FISHERY RESEARCH

IDAHO NATURAL PRODUCTION MONITORING AND EVALUATION

ANNUAL PROGRESS REPORT
February 1, 2013—January 31, 2014

Prepared by:
Carl Stiefel, Regional Fisheries Biologist
Kimberly A. Apperson, Regional Fisheries Biologist
Matthew Belnap, Regional Fisheries Biologist
Timothy Copeland, Senior Fishery Research Biologist
Matthew P. Corsi, Regional Fisheries Biologist
Robert Hand, Regional Fisheries Biologist
Patrick Kennedy, Senior Fishery Research Biologist
Jordan Messner, Regional Fisheries Biologist
Scott Putnam, Regional Fisheries Biologist
Kristin K. Wright, Fishery Research Biologist

IDFG Report Number 14-18
December 2014

IDAHO NATURAL PRODUCTION MONITORING AND EVALUATION

Project Progress Report

2013 Annual Report

Part 1—Project Overview
Part 2—Monitoring relative abundance and age composition of spring-summer Chinook salmon on the spawning grounds in Idaho
Part 3—Monitoring age composition of wild adult spring-summer Chinook salmon in the Snake River basin to estimate smolt-to-adult return rates
Part 4—The stock-recruitment relationship for wild/natural spring-summer Chinook salmon in the Snake River basin
Part 5— Wild Chinook salmon and steelhead juvenile density and spatial structure

By

Carl Stiefel
Kimberly A. Apperson
Matthew Belnap
Timothy Copeland
Matthew P. Corsi
Robert Hand
Patrick Kennedy
Jordan Messner
Scott Putnam
Kristin K. Wright

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

To

IDFG Report Number 14-18
December 2014

ABBREVIATIONS AND ACRONYMS

BH	Beverton-Holt
BPA	Bonneville Power Administration
BY	Brood Year
CI	Confidence Interval
COE	U.S. Army Corps of Engineers
CWT	Coded Wire Tag
DPS	Distinct Population Segment
EMAP	Environmental Monitoring and Assessment Program
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FANR	Females Available for Natural Reproduction
FL	Fork Length
GPM	General Parr Monitoring
GSI	Genetic Stock Identification
HOR	Hatchery Origin
ICBTRT	Interior Columbia Basin Technical Recovery Team
IDFG	Idaho Department of Fish and Game
INPMEP	Idaho Natural Production Monitoring and Evaluation Project
ISMES	Idaho Steelhead Monitoring and Evaluation Studies
LGR	Lower Granite Dam
MPG	Major Population Group
NOAAF	National Oceanic and Atmospheric Administration Fisheries
NOR	Natural Origin
NWFSC	Northwest Fisheries Science Center
ODFW	Oregon Department of Fish and Wildlife
PIT	Passive Integrated Transponder
RPA	Reasonable and Prudent Alternatives
SAR	Smolt to Adult Return Rate
SY	Smolt Year
VSP	Viable Salmonid Population

TABLE OF CONTENTS

Page

Table of Contents, continued.

LIST OF TABLES

Page

List of Tables, continued.

Page

List of Tables, continued.

Page

LIST OF FIGURES

Page

LIST OF APPENDICES

PART 1—PROJECT OVERVIEW

Populations of Chinook salmon *Oncorhynchus tshawytscha* and steelhead trout *O. mykiss* in the Snake River basin declined substantially following the construction of hydroelectric dams in the Snake and Columbia rivers. Raymond (1988) documented a decrease in survival of emigrating steelhead trout and Chinook salmon from the Snake River following the construction of dams on the lower Snake River during the late 1960s and early 1970s. Abundance rebounded slightly in the early 1980s, but then escapements over Lower Granite Dam (LGR) into the Snake River basin declined again (Busby et al. 1996). In recent years, abundances in the Snake River basin have slightly increased. The increase has been dominated by hatchery fish, while the returns of naturally produced Chinook salmon and steelhead trout remain critically low. As a result, Snake River spring-summer Chinook salmon (hereafter Chinook salmon) were classified as threatened in 1992 under the Endangered Species Act (ESA). Within the Snake River spring-summer Chinook salmon evolutionarily significant unit (ESU; Figure 1), there are seven major population groups (MPGs): Lower Snake River, Grande Ronde/Imnaha Rivers, South Fork Salmon River, Middle Fork Salmon River, Upper Salmon River, Dry Clearwater River, and the Wet Clearwater River. However, the Dry Clearwater River and the Wet Clearwater River MPGs are considered to have been extirpated and re-established with stocks from other MPGs. A total of 28 extant demographically independent populations have been identified. Snake River steelhead trout (hereafter steelhead) were classified as threatened under the ESA in 1997. Within the Snake River steelhead distinct population segment (DPS; Figure 2), there are six MPGs: Lower Snake River, Grande Ronde River, Imnaha River, Clearwater River, Salmon River, and Hells Canyon Tributaries (ICBTRT 2003, 2005; NMFS 2011). The Hells Canyon MPG is considered to have been extirpated. A total of 24 extant populations have been identified.

The purpose of the Idaho Natural Production Monitoring and Evaluation Project (INPMEP) is to provide information for monitoring the status of Idaho's wild Chinook salmon and steelhead populations with respect to the viable salmonid population (VSP) criteria defined by McElhany et al. (2000). In the 1950s, IDFG developed a program to index annual spawning escapement by enumerating Chinook salmon redds in selected areas with the intent to describe population trends over time. The total area and number of streams surveyed represents a large portion of wild Chinook salmon spawning habitat in Idaho (Hassemer 1993a). The number of redds counted in these areas provides an index of the annual wild adult Chinook salmon spawner abundance at the independent population scale (see ICBTRT 2003 and 2005 for population delineations). For adult Chinook salmon, 2013 data were collected in selected spawning tributaries in the Clearwater River and Salmon River subbasins to describe population-specific abundance, productivity, spatial structure, and diversity. For juvenile Chinook salmon and steelhead, we assessed spatial structure and productivity during 2013.

The INPMEP monitors the Idaho portion of the Snake River spring-summer Chinook salmon ESU (hereafter the aggregate) above LGR. The aggregate escapement of Snake River Chinook salmon and steelhead is measured at LGR, with the exception of the Tucannon River, Washington, population. Some wild fish are migrating to Washington or Oregon tributaries to spawn, but the majority is destined for Idaho. Age data collected at LGR are used to assign returning adults to specific brood years (BYs), for cohort analysis, and to estimate productivity and survival rates (Copeland et al. 2007, 2009, 2011, 2012, 2013; Copeland and Putnam 2009; Copeland and Roberts 2010; Kennedy et al. 2011, 2012, 2013; Schrader et al. 2011, 2012, 2013). In addition, escapement estimates by cohort are used to forecast run sizes in subsequent years, and these forecasts are the basis for preliminary fisheries management plans in the Columbia River basin. Escapement and composition of wild spring-summer

Chinook salmon at LGR are detailed in a separate report (Schrader et al. in preparation). Here, we provide an updated version of aggregate Chinook salmon age composition at LGR for estimating smolt-to-adult survival return rates. Also, we report the aggregate stock-recruit model using slightly different methods than past reports.

Information presented in this report is summarized according to the VSP criteria mentioned above. The data reported will be population-specific where possible. Population-specific redd survey data were added in the 2010 proposal to address the Reasonable and Prudent Alternatives (RPAs) 50 and 63, defined in the 2008 Federal Columbia River Power System Biological Opinion (http://www.nwr.noaa.gov/hydropower/fcrps_opinion/federal_columbia_river_power_system.html). We address RPA 50 to produce data relevant to Chinook salmon and steelhead population status assessments and will also provide data on hatchery fraction for Chinook salmon carcasses recovered on the spawning grounds. The fraction of hatchery Chinook salmon contributing to natural spawning is relevant to RPA 63.

PROJECT OBJECTIVES

Project tasks are grouped into four objectives. The purpose of each objective involves enumerating or describing individuals within the various life stages of wild Chinook salmon and steelhead. By understanding the transitions between life stages and associated controlling factors, we hope to achieve a mechanistic understanding of stock-specific population dynamics that will aide management, mitigation, and population recovery efforts.

Objective 1. Estimate 2013 adult abundance and composition of returning wild adult Chinook salmon passing LGR. In collaboration with the Chinook and Steelhead Genotyping for Genetic Stock Identification (GSI) at Lower Granite Dam (Bonneville Power Administration [BPA] project #2010-026-00), we will decompose the aggregate estimates into major population groups and, in some cases, populations. Over time, productivity will be assessed. These results are reported in a separate document (Schrader et al. in preparation).

Objective 2. Estimate population-specific abundance and composition of wild Chinook salmon on the spawning grounds in the Salmon River and Clearwater River subbasins.

Objective 3. Estimate lifecycle survival and freshwater productivity of the Snake River Chinook salmon ESU. There are two components: estimate aggregate smolt-to-adult survival rates and update a stock-recruit model.

Objective 4. Estimate the distribution and abundance of wild Chinook salmon and steelhead parr in tributaries of the Salmon River and Clearwater River subbasins in coordination with the Idaho Steelhead Monitoring and Evaluation Studies (ISMES; BPA project #1990-055-00). Estimate spatial structure and productivity.

REPORT TOPICS

In this annual progress report, we present technical results for work conducted during 2013. Part 2 contains results collated from Chinook salmon spawning ground surveys, including the number of redds counted in trend monitoring transects and the ages and production type of Chinook salmon carcasses (Objective 2). In 2013, extensive redd surveys were initiated in

Chamberlain basin to document the distribution of spawning activity within the basin and to validate the accuracy of redd expansion rates (trend reach surveys to complete population) to estimate total redd abundance. A detailed summary of this effort is found in Appendix A. Part 3 contains results from aging wild Chinook salmon from Lower Granite Dam and the estimation of smolt-to-adult return rates for the Snake River ESU (Objective 3). Part 4 is a report on the ongoing development of a stock-recruit model for the freshwater phase of wild Chinook salmon in the Snake River ESU (Objective 3). Part 5 is a summary of the parr density and juvenile salmonid spatial structure data collected in 2013 (Objective 4).

LITERATURE CITED

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Wauneta, and I. V. Lagomarsino. 1996. Status review of West Coast steelhead from Washington, Idaho, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-27.

Copeland, T., J. Johnson, S. Kraft, and P. R. Bunn. 2007. Idaho natural production monitoring and evaluation, 2006 annual report. Idaho Department of Fish and Game Report 07-31. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Copeland, T., J. Johnson, K. A. Apperson, J. M. Flinders, and R. Hand. 2009. Idaho natural production monitoring and evaluation project. Idaho Department of Fish and Game Report 09-06. 2008 annual report to the U.S. Department of Energy, Bonneville Power Administration. Contract 36423, Project 199107300. Idaho Department of Fish and Game, Boise.

Copeland, T., and S. Putnam. 2009. Idaho steelhead monitoring and evaluation studies. Idaho Department of Fish and Game Report 09-05. Annual report 2008, BPA Project 1990-055-00.

Copeland, T., and R. V. Roberts. 2010. Idaho steelhead monitoring and evaluation studies. Idaho Department of Fish and Game Report 10-08. Annual report 2009, BPA Project 1990-055-00.

Copeland, T., R. V. Roberts, and K. A. Apperson. 2011. Idaho steelhead monitoring and evaluation studies. Idaho Department of Fish and Game Report 11-09. Annual report 2010, BPA Project 1990-055-00.

Copeland, T., R. V. Roberts, and K. A. Apperson. 2012. Idaho steelhead monitoring and evaluation studies. Idaho Department of Fish and Game Report 12-04. Annual report 2011, BPA Project 1990-055-00.

Copeland, T., R. V. Roberts, B. Oldemeyer, and K. A. Apperson. 2013. Idaho steelhead monitoring and evaluation studies. Idaho Department of Fish and Game Report 13-07. Annual report 2013, BPA Project 1990-055-00.

Hassemer, P. 1993a. Salmon spawning ground surveys, 1989-1992. Idaho Department of Fish and Game. Project F-73-R-15. Pacific Salmon Treaty Program Award No. NA17FP0168-02. 32 p. plus appendices.

ICBTRT (Interior Columbia Basin Technical Recovery Team). 2003. Independent populations of Chinook, steelhead, and sockeye for listed Columbia basin ESUs. ICBTRT draft report July 2003.

ICBTRT (Interior Columbia Basin Technical Recovery Team). 2005. Updated population delineation in the interior Columbia basin. Memo to NMFS Northwest Regional Office May 11, 2005.

Kennedy, P., T. Copeland, J. Johnson, K. A. Apperson, J. Flinders, and R. Hand. 2011. Idaho Natural Production Monitoring and Evaluation, 2009-2010 annual progress report. Idaho

Department of Fish and Game Report 11-23. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Kennedy, P., T. Copeland, J. Johnson, K. A. Apperson, J. Flinders, R. Hand, and M. Corsi. 2012. Idaho Natural Production Monitoring and Evaluation, 2011 annual progress report. Idaho Department of Fish and Game Report 12-18. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Kennedy, P., K. A. Apperson, J. Flinders, M. Corsi, J. Johnson, R. Hand, and J. Messner. 2013. Idaho Natural Production Monitoring and Evaluation, 2012 annual progress report. Idaho Department of Fish and Game Report 13-12. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project1991-073-00. Portland, Oregon.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonids populations and the recovery of evolutionarily significant units. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-42.

NMFS (National Marine Fisheries Service). 2011. Five-year review: summary and evaluation of Snake River sockeye, Snake River spring-summer Chinook, Snake River fall-run Chinook, Snake River basin steelhead. NMFS, Northwest Region.

Raymond, H. L. 1988. Effects of hydroelectric development and fisheries enhancement on spring and summer Chinook salmon and steelhead in the Columba River basin. North American Journal of Fisheries Management 8:1-24.

Schrader, W. C., T. Copeland, M. W. Ackerman, K. K. Ellsworth, and M. R. Campbell. 2011. Wild adult steelhead and Chinook salmon abundance and composition at Lower Granite Dam, spawn year 2009. Idaho Department of Fish and Game Report 11-24. Annual report 2009, BPA Projects 1990-055-00, 1991-073-00, 2010-026-00.

Schrader, W. C., T. Copeland, P. Kennedy, M. W. Ackerman, K. K. Wright, and M. R. Campbell. 2012. Wild adult steelhead and Chinook salmon abundance and composition at Lower Granite Dam, spawn year 2010. Idaho Department of Fish and Game Report 12-16. Annual report 2010, BPA Projects 1990-055-00, 1991-073-00, 2010-026-00.

Schrader, W. C., M. P. Corsi, P. Kennedy, M.W. Ackerman. M. R. Campbell, K. K. Ellsworth, T. Copeland. 2013. Wild adult steelhead and Chinook salmon abundance and composition at Lower Granite Dam, spawn year 2011. Idaho Department of Fish and Game Report 13-15. Annual report 2011, BPA Projects 1990-055-00, 1991-073-00, 2010-026-00.

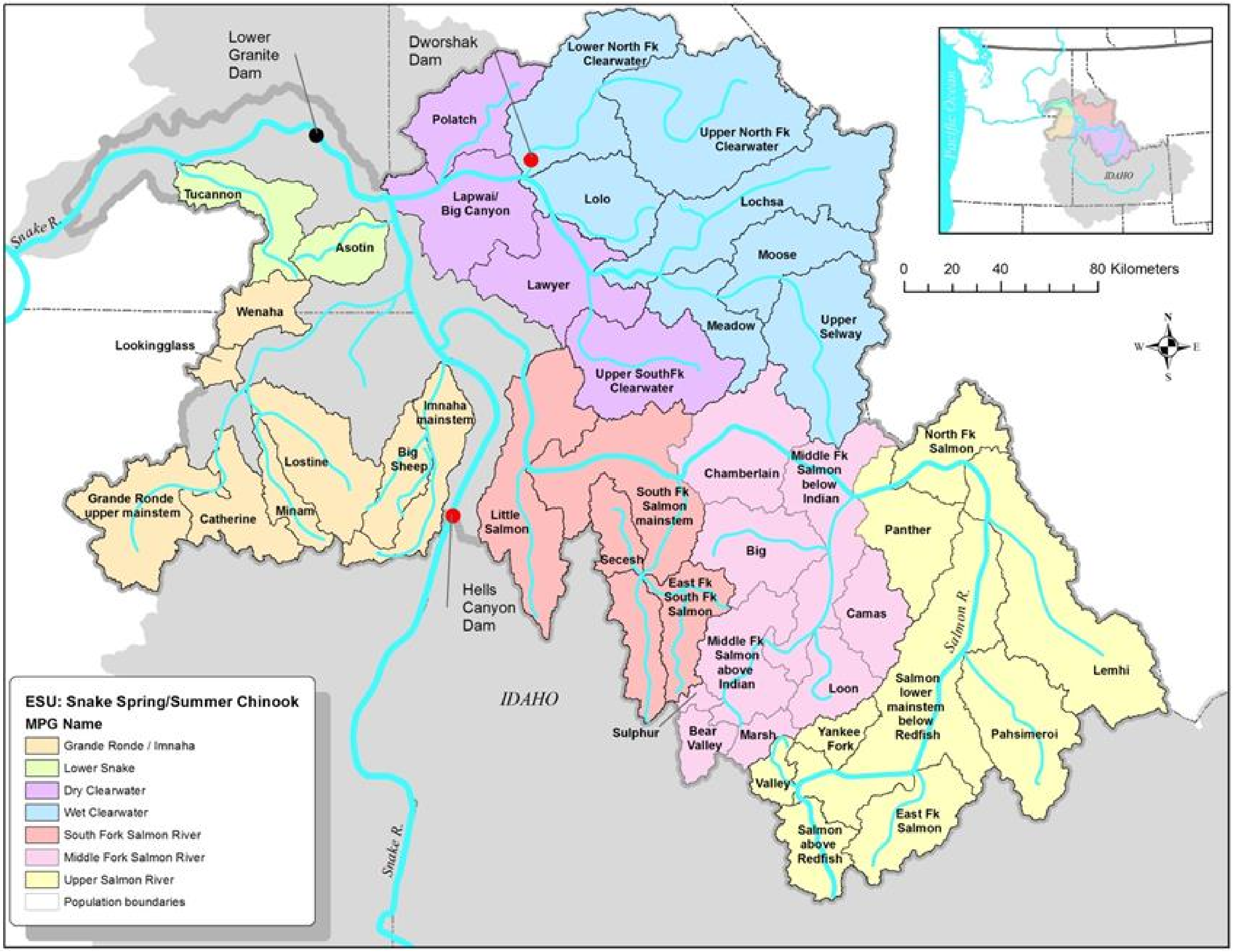


Figure 1. Spring-summer Chinook salmon populations and major population groups (MPGs) in the Snake River evolutionary significant unit (ESU).

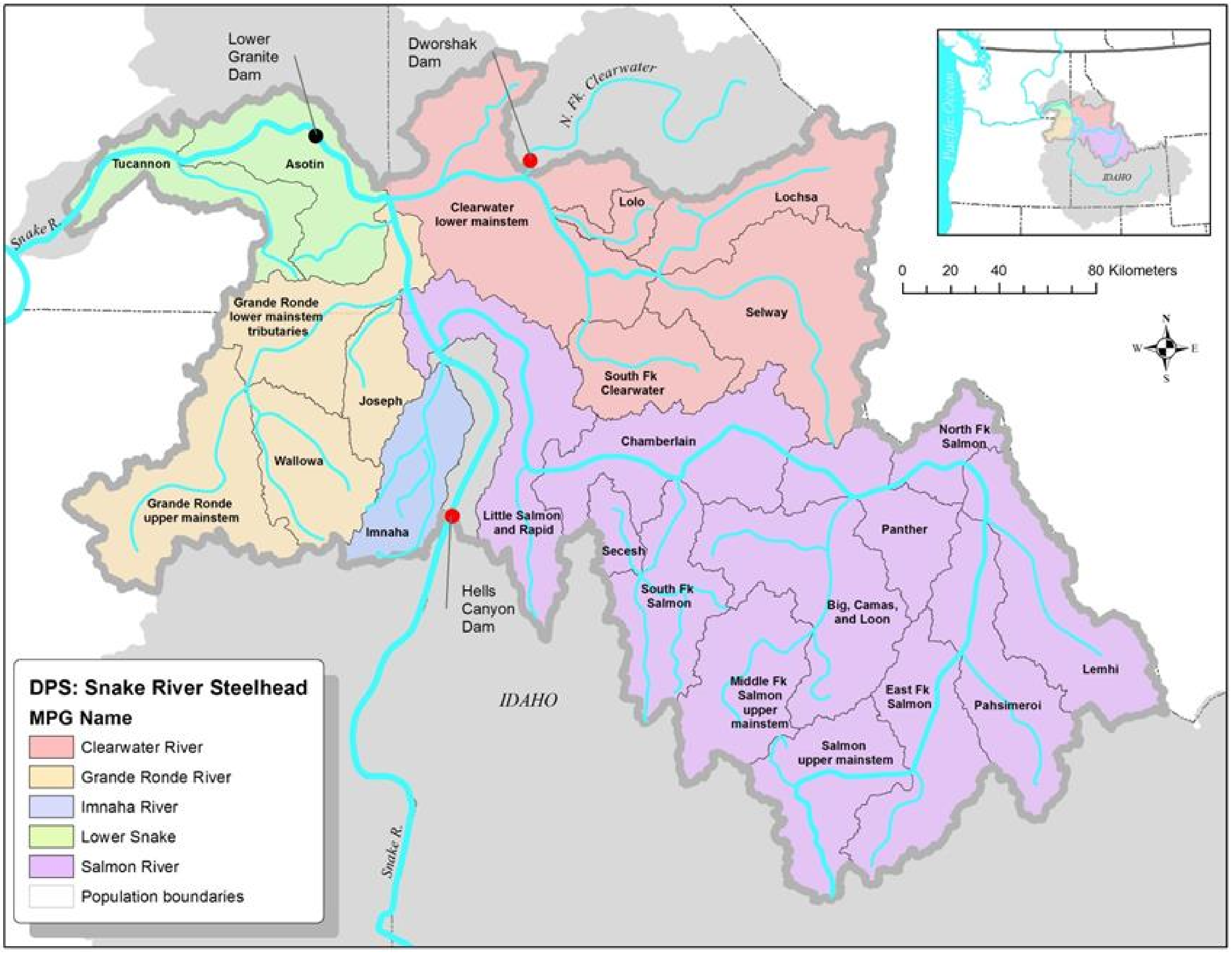


Figure 2. Summer steelhead populations and major population groups (MPGs) in the Snake River distinct population segment (DPS).

PART 2— MONITORING RELATIVE ABUNDANCE AND AGE COMPOSITION OF SPRING-SUMMER CHINOOK SALMON ON THE SPAWNING GROUNDS IN IDAHO

ABSTRACT

The Idaho Natural Production Monitoring and Evaluation Project monitors the status of wild Snake River spring-summer Chinook salmon populations in the Salmon River and Clearwater River subbasins. In this part of the report, we detail results from the 2013 Chinook salmon spawning ground surveys. We summarize redd surveys for Idaho trend transects, carcass surveys, and the length-at-age results. Surveyors documented 1,978 redds throughout Idaho. This included 558 redds in the South Fork Salmon River Major Population Group (MPG), 624 redds in the Middle Fork Salmon River MPG, 522 redds in the Upper Salmon River MPG, 147 redds in the Dry Clearwater River MPG, and 127 redds in the Wet Clearwater River MPG. We aged 1,229 Chinook salmon carcasses using dorsal fin rays in 2013; 400 from the South Fork Salmon River MPG; 407 from the Middle Fork Salmon River MPG; 328 from the Upper Salmon River MPG; 72 from the Dry Clearwater River MPG; and 22 from the Wet Clearwater River MPG. Aggregate estimates of mean length-at-age for Chinook Salmon in Idaho from 2010-2013 were similar for one- and two-ocean fish; however, length-at-age for three-and four-ocean fish in 2013 decreased slightly from the previous three years. Estimating ocean ages of spawning Chinook salmon using fin rays continues to be the preferred method for population-specific age composition; accuracy is estimated at 93.3%.

Authors:

Carl Stiefel
Regional Fisheries Biologist

Kimberly A. Apperson
Regional Fisheries Biologist

Matthew P. Corsi
Regional Fisheries Biologist

Patrick Kennedy
Senior Fishery Research Biologist

Jordan Messner
Regional Fisheries Biologist

Kristin K. Wright
Fishery Research Biologist

INTRODUCTION

Management of Snake River spring-summer Chinook salmon *Oncorhynchus tshawytscha* (hereafter Chinook salmon) requires the monitoring of adult abundance and escapement to spawning habitat. In Idaho, it is difficult to census all salmon returning to each population due to the large geographic area and difficult access in remote wilderness areas used by spawning Chinook salmon. In lieu of census counts, the Idaho Department of Fish and Game (IDFG) developed a program to index annual spawning abundance by counting salmon redds in selected transects. The core transects surveyed annually are hereafter referred to as "trend surveys" (Table 1). The use of annual trend surveys to index spawner abundance continues to be the most efficient method to monitor these populations (Gallagher et al. 2010). The sum of all trend transect area surveyed represents a large portion of Chinook salmon spawning habitat in Idaho (Pirtle 1956). The number of redds counted during surveys in these trend transects provide an index used to measure annual relative adult spawner abundance. Time series trends in adult abundance can be assessed from these redd survey data. Redd and carcass data are also used to derive point estimates of natural spawner abundance, smolt-to-adult survival, and recruitment-per-spawner estimates (ICBTRT 2005).

