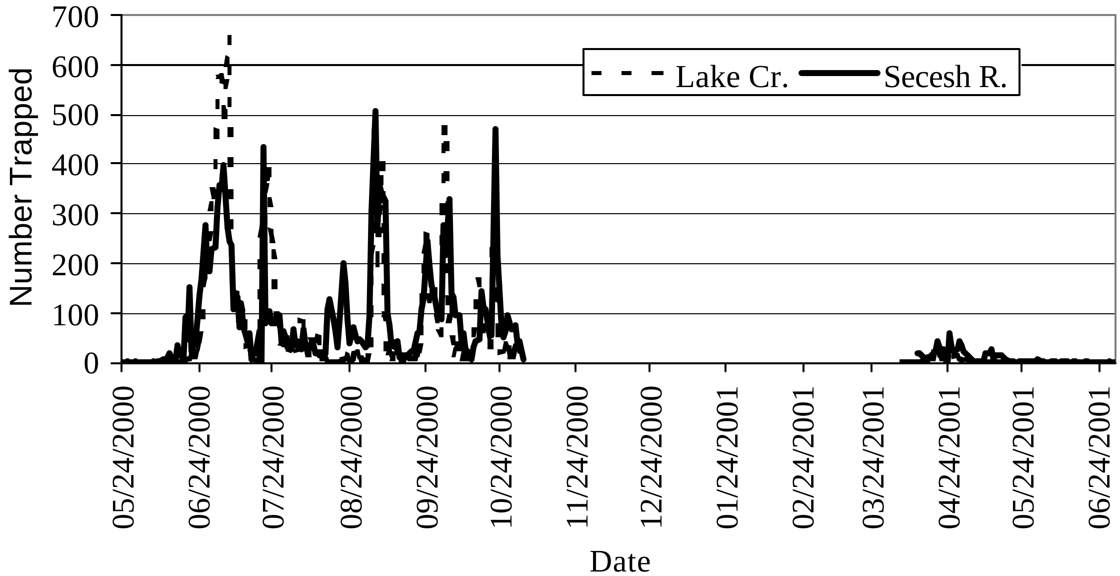


Figure 2. Daily trap captures of BY99 juvenile chinook salmon from Lake Creek and the Secesh River for Migratory Year 2000 - 2001.

Life History - Condition Factor

The condition factor of BY99 juvenile chinook salmon caught at the Lake Creek and Secesh River traps varied slightly across the migratory period, with noticeable decreases in July, October and November (Figure 3). Condition factors of fish sampled at the Lake Creek and Secesh River traps did not differ significantly (t-test; $p>0.05$), however this test might be confounded given that an estimated 8% to 31% of Lake Creek fish were recaptured downstream in the Secesh River trap in 2000. Observed length frequencies of BY99 juvenile chinook salmon captured at the Lake Creek and Secesh River rotary screw traps were also similar (Figure 4).

Life History - Growth

IDFG operates juvenile traps on the Salmon (river kilometer (RKM) 522.303.103) and Snake River (RKM 522.225). We used data from IDFG recaptures of PIT tagged Secesh River and Lake Creek juveniles (Appendix E) to determine growth rates. The parr groups PIT tagged in the summer season averaged a 33.7 mm increase in fork length for the Secesh River at an average of 0.14 mm/day. Lake Creek parr averaged a 29.4 mm increase in fork length at an average 0.13 mm/day. For the pre-smolt groups PIT tagged in the fall, the average increase in length for Secesh River juveniles was 19.3 mm at an average 0.10 mm/day. Lake Creek pre-smolts averaged an 18.9 mm increase in fork length at an average of 0.10 mm/day.

Table 7. Number of juvenile chinook salmon marked in Lake Creek, recaptured in the Secesh River trap, brood year 1997 through 1999.

Brood Year	Season	Marked at Lake Creek		Recaptures at Secesh River Trap			
				PIT-tags		Fin Clips	
		PIT-tags	FinClips	Number	Percent	Number	Percent
1999	Spring 2001	203	0	41	20.20	NA	NA
	Summer 2000	789	414	194	24.59	33	7.97
	Fall 2000	1,544	0	543	35.17	NA	NA
	Total BY99	2,536	414	778	30.68	33	7.97
1998	Spring 2000	168	0	8	4.76	NA	NA
	Summer 1999	742	2,646	83	11.19	237	9.00
	Fall 1999	1,114	525	344	30.88	177	33.71
	Total BY98	2,024	3,171	435	21.49	414	13.06
1997	Spring 1999	90	70	1	1.11	5	7.14
	Fall 1998	4,192	951	393	9.38	51	5.36
	Summer 1998	461	2,705	14	3.04	198	7.32
	Total BY97	4,743	3,726	408	8.60	254	6.82

Life History - Yearlings

One component of our trap captures is yearling chinook salmon. From the summer of 2000 through the spring of 2001, the number of BY99 yearlings captured represented 1.0% and 2.1% of the total catch respectively for the Secesh River and Lake Creek (Table 9). For the summer trap season, we trapped 225 yearlings in Lake Creek and 98 in the Secesh River. For the fall trap season, we trapped 17 yearlings in Lake Creek and 20 in the Secesh River. Yearlings were tagged and released with the BY99 parr and presmolt groups.

Life History - Yearling Detections

Brood year 1998 detection data are presented in Table 10. Total tag group survival estimates are increased by the inclusion of yearling detections (Appendix F).

Table 8. Average travel time (days) for juvenile chinook salmon to pass between the Lake Creek and the Secesh River trap (16 kilometers).

Brood Year	Season	Number Detected	Travel Time Range Low	Travel Time Range High	Average Travel Time
1999	Spring 2001	41	1	14	2.7
	Fall 2000	543	1	56	3.3
	Summer 2000	194	1	103	28.2
	Total BY99	778	1	103	9.46
1998	Spring 2000	8	1	2	1.25
	Fall 1999	344	1	41	4.2
	Summer 1999	83	1	97	18.4
	Total BY98	435	1	97	6.8
1997	Spring 1999	1	1	1	1
	Fall 1998	393	1	34	3.2
	Summer 1998	14	1	9	2.6
	Total BY97	408	1	34	3.15

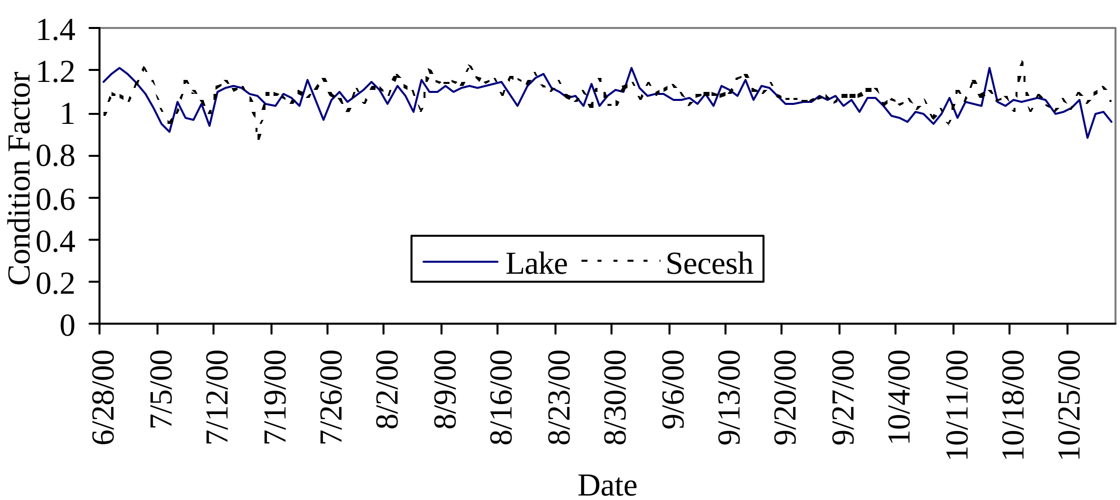
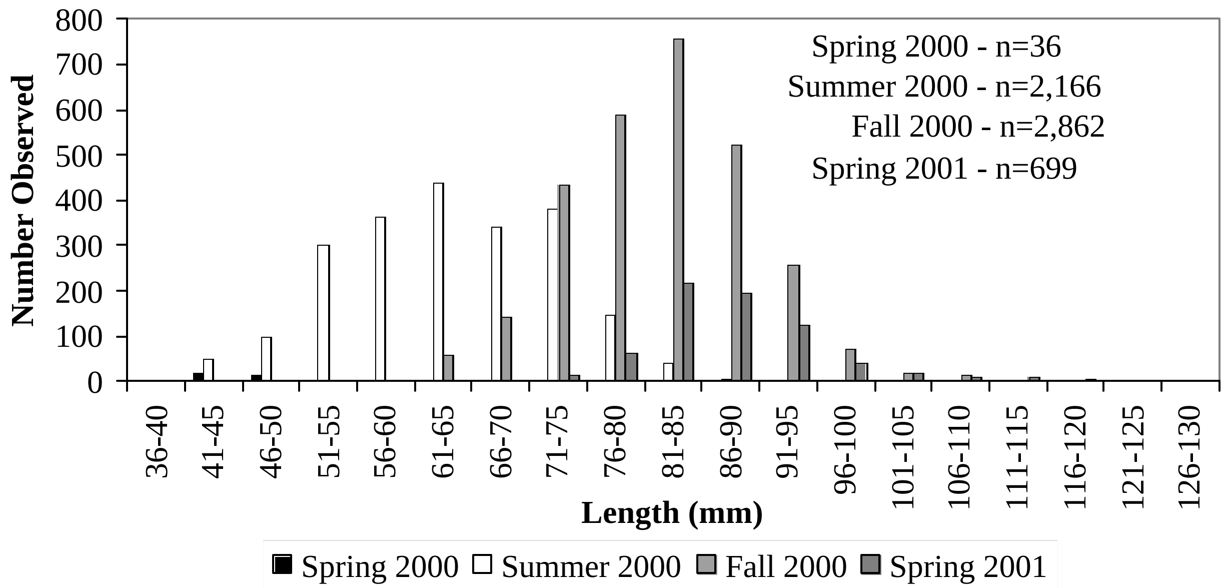


Figure 3. Condition factor of juvenile chinook salmon captured at traps in Lake Creek and the Secesh River from June 2000 through November 2000.