Chinook salmon redd surveys in Idaho were made as early as 1947. However, consistent trend surveys date back to 1957. The redd survey program incorporated additional spawning areas to support expanded monitoring activities and management requirements as necessary.

Chinook salmon carcass surveys were included when redd surveys were conducted from the ground. Carcass surveys provide information used to estimate population-specific length, age, sex ratios, and proportion of hatchery and wild fish on the spawning grounds. Prior to 1993, adipose fin-clips indicated the presence of a coded-wire-tag (CWT). Since 1993, most hatchery origin Chinook salmon released in the Snake River basin had an external mark, usually an adipose fin-clip, regardless of whether they have a CWT.

In 2004, the Interior Columbia Basin Technical Recovery Team (ICBTRT) was formed at the urging of the National Oceanic and Atmospheric Administration Fisheries (NOAAF) to refine the recovery monitoring process for the Endangered Species Act (ESA) status assessments. The ICBTRT identified three different scales of population structure for both Chinook salmon and steelhead; from spatially largest to smallest they include evolutionary significant unit (ESU), major population group (MPG), and population. Within the Snake River spring-summer Chinook salmon evolutionarily significant unit ESU, there are 7 MPGs and 29 extant demographically independent populations (Figure 1; ICBTRT 2003, 2005; NMFS 2011).

This section contains redd survey data used for trend analysis by managers and researchers along with fin-ray ages, frequencies of hatchery/wild fish, and average length-at-age of Chinook salmon on the spawning grounds by major population group (MPG).

METHODS

Redd Surveys

During 2013, redd survey methods were the same as past years using standardized procedures described in Hassemer (1993b). Redd survey transect names, transect boundaries, and target dates have generally remained constant and were described in Hassemer (1993a,

Table 1). Single-pass, peak-count surveys were made over each trend transect each year. Each survey was originally timed to coincide with the period of maximum spawning activity on a particular stream, based on historic observations, and assigned a target count-time window. The method chosen for each redd survey was dependent on the best visual technique for each trend area and ability to maximize the number of river miles surveyed. Methods included low-flying helicopter or single-pass ground surveys conducted on foot. Currently no redd survey trend transects are identified for the following populations: Little Salmon River, Upper Middle Fork Salmon River, Lapwai/Big Canyon Creeks, Potlatch River, Lawyer Creek, and Meadow Creek. Data was downloaded from https://fishandgame.idaho.gov/ifwis/portal/page/spawning-ground-survey on October 17, 2014.

Carcass Surveys

Carcasses were sampled from spawning areas throughout the Idaho portion of the study area consistent with methods in Copeland et al. (2004, Figure 3). Reaches were a subset of the redd survey transects described in Hassemer (1993a). Not all redd survey transects were surveyed from the ground; therefore, carcasses were not available for all populations. Because age composition, sex ratios, and hatchery/wild fraction can vary widely among populations, we have a minimum goal of 100 natural origin carcass samples from each population.

Each carcass was thoroughly examined for marks and tags to determine origin. Hatchery origin was identified visually by the presence of external marks, such as an adipose fin clip. Handheld CWT wands and Passive Integrated Transponder (PIT) tag readers were used to scan each carcass for the presence of internal tags, the presence of which could identify hatchery origin depending on their release history.

Biological information and samples were collected from each carcass as well. Fork and middle of eye-to-hypural lengths were measured using a tape measure. Sex was determined by examining the gonads. A genetic tissue sample was also collected. Lastly, four to five fin rays were removed for age composition analysis, see below.

Carcass Age Composition

Chinook salmon fin rays were processed and assigned an ocean-age. Freshwater age was assumed to be one year for all fin rays. Fin rays were dried, set in epoxy resin, cut into cross-sections with a bone saw, and mounted on microscope slides. All samples were aged independently by two technicians. Personnel were trained with reference fin rays and were required to demonstrate 90% accuracy in an aging test before they were allowed to begin aging new samples. If there was disagreement in age determination or the age did not match what was expected for fish length, then fins were aged again in a referee session. A referee session requires that three personnel observed the fin together and arrive at a consensus age. In some cases, a consensus could not be achieved and the fin ray was removed from analysis.

Hatchery personnel also collected dorsal fins from known ocean-age (PIT or CWT) hatchery adults at Rapid River, Sawtooth, Clearwater, Pahsimeroi, and McCall hatcheries. The known ocean-age samples were collected from Chinook salmon tagged as juveniles with PIT tags or CWTs and recovered as returning adults. The known ocean-age samples were randomly included with the wild samples to assess aging accuracy and train new personnel in growth patterns specific to the years being analyzed. Chinook salmon with a fork length less than 45 cm were removed from the known ocean-age sample due to the possibility that they were mini-jacks.

Carcass Data Analysis

We summarized 2013 carcass survey data in three ways: First, the number of carcasses collected was summarized by ocean-age for each population for each year. Second, the frequency of length-at-age (determined by fin ray analysis) was used to describe the Idaho populations above LGR. Point estimates and 95% confidence intervals for length-at-age were also estimated by MPG for years 2010-2013. Third, hatchery and natural origin carcass recoveries were summarized by population and MPG (data source: data was downloaded from https://fishandgame.idaho.gov/ifwis/portal/page/spawning-ground-survey October 22, 2014.).

RESULTS

Redd Surveys

We surveyed 1,978 Chinook salmon redds in trend transects in 2013 (Table 2). A total of 1,704 redds were in the Salmon River subbasin. This included 558 redds in the South Fork Salmon MPG; the majority (254) were in the South Fork Salmon River population. The Middle Fork Salmon River MPG had 624 redds, the majority of which (267) were in the Bear Valley/Elk Creek population. There were 522 redds in the Upper Salmon River MPG, the majority of which (189) were in the Upper Salmon River main-stem population (above Redfish Lake Creek). There were no surveys conducted in the Little Salmon River and Yankee Fork Salmon River population. Partial surveys were conducted in the Big Creek, Loon Creek, and Upper Salmon River (below Red Fish Lake Creek) populations.

A total of 274 redds were in the Clearwater River subbasin (Table 2). This included 147 redds in the Dry Clearwater MPG and 127 redds in the Wet Clearwater MPG. The majority of Clearwater River redds were in the South Fork Clearwater River population.

Carcass Surveys

During 2013, we sampled 2,752 Chinook salmon carcasses on Idaho spawning grounds (Table 3, Figure 3). Of these carcasses, 2,198 were natural origin while the remaining 554 were hatchery origin.

Carcass Age Composition

During 2013, we assigned ages to 1,229 fin rays (Table 3). Of the assigned ages, 24.3% were brood year (BY) 2010, 44.3% were BY 2009, 30.3% were BY 2008, and 1.1% were BY 2007.

For the South Fork Salmon River MPG, 26.8% of carcasses were BY 2010, 47.5% were BY 2009, 24.0% were BY 2008, and 1.8% were BY 2007 (n = 400; Table 3). For the Middle Fork Salmon River MPG, 30.0% were BY 2010, 35.6% were BY 2009, 33.7% were BY 2008, and 0.7% were BY 2007 (n = 407). For the Upper Salmon River MPG, 19.5% were BY 2010, 54.0% were BY 2009, 26.2% were BY 2008, and 0.3% were BY 2007 (n = 328). For the Dry Clearwater MPG, 4.2% were BY 2010, 27.8% were BY 2009, 63.9% were BY 2008, and 4.2% were BY 2007 (n = 72). For the Wet Clearwater MPG, 13.6 % were BY 2010, 54.5% were BY 2009, and 31.8% were BY 2008 (n = 22).

Of the 135 known ocean-age fin rays assigned ages, 93.3% were aged correctly. Mean coefficient of variation between primary readers for ocean age was 2.10%. Overall, there were 37 samples from BY 2010, 70 from BY 2009, and 28 from BY 2008. There were no BY 2007 fish in the known ocean-age samples.

The Idaho aggregated length distributions of one-ocean and two-ocean groups overlapped by 18 cm (Figure 4). The overlap between two- and three-ocean length distributions was 24 cm. The length distribution for four-ocean fish was within the three-ocean length distribution, but the sample size was small in 2013. Mean length-at-age for the Idaho aggregate for the one- and two-ocean fish was similar to the mean of the previous three years (Table 4). However, the mean length-at-age for three- and four-ocean fish decreased slightly from the mean of the previous three years.

DISCUSSION

The IDFG Chinook salmon spawning ground survey data are a key element in Idaho's Chinook salmon management. These data are used in annual forecasting which contribute to setting the Lower Columbia River fisheries before the Chinook salmon ever migrate into Idaho. Furthermore, hatchery Chinook salmon harvest rates and incidental take of wild catch-and-release fish are set according to the number of wild or natural adults.

The Chinook salmon information presented in this section was acquired during spawning ground surveys, which typically include both redd and carcass surveys. For monitoring wild Chinook salmon abundance, redd surveys account for a large proportion of each population's available spawning habitat in Idaho. In contrast to the redd surveys, the spatial and temporal distribution of carcass surveys could be improved to include more populations (Figure 3). Increased effort or spatially balanced sampling would benefit the analysis and interpretation of the biological data used to monitor these wild populations. However, the importance and utility of maintaining the long-term redd trend survey dataset is a higher priority than restructuring our current carcass survey design. Because most spring-summer Chinook salmon spawn during such a narrow time period, we have very little flexibility in altering our carcass survey design.

Currently, population-specific adult Chinook salmon abundances are indexed using redd surveys in most populations. The IDFG historical redd survey dataset is extensive and has recently been improved to be easily accessed and accommodate survey data from a variety of projects. Therefore, not all redd surveys conducted in Idaho were presented in this report.

The abundance of wild adult spawning spring-summer Chinook salmon in Idaho continues to be very low compared to historical estimates (Ford et al. 2010). In general, Idaho populations do not meet viability criteria, and therefore they continue to be listed under the ESA as threatened. Trends in spatial distribution follow trends in abundance. Adult spawner abundance is low in comparison to the vast area of habitat that Idaho has available for Chinook salmon to spawn in, which results in patchy and disjunct spatial structure of spawning Chinook salmon that are not well dispersed over the available habitat.

Biological data from carcass surveys provide estimates of length-at-age, age composition, sex composition, and hatchery fraction at the population scale with a resolution not currently available using data collected at Lower Granite Dam. These metrics are used to estimate the productivity of each population (ICBTRT 2005; Ford et al. 2010). Tissue samples obtained from carcasses also contribute to the genetic stock index baseline used to estimate the proportions of returning adults by population for harvest management and abundance monitoring (Ackerman et al. 2012).

Age composition was reported as frequencies of fish sampled from the spawning grounds at the MPG and population levels (Table 3). However, it is important to note fin ray sample size in some populations is lower than the 30-40 samples recommended by Gerritsen and McGrath (2007). IDFG employs a decision tree which provides a structured approach to develop an age composition estimate for individual populations when sample sizes are low, i.e. using a MPG level age composition as a surrogate for a population with low sample size. These adjusted population-specific age compositions are not covered in this document but are included IDFG's viable salmonid population tables (IDFG unpublished information).

Frequencies of hatchery and natural origin carcasses were reported as encountered; thus the reported ratio should be indicative of the hatchery/wild spawning fraction for Idaho populations. Most carcass surveys conducted by IDFG were within areas of controlled escapement such as natural production areas above hatchery weirs, or areas designed to monitor supplementation. For some supplemented populations (e.g., South Fork Salmon River) estimates of hatchery fraction may be biased high or low depending on the transect. For example, surveys conducted above a hatchery weir will identify natural fish almost exclusively because no hatchery fish are passed above weirs. Surveys immediately downstream from a hatchery weir will have a greater proportion of hatchery spawners due to fallout. For other populations with no history of hatchery supplementation (e.g., Middle Fork Salmon River MPG), we assume this bias does not exist. Thus, frequencies of fish encountered by production type provide an accurate estimate of hatchery fraction on these spawning grounds. In general, the frequency of hatchery carcasses encountered on the spawning grounds varied among MPGs, populations, and years.

Length-at-age varies by MPG and year in all years where sufficient data is available (Table 4). Overlapping confidence intervals for three- and four-ocean fish show that visual determinations of older fish ages based on length are not accurate. There were not enough carcasses in each age group to estimate population specific length-at-age which resulted in samples aggregated to the next highest population scale for each MPG. There were a few years where mean length-at-age increased for a year or two in some age classes. Mean length-at-age of two-ocean fish decreased most consistently. There are far fewer samples available for four-ocean fish, which is evidence that this age class is not well represented on the spawning grounds. Trends of decreasing length-at-age have recently been recognized in other Chinook salmon populations as well (Kendall and Quinn 2011). Sampling complications in the Clearwater River drainage have resulted in small sample sizes that reduce our ability to draw inferences from spawning ground survey results.

The status of population diversity can be monitored using genetic diversity, and the trends can be monitored using spawn timing, age distributions, fecundity, and sex ratios (Crawford and Rumsey 2011). Genetic diversity is estimated by the genotyping for Genetic Stock Identification (GSI) project at Lower Granite Dam (Bonneville Power Administration [BPA] project #2010-026-00; see Ackerman et al. 2012, Table 2). For the shorter-term trends, however, little information is available on spawn timing and fecundity. Estimating spawn timing is difficult using single-pass redd surveys. Currently, fecundity is not measured during IDFG carcass surveys because eggs and milt are already spent and not available to quantify. But population-specific sex ratios and age distributions are monitored on the spawning grounds annually.

RECOMMENDATIONS

1. Continue to refine and improve spawning ground survey data management, from quality assurance in the field to quality control of the Spawning Ground Survey database output, to ensure timely and accurate summaries for managers.

2. Publish protocols for redd surveys and carcass surveys to ensure standardized methods are used.

3. Maintain the IDFG trend surveys. Spatial and temporal changes to these surveys should be resisted unless well justified (e.g., evaluated change in peak spawn timing).

4. Evaluate the peak spawn timing and accuracy of the target survey dates for the trend surveys in at least one population per year.

5. Conduct power analyses to estimate the number of carcasses needed from each population to estimate age composition relative to the 10-year geometric mean of abundance.

6. Increase monitoring of wild or natural adult spawners in the Clearwater drainages to better understand those populations.

7. Expand previously reported length-at-age (Copeland et al. 2004) analyses through current years.

ACKNOWLEDGEMENTS

We are grateful to the Bonneville Power Administration and David Byrnes, our contracting officer's technical representative, for support and funding of this project (1991-073-00) conducted under contract number 59833. The Nez Perce Tribe, the Shoshone-Bannock Tribe, the University of Idaho, and many IDFG regional staff contributed to the spawning ground survey data. The majority of the spawning ground survey data was provided by the Idaho Supplementation Studies project (Bonneville Power Administration project #1989-098-00). The Middle Fork Salmon River redd surveys were provided by Russ Thurow (U.S. Forest Service). Emanuel Ziolkowski provided quality control for the spawning ground survey data. IDFG Information Systems Bureau, particularly Evan Brown and Chris Harrington, provided database management and technical oversight for the entire trend data set. Fin ray processing and aging were conducted by Dorianne Broglino, Nathan Abel, and Emanuel Ziolkowski. Paul Bunn coordinated BioSamples database management and created the carcass survey map for this report. This section benefited from reviews by Brett Bowersox, Lance Hebdon, and Bill Schrader. Cheryl Zink helped format and edit the document.

LITERATURE CITED

Ackerman, M. W., J. McCane, C. A. Steele, M. R. Campbell, A. P. Matala, J. E. Hess, and S. R. Narum. 2012. Chinook salmon and Steelhead Genotyping for Genetic Stock Identification at Lower Granite Dam. Idaho Department of Fish and Game Report 12-15. Annual Report, BPA Project 2010-026.

Copeland, T., J. Johnson, and P. R. Bunn. 2004. Idaho natural production monitoring and evaluation. Idaho Department of Fish and Game Report 04-47. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Crawford, B. A. and S. M. Rumsey. 2011. Guidance for Monitoring Recovery of Pacific Northwest Salmon & Steelhead listed under the Federal Endangered Species Act. National Marine Fisheries Service, NW Region. Seattle.

Ford, M. J., A. Albaugh, K. Barnas, T. Cooney, J. Cowen, J. Hard, R. Kope, M. M. McClure, P. McElhany, J. Myers, N. Sands, D. Teel, and L. A. Weitkamp. 2010. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. US Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-113.

Gallagher, S., P. Adams, D. Wright, and B. Collins. 2010. Performance of Spawner Survey Techniques at Low Abundance Levels. North American Journal of Fisheries Management 30:1086-1097.

Gerritsen, H. D. and D. McGrath. 2007. Precision estimates and suggested sample sizes for length-frequency data. Fisheries Bulletin 106:116-120.

Hassemer P. 1993a. Salmon spawning ground surveys, 1989-1992. Idaho Department of Fish and Game. Project F-73-R-15. Pacific Salmon Treaty Program Award No. NA17FP0168-02. 32 p. plus appendices.

Hassemer, P. 1993b. Draft manual of standardized procedures for counting Chinook salmon redds. Idaho Department of Fish and Game, Boise.

ICBTRT (Interior Columbia Basin Technical Recovery Team). 2003. Independent populations of Chinook, steelhead, and sockeye for listed Columbia basin ESUs. ICBTRT draft report July 2003.

ICBTRT (Interior Columbia Basin Technical Recovery Team). 2005. Updated population delineation in the interior Columbia Basin. Memo to NMFS Northwest Regional Office May 11, 2005.

Kendall, N. W. and T. P. Quinn. 2011. Length and Age Trends of Chinook salmon in the Nushagak River, Alaska, Related to Commercial and Recreational Fishery Selection and Exploitation, Transactions of the American Fisheries Society 140:3, 611-622.

Kennedy, P., T. Copeland, J. Johnson, K. A. Apperson, J. Flinders, R. Hand. 2011. Idaho Natural Production Monitoring and Evaluation, 2009-2010 annual progress report. Idaho Department of Fish and Game Report 11-23. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Kennedy, P., T. Copeland, J. Johnson, K. A. Apperson, J. Flinders, R. Hand. M. Corsi. 2012. Idaho Natural Production Monitoring and Evaluation, 2011 annual progress report. Idaho Department of Fish and Game Report 12-18. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Kennedy, P., K. A. Apperson, J. Flinders, M. Corsi, J. Johnson, R. Hand, and J. Messner. 2013. Idaho Natural Production Monitoring and Evaluation, 2012 annual progress report. Idaho Department of Fish and Game Report 13-12. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

NMFS (National Marine Fisheries Service). 2011. Five-year review: summary and evaluation of Snake River sockeye, Snake River spring-summer Chinook, Snake River fall-run Chinook, Snake River basin steelhead. NMFS, Northwest Region.

Pirtle, R. B. 1956. Field Studies to Estimate the Size and Timing of Runs of Anadromous Species of Fish in the Columbia and Snake River and Their Tributaries Above the Confluence of the Snake River. Idaho Department of Fish and Game, Boise.

Table 1. Transect name and target dates for redd surveys used to index wild Chinook salmon abundance by major population group and independent population. Populations with no trend monitoring transects are identified with “n/t”.

Major Population Group and Population	Surveyed in 2013 Y/N	Transect Name	Target Survey Date
South Fork Salmon River			
Little Salmon River	-	n/t	n/t
South Fork Salmon River	Y	NS-26	9/5
	Y	NS-27	9/5
	Y	NS-28	9/5
	Y	NS-29	9/5
Secesh River/Lake Creek	Y	WS-16	8/25-9/1
	Y	WS-17	8/25-9/1
	Y	WS-18	8/25
	Y	WS-19	8/25
East Fork South Fork Salmon River	Y	NS-30	9/1-9/5
	N	NS-31	9/1-9/5
	Y	NS-32	9/1-9/5
Middle Fork Salmon River			
Chamberlain Creek	Y	WS-1	8/25
	Y	WS-1a	8/25
Big Creek	Y	WS-13	9/5
	Y	WS-14a	9/5
	N	WS-14b	9/5
	Y	WS-14c	9/5
	Y	WS-14d	9/5
Lower Middle Fork Salmon	Y	WS-15	9/8
Camas Creek	Y	WS-8	8/25-9/5
Loon Creek	N	WS-6	8/25-9/5
	Y	WS-7	8/25-9/5
Sulphur Creek	Y	OS-4	8/21
	Y	WS-12	8/21
Bear Valley Creek	Y	WS-9a	8/27
	Y	WS-9b	8/27
	Y	WS-9c	8/27
	Y	WS-9d	8/27
	Y	WS-10a	8/27
	Y	WS-10b	8/27
	Y	WS-11a	8/27
	Y	WS-11b	8/27
	Y	WS-11c	8/27
Marsh Creek	Y	WS-2a	8/15-8/20
	Y	WS-2b	8/15-8/20
	Y	WS-3	8/15-8/20
	Y	WS-4	8/15-8/20
	Y	WS-5	8/15-8/20
Upper Middle Fork Salmon River	-	n/t	n/t
Upper Salmon River			
North Fork Salmon River	Y	NS-25a	9/8
	Y	NS-25b	9/8
	Y	NS-25c	9/8
Lemhi River	Y	NS-9	9/8
	Y	NS-10	9/8
Pahsimeroi River	Y	NS-33a	9/8
Lower Salmon River (mainstem)	Y	NS-17	9/8
	Y	NS-18	9/8
	Y	NS-19	9/8
	Y	NS-20	9/8
	Y	NS-21	9/8

Table 1. Continued.

Major Population Group and Population	Surveyed in 2013 Y/N	Transect Name	Target Survey Date
	Y	NS-22	9/8
	Y	NS-23	9/8
	N	NS-24	9/8
East Fork Salmon River	Y	NS-1a	9/8
	Y	NS-1b	9/8
	Y	NS-2a	9/8
	Y	NS-2b	9/8
Yankee Fork Salmon River	Y	NS-5	9/8
	Y	NS-6	9/8
	Y	NS-7	9/8
	Y	NS-8	9/8
Valley Creek	Y	NS-3a	9/8
	Y	NS-3b	9/8
	Y	NS-4	9/8
Upper Salmon River (mainstem)	Y	NS-12	8/31-9/5
	Y	NS-13a	9/8
	Y	NS-13b	9/8
	Y	NS-15a	9/8
	Y	NS-15b	9/8
	Y	NS-15c	9/8
	Y	NS-16	9/8
	Y	OS-1	8/31-9/5
	Y	OS-2	8/31-9/5
	Y	OS-3	8/31-9/5
	Y	OS-5	9/8
	Y	OS-6	9/8
Panther Creek	Y	NS-11	9/8
	Y	NS-11b	9/8
Dry Clearwater			
Lapwai/Big Canyon Creeks	-	n/t	n/t
Potlatch River	-	n/t	n/t
Lawyer Creek	-	n/t	n/t
South Fork Clearwater	Y	NC-1	9/3
	Y	NC-2a	9/3
	Y	NC-2b	9/3
	Y	NC-3	9/3
	Y	NC-4	9/1-9/5
	Y	NC-6	9/3
	Y	NC-8	9/3
Wet Clearwater			
Lolo Creek	Y	NC-14	9/3
Lochsa River	Y	NC-10	9/3
	Y	NC-11	9/3
	Y	NC-13	9/8
Meadow Creek	-	n/t	n/t
Moose Creek	Y	WC-3a	9/8
	Y	WC-3b	9/8
Upper Selway River	N	WC-1	9/8
	Y	WC-2	9/8
	Y	WC-4a	9/8
	Y	WC-4b	9/8
	Y	WC-5	9/8
	Y	WC-6	9/8
	Y	WC-7	9/8
	Y	WC-8	9/8
	Y	WC-9	9/8

Table 2. Wild Chinook salmon redds counted in Idaho trend transects in the Salmon River and Clearwater River subbasins during the years 2010-2013 by major population group and independent population (Kennedy et al. 2011, 2012, 2013).

Major Population Group and Population		2010	2011	2012	2013
South Fork Salmon River					
Little Salmon River		n/t[a]	n/t[a]	n/t[a]	n/t[a]
South Fork Salmon River		244[b]	750	467	254
Secesh River		299[b]	242	207	162
East Fork South Fork Salmon River		n/c[c]	n/c[c]	n/c[c]	142
	MPG total	543	992	674	558
Middle Fork Salmon River					
Chamberlain Creek		78[b]	114[b]	96	60
Big Creek		92[b]	96[b]	111[b]	72[b]
Lower Middle Fork Salmon		1	0	0	0
Camas Creek		17	3	22	14
Loon Creek		20	15	34	16[b]
Sulphur Creek		52	79	19	51
Bear Valley/Elk Creek		418	400	497	267
Marsh Creek		243	259	158	144
Upper Middle Fork Salmon		n/t[a]	n/t[a]	n/t[a]	n/t[a]
	MPG total	921	966	937	624
Upper Salmon River					
North Fork Salmon River		39	46	42	21
Lemhi River		79	99	63	60
Pahsimeroi River		47	56	74	76
Lower Salmon River		63[b]	119	95	21[b]
East Fork Salmon River		326	258	201	100[b]
Yankee Fork River		4[b]	9	n/c[c]	n/c[c]
Valley Creek		68	42	110[b]	49
Upper Salmon River		279	222[b]	348	189
Panther Creek		1	0	14	6
	MPG total	906	851	947	522
Dry Clearwater					
Lapwai/Big Canyon Creeks		n/t[a]	n/t[a]	n/t[a]	n/t[a]
Potlatch River		n/t[a]	n/t[a]	n/t[a]	n/t[a]
Lawyer Creek		n/t[a]	n/t[a]	n/t[a]	n/t[a]
South Fork Clearwater		144[b]	264[b]	160[b]	147
	MPG total	144	264	160	147
Wet Clearwater					
Lolo Creek		47	n/c[c]	n/c[c]	63
Lochsa River		50	69	36[b]	49
Meadow Creek		n/t[a]	n/t[a]	n/t[a]	n/t[a]
Moose Creek[d]		n/c[c]	n/c[c]	n/c[c]	4
Upper Selway River		23[b]	15[b]	6[b]	11[b]
	MPG total	120	84	42	127
	Idaho total	2,634	3,157	2,760	1,978

[a] n/t = No trend monitoring transects have been identified.
[b] Indicates partial survey of the trend transects for a population.
[c] n/c = No trend survey conducted.
[d] Partial survey, 9 km of the reaches 23 k were surveyed.

Table 3. Brood year and age class (fin ray derived) frequencies of wild Chinook salmon carcasses sampled from Idaho spawning grounds during 2013. Freshwater age was assumed to be one year. Frequencies are for all carcasses (hatchery [HOR] and natural [NOR] origin), recovered during surveys (data source: Spawning Ground Survey database).

	Brood Year and Age Class					**All Carcasses**	
	2010	**2009**	**2008**	**2007**	**Total**		
Major Population Group and Population	**1.1**	**1.2**	**1.3**	**1.4**	**Aged**	**HOR**	**NOR**
South Fork Salmon River							
Little Salmon River	-	-	-	-	-	-	-
South Fork Salmon River [a]	24	33	21	1	79	60	205
Secesh River [a]	20	38	9	1	68	3	310
East Fork South Fork Salmon River [a]	63	119	66	5	253	120	257
MPG total	107	190	96	7	400	183	772
Middle Fork Salmon River							
Chamberlain Creek	42	49	9	1	101	-	109
Big Creek	18	29	11	1	59	-	62
Lower Middle Fork Salmon River	1	-	-	-	1	-	1
Camas Creek [b]	-	-	-	-	-	-	-
Loon Creek	-	-	-	-	-	-	-
Sulphur Creek	14	13	4	-	31	1	37
Bear Valley Creek [b]	30	40	61	1	132	-	180
Marsh Creek	17	14	52	-	83	-	175
Upper Middle Fork Salmon River	-	-	-	-	-	-	-
MPG total	122	145	137	3	407	1	564
Upper Salmon River							
North Fork Salmon River	-	1	-	-	1	-	3
Lemhi River	11	44	3	-	58	-	103
Pahsimeroi River	8	19	4	-	31	1	68
Lower Salmon River	-	1	-	-	1	1	1
East Fork Salmon River	3	5	12	-	20	-	132
Yankee Fork Salmon River [b]	1	3	7	-	11	14	35
Valley Creek	11	24	15	-	50	1	50
Upper Salmon River [c]	30	80	45	1	156	97	185
Panther Creek [b]	-	-	-	-	-	0	27
MPG total	64	177	86	1	328	114	604
Dry Clearwater							
Lapwai/Big Canyon Creeks	-	-	-	-	0	-	-
Potlatch River	-	-	-	-	0	-	-
Lawyer Creek	-	-	-	-	0	-	-
South Fork Clearwater [a]	3	20	46	3	72	200	197
MPG total	3	20	46	3	72	200	197
Wet Clearwater							
Lolo Creek	-	-	-	-	-	11	19
Lochsa River	1	4	2	-	7	29	16
Meadow Creek	-	-	-	-	-	-	-
Moose Creek	2	1	1	-	4	10	7
Upper Selway River	-	7	4	-	11	6	19
MPG total	3	12	7	-	22	56	61
Idaho total	299	544	372	14	1,229	554	2,198

[a] Staff from the Nez Perce Tribe collected and provided all or part of the information.
[b] Staff from the Shoshone-Bannock Tribe collected and provided all or part of the information.
[c] Includes surveys above and below the Sawtooth Hatchery weir.

Table 4. Mean length (cm) at ocean-age (fin ray derived) for wild Chinook salmon, major population group and spawn year. Confidence intervals (95%) are given in parentheses.

			Mean Length (cm)			
			Ocean-Age			
Major Population Group	**Spawn Year**	**Sample Size**	**1**	**2**	**3**	**4**
South Fork Salmon	2010	591	54 (50-59)	78 (77-78)	92 (89-95)	97[a] --
	2011	337	56 (54-58)	76 (75-77)	91 (90-92)	93[b] (90-96)
	2012	383	51 (49-53)	74 (73-75)	89 (88-90)	94[a] --
	2013	400	56 (55-57)	75 (74-76)	89 (88-90)	88[b] (82-94)
Middle Fork Salmon	2010	238	50[b] (42-57)	77 (76-77)	94 (92-96)	89a --
	2011	329	53 (51-55)	74 (73-75)	92 (91-93)	92[b] (88-96)
	2012	383	51[b] (43-59)	73 (72-74)	91 (90-92)	98[b] (86-111)
	2013	407	53 (52-54)	73 (72-74)	91 (90-92)	83[b] (76-90)
Upper Salmon	2010	370	51 (48-54)	76 (75-77)	91 (90-93)	95[a] --
	2011	494	54 (52-55)	74 (74-75)	93 (92-94)	91[b] (84-97)
	2012	526	50[b] (48-52)	74 (73-74)	93 (92-94)	91[b] (86-97)
	2013	328	53 (51-55)	74 (73-75)	90 (89-91)	94[b] (94-94)
Dry Clearwater	2010	25	45[a] --	73 (71-75)	85[a] --	[c] --
	2011	54	51[b] (35-67)	74 (71-76)	86 (84-89)	[c] --
	2012	91	59[a] --	71 (70-72)	86 (83-90)	[c] --
	2013	66	56[b] (50-62)	69 (66-72)	84 (82-86)	83[b] (77-89)
Wet Clearwater	2010	7	[c] --	73[b] (69-77)	[c] --	[c] --
	2011	23	[c] --	73 (71-76)	91[b] (87-96)	[c] --
	2012	16	[c] --	69 (66-72)	82 (76-87)	[c] --
	2013	28	50[b] (46-54)	70 (67-73)	86[b] (81-89)	[c] --
Idaho Aggregate	2010	1,364	52 (50-55)	77 (77-77)	92 (91-93)	93[b] (90-96)
	2011	1,238	54 (53-55)	75 (74-75)	92 (91-92)	91 (89-94)
	2012	1399	51 (48-55)	73 (73-74)	91 (91-92)	93 (88-98)
	2013	1229	54 (53-55)	74 (74-74)	89 (88-90)	86 (82-90)

[a] Fewer than three samples in the estimate. Not enough to estimate confidence intervals.
[b] Fewer than ten samples in the estimate.
[c] No samples available to estimate an average.

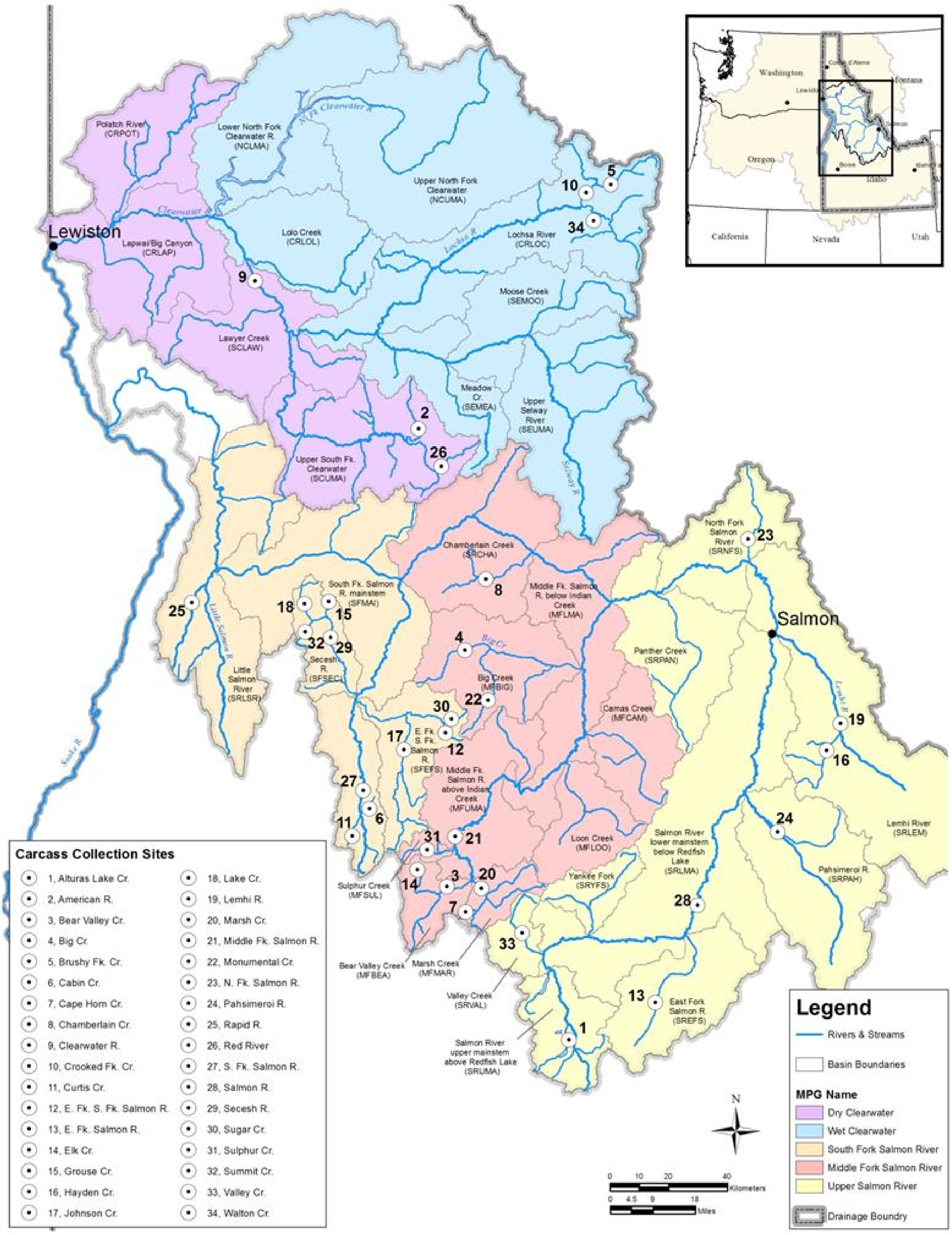


Figure 3. Spawning ground survey locations where wild Snake River spring-summer Chinook salmon carcasses were collected in 2013.

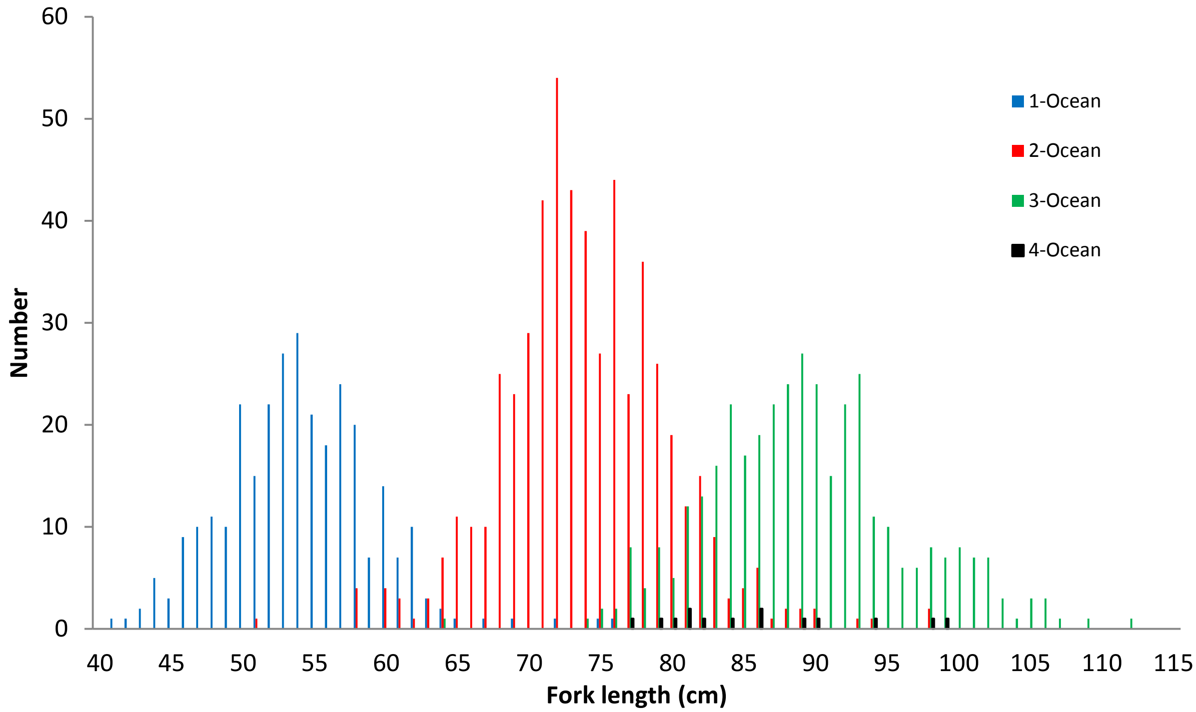


Figure 4. Length frequency by ocean-age (fin ray derived) of wild Snake River spring-summer Chinook salmon carcasses collected on the spawning grounds in Idaho during 2013. Ages were determined from fin ray analysis (*n* = 1,229).

PART 3— MONITORING AGE COMPOSITION OF WILD ADULT SPRING-SUMMER CHINOOK SALMON IN THE SNAKE RIVER BASIN TO ESTIMATE SMOLT-TO-ADULT RETURN RATES

ABSTRACT

Accurate determination of adult age composition is necessary for estimating smolt-to-adult return rates for wild Snake River spring-summer Chinook salmon *Oncorhynchus tshawytscha* over a long-term data series. For the 2013 adult return to Lower Granite Dam, total wild escapement was multiplied by scale-derived ocean age proportions to estimate escapement by age class. Technicians assigned total ages to 1,870 scale samples collected from adult wild Chinook salmon at Lower Granite Dam in 2013. These data were combined with previously collected data to complete the cohorts and estimate smolt-to-adult return rates. The life cycle is complete for smolt migration years 1996-2009, while the life cycle for smolt migration years 2010-2013 is ongoing. The smolt-to-adult return rate to Lower Granite Dam for smolt migration year 2009 was 2.51% and was the fourth time in the 14-year dataset the estimate exceeded the replacement threshold of 2.0%.

Author:

Carl Stiefel
Regional Fisheries Biologist

Patrick Kennedy
Senior Fishery Research Biologist

Kristin Wright
Fishery Research Biologist

INTRODUCTION

Age information is an important tool for fisheries management and monitoring the recovery of wild Snake River spring-summer Chinook salmon *Oncorhynchus tshawytscha*, hereafter Chinook salmon. Accurate age data are essential to assign returning Chinook salmon to a specific brood year for cohort and productivity analyses. Escapement estimates by cohort are used to forecast run sizes and are the basis for fisheries management plans in the Columbia River basin. Accurate age data, at least for the saltwater phase, are also essential to estimate survival such as smolt-to-adult return rate (SAR; Copeland et al. 2007).

METHODS

To estimate the aggregate SAR for wild Chinook salmon, we combined the age composition of adults at LGR with estimates of emigrating wild Chinook salmon smolts at LGR. Prior to 2005, fin ray data obtained from the spawning grounds were combined with fish lengths obtained at LGR to build age-length keys, which were applied to the aggregate run of wild Chinook salmon at LGR to estimate age composition. Since 2005, National Oceanic and Atmospheric Administration Fisheries (NOAAF) personnel have systematically sampled scales from adults at LGR such that age composition can be derived directly (Harmon 2009). Methods for adult Chinook salmon sampling at LGR, for scale processing in the lab and for estimating adult abundance and composition, are detailed in the annual LGR wild adult report (Schrader et al. 2011, 2012, 2013, and in preparation).

Smolt production in 2013 was estimated by dividing the daily count of wild smolts by the estimated collection efficiency for that day. The daily counts of wild Chinook salmon smolts at LGR were obtained from the Fish Passage Center website (www.fpc.org), accessed February 2014). Estimated daily smolt collection efficiencies were obtained from the Northwest Fisheries Science Center (NWFSC; Steve Smith, personal communication). Efficiencies were estimated by NWFSC personnel using procedures detailed in Sandford and Smith (2002). Daily abundance estimates were summed for the year to get total smolt production.

To calculate a SAR rate for a particular smolt year (SY), we used the sum of ocean returns from that cohort as the numerator and the estimate of wild smolts arriving at LGR as the denominator:

$$SAR_k = \frac{\sum_{l-1}^{4} r_{k+l}}{S_k},$$

where SAR_k is the smolt-to-adult return rate of smolt year k; r_{k+l} is the return from that cohort in year $k+l$; l is ocean age; and S_k is the estimate of smolts migrating in year k. The maximum value of l is four because that is the maximum ocean age observed for Chinook salmon at LGR (Copeland et al. 2004). We used formulas from Fleiss (1981) to estimate the 95% confidence limits on SAR values. The lower limit is given by

$$\frac{\left(2np + t_{\propto/2}^2 - 1\right) - t_{\propto/2}\sqrt{t_{\propto/2}^2 - (2 + 1/n) + 4p(nq + 1)}}{2\left(n + t_{\propto/2}^2\right)},$$

and the upper limit by

$$\frac{\left(2np + t_{\propto/2}^2 + 1\right) + t_{\propto/2}\sqrt{t_{\propto/2}^2 + (2 + 1/n) + 4p(nq + 1)}}{2\left(n + t_{\propto/2}^2\right)},$$

where n is the number of smolts, p is the SAR value as a proportion, q is 1-SAR, and $t_{\propto/2}$ is 1.96.

RESULTS

Total ages were assigned to 1,870 wild adult Chinook salmon scales sampled at LGR during 2013 (Table 5). Preliminary estimated total wild escapement to LGR during 2013 is 19,523 fish. Preliminary escapements by ocean age are 21 zero-ocean fish (mini-jacks >30 cm, FL); 6,682 one-ocean fish (jacks); 8,217 two-ocean fish; 4,582 three-ocean fish; and 21 four-ocean fish (Table 6).

Final SAR rates were calculated for cohorts from smolt migration years 1996-2007, and preliminary SAR rates were calculated for the smolt migration year 2008 through 2011 cohorts (Table 6). The preliminary SAR rate for the smolt migration year 2009 cohort, whose life cycle ended in 2013, is 2.51% (95% CI 2.48-2.54%). The life cycle for the smolt migration year 2010-2013 cohorts are still incomplete.

DISCUSSION

Smolt migration year 2009s SAR (2.51%) is below the previous year (4.21%) but still above the long-term mean of 1.82% (smolt migration years 1998-2008, Kennedy et al. 2013). This is the fourth time the SAR estimate has exceeded the 2.0% minimum value for replacement in the 14-year dataset. Preliminary results from smolt migration year 2010 suggest the 1.79% SAR will be below the peak observed in smolt migration year 2008 but still above the long-term mean.

ACKNOWLEDGEMENTS

We are grateful to the Bonneville Power Administration and David Byrnes, our contracting officer's technical representative, for support and funding of this project (1991-073-00) conducted under contract number 59833. Kala Hernandez, Cliff Hohman, Leslie Reinhardt and Will Schrader provided the age determination for scale samples collected at LGR. Darren Ogden (NOAAF) provided the supervision for sampling Chinook salmon at the LGR adult trap. Paul Bunn provided database management and quality assurance for the BioSamples data. Matthew Corsi and Tyler Gross contributed at the adult trap with sampling Chinook salmon and incorporating adult trap data into the database. This section benefited from reviews by Kimberly Apperson, Brett Bowersox, Mathew Belnap, Matthew Corsi, Lance Hebdon, and Bill Schrader. Last but not least we would like to thank Cheryl Zink for her help in formatting and editing the document.

LITERATURE CITED

Copeland, T., J. Johnson, and P. R. Bunn. 2004. Idaho natural production monitoring and evaluation, 2003 annual report. Idaho Department of Fish and Game Report 04-47. Bonneville Power Administration. Project 1991-073-00. Portland, Oregon.

Copeland, T., M. W. Hyatt, and J. Johnson. 2007. Comparison of methods used to age spring-summer Chinook salmon in Idaho: validation and simulated effects on estimated age composition. North American Journal of Fisheries Management 27:1393-1401.

Fleiss, J. L. 1981. Statistical methods for rates and proportions. 2nd edition. John Wiley and Sons, New York.

Harmon, J. 2009. Operation of the Lower Granite Dam adult trap, 2008. Bonneville Power Administration. Project 2005-002-00. Portland, Oregon.

Kennedy, P., K. A. Apperson, J. Flinders, M. Corsi, J. Johnson, R. Hand, and J. Messner. 2013. Idaho Natural Production Monitoring and Evaluation, 2012 annual progress report. Idaho Department of Fish and Game Report 13-12. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Sandford, B. P., and S. G. Smith. 2002. Estimation of smolt-to-adult return percentages for Snake River basin anadromous salmonids, 1990-1997. Journal of Agricultural, Biological and Environmental Statistics 7:243-263.

Schrader, W. C., T. Copeland, M. W. Ackerman, K. Ellsworth, R. Campbell. 2011. Wild adult steelhead and Chinook salmon abundance and composition at Lower Granite Dam, spawn year 2009. Idaho Department of Fish and Game Report 11-24. Annual report 2009, BPA Projects 1990-055-00, 1991-073-00, 2010-026-00.

Schrader, W. C., T. Copeland, P. Kennedy, M. W. Ackerman, K. K. Wright, M. R. Campbell. 2012. Wild adult steelhead and Chinook salmon abundance and composition at Lower Granite Dam, spawn year 2010. Idaho Department of Fish and Game Report 12-16. Annual report 2010, BPA Projects 1990-055-00, 1991-073-00, 2010-026-00.

Schrader, W. C., M. P. Corsi, P. Kennedy, M. W. Ackerman, M. R. Campbell, K. K. Wright, T. Copeland. 2013. Wild adult steelhead and Chinook salmon abundance and composition at Lower Granite Dam, spawn year 2011. Idaho Department of Fish and Game Report 13-15. Annual report 2011, BPA Projects 1990-055-00, 1991-073-00, 2010-026-00.

Table 5. Escapement, aging method used, and ocean age proportion of wild Chinook salmon at Lower Granite Dam by adult return year 1998-2013.

Adult Return Year	Wild Escapement	Aging Method	Sample Size	Ocean Age 0[a]	1	2	3	4	Total
1998	5,500	Fin rays	173	n/a	0.0222	0.1142	0.8303	0.0333	1.0000
1999	2,931	Fin rays	267	n/a	0.0805	0.7376	0.1539	0.0280	1.0000
2000	8,847	Fin rays	311	n/a	0.1695	0.7843	0.0462	0.0000	1.0000
2001	38,684	Fin rays	930	n/a	0.0419	0.9302	0.0273	0.0006	1.0000
2002	28,083	Fin rays	719	n/a	0.0121	0.5344	0.4435	0.0100	1.0000
2003	31,619	Fin rays	688	n/a	0.0743	0.1918	0.7187	0.0152	1.0000
2004	17,790	Fin rays	578	n/a	0.0552	0.8413	0.1011	0.0024	1.0000
2005	9,077	Scales	517	0.0039	0.0387	0.6499	0.3017	0.0058	1.0000
2006	9,067	Scales	745	0.0013	0.0309	0.7570	0.2081	0.0027	1.0000
2007	8,808	Scales	862	0.0012	0.1253	0.4292	0.4432	0.0012	1.0000
2008	16,379	Scales	618	0.0016	0.1408	0.6909	0.1650	0.0016	1.0000
2009	16,479	Scales	808	0.0000	0.2116	0.6077	0.1795	0.0012	1.0000
2010	27,664	Scales	1,151	0.0009	0.0495	0.9001	0.0495	0.0000	1.0000
2011	26,608	Scales	1,999	0.0070	0.1526	0.5553	0.2851	0.0000	1.0000
2012 [b]	21,733	Scales	2,009	0.0020	0.0538	0.6526	0.2892	0.0025	1.0001
2013 [c]	19,523	Scales	1,870	0.0011	0.3422	0.4209	0.2348	0.0011	1.0000

[a] Mini-jack (ocean age-0) samples were not sampled on the spawning grounds; thus mini-jack fin rays are not available for adult return years 1996-2004; only mini-jacks >30 cm, FL, were sampled for scales at Lower Granite Dam for adult return years 2005-2012.

[b] Preliminary until the adult return year 2012 Lower Granite Dam report is complete (Schrader et al., in preparation).

[c] Preliminary until the adult return year 2013 Lower Granite Dam report is complete (Schrader et al., in preparation).