Secesh River



Lake Creek

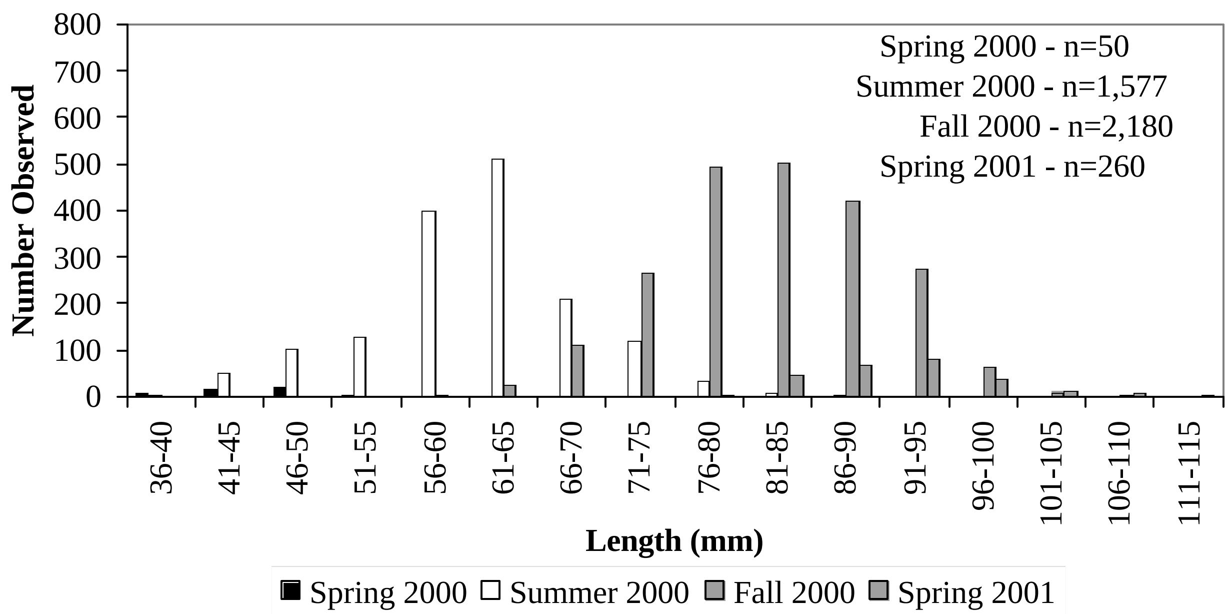


Figure 4. Length frequency of brood year 1999 juvenile chinook salmon measured at the Lake Creek and Secesh River rotary screw traps.

Table 9. Yearling chinook salmon captured at juvenile traps in the Secesh River and Lake Creek, summer brood year 1996 through 1999.

Stream	Brood Year	Trap Season	Number Trapped	Percent of Yearlings in Total Catch	Number PIT-tagged	Number detected
Secesh River	1999	Spring 2002	1	0.01	1	0
		Fall 2001	12	0.07	2	0
		Summer 2001	17	0.02	15	0
		Total BY99	30	0.03	18	0
	1998	Fall 2000	20	0.3	11	5
		Summer 2000	98	1.8	67	6
		Total BY98	118	1.0	78	11
	1997	Spring 2000	0	NA	NA	NA
		Fall 1999	354	3.7	85	19
		Summer 1999	179	1.8	38	4
		Total BY97	533	2.7	123	23
	1996	Fall 1998	4	0.1	0	0
		Summer 1998	3	0.0	2	0
		Total BY96	7	0.0	2	0
Lake Creek	1999	Fall 2001	8	0.08	4	2
		Summer 2001	17	0.07	13	0
		Total BY99	25	0.07	17	2
	1998	Fall 2000	17	0.3	10	4
		Summer 2000	225	3.4	178	10
		Total BY98	242	2.1	188	14
	1997	Spring 2000	1	0.6	1	
		Fall 1999	357	5.5	69	7
		Summer 1999	849	7.8	68	3
		Total BY97	1207	6.9	138	10
	1996	Fall 1998	15	0.1	7	1
		Summer 1998	116	0.5	66	0
		Total BY96	131	0.4	73	1

Table 10. Number of parr, presmolts, and smolts PIT tagged in Lake Creek and the Secesh River that remained a second year in fresh water prior to emigration (yearlings), brood years 1996 to 1999

Stream	Brood Year	Season Tagged	Normal Migration Year	Observed Migration Year	Number in Tag Group	Number Detected as Yearlings
Lake Creek	1999	Spring 2001	2001	2002	203	1
		Fall 2000	2001	2002	1,544	0
		Summer 2000	2001	2002	789	1
		Summer 2000	2001	2002	NA	NA
		Total			2,536	2
	1998	Spring 2000	2000	2001	168	5
		Fall 1999	2000	2001	1,114	5
		Summer 1999	2000	2001	742	0
		Summer 1999	2000	2001	603	4
		Total			2,627	14
	1997	Spring 1999	1999	2000	NA	NA
		Fall 1998	1999	2000	NA	NA
		Summer 1998	1999	2000	NA	NA
	1996	Spring 1998	1998	1999	99	4
		Fall 1997	1998	1999	588	4
		Summer 1997	1998	1999	588	1
		Total			1,275	9
Secesh River	1999	Spring 2001	2001	2002	510	4
		Fall 2000	2001	2002	1,754	0
		Summer 2000	2001	2002	1,274	0
		Summer 2000	2001	2002	586	0
		Total			4,124	4
	1998	Spring 2000	2000	2001	183	29
		Fall 1999	2000	2001	1,014	0
		Summer 1999	2000	2001	735	0
		Summer 1999	2000	2001	907	1
		Total			2,839	30
	1997	Spring 1999	1999	2000	NA	NA
		Fall 1998	1999	2000	NA	NA
		Summer 1998	1999	2000	NA	NA
	1996	Spring 1998	1998	1999	62	1
		Fall 1997	1998	1999	264	2
		Summer 1997	1998	1999	418	3
		Total			744	6

Detections – Passage

In 2000 for the Secesh River and Lake Creek, passage past LGJ for 90% of PIT-tagged wild/natural chinook salmon smolts took 46 days and 47 days respectively. The number of days required to pass 90% of PIT-tagged, wild/natural presmolts and parr from the Secesh River and Lake Creek was 29 days and 33 days respectively. Median passage dates for Secesh River smolts, presmolts, and parr were 2 June, 3 May, and 2 May respectively, and 9 June, 2 May, and 1 May for Lake Creek (Table 11). Overall, wild/natural juvenile emigration profiles in the Secesh River and Lake Creek are similar (Figure 5), although comparisons may be confounded by the capture and tagging of juveniles originating from Lake Creek in the Secesh River trap. Passage data are reported in Appendix G.

Table 11. Dates of passage past LGJ for first arrival, 10%, 50%, 90% and 100% of PIT tagged brood year 1999 parr, presmolts, and smolts tagged in Lake Creek and the Secesh River.

Stream	**Life History Stage**	**Proportion of run past LGJ**				
		First Arrival	10%	50%	90%	100%
Lake Creek	Parr	18-Apr-00	27-Apr-00	2-May-00	30-May-00	11-Jul-00
	Presmolt	10-Apr-00	27-Apr-00	3-May-00	26-May-00	17-Jul-00
	Smolt	15-May-00	20-May-00	2-Jun-00	8-Jul-00	15-Aug-00
Secesh River	Parr	15-Apr-00	27-Apr-00	1-May-00	25-May-00	28-Jun-00
	Presmolt	5-Apr-00	27-Apr-00	2-May-00	26-May-00	11-Jul-00
	Smolt	15-May-00	26-May-00	9-Jun-00	11-Jul-00	17-Aug-00

Total Juvenile Fish Survival Probability – SURPH2

We calculated juvenile survival rates to LGJ using SURPH2 (Table 12). Secesh River summer parr PIT-tagged by the NMFS (Achord; BPA 93-029-00) survived at a rate of 33.0% to LGJ. The NMFS did not PIT-tag summer parr in Lake Creek. Total survival probabilities of PIT tagged BY99 Secesh River and Lake Creek juveniles expressed as survival probabilities to last passage site are presented in Appendix I.

Adult Escapement (Return Year 2000)

In 2000, we found 41 redds in Legendary Bear Creek, 4 in Fishing Creek, 5 in Slate Creek, 153 in the Secesh River, and 180 in Lake Creek. Redd counts are summarized by stream and return year in Appendix G. We recovered 19 carcasses (11 hatchery 8 unmarked) in Legendary Bear Creek, one (unmarked) carcass in Fishing Creek, zero carcasses in Slate Creek, 82 carcasses (19 of unknown origin and 63 unmarked) in the Secesh River, and 178 carcasses (2 hatchery 176 unmarked) from Lake Creek. Female carcasses recovered in Legendary Bear Creek were 79% spawned on average (n=9), including one prespawning mortality, constituting an 11% prespawning of the total female carcasses recovered. One female carcass, which was 100% spawned was recovered in Fishing creek. In the Secesh River 31 female carcasses were recovered, no prespawning mortalities were observed, and carcasses were 99% spawned on average. We recovered 82 female carcasses in Lake Creek, with no observed prespawning mortalities, and carcasses were 98% spawned on average. The majority (82%) of all carcasses were recovered in index survey reaches (Table 13). Carcass gender and age are presented in Appendix H.

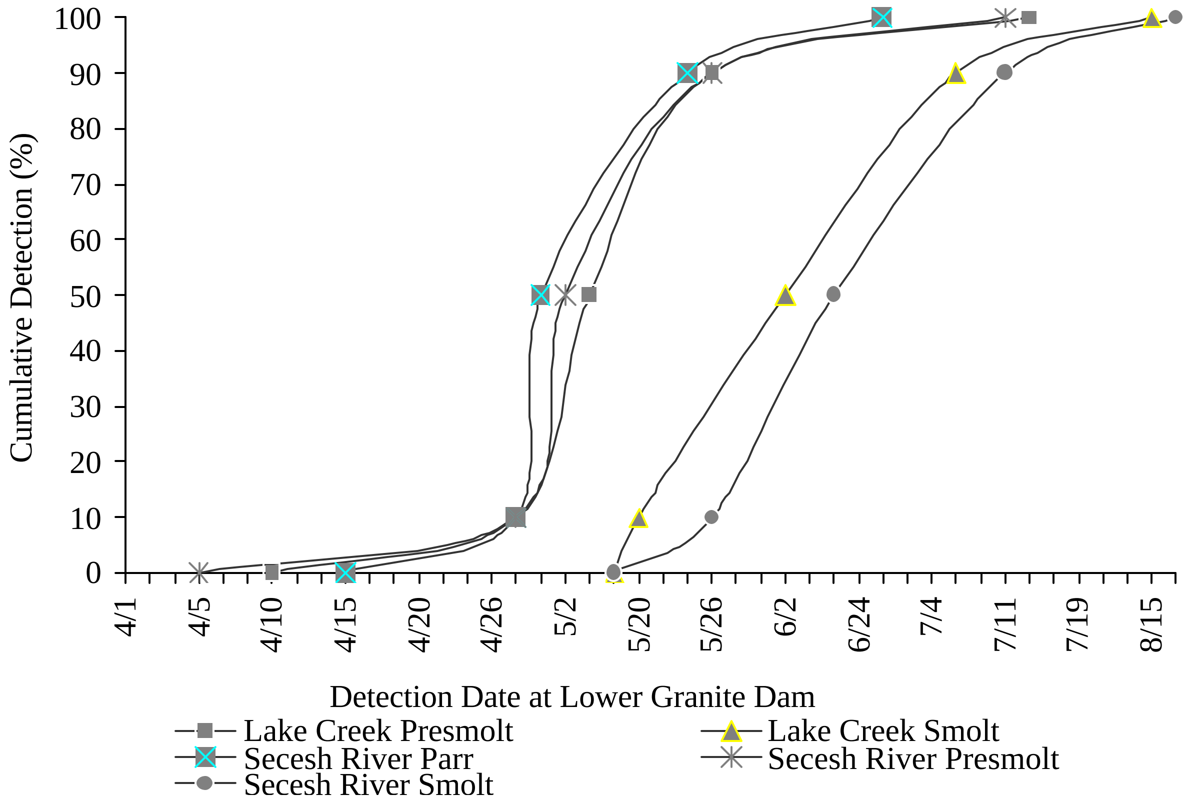


Figure 5. Cumulative percentage of PIT tagged chinook salmon detections at Lower Granite Dam by life stage for brood year 1999 parr, presmolts, and smolts. Data markers indicate first arrival, 10%, 50%, 90% and 100% detection levels.

Table 12. SURPH2 survival estimates to LGJ for brood year 1999 PIT tagged juvenile chinook salmon, and associated 95% Confidence Intervals.

Location	**Life Stage**	**Estimated Survival to LGJ**	**95% CI for LGJ Survival Estimate**
Secesh River	Parr	0.14	0.04 - 0.24
	Presmolt	0.12	0.07 - 0.18
	Smolt	0.05	0.03 - 0.07
	Combined	0.12	0.07 - 0.17
Lake Creek	Parr	0.27	0.22 - 0.32
	Presmolt	0.39	0.33 - 0.45
	Smolt	0.49	0.45 - 0.53
	Combined	0.36	0.32 - 0.40

Table 13. Distribution of recovered carcasses between index and extended reach redd survey areas in 2000.

Stream	Index Count	Extended Area Count	Total Count	% Index	% Extended
Secesh River	104	44	148	70	30
Lake Creek	157	22	179	88	12
Slate Creek	4	1	5	80	20
Legendary Bear Creek	41	0	41	100	0
Fishing Creek	4	0	4	100	0

DISCUSSION

Treatments

In the original research design by Bowles and Leitzinger (1991), no treatments were scheduled to occur in Fishing or Legendary Bear Creeks after 1997. However, poor adult returns resulted in a broodstock shortage, which limited the availability of juveniles for treatments. Therefore, releases were continued beyond the proposed timeline in order to more fully achieve release objectives. Nevertheless, the majority of ISS streams have not and will not receive the number of treatments prescribed in the original study design.

In Legendary Bear Creek, brood year 1990, 1992, 1993, and 1997 smolts were outplanted in 1992, 1994, 1995, and 1999. In Fishing Creek, brood year 1991, 1992, 1993, and 1997 parr were outplanted in 1992, 1993, 1994, and 1998. To date, outplants in Legendary Bear and Fishing Creek constitute treatment at only 44% of the prescribed level in the original ISS study design. Currently, ISS treatments are scheduled to cease after releases of brood year 2002 progeny (Lutch *et al.* 2003). If these treatments are completed as scheduled, Fishing Creek and Legendary Bear Creek will have been treated at 58% of the levels recommended in the original study design.

Population Estimates of Juvenile Fish Based on Snorkeling (Brood Year 1999)

Throughout the history of the ISS project, snorkeling has consistently produced juvenile abundance estimates with unacceptably large confidence intervals. Efforts to increase the size and number of sampled reaches and the use of alternate sampling methods failed to significantly improve the precision of abundance estimates (Nemeth et al. 1996). Wide confidence intervals associated with snorkeling estimates may be attributed to low fish densities, emigration, poor visibility, temperature, misidentification of fish, recording errors, a narrow time period when data are collected, and a lack of updated habitat data (Hansen and Lockhart in progress).

Although a decision was made in 1997 to discontinue the use of snorkeling to produce population estimates (Walters et al. 1999), the NPT continues to snorkel because it is the only technique available to estimate juvenile abundance in Fishing Creek and Legendary Bear Creek. The degree to which these estimates accurately reflect juvenile production is unknown, owing to the likelihood of fish moving into the Lochsa River 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. Additionally, a minimum number of sites are snorkeled in the Clearwater and Salmon River Subbasins to maintain a general parr monitoring database compiled by the Idaho Department of Fish and Game (BPA 1983-007-00).

Population Estimates of Juvenile Fish Based on Rotary Screw Trapping (Brood Year 1999)

Screw trap data provided narrow confidence intervals for juvenile fish population estimates compared to snorkel estimates. However, it is important to emphasize that collection of year-around screw trap data is necessary to accurately reflect total production. The inability to trap during high flows, ice conditions, or trap failures can result in incomplete data.

We define a trap day as two periods between 1800 to 0600 hours, and 0600 hours to 1800 hours. Our observations of fish movement suggest that there is a strong diurnal pattern to emigration, with the majority of fish emigrating between 2200 and 0400 hours. High water and debris cause the screw traps to be inoperable for short durations in the spring and early summer seasons. When a trap can only be operated between 1800 to 0600 hours we use the term "half day," and those data are included in analyses. However, if a trap is inoperable from 1800 to 0600 hours, we assume that the bulk of the daily emigration has been missed, and data from the entire trap day are excluded from analyses. When a trap day is missed, we interpolate emigration for that day by averaging emigration estimates from the previous and subsequent days.

Over the period of BY99 parr, presmolt, and smolt emigration (spring 2000 through spring 2001), we missed 13 half days and 18 full days of trapping in Lake Creek and seven half days and four full trap days in the Secesh River. In general, missed trap days were not consecutive. However, In Lake Creek high water forced us to remove the trap for 15 consecutive days (30 April 2000 through 14 May 2000). Emigration estimates for this period were interpolated using the daily average of juveniles captured on 28 April and 16 May 2000.

Due to anchor ice formation, we are unable to operate traps from late November through early April. We cannot quantify the proportion of the total juvenile emigration that occurs during this period. However, given that very few fish are captured immediately following trap installation, and very few fish are captured immediately prior to trap removal, we speculate that the majority of the emigration occurs during periods when the trap is installed.

Life History

Trap data from the Secesh River and Lake Creek indicate that the majority of wild/natural juvenile fish emigrate between July and August. To date, we have been unable to ascertain where these early emigrating fish rear; however we do know that the Secesh River/Lake Creek early emigrants move below trap sites in the South Fork Salmon River. This differs from the common assumption that juvenile chinook salmon emigrate from their natal streams in Idaho primarily during fall or during their second spring as age 1+ fish. Results from other ISS study streams were similar to those found on the Secesh River and Lake Creek and prompted coordinators to include a summer season in trapping schedules.

Yearlings

Yearling and precocial yearling chinook salmon have been documented in many streams (e.g., Unwin et al. 1999), however the ecological and evolutionary significance of this life history is not fully understood. To gather information about this life history strategy, we enumerate all captured yearlings, and PIT tag a group of these fish. A goal of 100 yearling (including precocial yearling) fish is targeted for PIT-tagging in the summer and fall seasons combined in Lake Creek and the Secesh River. Although a yearling PIT tag component was not included in the original study design (Bowles and Leitzinger 1991), we believe that evaluation of this life history strategy is required for valid comparisons of treatment and control groups. For example, alterations resulting from operation of hydroelectric facilities in the Columbia Basin have increased mortality of emigrating salmon. If survival through the hydrosystem is size-dependent, the survival rate of yearlings might be expected to differ relative to younger (smaller) conspecifics. Similarly, precocial yearlings have the potential to contribute to spawning without facing mortality associated with emigration. In either case, the presence of a natural yearling component might be considered a "spread the risk" strategy, potentially increasing the resiliency of chinook salmon spawning aggregates. If a yearling life history strategy is indeed beneficial, it is important that we include yearlings in our control stream analyses.

Detection data indicate that it is not uncommon for chinook salmon in Lake Creek and the Secesh River to reside for a second year in fresh water. Yearlings exhibit two strategies, either juveniles rear in the natal stream and leave during their third spring in fresh water, or more commonly, they emigrate from the natal stream and rear downstream from the Secesh River trap location. In 2000, we detected 39 yearlings at LGJ that exhibited the second strategy.

Carcasses of post-spawned precocial yearlings have been recovered in Lake Creek. Additionally, in Lake Creek, yearling sized juvenile chinook salmon have been observed at redds with adult males and females. To date, we have not been able to quantify the spawning contribution of precocial yearlings; therefore we cannot speculate on their evolutionary importance. However, given the high mortality associated with emigration to the ocean, and subsequent adult migration, it is conceivable that this life history may become increasingly important.