Table 6. Estimated number of wild Chinook salmon smolts at Lower Granite Dam, number of adults at Lower Granite Dam by ocean-age, and percent smolt-to-adult return rate (SAR). Fin ray samples were used to estimate age composition for adults returning from smolt migration years 1996-2004 (above the dashed line) whereas scale samples were used for smolt migration years 2005-2013 (below the dashed line). SAR confidence intervals (95%) are given in parentheses. Beginning in smolt migration year 2011 visual origin determination (hatchery or wild) at Lower Granite Dam was validated using parentage based tagging and adjusted accordingly.

Smolt Migration Year	Smolts	Ocean Age					%SAR (95% CI)
		0[a]	1	2	3	4	
1996	419,826	n/a	n/a [b]	628	451	0	0.26 (0.24-0.27)
1997	161,157	n/a	122	2,162	409	23	1.69 (1.62-1.75)
1998	599,159	n/a	236	6,938	1,056	281	1.42 (1.39-1.45)
1999	1,560,298	n/a	1,500	35,984	12,455	481	3.23 (3.20-3.26)
2000	1,344,382	n/a	1,621	15,007	22,724	43	2.93 (2.90-2.96)
2001	490,534	n/a	340	6,065	1,799	53	1.68 (1.65-1.72)
2002	1,128,582	n/a	2,349	14,966	2,739	24	1.78 (1.75-1.80)
2003	1,455,786	n/a	982	5,899	1,886	10	0.60 (0.59-0.62)
2004	1,517,951	n/a	351	6,865	3,903	27	0.73 (0.72-0.75)
2005	1,734,464	35	280	3,781	2,703	20	0.39 (0.38-0.40)
2006	1,227,474	12	1,104	11,316	2,957	0	1.25 (1.23-1.27)
2007	787,150	10	2,306	10,014	1,370	0	1.74 (1.71-1.77)
2008	856,556	27	3,488	24,900	7,587	54 [c]	4.21 (4.17-4.25) [c]
2009	894,629	0	1,370	14,775	6,285 [c]	21 [d]	2.51 (2.48-2.54) [d]
2010	1,275,339	24	4,059	14,182 [c]	4,582 [d]		1.79 (1.77-1.82)
2011	1,200,055	187	1,168 [c]	8,217 [d]			0.80 (0.78-0.81)
2012	1,719,047	44 [c]	6,682 [d]				
2013	1,152,951	21 [d]					

[a] Mini-jack (ocean age-0) samples were not sampled on the spawning grounds, thus mini-jack fin rays are not available for smolt migration years 1996-2004; only mini-jacks ≥30 cm, FL, were sampled for scales at Lower Granite Dam for smolt migration years 2005-2013.

[b] Jack (ocean age-1) samples were not collected for smolt migration year 1996.

[c] Preliminary until the spawn year 2012 Lower Granite Dam report is complete (Schrader et al., in preparation).

[d] Preliminary until the spawn year 2013 Lower Granite Dam report is complete (Schrader et al., in preparation).

PART 4—THE STOCK-RECRUITMENT RELATIONSHIP FOR WILD/NATURAL SPRING-SUMMER CHINOOK SALMON IN THE SNAKE RIVER BASIN

ABSTRACT

Stock-recruitment relationships are important for understanding how density-dependent factors affect abundance. In this report, we added the smolt abundance estimate at Lower Granite Dam for the brood year 2011 cohort to the 22-year time series dataset and updated the Beverton-Holt stock-recruit model for Snake River spring-summer Chinook. We computed intrinsic productivity to be 416 smolts per female and asymptotic production to be 1.57 million smolts estimated by nonlinear fit. Using this model and the observed number of females available for natural spawning in brood year 2012 (22,783 females) and 2013 (11,718 females), we estimated smolt production for each brood year to be 1.40 and 1.43 million smolts, respectively. These predicted values will be updated with observed values in subsequent reports.

Author:

Carl Stiefel
Regional Fisheries Biologist

Patrick Kennedy
Senior Fishery Research Biologist

INTRODUCTION

The relationship between parental abundance and subsequent recruitment of progeny is the focus of a significant portion of fisheries research and management efforts. A stock-recruitment analysis describes the intrinsic productivity of a population, or the demographic ability of a population to sustain itself, assuming all influential factors remain constant. This analysis is typically an empirical process simplifying the many intervening stages by aggregating life history stages (Hilborn and Walters 1992). The goal is to produce a predictive model, which is a description of the observed pattern, i.e. the regularities of the system under consideration (Rigler 1982). A mathematical model is chosen and fitted to the data, but such stock-recruit relationships often have poor explanatory power (Hall 1988).

Sources of variation in survival of Pacific salmon *Oncorhynchus sp.* can be split between freshwater and saltwater phases in approximately equal magnitudes (Bradford 1995). For threatened Snake River spring-summer Chinook salmon, hereafter Chinook salmon, variance in survival during both freshwater and saltwater life stages must be understood for decision makers to effectively select measures to promote recovery. Stock-recruit data are useful for evaluating and understanding the effectiveness of management efforts in the freshwater phase (Bradford et al. 2005).

Stock-recruitment relationships for Columbia River basin Chinook salmon have been described using a Beverton-Holt (BH) function (NPPC 1986) or a Ricker function (Petrosky et al. 2001). In a BH function, the relationship is regulated by density-dependent mortality during the juvenile stage and is asymptotic in shape (Beverton and Holt 1957). In a Ricker function, regulatory mechanisms cause declines in recruitment at higher stock densities (Ricker 1954). We used a BH function because previous work showed that it yielded a better model fit than the Ricker function (Copeland et al. 2004).

The most serious problem in a stock-recruitment analysis is error in estimation of adult and recruit abundance (Hilborn and Walters 1992). For Chinook salmon, smolt emigration is a convenient and meaningful stage to assess recruitment (Solomon 1985). The Columbia River hydrosystem presents a unique opportunity to estimate the stock-recruitment relationships (i.e. adult and smolt abundances) using the efficient counting mechanisms that exist at the dams in the Lower Snake River and the Columbia River. Previously, this project has constructed a stock-recruit model of wild smolt production by Chinook salmon spawning naturally upstream of Lower Granite Dam (LGR) (Kiefer et al. 2004; Copeland et al. 2004, 2005, 2006, 2007, 2008; Kennedy et al. 2011, 2012, 2013). The model is used to estimate the intrinsic productivity for the wild Snake River spring-summer Chinook salmon Evolutionary Significant Unit (ESU). Here, we updated the BH stock-recruit model with data from the 2011 brood year. We also used the model to predict how many smolts would be produced from the 2012 and 2013 cohorts based on the estimated female spawner abundance for those years.

METHODS

Females Available for Natural Reproduction

We estimated intrinsic productivity using a stock-recruit model for the aggregate population of Chinook salmon by relating the abundance of emigrating smolts at LGR to the number of female parents available for natural reproduction. The number of Chinook salmon females available for natural reproduction (FANR) upstream of LGR was estimated using methods consistent with Kennedy et al. (2013). The estimated number of adults per run type (excluding jacks) passing LGR during 2013 was obtained directly from the Fish Passage Center website (www.fpc.org, accessed February 2013). U.S. Army Corps of Engineers (COE) designates jack Chinook salmon as fish between 30 and 56 cm in length at Columbia River dams counting windows. Adult Chinook salmon that pass LGR between March 3 and June 17 are defined as "spring run," and those passing LGR between June 18 and August 17 are defined as "summer run." The total number of adult Chinook salmon (excluding jacks) captured at hatchery traps and the number of females taken into hatcheries was obtained from the Pacific States Marine Fish Commission hatchery database and the Oregon Department of Fish & Wildlife (ODFW; Joseph Feldhaus, personal communication). McCall and Pahsimeroi hatchery fish were considered summer run and all other hatchery stocks were considered spring run. The percentage of females, by run type, was estimated for all adult Chinook salmon identified to sex at hatchery weirs. The estimated percentage of females was applied to the aggregate LGR counts for each run type to estimate the total number of female Chinook salmon passing LGR. The total harvest estimates upstream of LGR were obtained from the Idaho Department of Fish and Game (IDFG) (Alan Byrne, personal communication), Nez Perce Tribe (Joe Oatman, personal communication), Shoshone-Bannock Tribes (Kurt Tardy, personal communication), and ODFW (Joseph Feldhaus, personal communication). Female harvest was estimated by multiplying run-specific total harvest by the respective sex ratio. To estimate the FANR, the adjusted hatchery female number and the adjusted number of females harvested upstream of LGR were subtracted from the estimated number of females passing LGR. Spring and summer FANR estimates were combined to estimate total FANR.

Stock-Recruit Model

Smolt production was estimated using daily counts of wild smolts at LGR and estimated daily collection efficiencies from March 26 to July 25, 2013. The total daily wild Chinook salmon smolt migration number was estimated by dividing the daily count of wild smolts by the estimated collection efficiency for that day. The daily counts of wild Chinook salmon smolts at LGR were obtained from the Fish Passage Center website (www.fpc.org, accessed February 2014) and estimated daily smolt collection efficiencies were obtained from the Northwest Fisheries Science Center (NWFSC; Steve Smith, personal communication). Efficiencies were estimated by NWFSC personnel using procedures detailed in Sandford and Smith (2002). Daily abundance estimates were summed for the year.

A Beverton-Holt function was used for this analysis. Kennedy et al. (2013) estimated the FANR for brood years (BYs) 1990-2010 and the number of smolts produced by BYs 1990-2010. We added the smolt estimate from the 2013 migration (BY 2011) to the data set and updated the stock recruitment model using the following formula (Beaverton and Holt 1975).

$$R = \frac{\alpha P}{1 + \beta P}$$

where P = parent year spawning escapement (i.e. FANR), R = recruits (smolts) produced by parent year spawning escapement (P), and α and β are fitted parameters. In this formulation, α is the recruits (smolts) per spawner and the value of α is the slope of the model near P = 0. β is a density-dependent parameter that is proportional to both fecundity and density-dependent mortality (Quinn and Deriso 1999). This is parameterization of the model is slightly different than in past reports (Kennedy et al. 2011, 2012, 2013). Model parameters were estimated using stock-recruitment vignettes developed by Ogle (2013) in the statistical program R (R Development Core Team 2010).

RESULTS

Females Available for Natural Reproduction

We estimated 11,718 female Chinook salmon were available for natural reproduction in 2013 (Table 7). From the estimated number of hatchery and wild adult Chinook salmon crossing LGR during 2013 (43,454), which excludes jacks by length, there were 20,297 females comprising 46.7% of the adult run. Estimated removals above LGR totaled 8,579 females. Hatchery take accounted for 3,270 and angler harvest, including estimated incidental mortality, accounted for 5,309 females.

Stock-Recruit Model

The Beverton-Holt stock-recruit model fit the data very well (Figure 5) and there was no obvious pattern in the model residuals when compared to predicted values (data not shown). For BYs 1990-2011, estimated intrinsic productivity (β) was 416 smolts per female and asymptotic (peak) production was 1.57 million natural smolts from the Snake River ESU. The estimated number of smolts emigrating from the Snake River ESU past LGR during smolt migration year 2013 (brood year 2011) was 1,152,951 Chinook salmon (Table 8). This completes the data set for BYs 1990-2011. The BH model predicts smolts production for brood years 2012 and 2013 to be 1.40 and 1.43 million smolts, respectively. These predicted values will be updated with observed values in subsequent reports.

DISCUSSION

The stock-recruit curve now describes intrinsic productivity for Chinook salmon over a 22-year time series (Figure 5). As escapement decreases, we observe that the predicted smolt abundances follow. Asymptotic production appears to be slightly under 1.6 million wild Chinook salmon smolts under current conditions. There are a number of candidate hypotheses for this observed asymptote in wild Chinook salmon productivity (Table 9).

Historical data that was used to estimate hatchery take may be a substantial source of uncertainty in the FANR time series. A hatchery database for all hatcheries in Idaho is approaching maturation which will result in improved hatchery return estimates. Past estimates of hatchery take and sex ratios should be reviewed for additional quality control when the data are finalized in the database.

The productivity of Idaho's aggregate spring-summer Chinook salmon population has varied widely over the time series as measured by the number of smolts-per-female (Table 8). Over the 22-year time series, there was an average of 149 smolts-per-female. Adult productivity varies with spawner abundance and typically decreases after years with high escapement. This stock-recruit curve describes productivity differently than the status assessments for the Endangered Species Act (ESA), so understanding how current productivity compares between methods is difficult.

ACKNOWLEDGEMENTS

We are grateful to the Bonneville Power Administration and David Byrnes, our contracting officer's technical representative, for support and funding of this project (1991-073-00) conducted under contract number 59833. This section benefited from reviews by Kimberly Apperson, Brett Bowersox, Mathew Belnap, Matthew Corsi, Lance Hebdon, and Bill Schrader. We would also like to thank Dr. Derek Ogle of Northland College for his assistance running the stock-recruitment code in R. Last but not least we would like to thank Cheryl Zink for her help in formatting and editing the document.

LITERATURE CITED

Adkison, M. D. 1995. Population differentiation in Pacific salmon: local adaptation, genetic drift, or the environment? Canadian Journal of Fisheries and Aquatic Sciences 52:2762-2777.

Arthaud, D., K. Kratz, J. Morrow, C Vandemoer, and M. Grady. In preparation. Streamflow and salmon production in the interior Columbia basin. National Marine Fisheries Service, Boise, Idaho.

Beverton, R. J. H., and S. J. Holt. 1957. On the dynamics of exploited fish populations. Fisheries Investigation Series 2, Vol. 19. U.K. Ministry of Agriculture and Fisheries, London, England. Bradford, M. J. 1995. Comparative review of Pacific salmon survival rates. Canadian Journal of Fisheries and Aquatic Sciences 52:1327-1338.

Bradford, M. J. 1995. Comparative review of Pacific salmon survival rates. Canadian Journal of Fisheries and Aquatic Sciences 52:1327-1338.

Bradford, M. J., J. Korman, and P. S. Higgins. 2005. Using confidence intervals to estimate the response of salmon populations (*Oncorhynchus* sp.) to experimental habitat alterations. Canadian Journal of Fisheries and Aquatic Sciences 62:2716-2726.

Copeland, T., J. Johnson, and P. R. Bunn. 2004. Idaho natural production monitoring and evaluation, 2003 annual progress report. Idaho Department of Fish and Game Report 04-47. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Copeland, T., J. Johnson, and P. R. Bunn. 2005. Idaho natural production monitoring and evaluation, 2004 annual progress report. Idaho Department of Fish and Game Report 05-38. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Copeland, T., J. Johnson, and P. R. Bunn. 2006. Idaho natural production monitoring and evaluation, 2005 annual progress report. Idaho Department of Fish and Game Report 06-30. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Copeland, T., J. Johnson, S. Kraft, and P. R. Bunn. 2007. Idaho natural production monitoring and evaluation, 2006 annual progress report. Idaho Department of Fish and Game Report 07-31. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Copeland, T., J. Johnson, and S. Putnam. 2008. Idaho natural production monitoring and evaluation, 2007 annual report. Idaho Department of Fish and Game Report 08-08. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Flebbe, P. A. 1997. Global climate change and fragmentation of native brook trout distribution in the southern Appalachian Mountains. Pages 117-121 in R. E. Gresswell, P. Dwyer, and R. H. Hamre, editors. Wild Trout VI: Putting the native back in wild trout, proceedings of the 6th Wild Trout Conference. Bozeman, Montana.

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

Hall, C. A. S. 1988. Assessment of several of the historically most influential theoretical models used in ecology and of the data provided in their support. Ecological Modeling 43:5-31.

Hamann, E. J. and B. P. Kennedy. 2012. Juvenile dispersal affects straying behaviors of adults in a migratory population. Ecology 93(4): 733-740.

Hilborn, R., and C. J. Walters. 1992. Quantitative fisheries stock assessment: choices, dynamics, and uncertainty. Kluwer Academic Publishers, Boston.

Isaak, D. J., and R. F. Thurow. 2006. Network-scale and temporal variation in Chinook salmon redd distributions: patterns inferred from spatially continuous replicate surveys. Canadian Journal of Fisheries and Aquatic Sciences 63:285-296.

Kennedy, P., T. Copeland, J. Johnson, K. A. Apperson, J. Flinders, and R. Hand. 2011. Idaho Natural Production Monitoring and Evaluation, 2009-2010 annual progress report. Idaho Department of Fish and Game Report 11-23. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Kennedy, P., T. Copeland, J. Johnson, K. A. Apperson, J. Flinders, R. Hand, and M. Corsi. 2012. Idaho Natural Production Monitoring and Evaluation, 2011 annual progress report. Idaho Department of Fish and Game Report 12-18. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Kennedy, P., K. A. Apperson, K. A. Apperson, M. Corsi, J. Johnson, R. Hand, and J. Messner. 2013. Idaho Natural Production Monitoring and Evaluation, 2012 annual progress report. Idaho Department of Fish and Game Report 13-12. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Kiefer, R. B., J. Johnson, P. R. Bunn, and A. Bolton. 2004. Natural production monitoring and evaluation. Annual report 2003. Idaho Department of Fish and Game Report 03-30. Prepared for U. S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Levin, P. S., S. Achord, B. E. Feist, and R. W. Zabel. 2002. Non-indigenous brook trout and the demise of Pacific salmon: a forgotten threat? Proceedings of the Royal Society of London B 269:1663-1670.

Lichatowich, J. A., and L. E. Mobrand. 1995. Analysis of Chinook salmon in the Columbia River from an ecosystem perspective. Prepared for U. S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 92-18. Portland, Oregon.

Naiman, R. J., R. E. Bilby, D. E. Schindler, and J. M. Helfield. 2002. Pacific salmon, nutrients, and the dynamics of freshwater and riparian ecosystems. Ecosystems 5:230-245.

NPPC (Northwest Power Planning Council). 1986. Columbia River basin fishery planning model. Technical discussion paper. Northwest Power Planning Council. Portland, Oregon.

Ogle, D. 2013. fishR Vinette – Stock-Recruitment Models. Northland College. Available at: http://fishr.wordpress.com/books/vignettes/

Petrosky, C. E., H. A. Schaller, and P. Budy. 2001. Productivity and survival rate trends in the freshwater spawning and rearing stage of Snake River Chinook salmon *Oncorhynchus tshawytscha*. Canadian Journal of Fisheries and Aquatic Sciences 58:1196-1207.

Pollock, M. M., G. R. Pess, T. J. Beechie, and D. R. Montgomery. 2004. The importance of beaver ponds to coho salmon production in the Stillaguamish River basin, Washington, USA. North American Journal of Fisheries Management 24:749-760.

Quinn, T. J., and R. B. Deriso. 1999. Quantitative fish dynamics. Oxford University Press, New York.

R Development Core Team. 2010. R: A language and environment for statistical computing. R. Foundation for Statistical Computing. Vienna, Austria. Available at http://www.R-project.org.

Ricker, W. E. 1954. Stock and recruitment. Journal of the Fisheries Research Board of Canada 11:559-623.

Rigler, F. H. 1982. Recognition of the possible: an advantage of empiricism in ecology. Canadian Journal of Fisheries and Aquatic Sciences 39:1323-1331.

Sandford, B. P., and S. G. Smith. 2002. Estimation of smolt-to-adult return percentages for Snake River basin anadromous salmonids, 1990-1997. Journal of Agricultural, Biological and Environmental Statistics 7:243-263.

Schoennagel, T., T. T. Veblen, W. H. Romme, J. S. Sibold, and E. R. Cook. 2005. ENSO and PDO variability affect drought-induced fire occurrence in Rocky Mountain subalpine forests. Ecological Applications 15:2000-2014.

Solomon, D. J. 1985. Salmon stock and recruitment, and stock enhancement. Journal of Fish Biology 27(Supplement A):45-57.

Thurow, R. F. 2000. Dynamics of chinook salmon populations within Idaho's Frank Church wilderness: implications for persistence. Pages 143-151 In: McCool, S. F.; Cole, D. N.; Borrie, W. T.; O'Loughlin, J. Wilderness science in a time of change conference-Volume 3: Wilderness as a place for scientific inquiry, May 23-27, 1999, Missoula, MT. U.S. Forest Service, Proceedings, RMRS-P-15-VOL-3.

Weber, E. D., and K. D. Fausch. 2003. Interactions between hatchery and wild salmonids in streams: differences in biology and evidence for competition. Canadian Journal of Fisheries and Aquatic Sciences 60:1018-1036.

Table 7. Estimated adult Chinook salmon females available for natural reproduction (FANR) for brood year 2013, estimated from percentage of females based on hatchery sex ratios applied to the total run at Lower Granite Dam, and accounting for adult females removed by harvest and at hatchery weirs. Harvest was increased by 10% to account for incidental hooking mortality.

		Run Type		
Estimate		**Spring**	**Summer**	**Total**
Dam count*		35,031	8,423	43,454
Percent females		46.4%	48.0%	46.7%
Total females		16,254	4,043	20,297
Removals				
	Hatchery	5,015	294	5,309
	Harvest	2,709	561	3,270
FANR		8,530	3,188	11,718

* Excludes jacks.

Table 8. Abundance of Snake River spring-summer Chinook salmon females available for natural reproduction (FANR), and the number of wild smolts estimated at Lower Granite Dam by brood year and smolt year used to construct the Beverton-Holt stock-recruit model. The result of the model estimated the number of smolts-per-female over the 22 year time series.

Brood Year	Smolt Year	FANR	Smolts	Smolts/ Female
1990	1992	4,976	527,000	105.9
1991	1993	2,916	627,037	215.0
1992	1994	6,826	627,942	91.9
1993	1995	8,514	1,558,786	183.1
1994	1996	1,043	419,826	402.5
1995	1997	497	161,157	324.3
1996	1998	1,556	599,159	385.1
1997	1999	11,885	1,560,298	131.3
1998	2000	3,726	1,344,382	360.8
1999	2001	1,630	490,534	300.9
2000	2002	8,733	1,128,582	129.2
2001	2003	51,902	1,455,786	28.1
2002	2004	31,415	1,517,951	48.3
2003	2005	26,126	1,734,464	66.4
2004	2006	28,374	1,227,474	43.3
2005	2007	10,899	787,150	72.2
2006	2008	9,253	856,556	92.6
2007	2009	8,562	894,629	104.5
2008	2010	22,942	1,275,339	53.2
2009	2011	17,314	1,200,055	67.5
2010	2012	36,348	1,719,047	48.2
2011	2013	30,755	1,152,951	37.5
2012	2014	22,783	1,387,050 *	
2013	2015	11,718	1,155,606 *	

* Predicted values based on the Berverton-Holt model

Table 9. Candidate hypotheses explaining density dependence observed in smolt production of Snake River spring-summer Chinook salmon populations during 1990-2012.

Hypothesis	Explanation
Marine-derived nutrients	Lack of adult carcasses reduces carrying capacity of infertile spawning streams (Naiman et al. 2002).
Retreat to core areas	Current spawners home to relatively small patches of habitat (Thurow 2000; Isaak and Thurow 2006, Hamann and Kennedy 2012).
Invasion of predators and competitors	Introduced species and hatchery-produced fish compete with and prey on young salmon (Levin et al. 2002; Weber and Fausch 2003).
Hatchery strays and supplementation fish	Hatchery fish do not spawn as effectively as natural fish, and strays or supplementation fish may increase localized density dependence. (Fleming and Gross 1993).
Habitat loss	Reduction of off-channel habitat in spawning and rearing areas (Pollock et al. 2004).
Temperature stress	Global warming and loss of tree cover via forest fires and grazing raise water temperatures at critical times (Flebbe 1997; Schoennagel et al. 2005).
Drought/low flows	High escapements are coincident with drought. Stream flow is critical to juvenile survival in the interior Columbia basin (Arthaud et al. 2004).
Life history diversity	Loss of local adaptations and temporal variations in movement lead to a reduction in occupied habitat and regional productivity (Adkison 1995; Lichatowich and Mobrand 1995).