Detections

PIT tagged BY99 Lake Creek parr, presmolts, and smolts detected at LGJ exhibited 13%, 27%, and 44% higher survival respectively than parr, presmolts, and smolts PIT tagged in the Secesh River. To date, we are unable to determine the cause of the mortality differential between these two groups of fish. Thus far, we have determined that differences in size, condition factor, or migration timing are insufficient to explain the observed survival discrepancy. In addition, we have been unable to isolate any environmental (e.g., hydrograph) or catastrophic (e.g., forest fire) events that can explain the observed survival differential. Finally, the difference cannot be explained by differences in handling or tagging, owing to the fact that the same field crew handles and tags fish at both sites. We will continue to explore alternatives to explain this phenomenon.

Wild, natural, and supplementation smolts typically exhibit the highest survival to LGJ relative to pre-smolts and parr. However, since smolts emigrate almost immediately after tagging, it is unclear whether the survival advantage is biologically meaningful. For example, while parr suffer higher mortality in transit to LGJ, there are a larger total number of parr to offset increased mortality. For supplementation fish, one could also hypothesize a survival advantage for fish with more experience in the natural environment. For example, while smolts exhibit a higher relative survival to LGJ, it is possible that parr to adult survival (measured from LGJ to LGD) might be greater than smolt to adult survival. Therefore, we suggest that it is imperative that juvenile to adult survival rates are calculated for parr, pre-smolts, and smolts.

The level of PIT tagging effort currently expended is insufficient (in most years) to obtain robust survival estimates to LGJ for some life history stages of juvenile chinook salmon PIT tagged in the Secesh River and Lake Creek. Recent statistical review of ISS data suggests that the number of PIT tags deployed should be increased (Table 14; Townsend and Skalski 2002). In addition, the ISS study currently relies on survival estimates for summer parr that are PIT tagged in the Secesh River and Lake Creek for BPA project number 9302900. Currently, for BPA project number 9302900, summer parr are captured in a one-time event via electrofishing in the Secesh River and Lake Creek. As such, it is unclear whether PIT tagged summer parr are actively emigrating. In addition, it is unclear whether summer parr, sampled via electrofishing, exhibit similar survival and behavior as juveniles sampled in ISS screw traps on the Secesh River and Lake Creek. Given these uncertainties, it might be advisable for the ISS study to PIT tag summer parr groups in common with other juveniles captured at screw traps.

While survival estimates for summer parr, parr, and presmolts could likely be improved by increasing PIT tag deployment, we are currently limited in our ability to PIT tag smolts. In the Secesh River and Lake Creek, an average of 98.7% (BY96 to BY99) of the total juvenile production emigrates as summer parr, parr, or presmolts, while only 1.3% remain in the natal stream until emigrating as smolts. Therefore, we rarely achieve the current ISS goal of PIT tagging 500 smolts in either the Secesh River or Lake Creek. Currently, surplus PIT tags from smolt tagging operations are distributed equally among parr and presmolt groups. In some years, redistribution of surplus smolt PIT tags enables us to nearly meet the higher recommended PIT tag levels for parr and presmolts in Lake Creek and presmolts in the Secesh River (Table 14).

Table 14. Current ISS PIT tag goals and number of PIT tags required for robust estimation of juvenile survival, by life stage, to LGJ.

Stream	**Life Stage**	**Current PIT tag Goal**	**Minimum PIT tag Requirement**
Lake Creek	Summer Parr	N/A*	566
	Parr	500	586
	Presmolt	500	664
	Smolt	500	876
Secesh River	Summer Parr	N/A*	564
	Parr	500	1,402
	Presmolt	500	633
	Smolt	500	513

N/A* The ISS study currently obtains survival estimates from summer parr PIT tagged in the Secesh River and Lake Creek from BPA project number 9302900.

In addition to being inadequate, in some years, to achieve statistically robust juvenile survival estimates to LGJ, current PIT tagging effort is too low to obtain statistically valid juvenile to adult survival estimates. Bowles and Leitzinger (1991) suggested a minimum tag rate between 7,500 and 15,000 juvenile chinook per stream to estimate juvenile to adult survival from LGJ to LGD. While this level of PIT tagging effort is likely cost-prohibitive, and logistically infeasible for implementation across all ISS study streams, we recommend that a subset of treatment and control streams in both the Clearwater and Salmon River Subbasins should be designated for increased tagging effort. Data from increased tagging in selected streams could potentially be used to interpolate juvenile to adult survival for streams with limited tagging effort.

Finally, given that the operation of the Federal Columbia River Power System (FCRPS) has changed since conception of the original study design, we question whether the survival estimates of PIT tagged juveniles are representative of the untagged population. Discrepancies in survival between the tagged and untagged population may result from the default operation at collector dams in which PIT tagged juveniles are returned to the river, rather than barged in common with untagged juveniles. This default operation is useful for SURPH2 survival probability calculations, owing to the necessity for at least two unique individual detections to be recorded. If survival of barged versus in-river emigrants differ, survival of PIT tagged juvenile groups would be expected to differ from untagged juveniles. The potential discrepancy in survival estimates between tagged and untagged groups is likely acceptable for some aspects of the ISS study. For example, we can still obtain relative differences in survival to LGJ between PIT tagged life history stages. In addition, if PIT tagging effort were increased, we could measure differences in juvenile to adult survival between PIT tagged treatment and control groups. However, these estimates would likely be misleading if applied to the untagged groups. Figure 6 illustrates the fate of PIT-tagged versus untagged BY98 juveniles from Lake Creek.

Several alternatives exist that would allow PIT tag groups to better represent the untagged population:

> 1). We could forego SURPH2 survival estimates, and barge all detected PIT tagged juveniles at LGJ. This alternative would allow a closer estimate of untagged juvenile survival. However, the loss of SURPH2 estimates would preclude the estimation of reach-specific juvenile survival, as well as estimation of juvenile survival to LGJ (which is an ISS objective). In addition, at current tagging rates, adult tag detections at LGD would likely be insufficient to calculate robust juvenile to adult survival estimates.
>
> 2). We could increase the total number of deployed PIT tags, and specify that PIT-tagged juveniles be barged in common with untagged juveniles. However, in order to maintain survival estimates to LGJ, enough PIT tags would have to be deployed such that multiple detections would be obtained.
>
> 3). We could PIT tag two groups of juveniles per life history stage per ISS stream. One PIT-tag group would be treated in a status quo manner, hence allowing calculation of SURPH2 survival probabilities. The second PIT tag group would be barged in common with untagged fish (presumably at the same rate), allowing a more representative juvenile to adult survival estimate.

We suggest that alternative three be pursued throughout the remainder of the ISS project. In addition to yielding more representative survival estimates, alternative three would allow us to maintain a PIT tag group that could be compared to previous years. By doing so, we could potentially apply a “correction” to previous survival estimates based on the survival differential measured between the barged and un-barged PIT-tagged groups.

Assuming that the coefficient of variation between treatment and control streams within a sub-basin will not exceed 50% within a year, 30 adult PIT-tag detections at LGD would yield an 80% probability of detecting a difference of at least 4% in juvenile to adult survival rates between treatment and control streams (Lichatowich and Cramer 1979). Based on mean observed juvenile to adult survival from LGJ to LGD for Lake Creek (0.0111), we would be required to deploy a minimum of 8,351 PIT-tags in the second release group in order to insure that a minimum of 30 adult detections are obtained at LGD. However, we caution that preliminary juvenile to adult survival rates are based on only three PIT tag detections at LGD. Alternatively, using SURPH2 survival estimates, and assuming a 1% juvenile to adult survival rate from John Day Dam to LGD, a minimum of 9,400 PIT tags would be required for the second release group. Assuming a John Day to LGD juvenile to adult survival rate of 0.75%, a minimum of 12,358 tags would be required for the second tag group.

Adult Escapement (Return Year 2000)

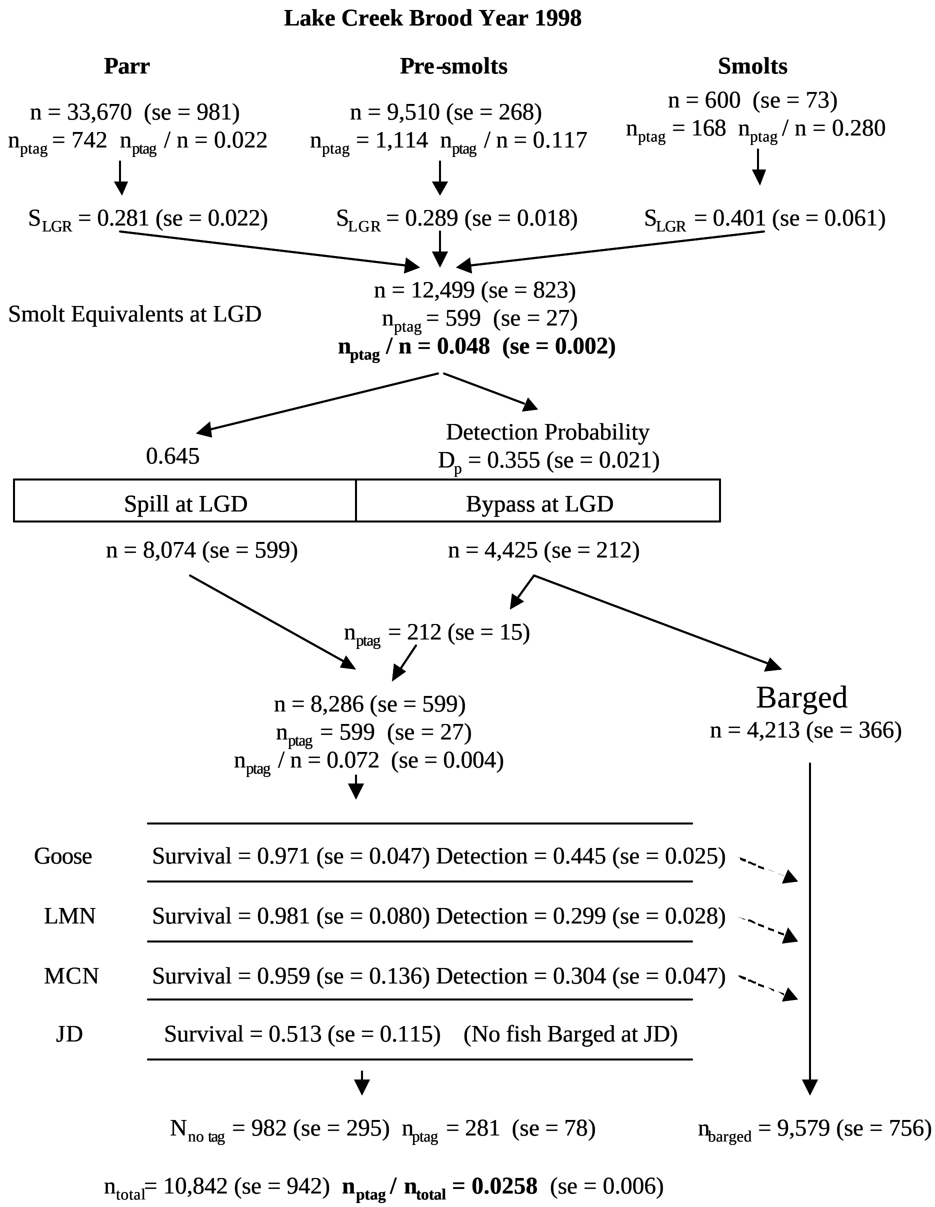
In the Salmon River streams we counted more redds in 2000 than in any other year of the ISS study (1992 to 2000). Since ISS began, the greatest number of redds for Clearwater River streams occurred in Legendary Bear (Papoose) Creek during 1997.

In 2000, we recovered 20 carcasses from the Clearwater River streams (19 from Legendary Bear Creek and one from Fishing Creek). The adults originated from spawning in BY95 through BY97. No age 1.1 carcasses were recovered, suggesting that none of the 1998 and 1999 supplementation parr and smolts returned as jacks.

In 2000, we recovered 260 carcasses from Salmon River streams (178 from Lake Creek, 82 from the Secesh River and 0 from Slate Creek). Seventeen recovered carcasses were age 1.1, 95 were age 1.2, 126 were age 1.3, and 22 could not be aged. Two marked carcasses (age 1.3) of undetermined origin were recovered in Lake Creek.

In Lake Creek adult fish began to arrive on June 22, 2000 (Faurot and Kucera 2001), and we observed redd construction at the end of July. Spawning in the upper section of Lake Creek was completed before the lower sections, consistent with previous observations. A variety of variables including the environment, behavior, or genetic differences could contribute to earlier spawning by Lake Creek adults. We will continue to monitor differences in spawn timing to determine whether Lake Creek may have a distinct spawning aggregate that differs from the Secesh River.

Given that redd counts may be used as the response variable by which to measure the success of supplementation, it is crucial that redd surveys are accurate, and that survey reaches are standardized. In addition, since adult returns can be used as a measure of productivity, it is imperative that accurate age data are obtained from recovered carcasses. To date, carcass ages have been based largely on a length-at-age relationship developed by Beamsderfer et al. (1997) and/or by ageing scales. Thus far, age data inferred from marked carcasses does not correspond well to ages inferred using the length at age key. In future years, we will incorporate bone ageing (using fin rays) to determine if this method results in more accurate estimates.



Key:

n = estimated number of juveniles
n_{ptag} = number of PIT tagged juveniles
n_{barged} = number of juveniles bypassed to barges at FCRPS facilities
S = estimated survival (SURPH2)
D_P = detection probability
se = standard error
LGD = Lower Granite Dam
Goose = Little Goose Dam
LMN = Lower Monumental Dam
MCN = McNary Dam
JD = John Day Dam

Figure 6. Fate of PIT tagged versus untagged juvenile chinook salmon based on brood year 1998 data from Lake Creek.

Although there have not been hatchery or supplementation outplants into Slate Creek, Lake Creek, or Secesh River, general production hatchery and supplementation carcasses have been recovered from all three streams. In order to accurately determine the magnitude of straying, it is helpful to mark all hatchery fish to enable identification of recovered carcasses.

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APPENDICES

APPENDIX A

Appendix A. Proposed and realized releases of juvenile chinook salmon into ISS treatment streams studied by the Nez Perce Tribe. NR indicates No Release.

Basin Stream Brood Year	Proposed Annual Treatment	Date Released	Life Stage Released	Number Released	Number PIT Tagged	Marks	Mean Fork Length (mm)
Clearwater River							
Fishing Creek	12,000 parr						
1999	0	NR					
1998	0	NR					
1997	0	07/29/98	Parr	12,827	990	CWT	107
1996	0	NR					
1995	12,000 parr	NR					
1994	12,000 parr	NR					
1993	12,000 parr	07/05/94	Parr	14,977	1,001	RV[a]	78
1992	12,000 parr	08/05/93	Parr	12,000	998	LV[b]	103
1991	12,000 parr	07/23/92	Parr	10,126	699	RV	65
Totals	60,000 parr			49,930	3,688		89
Legendary Bear	50,000 smolt						
1999	0	NR					
1998	0	NR					
1997	0	4/7/99	Smolt	47,950	1,500	CWT	134
1996	0	NR					
1995	50,000 smolt	NR					
1994	50,000 smolt	NR					
1993	50,000 smolt	04/05/95	Smolt	55,300	499	RV	120
1992	50,000 smolt	04/14/94	Smolt	16,110	499	LV	150
1991	50,000 smolt	NR					
1990	0	03/17/92	Smolt	72,773[c]	0	CWT	
Totals	250,000 smolt			192,133	2,498		130

Appendix A. Continued.

Basin Stream Brood Year	Proposed Annual Treatment	Date Released	Life Stage Released	Number Released	Number PIT Tagged	Marks	Mean Fork Length (mm)
Salmon River							
Slate Creek	240,000 presmolt						
1999	0	NR					
1998	0	NR					
1997	0	NR					
1996	0	NR					
1995	0	NR					
1994	0	NR					
1993	0	NR					
1992	0	NR					
1991	0	NR					
Totals	0						

[a] Right ventral fin clip.
[b] Left ventral fin clip.
[c] This smolt release was an unscheduled, non-ISS release. Smolts were reared at Kooskia National Fish Hatchery.

APPENDIX B

Appendix B. Summary of chinook salmon parr population estimates or densities obtained from snorkeling ISS streams in the Clearwater and Salmon Rivers, brood years 1991 – 1999. Relative Confidence intervals are the 90% confidence interval expressed as a percent of the estimate.

Subbasin Stream Brood Year	**Year Sampled**	**Population Estimate**	**± 90% CI**	**± Relative Confidence Interval (%)**	**% of Sampling Strata Snorkeled**	**Observed Density (#fish/100m^2)**
Clearwater						
Fishing Creek						
1999	2000	2.341	2,567	110	10.2	3.85
1998	1999	1,122	1,099	98	6.7	0.93
1997	1998	10,032	6,602	66	7.3	24.48
1996	1997	45	61	136	5.8	0.10
1995	1996	0	--	--	7.9	0.00
1994	1995	0	--	--	7.5	0.00
1993	1994	11,818	11,616	94	7.8	15.69
1992	1993	0	--	--	8.0	0.00
1991	1992	320	167	167	8.1	0.82
Legendary Bear Creek						
1999	2000	2,602	1,048	40	15.7	12.07
1998	1999	5,748	2,443	42	14.6	19.05
1997	1998	14,507	3,196	22	10.7	64.67
1996	1997	1,207	693	57	14.4	5.46
1995	1996	38	49	129	9.0	0.15
1994	1995	0	--	--	10.2	0.00
1993	1994	8,017	1,714	21	9.6	26.63
1992	1993	299	171	57	8.8	14.40
1991	1992	0	--	--	9.6	0.00

Appendix B. Continued.

Drainage Stream Brood Year	**Year Sampled**	**Population Estimate**	**± 90% CI**	**± Relative Confidence Interval (%)**	**% of Sampling Strata Snorkeled**	**Observed Density (#fish/100m^2)**
Salmon River Drainage						
Slate Creek						
1999	2000	NS	--	--	--	--
1998	1999	NS	--	--	--	--
1997	1998	NS	--	--	--	--
1996	1997	NS	--	--	--	--
1995	1996	NS	--	--	--	--
1994	1995	430	176	41	3.9	0.37
1993	1994	7,714	3,456	45	5.5	8.07
1992	1993	1,293	1,203	93	3.2	1.22
1991	1992	1,211	838	69	3.2	1.11
Secesh River						
1999	2000	*	*	*	1.2	3.19
1998	1999	*	*	*	1.0	3.44
1997	1998	*	*	*	1.2	1.85
1996	1997	*	*	*	--	--
1995	1996	*	*	*	3.5	1.29
1994	1995	*	*	*	3.3	1.31
1993	1994	*	*	*	3.9	4.93
1992	1993	*	*	*	2.6	3.99
1991	1992	*	*	*	2.6	7.38

*Snorkeling activities in the Secesh River and Lake Creek are pursued to update the General Parr Monitoring (GPM) database maintained by IDFG, and hence are not adequate or intended for the calculation of population estimates.

Appendix B. Continued.

Drainage Stream Brood Year	Year Sampled	Population Estimate	± 90% CI	± Relative Confidence Interval (%)	% of Sampling Strata Snorkeled	Observed Density (#fish/100m^2)
Lake Creek						
1999	2000	*	*	*	1.4	4.00
1998	1999	*	*	*	1.8	19.38
1997	1998	*	*	*	1.0	16.36
1996	1997	*	*	*	--	--
1995	1996	*	*	*	2.6	0.80
1994	1995	*	*	*	3.0	0.91
1993	1994	*	*	*	2.9	10.88
1992	1993	*	*	*	2.3	6.48
1991	1992	*	*	*	2.3	3.14

*Snorkeling activities in the Secesh River and Lake Creek are pursued to update the General Parr Monitoring (GPM) database maintained by IDFG, and hence are not adequate or intended for the calculation of population estimates.

APPENDIX C

Appendix C. Summary of juvenile chinook salmon emigration trap data for ISS streams studied by the Nez Perce Tribe, brood years 1995 through 1999.