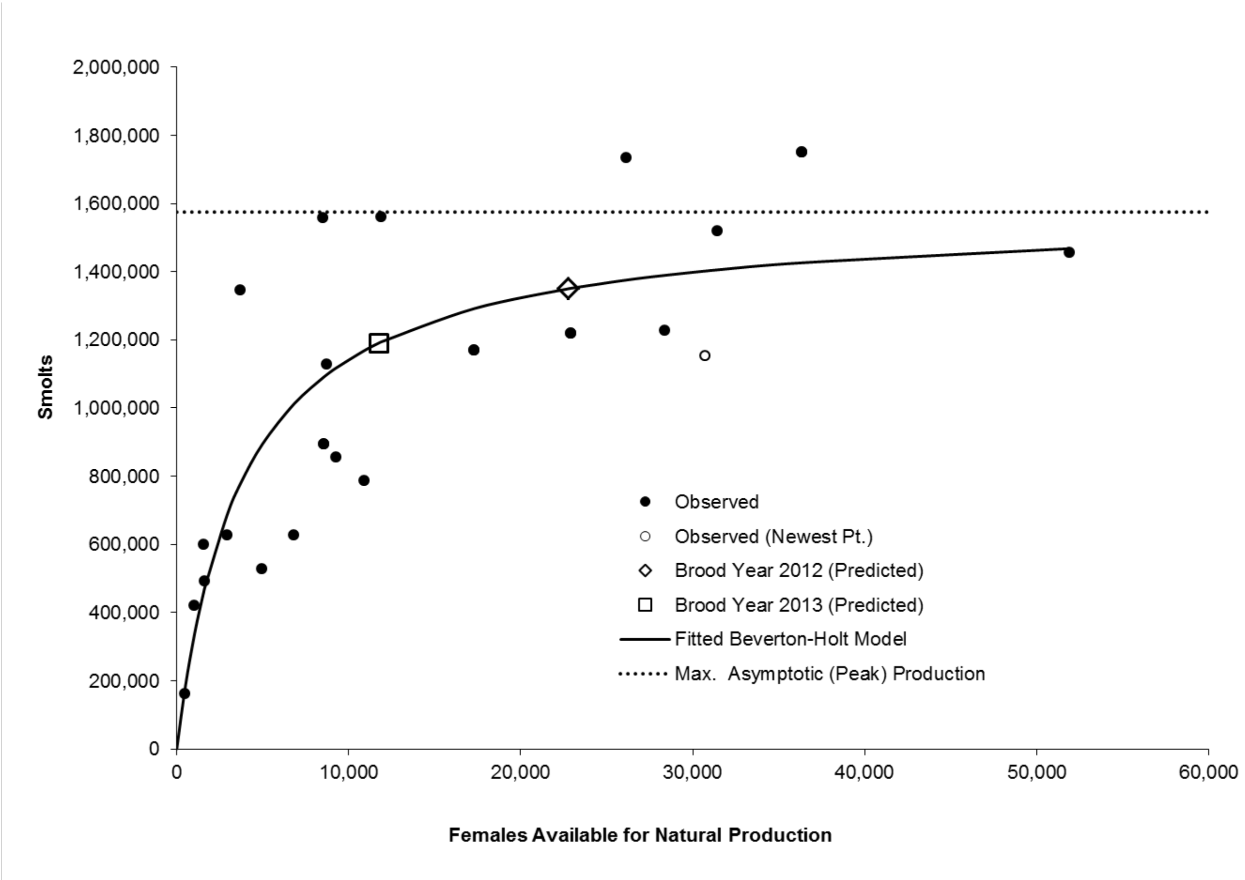


Figure 5. Comparison of observed smolt abundance at Lower Granite Dam and females available for natural reproduction for brood years 1990-2011. The Beverton-Holt stock-recruitment model's prediction of smolt production for brood years 2012 and 2013 were included for comparison. The open circle represents the most recent observed data point.

PART 5— WILD CHINOOK SALMON AND STEELHEAD JUVENILE DENSITY AND SPATIAL STRUCTURE

ABSTRACT

In this section of the report, we summarize the snorkel survey methods and results for 2013. Snorkel crews from Idaho Department of Fish and Game's Natural Production Monitoring and Evaluation, Steelhead Monitoring and Evaluation Studies, and regional management programs surveyed 393 transects to help describe juvenile Chinook salmon and steelhead density, productivity, and spatial structure. Thirty-three trend transects were surveyed in the Clearwater River subbasin, 118 trend transects were surveyed in the Salmon River subbasin, and five trend transects were surveyed in the Hells Canyon subbasin. Extensive survey panels were completed in the South Fork Clearwater and the Middle Fork Salmon River. Annual intensive survey panels were completed in the Potlatch River drainage, Rapid River, Crooked Fork Creek, Fish Creek, Crooked River, and Marsh Creek. We conducted mark-resight studies at 26 locations to assess detection probability for steelhead parr. Transect detection probabilities ranged from 0% to 64.3% with a mean of 37.6%.

Authors:

Kimberly A. Apperson
Regional Fisheries Biologist

Matthew Belnap
Regional Fisheries Biologist

Timothy Copeland
Senior Fisheries Research Biologist

Robert Hand
Regional Fisheries Biologist

Patrick Kennedy
Senior Fishery Research Biologist

Jordan Messner
Regional Fisheries Biologist

Scott Putnam
Regional Fisheries Biologist

Carl Stiefel
Fisheries Research Biologist

INTRODUCTION

Snorkel surveys are widely used for monitoring fish populations because they are a versatile, cost-effective technique. Snorkel surveys are particularly useful where environmental conditions limit the effectiveness of other techniques, such as electrofishing (Schill and Griffith 1984). Gear and personnel requirements are comparatively modest, allowing more remote locations to become feasible to sample (Hankin and Reeves 1988; Thurow 1994). Because snorkel surveys are non-lethal and less intrusive than other field methods, they are an appropriate means to monitor fishes listed under the Endangered Species Act (e.g., Chinook salmon, steelhead trout, and bull trout *Salvelinus confluentus*).

Snorkel surveys are one of the main techniques used by the IDFG to monitor juvenile salmonid populations. Methods for conducting fish abundance surveys by snorkeling have been developed and refined by IDFG for decades (e.g., Corley 1972, Lindland 1974, Reingold 1981). Current snorkel survey methods for monitoring the parr of Chinook salmon and steelhead trout were originally developed by Petrosky and Holubetz (1986) to assess effects of habitat improvement projects. This effort developed into the General Parr Monitoring program (GPM; Scully et al. 1990). Since then, IDFG snorkel survey methods evolved and were especially influenced by Thurow's (1994) review. More recently, O'Neal (2007) summarized current standards for conducting snorkel surveys for salmonids.

Snorkel survey results from 2013 are used to estimate the distribution and abundance of wild Chinook salmon and steelhead parr in tributaries of the Salmon River, Clearwater River, and Snake River subbasins.

METHODS

During 2013, field surveys were performed during summer base-flow conditions. The percentage of each habitat type (pool, pocket water, riffle, or run) within each transect was recorded in small streams. One to several snorkelers counted fish in each transect while moving upstream. The number of snorkelers depended on the stream width and visibility for upstream snorkels. Downstream snorkels were conducted at larger mainstem river sites where upstream snorkeling is not possible due to higher flows, or where downstream snorkeling has been historically used. For downstream snorkels, one snorkeler moved down each bank counting fish in the transect. All salmonids were identified to species, enumerated, and their size estimated to the nearest 25 mm length group. Chinook salmon parr were assigned an age based on length. Trout less than 50 mm cannot be distinguished between steelhead and westslope cutthroat trout *Oncorhynchus clarkii lewisi* with underwater observation and were therefore designated as "trout fry." Non-salmonid fishes, amphibians, and mussels were noted if present. After the crew snorkeled each transect, they measured the total linear length and one to ten widths to calculate the surface area.

We used a rotating panel design (Larsen et al. 2001) to select from previously established snorkeling transects. These surveys focused on anadromous salmonid with three objectives: 1) to conduct surveys at core and non-core trend transects for maintaining the long-term juvenile-to-juvenile productivity data series for steelhead; 2) to conduct extensive surveys to assess parr distribution and abundance at the population scale; and 3) to conduct intensive surveys to correlate parr densities with abundance of juvenile emigrants estimated from screw traps in target drainages.

For the first objective, transects were selected from previously established trend transects on a two-year rotating panel (Table 10). For the second and third objective, transect selection was based on a generalized random-tessellation stratification design (GRTS; Stevens and Olsen 2004) to be a spatially-balanced, probabilistic selection from all potential transects. A list of all potential transects in the Clearwater and Salmon rivers subbasins were obtained from the U.S. Environmental Protection Agency (EPA) office in Corvallis, Oregon using their Environmental Monitoring and Assessment Program (EMAP). These transects were plotted on a 1:100,000 stream layer and their order randomized by EPA. We used the anadromous stream data layer from StreamNet (www.streamnet.org) to determine which transects in each drainage were within the anadromous production zone. Transects that fell within a 100 m buffer of an anadromous stream were retained. An ordered list of approximately twice the desired number of transects was drawn for the study drainages. Each potential transect was assigned a unique code for data entry forms and the IDFG Standard Stream Survey database. Transect priority started with the lowest number (high priority) and proceeded to the highest number (low priority). High priority transects were included or rejected before lower priority transects could be considered in survey plans. Criteria for rejection were: 1) the transect could not be safely surveyed or transect boundaries adjusted to make it safe; 2) the location was above a barrier that would block spring movement of adult steelhead; 3) there was no water in the transect at the time of survey; 4) the private property owner denied access to the transect; or 5) the transect was too wide or complex to be surveyed efficiently by the full crew (typically six surveyors).

Forty GRTS transects were assigned to each large drainage (e.g. Potlatch River). Sample sizes were based upon previous power analysis (Copeland et al. 2008) and logistics. Small drainages were assigned desired sample sizes of 25. The desired transect length was 100 m, but transect length and location was adjusted by the crew leader based on stream conditions with transect bounds adjusted to fit within hydraulic controls. A transect was relocated upstream or downstream for up to 500 m from the designated point if necessary.

For all objectives, we report salmonid densities (standardized to abundance per 100 m^2). Occupancy rates observed by drainage were also reported for objectives two and three. The probabilistic selection of transects was considered a representative sample for the drainage; thus, the proportion of transects where a species is present in a drainage equals the occupancy rate. The total number of fish per species within each transect divided by the transect area equaled the density. Density was estimated by species for all transects surveyed annually.

Core and Non-core Trend Surveys

Both core and non-core trend transects are subsets of long-established GPM transects. Core trend transects were defined as locations where at least one survey had been conducted within each 5-year period during 1984-2011, including other transects deemed important (e.g., main stem Middle Fork Salmon River and Selway River transects). We identified 218 core trend transects (Table 10). Based on logistical difficulty, core transects are surveyed annually or every other year during the months of July and August. Non-core transects are surveyed opportunistically according to IDFG regional management needs.

Extensive Panel Surveys

Extensive panel surveys were conducted to assess steelhead and Chinook salmon parr distribution and abundance within drainages. Extensive panel drainages were chosen based on the data needs for steelhead spawning aggregates as defined by the Interior Columbia

Technical Recovery Team. For the 2013 extensive panel, we completed and continued the surveys of the South Fork Clearwater River and Upper Middle Fork Salmon River populations. Portions of the Lower Middle Fork Salmon population were not completed because of the Lodgepole Fire; these are scheduled to be surveyed in 2014. The 2013 surveys in the South Fork Clearwater drainage were in the western half of the area. The 2013 surveys in the Middle Fork Salmon River drainage included the drainages of Sulphur Creek, Pistol Creek, Loon Creek, as well as a few minor tributaries to the upper Middle Fork Salmon River. All areas were surveyed between June 19 and August 21, 2013.

Intensive Panel Surveys

Intensive snorkel surveys were conducted to develop a dataset to evaluate the relationship between fish density from snorkel surveys and juvenile steelhead emigrant abundance derived from rotary screw traps. Therefore, intensive panel surveys were only conducted upstream of associated screw traps. This knowledge can be applied to the extensive surveys to better understand the production of smolts out of those drainages. For the intensive panel in 2013, we chose the Potlatch River (lower Clearwater River steelhead population), Rapid River (Little Salmon River steelhead population), Fish Creek and Crooked Fork Creek (Lochsa River steelhead population), Crooked River (South Fork Clearwater River steelhead population), and Marsh Creek (Upper Middle Fork Salmon River steelhead population). Intensive panel surveys in the latter two drainages were contained within an extensive panel survey and therefore reported as an extensive panel survey. The relationship between fish density from snorkel surveys and juvenile steelhead emigrant abundance derived from rotary screw traps will be examined once sufficient data is available.

Detection Probability

We continued to evaluate the efficiency of snorkeling for juvenile steelhead at a subset of transects. A protocol modified from Thurow et al. (2006) was designed to allow us to estimate detection probability through observation of marked individuals. Juvenile steelhead and westslope cutthroat trout were collected in the transect via angling then measured, marked with an upper caudal notch, and released as close to the location of capture as possible. Transect lengths were generally around 100 m, but the length was increased if necessary to increase the number of marked fish in the transect. The next day, snorkeling began approximately one-half the transect length downstream of the transect (lower half of oversample transect) and the number of marked fish was recorded by length group. Then, the main transect (target transect) was snorkeled and all salmonids were counted and recorded by length group. Finally, a section approximately one-half the target transect length upstream of the main transect (upper half of oversample transect) was snorkeled and the number of marked fish was recorded by length group. Boundaries of target and oversample transects were adjusted to begin and end at hydraulic controls. Habitat variables described by Thurow et al. (2006) were measured in the target transect. We attempt to conduct these “mark-resight” surveys in 10% of our transects, annually. We present a summary of data collected at each transect. The probability of detection was computed as the number of marked fish seen in the target and oversample reaches divided by number marked. We assumed fish would not move farther than 50 m between marking and the subsequent snorkel survey.

RESULTS

During 2013, 393 snorkel surveys were completed, including 118 core trend, 38 non-core trend, and 237 combined intensive and extensive surveys. Five GPM trend sites were also used as intensive panel survey transects. Two of those transects were in the Crooked River drainage (West Fork Crooked River trend site WF2 = GRTS site 256578, and Crooked River trend site Control1 = GRTS site 50754); two were in the Crooked Fork Creek drainage (Crooked Fork Creek trend site 2 = GRTS site 64321, and Crooked Fork Creek trend site 1B = GRTS site 94017); and one was in the Rapid River drainage (Rapid River trend site RAP2 = GRTS site 19346).

Unless otherwise noted, six salmonid species were observed within major drainages, including steelhead trout, Chinook salmon, westslope cutthroat trout, bull trout, brook trout *Salvelinus fontinalis*, and mountain whitefish *Prosopium williamsoni*. Trout fry were also observed unless otherwise noted.

Core and Non-core Trend Surveys

Salmon River Subbasin

During 2013, 90 core and 28 non-core trend transects were surveyed in the Salmon River subbasin (Tables 11 and 12). Wild steelhead were observed at 98 transects; Chinook salmon were observed at 76 transects, westslope cutthroat trout were observed at 64 transects, bull trout were detected at 35 transects, brook trout were observed at 30 transects, mountain whitefish were observed at 77 transects, and hatchery rainbow trout were observed at three transects. Chinook salmon were the most abundant species and exceeded 30 fish/100 m^2 in 10 transects.

Middle Fork Salmon River—In the Middle Fork Salmon River drainage, 31 main-stem trend transects (27 core and six non-core) and 27 tributary trend transects (16 core and 11 non-core) were surveyed (Tables 11 and 12). Average abundance was highest for Chinook salmon parr (3.6 fish/100 m^2) with the highest observed abundance in the Velvet site (19.9 fish/100 m^2). Westslope cutthroat trout and mountain whitefish were the most encountered species at the various sites (n = 30). Brook trout were observed at 3 different sites in the mainstem Middle Fork Salmon River (VELVET, MARBLE, and HOSPPL sites).

Eighteen sites were snorkeled on MFSR tributaries. Average abundance was greatest for Chinook salmon parr (8.3 fish/100 m^2). The most encountered species at the various sites was Chinook salmon parr (n = 16).

Nine sites in the Big Creek drainage were surveyed. The mean density for Chinook was 20.6 fish/100 m^2. These mean densities were highly influenced by high densities in the upstream site. The mean density for steelhead trout was 1.9 fish/100 m^2. Five sites were visited and surveyed on Monumental Creek and the West Fork of Monumental Creek, a tributary of Big Creek. The mean density of steelhead and Chinook were 3.0 fish/100 m^2 and 13.1 fish/100 m^2, respectively. The West Fork Monumental Creek transect had very high Chinook abundance (48.6 fish/100 m^2).

Little Salmon River—Twelve trend transects were surveyed in the Little Salmon River drainage in 2013 (six core and six non-core; Tables 11 and 12). Mean density was highest for steelhead parr at 6.2 fish/100 m^2, with the highest density observed for this species at Rapid River transect RAP2 (13.5 fish/100 m^2).

Middle and Lower Salmon River—The middle and lower Salmon River basin sites were composed of Slate Creek, White Bird Creek, West Fork White Bird Creek, Chamberlain Creek, and West Fork of Chamberlain Creek (Tables 11 and 12). Five sites were surveyed in Slate Creek, three sites were surveyed in the White Bird Creek, and four were surveyed in Chamberlain Basin. Chinook salmon had a mean density of 10.3 fish/100 m^2 and steelhead had a mean density of 8.5 fish/100 m^2 for the basin. Chamberlain Creek had high Chinook salmon densities across all sites, which is reflected in the basinwide mean abundance. All sites in White Bird Creek had higher steelhead densities than the basinwide mean.

South Fork Salmon River—Seventeen trend transects were surveyed in the South Fork Salmon River drainage, all of which were core trend transects (Tables 11 and 12). All assigned sites in the South Fork Salmon River basin were surveyed, including two in the East Fork South Fork Salmon River, eight in Johnson Creek, two in Lake Creek, two in the Secesh River, and one each in Lick Creek, Rock Creek, and Sand Creek. The mean densities were 4.36 fish/100 m^2 for Chinook and 2.79 fish/100 m^2 for steelhead.

Upper Salmon River—Sixty-eight trend transects were surveyed in the upper Salmon River basin (Tables 11 and 12). Twelve sites were surveyed in the upper Salmon River drainage. Hatchery Rainbow trout were observed in two main stem Salmon River sites and in Valley Creek. Average abundance was greatest for Chinook salmon (16.52 fish/100 m^2) with the highest observed abundance in Valley Creek (61.96 fish/100 m^2). Cutthroat trout were observed in very low abundances and only observed in one Salmon River site.

Clearwater River Subbasin

In 2013, 23 core and 10 non-core transects were surveyed in the Clearwater River subbasin (Tables 13 and 14). Three of these transects were resurveyed later in the season to collect mark re-sight data; however, we include the full survey of the target reach here. Juvenile steelhead were observed at 29 transects, Chinook salmon parr were observed at 20 transects, westslope cutthroat trout were observed at 31 transects, bull trout were observed at 7 transects, brook trout were observed at 2 transects, and mountain whitefish were observed at 18 transects. Hybrid westslope cutthroat/steelhead were observed in two transects.

Lochsa River—Six core trend sites were surveyed in the Lochsa River basin (Table 13). No Bull Trout or Brook Trout were observed. The mean density for steelhead trout was 0.4 fish/100 m^2. The mean density for Chinook salmon was 0.1 fish/100 m^2.

Selway River—Six core and seven non-core transects were surveyed in the Selway River basin (Tables 13 and 14). No Brook Trout were observed. Westslope cutthroat/steelhead trout hybrids were observed at two sites. The mean density for steelhead trout was 3.46 fish/100 m^2. The mean density for Chinook salmon was 5.7 fish/100 m^2.

South Fork Clearwater River—Five core and two non-core were surveyed in the South Fork Clearwater River basin (Tables 13 and 14). The mean density for steelhead trout was 6.52 fish/100 m^2. The mean density for Chinook salmon was 3.5 fish/100 m^2.

Snake River Subbasin

Five core trend sites were surveyed in Hells Canyon (Table 15). Three transects were in Granite Creek and two were in Sheep Creek. Steelhead trout and Chinook salmon were the only salmonids observed. Steelhead trout were observed at all sites. The mean density for steelhead trout was 24.8 fish/100 m^2. Chinook salmon were observed at all of the sites. The mean density for Chinook salmon was 3.4 fish/100 m^2.

Extensive and Intensive Panel Surveys

South Fork Clearwater River (Clearwater River subbasin)

Extensive and intensive panel transects were surveyed in the South Fork Clearwater River drainage during 2013, the latter in the Crooked River drainage (Table 16). Seventy transects were completed. Westslope cutthroat trout were the most abundant species observed in the drainage, with a mean density of 3.2 fish/100 m^2, and were observed in 61 transects. Steelhead trout were the second most abundant species in the drainage, with a mean density of 1.7 fish/100 m^2, and were observed in 53 transects. Chinook salmon parr were observed in 14 transects but were extremely abundant in one transect (Meadow Creek 37026), which raised mean abundance in the drainage to 0.68 fish/100 m^2. Barriers were identified on Droogs Creek and a Peasley Creek tributary. It is believed that these barriers inhibit fish passage. On the other hand, there are two putative barriers on Johns Creek that were not observed. Johns Creek transect 17106 is above both barriers yet Chinook salmon parr were observed there. Drainage-wide occupancy rates for Chinook salmon and steelhead trout were 20% and 76%, respectively. The extensive panel surveys in Crooked River will also serve as intensive panel surveys.

Middle Fork Salmon River (Salmon River subbasin)

Extensive and intensive panel transects were surveyed in the in the Middle Fork Salmon River drainage, the latter in Marsh Creek (Table 17). Thirty-eight transects were completed. Juvenile steelhead were identified at 27 transects, Chinook salmon were identified at 18 transects, westslope cutthroat trout were identified at 29 transects, bull trout were identified at 17 transects, mountain whitefish were identified at 21 transects, and brook trout were not identified at any transects. Observed mean density was highest for Chinook salmon parr (3.5 fish/100 m^2). Westslope cutthroat trout was the second most abundant species observed, with a mean density of 1.8 fish/100 m^2. Drainage-wide occupancy rates for juvenile Chinook salmon and steelhead trout were 47% and 71% respectively. The extensive panel surveys in Marsh Creek will also be used as intensive panel surveys.

Intensive Panel Surveys

Potlatch River (Clearwater River Subbasin)

Thirty-nine intensive panel survey transects were completed in the Potlatch River drainage during 2013 (Table 18). No westslope cutthroat trout, bull trout, or mountain whitefish were observed. Juvenile steelhead were observed at 27 transects, with a mean density of 2.4 fish/100 m^2. Brook trout were observed at 17 transects with a mean density of 1.6 fish/100 m^2. Chinook salmon parr were observed at two of 13 transects in the East Fork Potlatch River, for a mean density of 0.12 fish/100 m^2 in that stream. The occupancy rate for steelhead within the drainage was 69%.

Fish Creek (Clearwater River Subbasin)

In the Fish Creek drainage, a total of 21 intensive panel transects were surveyed (Table 19). A site on upper Willow Creek was attempted but could not be reached because of snow drifts and poor road conditions. No Bull Trout were observed. Westslope cutthroat trout were observed in all of the sites surveyed and their densities were highest in the upper portion of the drainage. Mountain whitefish were the least abundant and only observed in one site. Steelhead parr were the most abundant taxa and were observed in all but three of the sites surveyed. Their densities ranged from 0.52/100 m^2 (upper Hungery Creek) to 22.74/100 m^2 (middle Hungery Creek). Occupancy rate of the Fish Creek drainage by juvenile steelhead was 86%.

Crooked Fork Creek (Clearwater River Subbasin)

In the Crooked Fork drainage, 24 intensive panel transects were surveyed during 2013 (Table 20). Steelhead trout and westslope cutthroat trout were observed at 21 of the sites. The mean densities for steelhead trout and westslope cutthroat trout were 1.23 fish/100 m^2 and 1.26 fish/100 m^2, respectively. Chinook salmon were observed at 11 of the sites and were the most abundant species with a mean density of 1.5 fish/100 m^2. Chinook parr densities were extremely high at Brushy Fork transect 101185 (31.1 fish/100 m^2). A barrier was identified on Boulder Creek severe enough to inhibit fish passage. Thus, the two sites upstream of this were not surveyed. Pictures of this barrier can be found on the Stream Survey Database in association with sites 131265 and 193.

Rapid River (Salmon River Subbasin)

In the Rapid River drainage, a total of 20 sites were surveyed (Table 21). The lowest site in the system was not surveyed because the landowner denied access. This site is also unsafe due to very swift flows; therefore, it is rejected for future surveys. Both hatchery and natural origin Chinook salmon parr were observed. No brook trout were observed. Bull trout were the only species present in the upper six sites. Steelhead parr were found in higher densities farther down the drainage. Bull trout were observed in all but one site surveyed with a mean density of 1.6/100 m^2. Steelhead trout parr were most abundant with a mean density of 3.3/100 m^2. They were observed in all but the upper six sites in the headwaters of Rapid River. Occupancy rate of the Rapid River drainage by juvenile steelhead was 70%.

Marsh Creek (Salmon River Subbasin)

Twenty-five intensive sites were surveyed in the Marsh Creek drainage during 2013 (Tables 17). Trout fry were observed in 40% (10) of the sites surveyed, and the mean density of trout fry across sites was 0.5 fish/100 m^2. Steelhead trout and westslope cutthroat trout were observed at 68% (17) and 4% (1) sites respectively. Mean densities of steelhead and westslope cutthroat trout were 2.2 fish/100 m^2 and <0.1 fish/100 m^2 respectively. Chinook salmon were observed at 52% (13) of the sites and had the highest densities of all species observed (12.1 fish/100 m^2). Bull trout were observed in 44% (11) of the sites with a mean density of 0.4 fish/100 m^2. Brook trout were observed in 68% (17) of the sites surveyed with a mean density of 1.7 fish/100 m^2. Whitefish were observed in 28% (7) of the sites surveyed with a mean density of 0.2 fish/100 m^2 across sites.

Detection Probability

We conducted mark-resight studies at 26 transects to assess detection probability for steelhead parr in 2013 (Table 22). Selected habitat variables measured at these locations are not included in this report. Crews marked 581 fish (including several westslope cutthroat trout) and detected 225 of them. Ten were observed outside of the main survey unit, six of which were downstream. Transect detection probabilities ranged from 0% to 64.3% with a mean of 37.6%.

DISCUSSION

Densities of steelhead and Chinook salmon in core trend transects have fluctuated over the last five years (Table 23). Densities of Chinook salmon in the Clearwater River subbasin have declined since 2009 but were much more erratic in the Salmon River subbasin, peaking in 2012. Steelhead densities were much more concordant between basins, peaking in 2012 and declining in 2013.