Subbasin Stream Brood Year	Trap Start Date	Trap End Date	Total Number of Days Trapped [a]	Number of Unmarked Fish Trapped	Number Marked and Released Upstream	Number of Recaptures	Mean Trap Efficiency
Salmon							
Secesh River							
1999	4/10/01	6/30/01	81.5	557	511	147	0.288
	9/1/00	11/2/00	62.5	7,074	1,436	486	0.339
	7/1/00	8/31/00	61	5,666	1,044	263	0.252
1998	5/15/00	6/30/00	45.5	186	181	25	0.143
	9/1/99	11/3/99	60.5	8,907	684	235	0.345
	7/1/99	8/31/99	62	9,451	2,311	309	0.134
1997	4/21/99	6/30/99	40	328	26	5	0.185
	9/1/98	11/4/98	64.5	4,080	422	50	0.121
	7/1/98	8/31/98	62	13,774	2,382	287	0.121
1996	4/14/98	6/30/98	71.5	264	48	5	0.122
	9/1/97	11/6/97	60	3,535	380	44	0.136
	7/2/97	8/30/97	35.5	3,295	408	40	0.098
1995	6/18/97	6/24/97	3	2	0	0	--

Appendix C. Continued.

Subbasin Stream Brood Year	Trap Start Date	Trap End Date	Total Number of Days Trapped [a]	Number of Unmarked Fish Trapped	Number Marked and Released Upstream	Number of Recaptures	Mean Trap Efficiency
Salmon							
Lake Creek							
1999	4/4/01	6/30/01	85.5	208	205	84	0.413
	9/1/00	11/1/00	61	5,130	1,186	651	0.549
	7/1/00	8/31/00	60.5	6,427	757	341	0.451
1998	4/17/00	6/30/00	55.5	170	142	40	0.287
	9/1/99	11/3/99	61.5	6,317	579	395	0.683
	7/1/99	8/31/99	62	10,927	2,593	843	0.325
1997	3/24/99	6/30/99	69	161	70	28	0.408
	9/1/98	11/4/98	64.5	11,573	951	537	0.565
	7/1/98	8/31/98	62	25,544	2,705	844	0.312
1996	4/14/98	6/30/98	71.5	124	13	3	0.286
	9/1/97	11/12/97	54.5	1,982	116	19	0.173
	7/1/97	8/30/97	38	4,370	572	137	0.231
1995	6/24/97	6/25/97	1	0	0	0	--

[a] Traps did not operate on some days, usually due to high water, obstruction with debris or ice, or mechanical failure.

APPENDIX D

Appendix D. Summary of juvenile chinook salmon screw trap emigration estimates for ISS streams studied by the Nez Perce Tribe, Brood Years 1995 – 1999 (Spring 1997 – Spring 2001)

Subbasin Stream Brood Year	Calendar Year	Season or Brood Year	Number of Days Trapped [a]	Emigration Estimate	Confidence Interval Range (90%)
Salmon Secesh River					
1999	2001	Spring	81.5	2,058	1,679-2,362
	2000	Fall	62.5	22,155	19,704-25,082
	2000	Summer	61	23,384	19,950-28,281
	2000	Spring	35	20,742	11,566-36,119
		Total BY99	205	64,492	51,554-77,430
1998	2000	Spring	45.5	1,402	908-2,195
	1999	Fall	60.5	30,979	27,362-35,578
	1999	Summer	62	86,101	73,849-101,899
		Total BY98	168	118,482	105,921-134,179
1997	1999	Spring	35	3,152	2,162-5,033
	1998	Fall	64.5	44,178	33,116-65,234
	1998	Summer	62	128,655	111,244-149,446
		Total BY97	161.5	175,985	154,237-205,611
1996	1998	Spring	71.5	3,700	1,710-6,957
	1997	Fall	60	25,497	18,036-31,714
	1997	Summer	35.5	39,278	27,355-58,424
		Total BY96	167	68,475	51,696-85,865
1995	1997	Spring	3	--	--

Appendix D. Continued.

Subbasin Stream Brood Year	Calendar Year	Season or Brood Year	Number of Days Trapped [a]	Emigration Estimate	Confidence Interval Range (90%)
Salmon					
Lake Creek					
1999	2001	Spring	85.5	536	394-623
	2000	Fall	61	9,388	8,754-10,062
	2000	Summer	60.5	16,189	13,255-20,773
	2000	Spring	36	4,557	3,195-6,647
		Total BY99	207	30,670	27,354-35,522
1998	2000	Spring	55.5	876	650-1,241
	1999	Fall	61.5	9,064	8,541-9,648
	1999	Summer	62	38,904	35,850-42,307
		Total BY98	179	48,844	45,911-52,518
1997	1999	Spring	50	478	353-650
	1998	Fall	64.5	23,054	21,927-24,273
	1998	Summer	62	87,035	81,182-93,611
		Total BY97	176.5	110,567	104,550-117,267
1996	1998	Spring	71.5	917	312-1,075
	1997	Fall	54.5	18,008	11,577-27,015
	1997	Summer	38	27,947	23,918-33,769
		Total BY96	164	46,872	38,465-58,423
1995	1997	Spring	1		

[*] Emigration estimates in this report were calculated using GAUSS (Steinhorst 2000), in previous report years estimates were obtained via a bootstrap algorithm (Murphy *et al.*, unpublished). Therefore, confidence intervals reported in 1992 (Arnsberg 1993), 1993 (Hesse and Arnsberg 1994), and 1994 (Hesse *et al.*, 1995) NPT ISS reports, and the 1996 ISS cooperators report (Walters *et al.*, 1999) differ from those listed here.

[a] Traps did not operate on some days, usually due to high water, obstruction from debris or ice, or mechanical failure.

APPENDIX E

Appendix E. Change in fork length for juvenile chinook salmon tagged in Lake Creek and the Secesh River recaptured at downstream traps.

Stream	Season	Tag Length (mm)	Recapture Season	Recapture Site	Recapture Length (mm)	Length Increase (mm)	Growth/Day (mm)
Secesh River	Summer 94	67	Spring 95	Snake River	90	23	0.09
	Summer 97	62	Spring 98	Salmon River	88	26	0.11
	Summer 98	57	Spring 99	Salmon river	94	37	0.16
	Summer 99	64	Spring 00	Salmon River	100	36	0.14
	Summer 99	71	Spring 00	Salmon River	95	24	0.11
	Summer 99	68	Spring 00	Salmon River	107	39	0.16
	Summer 99	63	Spring 00	Salmon River	103	40	0.16
	Summer 00	58	Spring 01	Salmon River	111	53	0.21
	Summer 00	65	Spring 01	Salmon River	90	25	0.12
		Summer Average				33.7	0.14
	Fall 97	95	Spring 98	Salmon River	110	15	0.09
	Fall 98	70	Spring 99	Salmon River	99	29	0.15
	Fall 98	79	Spring 99	Salmon River	94	15	0.07
	Fall 98	80	Spring 99	Snake River	88	8	0.04
	Fall 98	91	Spring 99	Snake River	102	11	0.04
	Fall 99	88	Spring 00	Salmon River	98	10	0.06
	Fall 99	74	Spring 00	Snake River	107	33	0.17
	Fall 00	76	Spring 01	Salmon River	102	26	0.13
	Fall 00	80	Spring 01	Salmon River	100	20	0.1
	Fall 00	75	Spring 01	Salmon River	101	26	0.13
	Fall 00	87	Spring 01	Salmon River	106	19	0.11
		Fall Average				19.3	0.1

Appendix E. Continued.

Stream	Season	Tag Length (mm)	Recapture Season	Recapture Site	Recapture Length (mm)	Length Increase (mm)	Growth/Day (mm)
Lake Creek	Summer 92	80	Spring 93	Snake River	98	18	0.07
	Summer 94	55	Spring 95	Snake River	93	38	0.14
	Summer 94	55	Spring 95	Salmon River	77	22	0.1
	Summer 97	74	Spring 98	Salmon River	98	24	0.11
	Summer 97	68	Spring 98	Salmon River	75	7	0.03
	Summer 97	64	Spring 98	Salmon River	95	31	0.14
	Summer 98	59	Spring 99	Salmon River	88	29	0.14
	Summer 98	76	Spring 99	Salmon River	95	19	0.09
	Summer 98	64	Spring 99	Salmon River	109	45	0.21
	Summer 98	70	Spring 99	Salmon River	106	36	0.17
	Summer 99	60	Spring 00	Snake River	96	36	0.15
	Summer 99	63	Spring 00	Salmon river	106	43	0.17
	Summer 99	80	Spring 00	Salmon River	96	16	0.07
	Summer 99	70	Spring 00	Snake River	118	48	0.2
		Summer Average				29.4	0.13

Appendix E. Continued.

Stream	Season	Tag Length (mm)	Recapture Season	Recapture Site	Recapture Length (mm)	Length Increase (mm)	Growth/Day (mm)
Lake Creek	Fall 97	84	Spring 98	Salmon River	108	24	0.13
	Fall 97	82	Spring 98	Salmon River	96	14	0.1
	Fall 98	73	Spring 99	Salmon River	89	16	0.08
	Fall 98	78	Spring 99	Salmon River	102	24	0.11
	Fall 98	78	Spring 99	Salmon River	106	28	0.13
	Fall 98	82	Spring 99	Salmon River	92	10	0.05
	Fall 98	81	Spring 99	Salmon River	97	16	0.09
	Fall 98	82	Spring 99	Salmon River	105	23	0.12
	Fall 98	83	Spring 99	Salmon River	97	14	0.08
	Fall 98	88	Spring 99	Snake River	94	6	0.03
	Fall 98	59	Spring 99	Snake River	104	45	0.2
	Fall 98	86	Spring 99	Snake River	110	24	0.12
	Fall 98	92	Spring 99	Snake River	100	8	0.04
	Fall 98	83	Spring 99	Snake River	99	16	0.08
	Fall 99	66	Spring 00	Salmon River	94	28	0.15
	Fall 99	81	Spring 00	Salmon River	100	19	0.1
	Fall 00	90	Spring 01	Salmon River	112	22	0 .12
	Fall 00	93	Spring 01	Salmon River	102	9	0.04
	Fall 00	88	Spring 01	Salmon River	100	12	0.06
	Fall 00	94	Spring 01	Salmon River	101	7	0.04
	Fall 00	78	Spring 01	Salmon River	110	32	0.16
			Fall Average			18.9	0.1

APPENDIX F

Appendix F. SURPH2 survival probabilities to the Lower Granite Dam juvenile bypass facility for PIT tagged juvenile chinook salmon, brood years 1995 through 1999.

Subbasin	Stream	Brood Year	Life History Stage	Number PIT Tagged	Survival Probability at LGJ (SE)
Clearwater	Fishing Creek	1999	NA	0	NA
		1998	NA	0	NA
		1997	Parr (11N)	173	0.182 (0.038)
			Parr (11H)	990	0.004 (0.003)
Clearwater	Legendary Bear Creek	1999	NA	0	NA
		1998	NA	0	NA
		1997	Parr (11N)	833	0.161 (0.017)
			Smolt (11H)	1,500	0.600 (0.025)
Salmon	Secesh River	1999	Total BY99	3,538 d	0.352 (0.008) d
			Smolt	510	0.389 (0.023)
			Presmolt	1,754	0.373 (0.012)
			Parr	1,274	0.310 (0.013)
			Parr c	586	0.330 (0.020)
		1998	Total BY98	1,932 d	0.269 (0.014) d
			Smolt	183	0.247 (0.037)
			Presmolt	1,014	0.327 (0.023)
			Parr	735	0.379 (0.063)
			Parr c	907	0.158 (0.018)
		1997	Total BY97	3,220	0.243 (0.009)
			Smolt	205	0.314 (0.034)
			Presmolt	1,819	0.173 (0.010)
			Parr	260	0.175 (0.031)
			Parr c	936	0.144 (0.015)
		1996	Total BY96	1,274	0.322 (0.016)
			Smolt	98	0.364 (0.048)
			Presmolt	588	0.338 (0.026)
			Parr c	588	0.304 (0.024)
		1995	Parr c	260	0.229 (0.032)

Appendix F. Continued.

Subbasin	Stream	Brood Year	Life History Stage	Number PIT Tagged	Survival Probability at LGJ (SE)
Salmon	Lake Creek	1999	Total BY99	2,536 d	0.360 (0.010) d
			Smolt	203	0.490 (0.036)
			Presmolt	1,544	0.390 (0.013)
			Parr	789	0.267 (0.016)
			Parr c	0	NA
		1998	Total BY98	2,024d	0.264 (0.012)d
			Smolt	168	0.401 (0.061)
			Presmolt	1,114	0.289 (0.018)
			Parr	742	0.281 (0.022)
			Parr c	603	0.151 (0.021)
		1997	Total BY97	6,076	0.250 (0.008)
			Smolt	90	0.404 (0.070)
			Presmolt	4,175	0.263 (0.014)
			Parr	466	0.223 (0.025)
			Parr c	545	0.189 (0.045)
		1996	Total BY96	743	0.305 (0.020)
			Smolt	61	0.543 (0.069)
			Presmolt	264	0.394 (0.048)
			Parr c	418	0.227 (0.023)
		1995	Parr c	400	0.201 (0.041)

[a] The last passage site is the detection facility upstream of the facility that recorded the last detection of any PIT-tags (i. e. Passage site = John Day, last detection was at Bonneville.

[b] Standard errors are given in parentheses.

[c] PIT-tagged by NMFS

[d] Does not include parr tagged by NMFS

Appendix G. Summary of chinook salmon redds and average number of redds per kilometer for ISS streams studied by the Nez Perce Tribe, return years 1991 through 2000.

Subbasin	**Stream**	**Year**	**Stream Length Sampled (km)**	**Number of Redds Counted**	**Average Number of Redds per Kilometer**
Clearwater	Fishing Creek	2000	6	4	0.67
		1999	6	4	0.67
		1998	6	11	1.83
		1997	6	17	2.83
		1996	6	1	0.17
		1995	6	0	0
		1994	6	0	0
		1993	6	0	0
		1992	6	1	0.17
Clearwater	Legendary Bear Creek	2000	6	41	6.83
		1999	6	4	0.67
		1998	6.8	13	1.91
		1997	6.8	61	8.97
		1996	3	7	2.33
		1995	3	1	0.33
		1994	3	0	0
		1993	3	15	5
		1992	3	10	3.33
Salmon	Slate Creek	2000	15.05	5	0.33
		1999	34.61	2	0.06
		1998	28.6	8	0.28
		1997	15.05	8	0.53
		1996	5.5	0	0
		1995	5.5	3	0.54
		1994	5.5	1	0.18
		1993	5.5	1	0.18
		1992	5.5	4	0.72
		1991	5.5	6	1.08

Appendix G. Continued.

Subbasin	Stream	Year	Stream Length Sampled (km)	Number of Redds Counted	Average Number of Redds per Kilometer
Salmon	Secesh River	2000	32.1	153	4.77
		1999	32.1	42	1.31
		1998	32.1	69	2.15
		1997	32.1	89	2.77
		1996	10.3	42	4.08
		1995	10.3	18	1.75
		1994	10.3	21	2.04
		1993	10.3	91	8.83
		1992	10.3	66	6.41
		1991	10.3	62	6.02
Salmon	Lake Creek	2000	20.76	180	8.67
		1999	20.76	24	1.16
		1998	20.76	50	2.41
		1997	20.76	55	2.65
		1996	13.6	31	2.28
		1995	13.6	12	0.88
		1994	13.6	12	0.88
		1993	13.6	44	3.24
		1992	13.6	43	3.16
		1991	13.6	34	2.5

APPENDIX H

Appendix H. Number of chinook salmon carcasses sampled during spawning ground surveys for return year 1992 through return year 2000. Ages were estimated using a length-at-age relationship (1.1 <640 mm; 1.2 640-789 mm; 1.3 >789 mm; Beamsderfer *et al.* 1997) or by scales when fork lengths were not available. Fin clip: NO = no fin clip, AD = adipose, RV = right ventral, LV = left ventral, UNK = unknown if any fin clips. RY = return year.

					Age Group																	
					1.1						1.2						1.3					
					Male		Female		Total		Male		Female		Total		Male		Female		Total	
Basin	**Stream**	**RY**	**No.**	**Fin Clip**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Clearwater River																						
	Fishing Creek	2000	1	NO															1	100	1	100
		1999	0																			
		1998	0																			
		1997	1	UNK							1	100			1	100						
			2	AD							1	50			1	50			1	50	1	50
		1996	0																			
		1995	0																			
		1994	0																			
		1993	1	UNK													1	100			1	100
		1992	0																			
		Subtotal	2	UNK							1	50			1	50	1	50			1	50
			2	AD							1	50			1	50			1	50	1	50
			1	NO															1	100	1	100
		Totals	5								2	40			2	40	1	20	2	40	3	60

Appendix H. Continued.

					Age Group																	
					1.1						1.2						1.3					
					Male		Female		Total		Male		Female		Total		Male		Female		Total	
Basin	**Stream**	**RY**	**No.**	**Fin Clip**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Clearwater River																						
Legendary Creek	Bear																					
		2000	1 [a]	UNK																		
			10	AD							2	20	7	70	9	90	1	10			1	10
			8	NO							3	38	3	38	6	75	2	25			2	25
		1999	1	NO									1	100	1	100						
		1998	4	NO													1	25	3	75	4	100
		1997	7 [b]	UNK									1	14	1	14	1	14	2	28	3	43
			34 [c]	RV							7	20	18	53	25	73	1	3	3	9	4	12
			17 [d]	AD									7	41	7	41	4	23	3	18	7	41
			4 [e]	NO							1	25	1	25	2	50	1	25			1	25
		1996	1	RV													1	100			1	100
		1995	1	AD															1	100	1	100
		1994	0																			
		1993	3	NO									1	33	1	33	1	33	1	33	2	67
		1992	0																			
		Subtotal	20	NO							4	20	6	30	10	50	5	25	4	20	9	45
			28	AD							2	7	14	50	16	57	5	18	4	14	9	32
			35	RV							7	20	18	51	25	71	2	6	3	8	5	14
			8	UNK									1	14	1	14	1	14	2	28	3	43
		Totals	91								13	14	39	43	52	57	13	14	13	14	26	29

[a] = Female of unknown age (100%)
[b] = Includes one female, one male, and one unknown sex of unknown ages (43%).
[c] = Includes 3 female, one male, and one unknown sex of unknown ages (15%).
[d] = Includes one female and 2 males of unknown age (18%).
[e] = Includes one female of unknown age (25%).

Appendix H. Continued.

					Age Group																	
					1.1						1.2						1.3					
					Male		Female		Total		Male		Female		Total		Male		Female		Total	
Basin	**Stream**	**RY**	**No.**	**Fin Clip**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Salmon River																						
	Slate Creek	2000	0																			
		1999	0																			
		1998	2	NO													1	50	1	50	2	100
		1997	1 [a]	UNK																		
			1[b]	AD																		
			1	NO							1	100			1	100						
		1996	0																			
		1995	0																			
		1994	0																			
		1993	1	NO									1	100	1	100						
		1992	0																			
		Subtotal	4	NO							1	25	1	25	2	50	1	25	1	25	2	50
			1 [a]	UNK																		
			1 [b]	AD																		
		Totals	6								1	17	1	17	2	33	1	17	1	17	2	33

[a] = Unknown age, unknown sex, and unknown clip (100%).
[b] = Unknown sex or age (100%).

Appendix H. Continued.