Population assessment in part depends on judgments on whether spawning reaches are accessible to anadromous fish. The most current status assessment (Ford et al. 2010) includes locations of barriers that we have not observed. These locations are based on surveys completed over 50 years ago (e.g., Murphy and Metsker 1962). As far as logistically possible, field crews need to visit these locations and verify the status of the putative barrier. At the least, photographs of the site should be taken.

Detection probability was computed as the number of marked fish seen in the target and oversample reaches divided by number marked. We included all marked fish observed in the oversample reaches because movement of marked fish from the target reach biased the estimate downwards. Keeping marked fish from the overreaches in the calculation increases precision because each marked fish is treated as an independent trial: seen or not seen. Habitat variables were not measured outside of the target transect in the oversample reaches, nor are fishes other than marked steelhead parr enumerated, so there has been some disagreement among the co-authors about this estimate. We will evaluate the difference to determine the best approach for subsequent reports.

The general parr monitoring (GPM) program, through INPMEP and ISMES, has monitored the abundance and distribution of anadromous salmonids since 1985. A large proportion of Idaho's Chinook salmon and steelhead habitat is located within congressionally-designated wilderness areas and the GPM dataset, which includes the core trend transects, is the best description of juvenile salmonid abundance and occurrence (Copeland and Meyer 2011).

Population spatial structure in the VSP arena is ideally based on distribution of spawning adults. Observations of spawning steelhead in Idaho are not reliable because of snowmelt-related turbidity and changing flow conditions during the spring spawning period (Thurow 1985); therefore, we use parr distribution as a surrogate. This assumes that parr do not move long distances from where they emerged until the time of the survey.

The major metric for evaluation of spatial structure is occupancy rate in terms of arrangement and continuity of distribution and the variety of habitats occupied. For the latter, terrestrial ecoregion is used as a large-scale indicator of major habitat type (ICBTRT 2005). We found that occupancy rates were high in the watersheds we surveyed (70%-89%). Although these watersheds do not encompass an entire population as defined by the ICBTRT (2005), they are useful indicators of population status. Fish Creek is one of seven major spawning aggregates in the Lochsa population, but it contains the majority of the Clearwater Mountains and Breaks ecoregions in the population. The Rapid River watershed contains approximately half of the only major spawning aggregate in the Little Salmon population. For each population, the ICBTRT (2005) rated spatial risks as low or very low. Those ratings agree with our results.

RECOMMENDATIONS

1. Maintain GPM trend series by surveying all 2,018 core trend transects on a two-year rotating panel.

2. Update the GPM trend analysis using recent data in the time series. Maintain analytical consistency with methods from the 2006 INPMEP report (Copeland et al. 2007).

3. Calibrate parr densities with production of juvenile emigrants estimated from screw traps in target drainages using intensive survey results.

4. Assess and update barrier locations listed in the StreamNet database.

ACKNOWLEDGEMENTS

We are grateful to the Bonneville Power Administration and David Byrnes, our contracting officer's technical representative, for support and funding of this project (1991-073-00) conducted under contract number 59833. Surveys in the Middle Fork Salmon River were funded by the Dingell-Johnson Act and License funds. Ron Roberts and the ISMES snorkel crew provided data for the general parr monitoring and snorkel surveys. This section benefited from reviews by Brett Bowersox, Lance Hebdon, Patrick Kennedy, and Bill Schrader. Cheryl Zink helped format and edit the document.

LITERATURE CITED

Copeland, T., J. Johnson, S. A. Kraft, and P. R. Bunn. 2007. Idaho natural production monitoring and evaluation, 2006 annual progress report. Idaho Department of Fish and Game Report 07-31. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Copeland, T., J. Johnson, S. Kraft, and P. R. Bunn. 2008. Idaho natural production monitoring and evaluation, 2007 annual progress report. Idaho Department of Fish and Game Report 08-08. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

Copeland, T., and K. A. Meyer. 2011. Interspecies synchrony in salmonid densities associated with large-scale bioclimatic conditions in Central Idaho. Transactions of the American Fisheries Society 140:4. pp 928-942.

Corley, D. R. 1972. Snorkel trend counts of fish in the Middle Fork – 1971. Idaho Department of Fish and Game, Boise.

Ford, M. J., A. Albaugh, K. Barnas, T. Cooney, J. Cowen, J. Hard, R. Kope, M. M. McClure, P. McElhany, J. Myers, N. Sands, D. Teel, and L. A. Weitkamp. 2010. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. US Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-113.

Hankin, D.G., and G.H. Reeves. 1988. Estimating total fish abundance and habitat area in small streams based on visual estimation techniques. Canadian Journal of Fisheries and Aquatic Sciences 45:834-844.

ICBTRT (Interior Columbia Basin Technical Recovery Team). 2005. Updated population delineation in the interior Columbia Basin. Memo to NMFS Northwest Regional Office May 11, 2005.

Larsen, D. P., T. M. Kincaid, S. E. Jacobs, and N. S. Urquhart. 2001. Designs for evaluating local and regional scale trends. BioScience 51:1069-1078.

Lindland, R. L. 1974. Distribution and abundance of cutthroat trout in the Selway River. Evaluation of survival of angling regulations in management of cutthroat trout, job performance report. Project F-49-R-12. Idaho Department of Fish and Game, Boise.

Murphy, L. W., and H. E. Metsker. 1962. Inventory of Idaho streams containing anadromous fish including recommendations for improving production of salmon and steelhead. Part II Clearwater River drainage. Report to US Department of the Interior, Bureau of Commercial Fisheries. Contract 14-19-001-431. Idaho Department of Fish and Game, Boise.

O'Neal, J. S. 2007. Snorkel surveys. Pages 325-340 in D.H. Johnson, B.M. Shrier, J.S. O'Neal, J.A. Knutzen, X. Augerot, T.A. O'Neil, and T.N. Pearsons. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda, Maryland.

Petrosky, C. E. and T. B. Holubetz. 1986. Idaho habitat evaluation for off-site mitigation record, annual report 1985. Project 83-7, contract DE-AI79-84BP13381. Bonneville Power Administration, Portland, Oregon.

Reingold, M. 1981. Middle Fork Salmon River fisheries investigations. Job performance report. Project F-73-R-3. Idaho Department of Fish and Game, Boise.

Schill, D.J., and J.S. Griffith. 1984. Use of underwater observations to estimate cutthroat trout abundance in the Yellowstone River. North American Journal of Fisheries Management 4:479-487.

Scully, R. J., E. J. Leitzinger, and C. E. Petrosky. 1990. Idaho habitat evaluation for off-site mitigation record, annual report 1988. Project 83-7, contract DE-AI79-84BP13381. Bonneville Power Administration, Portland, Oregon.

Stevens, D. L., and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99:262-278.

Thurow, R. 1985. Middle Fork Salmon River fisheries investigations. Job Completion report, Federal Aid in Sport Fish Restoration project F-73-R-6. Idaho Department of Fish and Game, Boise.

Thurow, R.F. 1994. Underwater methods for study of salmonids in the intermountain west. General Technical Report INT-GTR-307, Intermountain Research Station, USDA Forest Service, Boise, Idaho.

Thurow, R. F., J. T. Peterson, and John W. Guzevich. 2006. Utility and validation of day and night snorkel counts for estimating bull trout abundance in first- to third-order streams. North American Journal of Fisheries Management 26:217-232.

Table 10. IDFG core trend snorkel survey transects n = 218 by Snake River steelhead major and independent population. Middle Fork Salmon River and its tributaries were surveyed by regional management crews funded by the Dingell-Johnson Act and License funds.

Steelhead Major and Independent Population	Stream Name	Stratum	Transect Name
Hells Canyon Tributaries			
Hells Canyon (SNHCT-s)	Granite Creek	---	1
	Granite Creek	---	3
	Sheep Creek	---	1
	Sheep Creek	---	2
Independent Population Total:			4
MPG Total:			4
Clearwater River			
Lower Clearwater River (CRLMA-s)	Big Canyon Creek	---	1
Independent Population Total:			1
Lolo Creek (CRLOL-s)	---	N/A	N/A
Independent Population Total:			0
South Fork Clearwater River (CRSFC-s)	American River	2	1
	American River	3	2
	Crooked River	1	BOULDER-A
	Crooked River	1	BOULDER-B
	Crooked River	1	SILL-LOG-B
	Crooked River	2	CONTROL1
	Crooked River	2	CONTROL2
	Crooked River	2	TREAT2
	Crooked River	3	NATURAL1
	Crooked River	4	MEANDER1
	Crooked River	C	CAN2
	Crooked River	C	CAN3
	East Fork Crooked River	H	EF1
	East Fork Crooked River	H	EF2
	Johns Creek	1	1
	Johns Creek	1	2
	Johns Creek	2	3
	Red River	1	CNTL 1
	Red River	1	CNTL 2
	Red River	2	CNTL 2
	Red River	2	TREAT 2
	Red River	4	CNTL 2
	Red River	4	TREAT 2
	Red River	5	CNTL 2
	Red River	5	TREAT 2
	Relief Creek	1	1A
	Relief Creek	1	1B
	Tenmile Creek	---	1
	West Fork Crooked River	H	WF1
	West Fork Crooked River	H	WF2
Independent Population Total:			30
Lochsa River (CRLOC-s)	Brushy Fork	3	1
	Brushy Fork	3	2
	Colt Creek		BRIDGE
	Crooked Fork Creek	1	2A
	Crooked Fork Creek	2	3A
	Crooked Fork Creek	2	4A
	Crooked Fork Creek	3	1
	Crooked Fork Creek	3	2
	Crooked Fork Creek	3	2B
	Crooked Fork Creek	4	1B
	Fish Creek	---	1
	Fish Creek	---	2
	Lochsa River	---	L1
	Lochsa River	---	L2

Table 10. Continued

Steelhead Major and Independent Population	Stream Name	Stratum	Transect Name
	Lochsa River	---	L3
	Lochsa River	---	L4
	Old Man Creek	---	1
	Postoffice Creek	---	1
	Postoffice Creek	---	2
	Warm Springs Creek	---	1
	White Sands Creek	---	LWRMONITOR
Independent Population Total:			21
Selway River (CRSEL-s)	Bear Creek	---	1
	Bear Creek	---	2
	Deep Creek	---	CACTUS
	Deep Creek	---	SCIMITAR
	East Fork Moose Creek	---	3
	Meadow Creek	---	1
	Moose Creek	---	1
	Moose Creek	---	2
	Running Creek	---	1
	Running Creek	---	2
	Selway River	---	HELLSHALF
	Selway River	---	LITTLE-CW
	Selway River	---	MAG-XING
	Selway River	---	RUNNING CR
	Three Links Creek	---	1
	White Cap Creek	3	1
	White Cap Creek	4	2
	White Cap Creek	5	3
Independent Population Total:			18
MPG Total:			70
Salmon River			
Little Salmon River (SRLSR-s)	Boulder Creek	ABOVE	1
	Boulder Creek	ABOVE	2
	Boulder Creek	BELOW	3
	Boulder Creek	BELOW	5
	Hazard Creek	---	HAZ1
	Little Salmon River	---	1
	Little Salmon River	---	2
	Rapid River	BLW W FK	RAP2
	Slate Creek	---	1
	Slate Creek	---	2
	Slate Creek	---	3
	Slate Creek	---	4
	Slate Creek	---	6
	South Fork White Bird Creek	---	SF-#2
	South Fork White Bird Creek	---	SF-#3
	West Fork Rapid River	BLW FALLS	RAP1
	White Bird Creek	---	1
Independent Population Total:			17
South Fork Salmon River (SFMAI-s)	East Fork South Fork Salmon	ABV JHNSN	3
	East Fork South Fork Salmon	BLW JHNSN	6
	East Fork South Fork Salmon	BLW JHNSN	7
	Johnson Creek	LOWER IV	L2
	Johnson Creek	LOWER IV	L3
	Johnson Creek	MID LOWIII	PW3B
	Johnson Creek	MID UPR II	PW3A
	Johnson Creek	UPPER I	M1
	Johnson Creek	UPPER I	M2
	Johnson Creek	UPPER I	M3
	Johnson Creek	UPPER I	PW1A
	Rock Creek	UPPER I	M1
	Sand Creek	UPPER I	M2
	South Fork Salmon River	---	11
	South Fork Salmon River	---	14
	South Fork Salmon River	---	16

Table 10. Continued.

Steelhead Major and Independent Population	Stream Name	Stratum	Transect Name
	South Fork Salmon River	---	5
	South Fork Salmon River	---	7
	South Fork Salmon River	---	POVERTY
	South Fork Salmon River	---	STOLLE1
	South Fork Salmon River	---	STOLLE2
Independent Population Total:			21
Secesh River (SFSEC-s)	Lake Creek	---	BURGDORF
	Lake Creek	---	WILLOW CR
	Lick Creek	---	L3
	Secesh River	---	GROUSE
	Secesh River	---	LONG-GULCH
Independent Population Total:			5
Chamberlain Creek (SRCHA-s)	Bargamin Creek	---	1
	Bargamin Creek	---	2
	Chamberlain Creek	---	CHA1
	Chamberlain Creek	---	CHA4
	Sheep Creek	---	L1
	Sheep Creek	---	L2
	West Fork Chamberlain Cr.	---	CHA2
	West Fork Chamberlain Cr.	---	CHA3
Independent Population Total:			8
Lower Middle Fork Salmon River (Loon Creek and below; MFBIG-s)	Big Creek	LOWER	L1
	Big Creek	MIDDLE	Cabin Cr
	Big Creek	MIDDLE	TAYLOR 1
	Big Creek	UPPER	LOGAN CR
	Camas Creek	---	2
	Camas Creek	---	CAM1
	Loon Creek	C CHANNEL	2
	Loon Creek	LNM1	3
	Loon Creek	PACK BR	1
	Middle Fork Salmon River	2	HOSPPL
	Middle Fork Salmon River	2	HOSPRUN
	Middle Fork Salmon River	2	TAPPANPOOL
	Middle Fork Salmon River	2	TAPPANRUN
	Middle Fork Salmon River	3	AIRSTRIP
	Middle Fork Salmon River	3	FLYING-B
	Middle Fork Salmon River	3	SURVEY
	Middle Fork Salmon River	4	BIG-CR-BR
	Middle Fork Salmon River	4	GOATPOOL
	Middle Fork Salmon River	4	GOATRUN
	Middle Fork Salmon River	4	LITOUZEL
	Middle Fork Salmon River	4	LOVEBAR
	Middle Fork Salmon River	4	OTTERBAR
	Middle Fork Salmon River	4	SHIPISLAND
	Monumental Creek	---	MON1
	Monumental Creek	---	MON2
	Monumental Creek	---	MON3
	Monumental Creek	---	MON5
	West Fork Monumental Creek	---	MON4
Independent Population Total:			28
Upper Middle Fork Salmon River (above Loon Creek; MFUMA-s)	Beaver Creek	---	A
	Beaver Creek	---	B
	Cape Horn Creek	1	A
	Cape Horn Creek	2	B
	Elk Creek	---	1A
	Elk Creek	---	1B
	Elk Creek	---	2A
	Elk Creek	---	2B
	Knapp Creek	1	A
	Knapp Creek	1	B
	Knapp Creek	1	LCKD FENCE

Table 10. Continued.

Steelhead Major and Independent Population	Stream Name	Stratum	Transect Name
	Marble Creek	UPPER	MAR1
	Marble Creek	UPPER	MAR1B
	Marble Creek	UPPER	MAR2
	Marsh Creek	1	A
	Marsh Creek	1	B
	Marsh Creek	3	A
	Marsh Creek	4	B
	Marsh Creek	5	A
	Middle Fork Salmon River	1	BOUNDARY
	Middle Fork Salmon River	1	ELKHORN
	Middle Fork Salmon River	1	GRDLHOLE
	Middle Fork Salmon River	1	GREYHOUND
	Middle Fork Salmon River	1	INDIAN
	Middle Fork Salmon River	1	RAPID-R
	Middle Fork Salmon River	1	SHEEPEATER
	Middle Fork Salmon River	1	VELVET
	Middle Fork Salmon River	2	COUGAR
	Middle Fork Salmon River	2	LJACKASS
	Middle Fork Salmon River	2	MARBLPL
	Middle Fork Salmon River	2	PUNGO
	Middle Fork Salmon River	2	ROCK IS
	Middle Fork Salmon River	2	SKIJUMP
	Middle Fork Salmon River	2	WHITEYCX
Independent Population Total:			34
Panther Creek (SRPAN-s)	Horse Creek	---	L1
	Horse Creek	---	L2
	Panther Creek	ABOVE	PC9
	Panther Creek	DS-BIGD	PC4
	Panther Creek	DS-BLACKB	PC6
	Panther Creek	DS-CLEAR	PC1
Independent Population Total:			6
North Fork Salmon River (SRNFS-s)	North Fork Salmon River	2	DAHLONEGA
	Pine Creek	---	BRIDGE
	Pine Creek	---	SAWMILL CR
	North Fork Salmon River	2	HUGHES
Independent Population Total:			4
Lemhi River (SRLEM-s)	Big Springs Creek	LEM1	A
	Hayden Creek	HC2	B
	Hayden Creek	HC3	B
	Lemhi	1	LEM3A
Independent Population Total:			4
Pahsimeroi River (SRPAH-s)	Pahsimeroi River	LOWER	DWTNLANE
Independent Population Total:			1
East Fork Salmon River (SREFS-s)	East Fork Salmon River	ABOVE-WEIR	2
	East Fork Salmon River	ABOVE-WEIR	3
	Morgan Creek	UPPER	BLM CAMP
Independent Population Total:			3

Table 10. Continued.

Steelhead Major and Independent Population	Stream Name	Stratum	Transect Name
Upper Salmon River (SRUMA-s)	Alturas Lake Creek	2	2B
	Redfish Lake Creek	---	LOWER
	Redfish Lake Creek	---	WEIR DS
	Salmon River	1	RBNSN-BAR
	Salmon River	2	2B
	Salmon River	3	3B
	Salmon River	3	3BRA
	Salmon River	4	4B
	Salmon River	7	7A
	Valley Creek	1	B
	Valley Creek	3	A
	Valley Creek	3	B
	Valley Creek	6	B
Independent Population Total:			13
MPG Total:			144
Snake River DPS Total:			218

Table 11. Densities (fish/100 m^2) of salmonids observed at 90 core trend transects snorkeled in the Salmon River subbasin during 2013. Trout fry = all trout <50 mm that could not be distinguished between steelhead and cutthroat trout. Middle Fork Salmon River and its tributaries were surveyed by regional management crews funded by the Dingell-Johnson Act and License funds.

		Density (fish/100 m^2)									
Stream	Transect	Trout Fry	Steelhead	Hatchery Rainbow Trout	Chinook salmon	Cutthroat Trout	Bull Trout	Brook Trout	Whitefish	Visibility (m)	Temp (C)
Alturas Lake Creek	2B	1.30	0.10	0.00	8.43	0.00	0.00	2.71	2.71	1.5	16.0
Beaver Creek	3B	1.74	1.74	0.00	3.38	0.00	0.00	0.77	0.00	1.5	16.0
Big Creek	Cabin Cr	0.00	0.09	0.00	0.00	0.86	0.00	0.00	0.80	2.1	10.0
Big Creek	L1	0.03	5.42	0.00	5.52	1.45	0.00	0.00	2.49	3.0	14.5
Big Creek	TAYLOR 1	0.00	0.32	0.00	11.80	1.65	0.00	0.00	1.26	2.4	17.0
Boulder Creek	1	0.34	3.21	0.00	0.00	0.00	0.00	8.61	0.00	1.6	14.0
Boulder Creek	2	0.00	4.57	0.00	0.00	0.27	0.00	0.36	0.00	1.5	9.0
Boulder Creek	3	0.82	11.75	0.00	3.01	0.00	0.27	0.55	0.00	1.5	13.0
Boulder Creek	5	0.15	7.48	0.00	0.46	0.00	0.00	0.00	0.00	1.3	14.0
Camas Creek	99/CAM1	0.00	6.53	0.00	1.20	0.86	0.52	0.00	2.75	2.0	11.0
Camas Creek	99/2	0.00	0.00	0.00	0.64	1.75	0.16	0.00	1.11	1.6	14.0
Cape Horn Creek	2B	0.00	0.23	0.00	53.01	0.00	0.00	0.69	0.23	2.7	14.0
Cape Horn Creek	1A	0.57	0.28	0.00	20.93	0.00	0.00	0.14	0.14	2.8	13.0
Chamberlain Creek	CHA1	0.00	1.37	0.00	37.38	0.00	0.34	0.00	0.34	3.0	10.0
Chamberlain Creek	CHA4	0.00	0.00	0.00	22.39	0.00	0.12	0.00	0.00	2.6	15.0
EF SF Salmon River	6	0.40	1.50	0.00	20.10	0.50	0.08	0.00	2.40	3.0	18.0
EF SF Salmon River	7	0.00	4.32	0.00	2.52	0.18	0.00	0.00	0.81	2.8	14.0
Johnson Creek	L2	0.00	5.92	0.00	0.59	0.41	0.06	0.00	0.83	2.4	18.0
Johnson Creek	L3	0.04	10.77	0.00	13.31	0.98	0.04	0.00	0.81	2.5	18.0
Johnson Creek	M1	1.98	0.12	0.00	0.00	0.00	0.00	5.81	0.00	2.4	18.0
Johnson Creek	M2	1.07	0.48	0.00	0.00	0.00	0.12	4.65	0.00	2.0	17.0
Johnson Creek	M3	0.14	0.00	0.00	0.00	0.00	0.00	4.76	0.00	2.0	14.0
Johnson Creek	PW1A	0.00	2.06	0.00	0.00	0.00	0.05	1.18	0.00	2.0	14.0
Johnson Creek	PW3A	0.00	4.80	0.00	0.00	0.00	0.00	0.46	0.00	3.5	10.0
Johnson Creek	PW3B	0.00	1.81	0.00	0.00	0.08	0.00	0.00	0.27	3.4	15.0
Lake Creek	BURGDORF	8.94	0.75	0.00	6.04	0.00	0.00	3.19	0.35	2.5	14.0
Lake Creek	WILLOW CR	0.00	0.44	0.00	1.77	0.00	0.00	0.00	0.00	2.4	13.0
Lick Creek	L3	0.92	11.83	0.00	0.00	1.71	0.00	0.00	0.13	3.0	15.0
Little Salmon River	2	1.60	7.89	0.00	4.20	0.00	1.15	0.00	0.00	2.0	16.0
Loon Creek	PACK BR/1	0.00	0.00	0.00	0.00	0.15	0.00	0.00	1.22	1.7	18.0
Loon Creek	LMN1/3	0.00	1.79	0.00	0.15	0.30	0.00	0.00	1.49	1.7	19.0
Loon Creek	C CHANNEL/2	0.00	0.03	0.00	0.06	0.73	0.00	0.00	2.28	1.6	18.0
MF Salmon River	BOUNDARY	0.00	0.16	0.00	0.98	2.79	0.00	0.00	0.49	2.5	15.0
MF Salmon River	3/FLYING-B	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.44	1.5	18.0
MF Salmon River	3/AIRSTRIP	0.00	0.00	0.00	0.00	0.57	0.00	0.00	0.95	1.2	18.0
MF Salmon River	3/SURVEY	0.00	0.00	0.00	0.00	2.33	0.00	0.00	2.33	1.0	20.0
MF Salmon River	4/BIG-CR-BR	0.00	0.11	0.00	0.00	0.34	0.00	0.00	0.00	1.2	18.0
MF Salmon River	4/LOVEBAR	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.79	1.0	18.0

Table 11. Continued.

Stream	Transect	Density (fish/100 m^2) Trout Fry	Steelhead	Hatchery Rainbow Trout	Chinook salmon	Cutthroat Trout	Bull Trout	Brook Trout	Whitefish	Visibility (m)	Temp (C)
MF Salmon River	4/SHIPISLAND	0.00	0.66	0.00	0.00	0.55	0.00	0.00	0.55	1.8	19.0
MF Salmon River	4/LITOUZEL	0.00	0.00	0.00	0.29	0.57	0.00	0.00	1.44	1.0	19.0
MF Salmon River	4/OTTERBAR	0.00	1.22	0.00	0.00	0.35	0.00	0.00	0.00	1.0	17.0
MF Salmon River	4/GOATPOOL	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.19	1.0	19.0
MF Salmon River	4/GOATRUN	0.00	0.41	0.00	0.00	0.20	0.00	0.00	1.64	1.0	19.0
MF Salmon River	2/TAPPANPOOL	0.00	0.18	0.00	0.00	0.73	0.00	0.00	0.91	1.0	19.0
MF Salmon River	2/HOSPRUN	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.76	1.0	19.0
MF Salmon River	2/HOSPPL	0.00	0.00	0.00	0.00	0.31	0.00	0.31	0.94	1.0	19.0
MF Salmon River	2/ROCK IS	0.00	0.82	0.00	2.05	1.54	0.00	0.00	0.10	2.0	17.0
MF Salmon River	2/WHITEYCX	0.00	0.00	0.00	0.00	0.49	0.00	0.00	1.23	2.0	17.0
MF Salmon River	2/LJACKASS	0.00	0.00	0.00	9.57	1.31	0.00	0.00	1.13	1.2	18.0
MF Salmon River	2/SKIJUMP	0.00	0.12	0.00	1.38	0.46	0.00	0.00	1.73	1.4	17.0
MF Salmon River	2/MARBLPL	0.00	0.18	0.00	0.53	2.02	0.09	1.41	0.97	2.0	16.0
MF Salmon River	2/PUNGO	0.00	0.00	0.00	2.03	1.83	0.20	0.00	3.86	1.6	15.0
MF Salmon River	1/INDIAN	0.00	2.70	0.00	14.87	5.95	0.00	0.00	5.68	1.4	19.0
MF Salmon River	1/RAPID-R	0.00	0.79	0.00	0.99	2.19	0.00	0.00	6.96	1.7	14.0
MF Salmon River	1/GREYHOUND	0.00	0.63	0.00	19.44	1.14	0.00	0.00	1.01	2.0	19.0
MF Salmon River	1/SHEEPEATER	0.00	3.41	0.00	8.53	0.53	0.00	0.00	0.43	2.3	18.0
MF Salmon River	1/ELKHORN	0.00	0.67	0.00	5.01	2.17	0.17	0.00	1.34	2.2	17.0
MF Salmon River	1/VELVET	0.00	0.79	0.00	19.87	0.79	0.00	0.40	2.78	1.7	14.0
MF Salmon River	1/GRDHOLE	0.00	0.57	0.00	8.60	1.98	0.00	0.00	0.19	2.1	18.0
Monumental Creek	Mon1	0.00	2.47	0.00	0.57	0.38	0.00	0.00	0.00	3.2	12.0
Monumental Creek	Mon2	0.00	3.35	0.00	0.00	1.12	0.22	0.00	0.00	1.4	15.0
Monumental Creek	Mon3	6.00	8.55	0.00	16.19	0.15	0.15	0.00	1.50	2.6	14.0
Monumental Creek	Mon5	0.00	0.40	0.00	0.00	0.40	0.00	0.00	0.13	2.7	12.0
Pahsimeroi River	LOWER/DWTNLN	3.31	37.80	0.00	40.80	0.00	0.00	1.89	30.22	1.8	17.0
Panther Creek	ABOVE/PC9	0.86	11.67	0.00	8.86	0.00	0.00	1.51	0.65	1.7	17.0
Rapid River	RAP2	2.65	13.51	0.00	0.00	0.00	0.26	0.00	0.00	3.1	11.0
Rock Creek	M1	33.72	0.00	0.00	0.00	0.00	0.00	12.32	0.00	3.3	20.0
Salmon River	4B	0.00	0.06	0.00	0.00	0.00	0.23	0.00	17.40	3.5	10.0
Salmon River	7A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	4.3	8.0
Salmon River	3BRA	0.40	0.89	0.74	8.81	0.00	0.03	0.12	0.99	3.7	12.0
Salmon River	3B	0.09	0.04	0.00	3.05	0.00	0.00	0.04	0.00	2.1	12.0
Salmon River	2B	0.00	1.07	0.46	14.47	0.25	0.10	0.00	7.62	1.4	15.0
Salmon River	1/RBNSN-BAR	0.00	0.91	0.00	0.85	0.00	0.00	0.00	2.21	1.2	15.0
Sand Creek	M2	0.00	0.00	0.00	0.00	0.00	0.00	20.12	0.23	1.8	16.0
Secesh River	GROUSE	0.13	1.05	0.00	3.55	0.00	0.00	0.00	0.39	1.9	15.0
Secesh River	LONG-GULCH	0.00	1.59	0.00	26.30	0.00	0.28	0.00	0.16	2.3	15.0
Slate Creek	1	0.36	4.11	0.00	0.07	1.87	0.00	0.00	0.07	1.2	18.0
Slate Creek	2	0.07	5.56	0.00	2.96	0.94	0.00	0.14	0.00	1.3	18.0
Slate Creek	3	0.45	7.17	0.00	0.54	1.00	0.09	0.18	0.00	1.3	13.0
Slate Creek	4	0.00	9.15	0.00	5.62	0.33	0.11	0.00	0.00	1.3	13.0
Slate Creek	6	0.00	5.00	0.00	0.90	0.50	0.10	0.00	0.00	1.30	14.0
SF White Bird Creek	SF-#3	1.37	25.03	0.00	0.00	0.00	0.00	0.00	0.00	1.60	20.0

Table 11. Continued.

Stream	Transect	Density (fish/100 m^2) Trout Fry	Steelhead	Hatchery Rainbow Trout	Chinook salmon	Cutthr oat Trout	Bull Trout	Brook Trout	Whitefish	Visibility (m)	Temp (C)
Valley Creek	1B	0.47	0.34	0.61	14.75	0.00	0.07	0.00	0.27	2.2	9.0
Valley Creek	3B	1.09	0.44	0.00	37.11	0.00	0.00	0.55	0.22	2.0	18.0
Valley Creek	6B	0.44	1.32	0.00	61.96	0.00	0.00	1.76	0.00	1.5	15.0
Valley Creek	3A	0.41	0.82	0.00	31.53	0.00	0.00	0.05	1.23	1.9	16.0
WF Chamberlain Creek	CHA2	0.00	5.09	0.00	36.00	0.00	0.00	0.00	0.17	2.50	17.0
WF Chamberlain Creek	CHA3	0.00	6.84	0.00	18.02	0.00	0.00	0.00	0.00	3.70	12.0
WF Monumental Creek	MON4	4.16	0.00	0.00	48.62	0.27	0.13	0.00	0.13	3.80	11.0
White Bird Creek	1	0.23	14.93	0.00	0.00	0.00	0.00	0.00	0.00	1.60	18.0
Mean		0.85	3.12	0.02	7.70	0.56	0.06	0.83	1.39		
SD		3.74	5.64	0.11	13.18	0.90	0.15	2.76	3.79		

Table 12. Densities (fish/100 m^2) of salmonids observed at 28 non-core trend transects snorkeled in the Salmon River subbasin during 2013. Trout fry = all trout <50 mm that could not be distinguished between steelhead and cutthroat trout. Middle Fork Salmon River and its tributaries were surveyed by regional management crews funded by the Dingell-Johnson Act and License funds.

		Density (fish/100 m^2)								
Stream	**Transect**	**Trout Fry**	**Steelhead**	**Chinook salmon**	**Cutthroat Trout**	**Bull Trout**	**Brook Trout**	**Whitefish**	**Visibility (m)**	**Temp (C)**
Big Creek	NEAR FORD	0.53	1.82	64.98	0.00	0.00	0.91	0.00	3.30	12.0
Camas Creek	99/L1-MOUTH	0.00	2.52	2.00	2.96	0.30	0.00	5.56	2.0	18.0
Camas Creek	99/UPPER	0.00	3.60	1.08	4.50	0.54	0.00	3.60	2.0	18.0
Hannah Slough	UPS Garden Cr	0.00	0.66	17.30	0.00	0.00	0.00	0.00	1.5	17.0
Indian Creek	99/UPPER	0.00	0.40	3.40	0.20	0.20	0.00	1.80	2.0	18.0
Indian Creek	99/LOWER	0.00	3.16	5.00	0.79	0.00	0.00	0.79	2.0	18.0
Loon Creek	99/L2 RUN	0.00	4.40	4.40	1.41	0.00	0.00	0.79	1.7	19.0
Loon Creek	99/L1 BRIDGE	0.00	2.26	0.00	2.83	0.57	0.00	10.18	1.7	19.0
Marble Creek	LOWER/L1	0.00	0.00	0.12	0.00	0.00	0.00	0.00	2.0	18.0
Marble Creek	3A	0.00	0.49	45.74	0.00	0.00	3.57	0.00	1.0	15.0
MF Salmon River	MIDDLE/AIRSTP	0.00	0.83	2.08	0.83	0.00	0.00	0.21	1.2	19.0
MF Salmon River	LOWER/CLIFPL	0.00	0.00	0.00	0.00	0.00	0.00	0.08	1.0	19.0
MF Salmon River	LOWER/HANPOL	0.00	0.21	0.00	0.42	0.00	0.00	0.00	1.0	17.0
MF Salmon River	MIDDLE/WCPB	0.00	0.68	0.00	2.60	0.00	0.00	0.73	1.6	17.0
MF Salmon River	UPPER/Mah Cmp	0.00	0.50	10.50	7.00	0.00	0.00	1.00	1.0	19.0
MF Salmon River	UPPER/LICRGS	0.00	0.00	10.44	3.82	0.00	0.00	4.12	2.0	17.0
Pahsimeroi River	1/PONDS	2.96	0.94	47.14	0.00	0.00	0.39	9.79	2.0	16.0
Pahsimeroi River	WEIR/WEIR	0.00	22.63	49.50	0.00	0.00	0.00	24.68	1.2	16.0
Panther Creek	ABOVE/PC10	1.99	11.92	1.24	0.00	0.00	0.00	0.00	1.9	16.0
Pistol Creek	99/L2	0.00	1.59	3.39	0.55	0.00	0.00	0.48	3.2	18.0
Pistol Creek	99/L1	0.00	1.72	4.69	0.39	0.00	0.00	0.86	3.2	18.0
Rapid River	PARADISE	0.00	1.28	0.00	0.00	2.14	0.00	0.00	2.5	10.0
Rapid River	COPPER CR	0.09	1.80	0.00	0.00	0.95	0.00	0.00	2.9	10.0
Rapid River	CASTLE CR	0.00	6.96	0.20	0.00	0.39	0.00	0.00	2.5	11.5
Rapid River	CORA CLIFF	4.33	7.13	0.00	0.00	0.27	0.00	0.00	2.3	13.0
Rapid River	4	0.00	5.50	0.09	0.00	0.18	0.00	0.00	2.3	13.0
Rapid River	CLIFF HANG	0.24	3.50	0.00	0.00	0.00	0.00	0.00	2.5	11.0
SF White Bird Creek	SFWBC1	1.02	17.40	0.00	0.00	0.00	0.00	0.00	1.60	19.00
Mean		0.40	3.71	9.76	1.01	0.20	0.17	2.31		
SD		1.03	5.39	18.20	1.75	0.45	0.69	5.19		

Table 13. Densities (fish/100 m^2) of salmonids observed at 23 core trend transects snorkeled in the Clearwater River subbasin during 2013. Trout fry = all trout <50 mm that could not be distinguished between steelhead and cutthroat trout.

Stream	Transect	Trout Fry	Steelhead	Chinook salmon	Cutthroat Trout	Bull Trout	Brook Trout	Whitefish	Cutt/Steel Hybrid	Visibility (m)	Temp (C)
Bear Creek	1	0.00	2.34	1.98	0.95	0.00	0.00	1.17	0.07	NA	17
Bear Creek	2	0.00	0.28	0.23	0.05	0.00	0.00	0.00	0.00	NA	17
Colt Creek	Bridge	0.00	0.00	0.00	2.54	0.00	0.00	0.00	0.00	2.2	NA
EF Moose Creek	3	0.00	1.68	0.56	0.52	0.00	0.00	0.12	0.00	NA	NA
Fish Creek	1	5.92	11.73	0.00	1.25	0.00	0.00	0.00	0.00	2.7	15.0
Fish Creek	2	0.00	8.80	0.23	0.31	0.00	0.00	0.00	0.00	2.9	14.0
Johns Creek	1	0.52	6.20	7.24	1.55	0.00	0.00	0.26	0.00	4.1	21.1
Johns Creek	2	0.00	2.50	1.75	1.50	0.25	0.25	0.25	0.00	4.2	21.1
Johns Creek	1;1	4.82	24.28	9.05	1.55	0.00	0.00	0.52	0.00	1.8	16.0
Johns Creek	1;2	0.00	2.50	1.75	1.50	0.25	0.25	0.25	0.00	4.2	21.0
Johns Creek	2;3	0.12	1.95	0.00	1.46	0.00	0.00	0.00	0.00	3.5	15.5
Lochsa River	L1	0.00	0.18	0.28	0.15	0.00	0.00	0.05	0.00	6.6	20
Lochsa River	L2	0.00	0.07	0.08	0.02	0.00	0.00	0.33	0.00	2.3	21
Lochsa River	L3	0.00	0.35	0.00	0.42	0.00	0.00	0.01	0.00	6.5	NA
Lochsa River	L4	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	6.4	NA
Meadow Creek	1	0.52	0.86	70.18	0.17	0.06	0.00	0.40	0.00	5	20.3
Old Man Creek	1	0.15	5.69	0.46	1.00	0.00	0.00	0.92	0.00	2.9	16.0
Post Office Creek	1	9.06	1.72	0.00	4.22	0.00	0.00	0.00	0.00	4.6	14.6
Running Creek	1	0.00	1.34	0.00	0.12	0.00	0.00	0.12	0.12	NA	16.5
Tenmile Creek	1	1.03	4.12	4.26	1.62	0.00	0.00	0.00	0.00	4.9	4.9
Tenmile Creek	1	2.83	11.32	13.35	1.87	0.49	0.00	0.00	0.00	2.0	13.0
Three Links Creek	1	0.00	17.09	0.00	0.85	0.00	0.00	0.00	0.00	NA	15
WF Crooked River	>H>WF1	0.00	1.90	0.00	0.86	0.17	0.00	0.00	0.00	2.5	14
Mean		1.09	4.65	4.84	1.06	0.05	0.02	0.19			
SD		2.36	6.21	14.66	0.98	0.12	0.07	0.31			

Table 14. Densities (fish/100 m^2) of salmonids observed at 10 non-core trend transects snorkeled in the Clearwater River subbasin during 2013. Trout fry = all trout <50 mm that could not be distinguished between steelhead and cutthroat trout.

		Density (fish/100 m^2)								
Stream	Transect	Trout Fry	Steelhead	Chinook salmon	Cutthroat Trout	Bull Trout	Brook Trout	Whitefish	Visibility (m)	Temp (C)
EF Moose Creek	2	0.00	0.16	0.32	0.27	0.00	0.00	0.00	NA	21
Johns Creek	2;4	0.47	2.59	0.00	4.48	0.00	0.00	0.00	2.1	14.0
Marten Creek	1	0.00	17.65	0.00	0.00	0.00	0.00	0.00	NA	NA
NF Moose Creek	4	0.00	3.29	0.73	1.95	0.00	0.00	0.73	NA	NA
Selway River	North Star Ranch	0.00	0.00	0.31	1.07	0.00	0.00	0.65	NA	16.5
Selway River	Below Tango Creek	0.00	0.26	0.08	0.35	0.00	0.00	0.26	NA	NA
Selway River	Big Bend	0.00	0.00	0.00	0.30	0.00	0.00	0.23	NA	15
Selway River	Bad Luck Creek	0.00	0.00	0.00	0.58	0.05	0.00	0.48	NA	NA
Tenmile Creek	2	0.00	2.99	0.41	0.82	0.00	0.00	0.00	3.6	14.8
Tenmile Creek	2	1.51	11.34	0.41	1.32	0.10	0.00	0.10	2.3	14.5
Mean		0.20	3.83	0.23	1.11	0.02	0.00	0.25		
SD		0.48	5.96	0.25	1.32	0.03	0.00	0.28		

Table 15. Densities (fish/100 m^2) of salmonids observed at five core trend transects snorkeled in the Hells Canyon reach of the Snake River subbasin during 2013. Trout fry = all trout <50 mm that could not be distinguished between steelhead and cutthroat trout.

		Density (fish/100 m^2)								
Stream	Transect	Trout Fry	Steelhead	Chinook salmon	Cutthroat Trout	Bull Trout	Brook Trout	Whitefish	Visibility (m)	Temp (C)
Granite Creek	1	0.00	10.79	0.20	0.00	0.00	0.00	0.00	NA	16
Granite Creek	2	1.44	31.63	0.72	0.00	0.00	0.00	0.00	NA	16
Granite Creek	3	13.52	23.01	12.94	0.00	0.00	0.00	0.00	NA	12
Sheep Creek	1	0.00	33.64	2.46	0.00	0.00	0.00	0.00	NA	14.5
Sheep Creek	2	3.55	11.01	0.89	0.00	0.00	0.00	0.00	NA	15
Mean		4.63	24.77	3.44	0.00	0.00	0.00	0.00	0.00	
SD		6.10	15.42	5.84	0.00	0.00	0.00	0.00	0.00	

Table 16. Densities (fish/100 m^2) of salmonids observed at 70 intensive and extensive panel transects snorkeled in the South Fork Clearwater River drainage, June 19-26, July 18-25, and August 14-21, 2013. Trout fry = all trout <50 mm that could not be distinguished between steelhead and cutthroat trout.

		Density (fish/100 m^2)								
Stream	Transect	Trout Fry	Steelhead	Chinook	Cutthroat	Bull Trout	Brook Trout	Whitefish	Visibility (m)	Temp (C)
Adams Creek	36658	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.3	16.8
Alder Cr trib.	60578	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.2	7.0
Baldy Creek	38050	0.00	0.94	0.00	5.16	0.00	0.00	0.00	1.5	8.0
Bear Creek	56610	1.47	0.74	0.74	5.15	0.00	0.00	0.00	2.5	9.0
Beaver Creek	40226	0.51	0.00	0.00	1.78	0.00	0.00	0.00	2.5	8.0
Beaver Creek	72994	0.32	1.61	0.00	1.61	0.00	0.00	0.00	2.3	8.0
Crooked River	5698	0.00	1.09	0.33	1.63	0.00	0.00	0.44	3.0	15.0
Crooked River	50754	0.09	0.19	0.09	1.04	0.00	0.00	0.00	1.7	11.0
Crooked River	72258	0.00	0.28	0.00	0.37	0.00	0.00	0.28	1.9	9.0
Crooked River	73282	0.90	0.40	0.00	0.50	0.00	0.00	0.10	1.3	10.0
Crooked River	161346	0.00	1.10	0.00	0.09	0.00	0.00	0.55	1.4	10.0
Crooked River	202306	0.15	0.00	0.29	1.25	0.07	0.00	0.22	2.1	11.0
Crooked River	214594	0.00	1.49	0.00	1.57	0.90	0.00	0.09	1.6	9.0
Crooked River	243266	0.85	1.63	0.00	0.06	0.00	0.06	0.28	1.3	11.0
EF Crooked R	55874	0.00	1.63	0.00	0.30	0.00	0.00	0.00	1.6	7.0
EF Crooked R	219714	0.00	1.45	0.00	0.42	0.00	0.00	0.00	1.6	6.0
EF Relief Cr	58946	0.91	6.34	0.00	3.17	0.00	0.00	0.00	1.4	9.0
EF Relief Cr	157250	0.35	0.71	0.00	2.47	0.00	0.00	0.00	1.9	7.0
EF Relief Cr	247362	0.91	0.91	0.00	4.08	0.00	0.00	0.00	1.5	7.0
Fall Creek	63650	0.00	0.00	0.00	9.27	0.00	0.00	0.00	2.8	9.0
Fall Creek	66722	0.00	1.09	0.00	6.52	0.00	0.00	0.00	1.9	10.0
Fivemile Creek	14914	0.00	0.27	0.00	2.17	0.00	0.00	0.00	1.7	6.0
Fivemile Creek	186946	0.00	0.00	0.00	3.80	0.00	0.00	0.00	1.7	7.5
Gospel Creek	31954	0.00	1.98	0.00	0.59	0.00	0.00	0.00	2.8	9.0
Gospel Creek	82642	0.00	0.23	0.00	2.54	0.00	0.46	0.00	2.5	10.0
Haysfork Creek	54434	0.00	1.48	0.00	3.85	0.00	0.00	0.00	1.6	10.0
Johns Creek	162	0.00	4.56	0.78	0.43	0.00	0.00	0.21	3.4	NA
Johns Creek	16546	0.77	5.70	0.36	0.12	0.00	0.00	0.06	3.3	13.0
Johns Creek	17106	0.28	7.83	0.18	0.83	0.00	0.00	0.00	2.2	14.0
Johns Creek	58066	0.11	3.41	0.00	1.06	0.11	0.00	0.00	3.5	15.5
Left Fk Fall Cr	83106	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.7	7.0
Meadow Creek	7330	0.22	0.44	0.00	7.51	0.00	0.00	0.00	1.8	8.0
Meadow Creek	20642	0.00	5.22	0.00	5.74	0.17	0.00	0.00	1.2	9.0
Meadow Creek	37026	3.95	10.66	38.69	5.92	0.00	5.92	0.00	1.5	12.0
Meadow Creek	77986	0.12	3.75	0.00	2.50	0.00	0.00	0.00	1.4	14.0
Mill Creek	1842	0.00	2.12	0.00	9.55	0.00	0.00	0.00	3.6	19.0
Mill Creek	5938	0.00	0.73	0.00	27.98	0.00	0.00	0.00	2.9	19.0
Mill Creek	34610	0.00	5.07	0.00	7.10	0.00	0.00	0.00	2.5	14.0
Mill Creek	42802	0.00	0.00	0.00	8.84	0.00	0.00	0.00	3.0	20.3
Mill Creek	67378	0.00	2.48	0.00	7.01	0.00	0.00	0.00	3.2	14.0
Mill Creek	73890	1.50	4.84	0.00	3.23	0.00	0.00	0.00	1.3	11.0
Mill Creek	83762	0.21	0.82	0.00	14.21	0.00	0.00	0.00	1.8	16.8
Moores Creek	15570	0.00	0.00	0.00	2.67	0.00	0.00	0.00	2.6	5.5
Moores Creek	48338	0.00	0.00	0.00	9.58	0.31	0.00	0.00	2.7	9.0
Mule Creek	85282	0.00	0.74	0.00	0.25	0.00	0.00	0.00	2.5	13.0
Newsome Cr	19746	0.00	3.10	0.00	4.01	0.00	0.00	0.00	1.8	8.0
Newsome Cr	21794	0.00	2.11	0.00	0.00	0.00	0.00	0.00	2.5	8.0
Newsome Cr	47266	0.07	0.51	0.00	0.22	0.00	0.29	0.00	2.6	11.0
Newsome Cr	80034	0.00	2.57	1.48	2.15	0.00	0.00	0.51	1.9	13.0
Newsome Cr	87330	0.00	0.58	0.29	2.31	0.00	0.00	0.00	2.1	7.0
Nugget Creek	15650	3.71	5.19	2.97	0.00	0.00	0.00	0.00	1.2	8.0
Pilot Creek	21666	0.23	0.00	0.00	3.48	0.00	0.00	0.00	1.6	8.0
Radcliff Creek	52514	0.00	1.32	0.00	0.00	0.00	0.00	0.00		8.0
Relief Creek	124482	0.28	2.55	0.00	1.42	0.00	0.00	0.00	2.0	NA
Relief Creek	181826	1.02	0.00	0.00	3.82	0.00	0.00	0.00	1.9	9.0
Relief Creek	235074	0.36	1.46	0.00	1.46	0.00	0.00	0.00	1.8	NA

Table 16. Continued

Stream	Transect	Density (fish/100 m^2) Trout Fry	Steelhead	Chinook salmon	Cutthroat Trout	Bull Trout	Brook Trout	Whitefish	Visibility (m)	Temp (C)
SF Clearwater R	94498	1.90	0.99	0.13	0.26	0.09	0.00	1.21	3.9	23.2
Tenmile Creek	18130	0.72	0.36	0.36	6.09	0.90	0.00	0.00	4.2	15.3
Tenmile Creek	50898	0.17	0.00	0.00	0.35	0.00	0.00	0.00	5.4	11.5
Tenmile Creek	89666	0.00	0.76	0.00	6.87	0.22	0.00	0.33	3.8	17.4
WF Crooked R	170562	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.5	8.0
WF Crooked R	105026	0.00	0.00	0.00	2.19	0.00	0.00	0.00	2.6	6.0
WF Crooked R	178754	0.00	0.70	0.00	1.26	0.00	0.00	0.00	2.8	7.0
WF Crooked R	236098	0.00	0.13	0.00	0.53	0.00	0.00	0.00	2.5	6.0
WF Crooked R	244290	0.33	0.33	0.00	0.87	0.00	0.11	0.00	2.4	6.0
WF Crooked R	256578	0.00	0.99	0.00	0.00	0.00	0.00	0.00	1.7	7.0
WF Gospel Cr	97490	0.80	0.00	0.00	6.22	0.00	0.00	0.00	2.2	14.0
WF Newsome Cr	9378	0.00	1.84	0.00	0.20	0.00	0.00	0.00	2.5	7.0
Whiskey Creek	13890	0.60	7.22	0.60	4.21	0.00	0.00	0.00	2.2	9.0
Williams Creek	9938	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA
Mean		0.34	1.67	0.68	3.17	0.04	0.10	0.06		
SD		0.73	2.19	4.63	4.29	0.16	0.71	0.18		
Occupancy		43%	76%	20%	87%	11%	7%	17%		

Table 17. Densities (fish/100 m^2) of salmonids observed at 63 intensive and extensive panel transects snorkeled in the Middle Fork Salmon River drainage, July 6 to August 19, 2013. Trout fry = all trout <50 mm that could not be distinguished between steelhead and cutthroat trout.