					Age Group																	
					1.1						1.2						1.3					
					Male		Female		Total		Male		Female		Total		Male		Female		Total	
Basin	**Stream**	**RY**	**No.**	**Fin Clip**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Salmon River																						
	Secesh River	2000	19 [a]	UNK																		
			63	NO	6	10	1	2	7	11	4	6	16	25	20	32	21	33	15	24	36	57
		1999	23 [b]	NO	1	4	1	4	2	7	2	7	2	7	4	17	8	35	6	26	14	61
		1998	3 [a]	UNK																		
			1	LV													1	100			1	100
			2	AD															2	100	2	100
			18	NO													11	61	7	39	18	100
		1997	4 [c]	UNK							1	25	1	25	2	50			1	25	1	25
			12 [d]	AD							4	33	3	25	7	58	4	33			4	33
			51 [e]	NO							14	27	14	27	28	55	7	14	7	14	14	27
		1996	43	NO	1	2.3	1	2.3	2	4.7	17	40	9	21	26	60	8	19	7	16	15	35
			1	AD							1	100			1	100						
		1995	23	NO	4	17			4	17	5	22	4	17	9	39	6	26	4	17	10	43
		1994	9	NO							2	22	3	33	5	56	1	11	3	33	4	44
			1	AD															1	100	1	100
		1993	66	NO							12	18	6	9.1	18	27	16	24	32	48	48	73
		1992	57	NO							34	60	15	26	49	86	5	8.8	3	5.3	8	14
		Subtotal	353 [b,e]	NO	12	3	3	1	15	4	90	25	69	20	159	45	83	24	84	24	167	47
			16 [d]	AD							5	31	3	19	8	50	4	25	3	19	7	42
			1	LV													1	100			1	100
			26 [a,c]	UNK							1	14	1	14	2	28			1	14	1	14
		Totals	396 [a,b,c,d,e]		12	3	3	1	15	4	96	24	73	18	169	43	88	22	88	22	176	44

[a] = All of unknown sex and unknown age (100%)
[b] = Includes one 1.2 of unknown sex (4%) and one male (4%) and one female (4%) of unknown length
[c] = Includes one fish of unknown sex and unknown age (25%)
[d] = Includes one female of unknown age (8%)
[e] = Includes two age 1.3 of unknown sex and 3 males and 4 females of unknown age (18%)

Appendix H. Continued.

Basin	Stream	RY	No.	Fin Clip	1.1 Male n	1.1 Male %	1.1 Female n	1.1 Female %	1.1 Total n	1.1 Total %	1.2 Male n	1.2 Male %	1.2 Female n	1.2 Female %	1.2 Total n	1.2 Total %	1.3 Male n	1.3 Male %	1.3 Female n	1.3 Female %	1.3 Total n	1.3 Total %
Salmon River																						
	Lake Creek	2000	2	AD									2	100	2	100						
			176[a]	NO	10	6			10	6	28	16	45	26	73	41	58	33	32	18	90	51
		1999	1	AD	1	100			1	100												
			16	NO	1	6			1	6	1	6	3	19	4	25	6	38	5	31	11	69
		1998	1	AD													1	100			1	100
			1	RV															1	100	1	100
			21	NO	1	5			1	5							7	33	13	43	20	76
		1997	6 [b]	UNK							1	17	2	33	3	50						
			2	AD									1	50	1	50	1	50			1	50
			20 [c]	NO							4	20	8	40	12	60	2	10	4	20	6	30
		1996	24	NO							6	25	10	42	16	67	2	8	6	25	8	33
		1995	3	NO							1	33	2	67	3	100						
		1994	3	NO			1	33	1	33			2	67	2	67						
		1993	13	NO							1	8			1	8	6	46	6	46	12	92
		1992	24	NO			1	4	1	4	9	38	10	42	19	79	3	13	1	4	4	17
		Subtotal	300 [a,c]	NO	12	4	2	1	14	5	22	7	35	12	57	19	26	9	35	12	61	20
			6	AD	1	17			1	17			3	50	3	50	2	33			2	33
			1	RV															1	100	1	100
			6 [b]	UNK							1	17	2	33	3	50						
		Totals	313[a,b,c]		13	4	2	1	15	5	51	16	85	27	136	43	86	27	68	22	154	49

[a] Includes 3 females of unknown age
[b] Includes one female, one male, and one unknown sex of unknown ages (50%).
[c] Includes 2 females of unknown age (10%).

APPENDIX I

Appendix I. Detections of PIT-tagged juvenile chinook salmon at LGJ, brood years 1991through1999. Passage dates of 10%, 50%, and 90% represent percentages of the total number of detections at Lower Granite Dam only. For Origin, N = natural, H = hatchery, W = wild.

Subbasin Stream	Brood Year	Life Stage	Origin	Number Tagged	Detections at LGJ (%)	10% Passage Date at LGJ	50% Passage Date at LGJ	90% Passage Date at LGJ
Clearwater	1999	parr	N	0	NA	NA	NA	NA
Fishing Creek		parr	H	0	NA	NA	NA	NA
	1998	parr	N	0	NA	NA	NA	NA
		parr	H	0	NA	NA	NA	NA
	1997	parr	N	173	4.0	04/18/99	04/30/99	05/21/99
		parr	H	990	0.1	04/19/99	--	--
	1993	parr	H	1,001	3.1	04/23/95	05/12/95	06/09/95
	1992	parr	H	998	1.3	04/25/94	05/11/94	07/13/94
	1991	parr	H	699	1.9	05/08/93	05/15/93	05/05/93

Appendix I. Continued.

Subbasin Stream	Brood Year	Life Stage	Origin	Number Tagged	Detections at LGJ (%)	10% Passage Date at LGJ	50% Passage Date at LGJ	90% Passage Date at LGJ
Clearwater	1999	smolt	H	0	NA	NA	NA	NA
Legendary		parr	N	0	NA	NA	NA	NA
Bear	1998	smolt	H	0	NA	NA	NA	NA
Creek		parr	N	388	4.4	04/28/00	05/25/00	06/16/00
	1997	smolt	H	1,500	13.5	04/26/99	05/07/99	05/20/99
		parr	N	833	4.9	05/01/99	05/27/99	06/10/99
		(parrMT) [a]	N	156	4.5	05/23/99	06/07/99	06/08/99
		(parrBS) [b]	N	677	5.0	05/01/99	05/26/99	06/10/99
	1993	smolt	H	499	24.6	04/21/95	04/29/95	05/08/95
		presmolt	N	7290	5.2	05/07/95	06/01/95	06/18/95
	1992	smolt	H	499	26.3	04/27/94	05/08/94	05/12/94

[a] These parr were caught by minnow traps and are included in the parr total.
[b] These parr were caught by beach seine and are included in the parr total.

Appendix I. Continued.

Subbasin Stream	Brood Year	Life Stage	Origin	Number Tagged	Detections at LGJ (%)	10% Passage Date at LGJ	50% Passage Date at LGJ	90% Passage Date at LGJ
Salmon	1999	smolt	W	510	32.2	05/26/01	06/09/01	07/11/01
Secesh River		presmolt	W	1,754	32.7	04/27/01	05/02/01	05/26/01
		parr	W	1,274	27.5	04/27/01	05/01/01	05/25/01
		parr [a,e]	W	586	29.0	04/25/01	05/01/01	05/26/01
	1998	smolt	W	183	18.0	06/24/00	07/04/00	07/23/00
		presmolt	W	1,014	11.7	04/14/00	04/26/00	05/26/00
		parr	W	735	6.3	04/14/00	04/22/00	05/24/00
		parr [a]	W	907	4.4	04/13/00	04/25/00	06/05/00
	1997	smolt	W	204	16.2	06/08/99	06/24/99	07/22/99
		presmolt	W	1,853	7.4	04/19/99	04/26/99	05/26/99
		parr	W	261	3.1	04/18/99	04/25/99	05/02/99
		parr [a]	W	936	3.8	04/06/99	04/23/99	05/30/99
	1996	smolt [b]	W	99	20.2	05/11/98	06/23/98	07/10/98
		presmolt	W	643	13.1	04/12/98	04/27/98	05/22/98
		parr	W	4	--	--	--	--
		parr [a,c]	W	588	12.8	04/07/98	04/24/98	05/19/98
	1995	parr [a,d]	W	260	13.5	04/10/97	04/21/97	04/25/97
	1994	parr [a]	W	571	4.6	04/14/96	04/25/96	05/29/96
	1993	parr [a]	W	1,549	5.8	04/14/95	04/30/95	05/24/95
	1992	parr [a]	W	422	8.5	04/22/94	04/26/94	07/11/94
	1991	parr [a]	W	327	8.6	04/27/93	05/01/93	06/24/93

[a] Parr that were tagged by the National Marine Fisheries Service (NMFS)
[b] For BY96 smolts, two detections in 1999 were not included in passage data but are included in detection data.
[c] For BY96 parr tagged by NMFS, one detection in 1999 was not included in passage data but is included in detection data.
[d] For BY95 parr tagged by NMFS, one detection in 1998 was not included in passage data but is included in detection data.
[e] For BY99 parr tagged by NMFS, one detection in 2000 was not included in passage data but is included in detection data.

Appendix I. Continued.

Subbasin Stream	Brood Year	Life Stage	Origin	Number Tagged	Detections at LGJ (%)	10% Passage Date at LGJ	50% Passage Date at LGJ	90% Passage Date at LGJ
Salmon	1999	smolt	W	203	44.8	05/20/01	06/02/01	07/06/01
Lake Creek		presmolt	W	1,544	33.3	04/27/01	05/03/01	05/26/01
		parr	W	789	24.3	04/27/01	05/02/01	05/30/01
	1998	smolt	W	168	18.5	06/08/00	07/02/00	07/17/00
		presmolt	W	1,114	10.8	04/14/00	04/24/00	05/30/00
		parr	W	742	9.0	04/14/00	04/20/00	05/20/00
		parr [a]	W	603	5.0	04/13/00	05/03/00	07/01/00
	1997	smolt	W	90	18.9	06/11/99	07/12/99	07/26/99
		presmolt	W	4,190	6.2	04/18/99	04/25/99	06/03/99
		parr	W	461	6.1	04/03/99	04/22/99	05/23/99
		parr [a]	W	545	3.8	04/21/99	04/26/99	05/27/99
	1996	smolt [b]	W	64	34.4	05/28/98	06/26/98	07/07/98
		presmolt	W	264	14.0	04/10/98	04/24/98	05/14/98
		parr [a,c]	W	418	11.5	04/03/98	04/25/98	05/22/98
	1995	parr [ba d]	W	400	6.5	04/11/97	04/25/97	07/02/97
	1994	parr [a]	W	135	7.4	04/15/96	04/25/96	05/09/96
	1993	parr [a]	W	405	6.4	04/17/95	05/09/95	06/07/95
	1992	parr [a]	W	252	7.1	04/21/94	04/28/94	05/19/94
	1991	parr [a]	W	255	5.5	04/23/93	04/29/93	06/22/93

[a] Parr that were tagged by the National Marine Fisheries Service (NMFS)
[b] For BY96 smolts, one detection in 1999 was not included in passage data but are included in detection data.
[c] For BY96 parr tagged by NMFS, four detections in 1999 were not included in passage data but is included in detection data.
[d] For BY95 parr tagged by NMFS, eight detections in 1998 were not included in passage data but is included in detection data.