		Density (fish/100 m^2)								
Stream	**Transect**	**Trout Fry**	**Steelhead**	**Chinook salmon**	**Cutthroat Trout**	**Bull Trout**	**Brook Trout**	**Whitefish**	**Visibility (m)**	**Temp (C)**
Bear Creek	109911	0.00	0.47	0.00	0.00	2.81	0.94	0.00	2.3	12.0
Beaver Creek	51031	0.16	0.47	0.47	0.00	0.00	1.71	0.31	1.5	10.0
Beaver Creek	15703	0.00	0.52	1.31	0.00	0.00	0.26	0.00	2.1	9.0
Beaver Creek	97111	0.00	0.00	0.00	0.00	1.19	0.00	0.00	3.7	12.0
Beaver Creek	32111	0.00	0.00	0.00	0.00	1.11	0.00	0.00	3.4	12.0
Beaver Creek	83799	0.00	0.38	0.00	0.00	0.00	1.13	0.00	1.8	10.0
Beaver Creek	27991	2.63	1.44	19.80	0.00	0.00	0.16	0.48	1.5	16.0
Bench Creek	101719	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.3	7.0
Bennett Creek	2287	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.4	11.0
Cape Horn Cr	150871	0.00	1.74	56.26	0.00	0.44	0.15	0.44	2.4	16.0
Cottonwood Cr	1391	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.0	8.0
Cottonwood Cr	43251	0.00	0.00	0.00	10.28	0.37	0.00	0.00	3.5	11.0
Cottonwood Cr	25967	0.00	0.00	0.00	10.95	0.00	0.00	0.00	3.5	11.0
EF Mayfield Cr	87407	0.40	0.20	4.02	1.21	0.20	0.00	0.00	1.1	12.0
EF Mayfield Cr	54639	0.00	0.00	0.00	0.00	3.71	0.00	0.00	1.7	9.0
Elkhorn Creek	15351	0.00	0.38	0.00	0.00	4.77	0.00	0.00	3.4	14.0
Honeymoon Cr	20471	0.33	0.00	0.00	1.30	0.65	0.00	0.00	2.8	12.0
Knapp Creek	60759	0.00	0.66	27.68	0.00	0.00	2.43	0.44	1.8	13.0
Knapp Creek	164695	0.75	0.00	0.00	0.00	0.00	3.36	0.00	3.3	14.0
Knapp Creek	40279	5.56	6.02	4.94	0.00	0.00	11.12	0.00	3.5	14.0
Knapp Creek	73047	1.07	3.10	0.00	0.00	0.00	1.07	0.00	3.1	14.0
Knapp Creek	126295	0.56	8.67	18.46	0.00	0.00	6.71	0.00	4.5	14.0
Knapp Creek	130391	0.36	0.71	0.00	0.00	0.00	5.70	0.00	3.3	14.0
Little Pistol Cr	69615	0.38	0.19	0.00	0.38	1.15	0.00	0.00	3.4	12.0
Lola Creek	60247	0.00	2.79	2.44	0.00	2.44	0.00	0.00	3.2	12.0
Loon Creek	81263	0.00	0.00	0.00	0.00	0.57	0.00	0.00	2.8	10.0
Loon Creek	74991	0.00	0.53	0.08	0.76	0.00	0.00	2.06	1.6	13.0
Loon Creek	45295	0.00	5.16	2.79	1.18	0.00	0.00	1.86	1.7	19.0
Loon Creek	84207	0.00	2.90	10.76	1.32	0.00	0.00	4.49	1.4	13.0
Loon Creek	75119	0.00	6.02	0.00	0.08	0.08	0.00	1.98	2.5	17.0
Loon Creek	53615	0.00	2.35	6.23	0.48	0.07	0.00	1.66	1.7	15.0
Loon Creek	83311	0.00	2.77	0.00	0.67	0.08	0.00	2.77	1.1	11.0
Loon Creek	83183	0.05	0.36	3.90	0.77	0.00	0.00	2.77	1.5	16.0
Loon Creek	80239	0.00	1.21	2.10	1.42	0.00	0.00	3.88	2.9	11.0
Loon Creek	72047	0.00	1.39	0.07	0.33	0.00	0.00	1.65	2.9	9.0
Marsh Creek	56663	0.00	0.12	39.29	0.00	0.00	1.96	0.35	2.4	17.0
Marsh Creek	89431	0.11	2.52	26.16	0.00	0.11	0.32	0.00	2.7	16.0
Marsh Creek	125783	0.00	12.06	16.39	0.00	0.07	0.28	1.92	1.9	17.0
Marsh Creek	105815	0.00	13.21	80.93	0.00	0.89	1.78	2.11	2.8	16.0
Mayfield Creek	39279	0.00	2.69	12.60	0.32	0.32	0.00	1.18	1.5	12.0
Mayfield Creek	76143	0.00	0.41	0.82	2.72	0.41	0.00	0.27	2.0	10.0
Pistol Creek	12319	0.00	2.01	24.05	3.36	0.00	0.00	0.34	2.8	11.0
Pistol Creek	16399	0.49	0.97	0.00	0.97	0.00	0.00	0.00	2.9	17.0
Pistol Creek	24047	0.00	3.62	13.22	2.37	0.11	0.00	0.34	2.5	14.0
Pistol Creek	32239	0.00	4.52	24.15	3.34	0.10	0.00	0.69	3.6	11.0
Pistol Creek	41967	0.00	2.09	4.18	1.29	0.00	0.00	1.89	3.2	18.0
Pistol Creek	61471	0.00	0.00	0.00	16.76	0.55	0.00	0.00	3.2	16.0
Soldier Creek	21999	0.00	0.92	0.00	1.23	0.00	0.00	0.00	3.5	8.0
Sulphur Creek	2039	2.35	0.09	3.11	0.38	0.00	0.00	2.54	2.7	13.0
Sulphur Creek	28663	0.00	0.10	4.44	0.30	0.00	0.00	2.42	3.3	11.0
Sulphur Creek	31735	0.38	0.85	0.00	0.08	0.00	0.00	0.23	2.4	13.0
Sulphur Creek	36855	0.00	1.96	0.13	0.52	0.00	0.00	0.13	2.6	12.0
Sulphur Creek	64503	4.88	0.70	13.07	1.22	0.00	0.00	3.40	2.6	13.0
Sulphur Creek	8183	0.00	2.12	0.00	0.87	0.00	0.00	3.49	2.8	8.0

Table 17. Continued

Stream	Transect	Density (fish/100 m^2) Trout Fry	Steelhead	Chinook salmon	Cutthroat Trout	Bull Trout	Brook Trout	Whitefish	Visibility (m)	Temp (C)
Swamp Creek	120151	0.00	0.00	0.00	0.00	0.89	0.00	0.00	2.9	10.0
Swamp Creek	21847	0.75	0.00	8.30	0.38	0.38	3.77	0.00	3.6	15.0
Trail Creek	19823	0.00	0.23	0.00	0.00	0.00	0.00	0.00	1.2	8.0
Unn trib to Winn.	141143	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.6	9.0
WF Mayfield Cr	101743	0.00	0.00	0.00	0.00	6.79	0.00	0.00	2.5	9.0
WF Mayfield Cr	25455	0.00	0.00	0.00	0.00	3.09	0.00	0.00	2.5	11.0
WF Mayfield Cr	92527	0.00	0.00	0.00	0.00	2.36	0.00	0.00	2.7	7.0
Winnemucca Cr	123735	0.40	0.80	0.00	0.00	0.80	0.00	0.00	3.5	10.0
Winnemucca Cr	18263	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	10.0
Mean		0.34	1.63	6.86	1.07	0.58	0.91	0.73		
SD		1.01	2.68	14.35	2.80	1.26	2.12	1.17		
Occupancy		29%	70%	49%	48%	46%	27%	44%		

Table 18. Densities (fish/100 m^2) of salmonids observed at 39 intensive panel transects snorkeled in the Potlatch River drainage, from June 5 to June 11, 2013. Trout fry = all trout <50 mm that could not be distinguished between steelhead and cutthroat trout.

		Density (fish/100 m^2)					
Stream	**Transect**	**Trout Fry**	**Steelhead**	**Brook Trout**	**Chinook Salmon**	**Visibility (m)**	**Temp (C)**
Big Bear Creek	30690	0.00	0.00	0.00	0.00	0.8	14.0
Big Bear Creek	79842	0.00	0.00	0.00	0.00	1.0	21.5
Big Bear Creek	91154	14.24	2.02	0.00	0.00	1.5	13.0
Big Bear Creek	106514	0.00	0.00	0.00	0.00	1.9	20.0
Big Bear Creek	107538	15.78	1.30	0.00	0.00	1.6	13.0
Big Bear Creek	169954	0.00	0.00	0.00	0.00	1.0	14.0
Bobs Creek	37745	0.00	3.88	3.88	0.00	1.3	12.0
Bobs Creek	54129	2.52	0.84	19.30	0.00	1.4	12.0
Cedar Creek	16866	5.74	30.03	0.00	0.00	1.8	15.0
Cedar Creek	59106	0.00	0.57	0.00	0.00	1.2	11.0
EF Potlatch River	2929	0.00	0.23	0.46	0.00	1.2	10.0
EF Potlatch River	13169	0.46	3.25	0.23	0.00	1.7	15.0
EF Potlatch River	34786	0.00	1.35	0.00	0.00	1.8	22.0
EF Potlatch River	45937	0.71	5.57	3.00	0.00	2.7	15.0
EF Potlatch River	95089	12.95	0.00	14.47	0.00	1.7	12.0
EF Potlatch River	130018	0.00	2.34	0.11	0.11	2.1	20.0
EF Potlatch River	134001	0.29	0.29	0.00	0.00	0.0	10.0
EF Potlatch River	136049	0.00	0.00	0.00	0.00	1.8	10.0
EF Potlatch River	144241	0.44	1.65	3.84	0.00	1.7	17.0
EF Potlatch River	168817	0.00	1.09	0.00	0.00	1.9	10.0
EF Potlatch River	182242	0.16	0.32	0.00	0.00	2.0	10.0
EF Potlatch River	359394	0.00	1.01	1.09	1.43	1.4	15.0
EF Potlatch River	457698	0.48	0.00	0.00	0.00	1.7	12.0
Pine Creek	98018	20.88	0.77	0.00	0.00	1.0	12.0
Pine Creek	153570	10.64	0.00	0.00	0.00	1.4	10.0
Pine Creek	181266	9.49	0.86	0.00	0.00	1.0	20.0
Pine Creek	364258	3.47	0.00	0.00	0.00	1.0	15.0
Pine Creek	393698	0.00	1.18	0.00	0.00	1.0	21.0
Pine Creek	413410	0.96	3.07	0.00	0.00	1.3	22.0
Ruby Creek	2018	0.00	1.56	0.00	0.00	2.0	19.0
Ruby Creek	31714	8.99	12.16	0.53	0.00	2.0	11.0
Schwartz Creek	24594	1.19	7.74	0.00	0.00	1.7	9.0
WF Potlatch River	16354	0.00	1.12	1.12	0.00	2.8	16.0
WF Potlatch River	89221	0.00	0.00	5.73	0.00	2.0	14.0
WF Potlatch River	121989	12.53	5.37	1.79	0.00	1.6	13.0
WF Potlatch River	384133	0.00	1.41	0.70	0.00	1.5	16.0
WF Potlatch River	393186	0.00	0.00	3.94	0.00	1.8	15.0
WF Potlatch River	416901	0.00	0.00	0.71	0.00	1.0	15.0
WF Potlatch River	417762	0.00	0.98	1.13	0.00	1.6	16.0
Mean		3.13	2.36	1.59	0.04		
SD		5.55	5.17	3.90	0.23		
Occupancy		49%	69%	44%	5%		

Table 19. Densities (fish/100 m^2) of salmonids observed at 21 intensive panel transects snorkeled in the Fish Creek drainage from July 5 to July 12, 2013. Trout fry includes all trout <50 mm.

		Density (fish/100 m^2)						
Stream	**Site**	**Trout Fry**	**Steelhead**	**Chinook Salmon**	**Cutthroat Trout**	**Whitefish**	**Visibility (m)**	**Temp (C)**
Fish Creek	167874	0.08	2.56	0.00	0.32	0.00	2.6	19.0
Fish Creek	57378	0.00	0.00	0.00	17.71	0.00	2.7	9.0
Fish Creek	69666	0.00	0.00	0.00	7.19	0.00	1.9	12.0
Fish Creek	194498	0.17	7.36	0.00	1.71	0.00	2.7	14.0
Fish Creek	96194	0.00	1.12	0.00	0.42	0.00	2.5	13.0
Fish Creek	151490	0.12	1.49	0.00	0.12	0.00	3.2	14.5
Fish Creek	20418	0.68	6.16	1.01	2.36	0.00	2.6	17.0
Fish Creek	102338	0.12	4.41	0.81	0.93	0.00	2.5	19.5
Fish Creek	172738	0.95	12.14	0.60	3.33	0.00	2.5	14.0
Fish Creek	74434	1.37	15.32	0.00	0.58	0.00	2.5	17.0
Fish Creek	41666	0.00	8.28	0.12	0.69	0.00	2.9	14.0
Fish Creek	12994	0.92	10.67	0.00	0.14	0.21	3.3	15.0
Hungery Creek	164770	1.54	2.56	0.00	9.47	0.00	2.2	13.0
Hungery Creek	24610	1.29	0.81	0.00	11.61	0.00	2.3	11.0
Hungery Creek	33698	0.00	0.52	0.00	4.40	0.00	2.4	9.0
Hungery Creek	17314	0.00	6.68	0.00	2.23	0.00	2.6	11.0
Hungery Creek	97698	0.00	22.74	0.00	2.41	0.00	2.8	12.0
Hungery Creek	213922	0.00	4.13	0.00	0.66	0.00	2.5	12.0
Hungery Creek	58050	0.17	17.86	2.07	0.83	0.00	2.6	16.0
Willow Creek	221890	0.00	0.00	0.00	8.18	0.00	2.4	14.0
Willow Creek	156354	0.00	5.01	0.00	6.37	0.00	2.4	12.0
Mean		0.35	6.18	0.22	3.89	0.01		
SD		0.52	6.23	0.50	4.54	0.04		
Occupancy		52%	86%	24%	100%	5%		

Table 20. Densities (fish/100 m^2) of salmonids observed at 24 intensive panel transects snorkeled in the Crooked Fork Creek drainage in July and August, 2013. Trout fry = all trout <50 mm that could not be distinguished between steelhead and cutthroat trout.

Stream	Transect	Trout Fry	Steelhead	Chinook salmon	Cutthroat Trout	Bull Trout	Brook Trout	Whitefish	Vis. (m)	Temp (C)
Boulder Creek	34625	0.00	3.06	0.25	2.08	0.12	0.00	0.00	8.00	NA
Brushy Fork	21313	0.00	1.22	0.00	0.43	0.00	0.00	0.00	5.60	NA
Brushy Fork	101185	1.33	0.85	31.14	3.62	0.00	0.00	0.00	11.70	13.90
Brushy Fork	103233	0.00	0.00	0.35	0.00	0.00	0.00	0.00	3.90	NA
Brushy Fork	117569	0.00	3.22	0.71	0.71	0.00	0.00	0.00	2.80	12.00
Brushy Fork	136001	0.00	0.43	0.00	0.00	0.00	0.00	0.00	5.90	NA
Brushy Fork	150337	0.00	3.50	0.00	1.12	0.00	0.00	0.00	6.30	14.00
Crooked Fork	10049	0.00	0.74	0.00	1.17	0.00	0.00	0.00	11.30	NA
Crooked Fork	12097	0.23	2.32	0.50	0.43	0.00	0.00	0.10	4.70	14.00
Crooked Fork	28481	0.00	1.15	0.10	1.12	0.00	0.03	0.31	4.30	17.00
Crooked Fork	48961	0.00	1.53	0.00	1.33	0.00	0.00	0.00	6.80	NA
Crooked Fork	64321	0.08	0.17	0.25	0.33	0.00	0.00	0.00	4.90	NA
Crooked Fork	67393	0.68	0.12	1.11	0.43	0.00	0.00	0.06	7.10	14.90
Crooked Fork	80705	0.00	1.60	0.00	8.01	0.00	0.00	0.00	5.50	10.00
Crooked Fork	94017	0.10	2.89	0.69	0.88	0.00	0.00	0.34	5.80	15.00
Crooked Fork	97089	0.05	1.37	0.10	0.00	0.00	0.00	0.00	9.20	NA
Crooked Fork	122689	0.00	0.00	0.00	4.44	0.00	0.00	0.00	8.40	10.00
Crooked Fork	132929	0.00	0.30	0.00	0.18	0.00	0.00	0.00	3.80	NA
Crooked Fork	151361	0.49	0.72	0.13	0.66	0.00	0.00	0.00	4.80	12.00
Crooked Fork	159553	0.74	2.13	0.00	0.85	0.00	0.00	0.50	5.10	16.00
Crooked Fork	165697	0.00	0.96	0.00	0.53	0.00	0.00	0.00	4.80	NA
Hopeful Creek	105281	0.00	0.00	0.00	1.17	0.00	0.00	0.00	5.50	NA
Spruce Creek	111425	0.00	0.17	0.00	0.17	0.00	0.00	0.00	4.50	NA
Spruce Creek	123969	0.00	0.97	0.00	0.54	0.00	0.00	0.00	6.50	NA
Mean		0.15	1.23	1.47	1.26	0.01	0.00	0.05		
SD		0.33	1.10	6.33	1.79	0.02	0.01	0.13		
Occupancy		33%	88%	46%	88%	4%	4%	21%		

Table 21. Densities (fish/100 m^2) of salmonids observed at 20 intensive panel transects snorkeled in the Rapid River drainage from July 31 to August 7, 2013. Trout fry includes all trout <50 mm.

		Density (number/100 m^2)							
Stream	**Site**	**Trout Fry**	**Steelhead**	**Wild Chinook**	**Hatchery Chinook**	**Cutthroat Trout**	**Bull Trout**	**Visibility (m)**	**Temp (C)**
Rapid River	135250	0.00	0.00	0.00	0.00	0.00	3.22	3.3	7.0
Rapid River	200786	0.00	0.00	0.00	0.00	0.00	4.46	3.2	9.0
Rapid River	24658	0.00	0.00	0.00	0.00	0.00	2.47	3.2	8.0
Rapid River	237650	0.00	0.00	0.00	0.00	0.00	3.73	3.0	9.0
Rapid River	90194	0.00	0.00	0.00	0.00	0.00	3.94	3.1	10.0
Rapid River	155730	0.00	0.00	0.00	0.00	0.00	2.83	3.2	10.0
Rapid River	196690	0.00	0.77	0.00	0.00	0.00	3.23	3.2	7.0
Rapid River	323474	0.36	1.50	0.00	0.00	0.00	2.57	3.3	10.0
Rapid River	192402	0.00	0.62	0.00	0.00	0.00	1.45	2.9	10.0
Rapid River	126866	0.00	0.46	0.00	0.00	0.00	1.71	2.8	10.0
Rapid River	17298	0.51	4.75	0.00	0.00	0.00	0.40	2.5	11.0
Rapid River	15762	0.09	6.49	0.00	0.00	0.00	0.27	1.8	9.5
Rapid River	294290	0.00	9.39	0.00	0.00	0.21	0.11	2.8	10.0
Rapid River	324498	0.33	3.56	0.00	0.00	0.00	0.25	2.9	9.5
Rapid River	390034	1.85	4.39	0.00	0.00	0.00	0.17	2.5	11.0
Rapid River	62354	1.97	5.05	0.24	0.00	0.00	0.16	3.4	12.5
Rapid River	193426	0.00	5.87	0.00	0.00	0.00	0.34	2.3	11.0
Rapid River	19346	2.65	13.51	0.00	0.00	0.00	0.26	3.1	11.0
Rapid River	215954	7.79	6.01	0.96	1.63	0.07	0.22	2.1	12.0
WF Rapid River	163218	0.14	2.84	0.00	0.00	0.00	0.00	2.7	9.5
Mean		0.78	3.26	0.06	0.08	0.01	1.59		
SD		1.78	3.62	0.21	0.36	0.05	1.52		
Occupancy		45%	70%	10%	5%	10%	95%		

Table 22. Steelhead trout detection probabilities from 26 mark-resight transects during 2013. Asterisks indicate that juvenile cutthroat trout were included in the number of fish marked.

Stream	Transect	Number Marked	Number Resighted	Efficiency (%)	Visibility (m)	Temp (C)
Crooked Fork Creek	CF Resight 2013	19	5	26.3	7.6	21.3
Brushy Fork	BF Resight 2013	30	12	40.0	7.5	15.8
EF SF Salmon River	RE 1	14*	7	50.0	2.2	14.0
EF SF Salmon River	RE 2	30*	9	30.0	2.4	13.0
Johnson Creek	RE 4	20*	9	45.0	2.7	15.0
Johnson Creek	RE 2	25	3	12.0	2.7	13.0
Johnson Creek	RE 1	14	6	42.9	1.8	13.0
Johnson Creek	RE 3	13*	6	46.2	2.7	14.0
Loon Creek	Resight Airstrip	19*	11	57.9	2.0	10.0
Loon Creek	Resight Above Trail Cr	20*	10	50.0	2.0	10.0
Mayfield Creek	Upper Resight 2013	22	13	59.1	2.6	12.0
Mayfield Creek	Lower Resight 2013	28*	18	64.3	2.6	13.0
John's Creek	GPM 1:1	32*	13	40.6	1.8	16.0
John's Creek	John's Falls	30	17	56.7	3.4	16.0
Mill Creek	2 Mile Bridge	14	7	50.0	1.7	15.0
Mill Creek	73890	35	20	57.1	3.3	16.0
Tenmile Creek	GPM TM1	25*	7	28.0	2.0	13.0
Tenmile Creek	GPM TM2	29*	12	41.4	2.3	14.5
Tenmile Creek	89666	25*	9	36.0	4.8	12.0
Crooked River	5698	12	2	16.7	3.0	15.0
Crooked River	161346	7*	0	0.0	2.0	10.0
Newsome Creek	80034	22*	2	9.1	1.9	13.0
Rapid River	19346	20	10	50.0	3.1	11.0
Rapid River	62354	20	5	25.0	3.4	12.5
Fish Creek	41666	29*	9	31.0	2.9	14.0
Fish Creek	GPM2	27*	3	11.1	2.9	14.0

Table 23. Comparison of annual mean densities (fish/100 m^2) of Chinook salmon and steelhead trout in trend transects in the Salmon and Clearwater River subbasins.

	Chinook salmon		Steelhead trout	
Year	**Salmon**	**Clearwater**	**Salmon**	**Clearwater**
2009	9.03	9.93	2.69	1.97
2010	4.44	7.98	2.32	2.07
2011	8.18	6.07	4.75	1.10
2012	9.16	3.38	5.31	5.98
2013	6.11	3.44	3.30	4.40

APPENDICES

Appendix A. Extended Spawning Ground Surveys in the Chamberlain Creek Chinook Salmon Population in 2013.

Authors: Timothy Copeland, Dorianne Broglino, and Nathan Abel

INTRODUCTION

Snake River spring-summer Chinook salmon (hereafter Chinook salmon) were classified as threatened in 1992 under the Endangered Species Act (ESA). However, specific data on some Snake River steelhead and Chinook salmon populations are lacking, particularly key parameters such as abundance, age composition, genetic diversity, recruits per spawner, and survival rates (ICBTRT 2003). The key metrics to assessing viability of salmonid populations are abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). In the 1950s, IDFG developed a program to index annual spawning escapement by enumerating Chinook salmon redds in selected areas. Currently, the total area and number of streams surveyed represents a large portion of wild Chinook salmon spawning habitat (Hassemer 1993a). The number of redds counted in these areas provide an index of the annual wild adult Chinook salmon spawner abundance at the independent population scale (see ICBTRT 2003 for population delineations).

Chamberlain Creek supports a population of Chinook salmon within the Middle Fork Salmon River major population group (MPG). Recovery planning objectives for the Middle Fork Salmon MPG include the Chamberlain Creek as being viable (Ford et al. 2010). However, past assessments of the status of this population have been hampered by several data gaps (see Ford et al. 2010). The current index transects surveyed compose only 16% of the total weighted spawning habitat within Chamberlain Creek. Additionally, many carcass surveys (on which age structure and hatchery influence metrics depend) have yielded minimal or no data. Hence, assessments were completed based on assumptions rather than specific information.

The Chamberlain Creek Chinook population is apparently the most robust population in the Middle Fork Salmon MPG (see Table 3.4-1 in Ford et al. 2010). Recent work has found that the population is genetically distinct (Ackerman and Campbell 2012). Further, samples taken at Lower Granite Dam have led to abundance estimates of more than 500 adults in the population in 2010 and 2011 (Schrader et al. 2012, 2013). Given this information, it is desirable to collect more specific data on the Chamberlain Creek population to verify the foregoing inferences.

Our objectives in this report are to summarize the results of the extended spawning ground survey conducted in August 2013 within the Chamberlain Basin. The goals of the extended survey were to:

1) Detail the extent of spawning in Chamberlain Creek outside of the current trend transects.
2) Collect additional carcasses throughout the area.
3) Compare and contrast redd counts from the current trend transects to the other areas surveyed.

METHODS

Determining New Survey Areas

The Chamberlain Creek area is remote and rugged; therefore, careful planning is necessary for efficient surveys. The Chamberlain Creek Chinook salmon population is composed of several drainages (Figure 1). The areas surveyed in 2013 include the upper reaches of Chamberlain Creek and the West Fork Chamberlain, as well as the lower end of Game Creek. These areas correspond with many of the areas identified as having high intrinsic potential in the NOAA habitat assessment (Ford et al. 2010; Figures 1 and 2). The other tributaries adjacent to the survey area (e.g. Flossie Creek, Moose Creek) proved to be too small to contain usable salmon habitat.

Access is important in backcountry surveys. Stonebraker Ranch was used as a base camp to conduct the extended survey. There were suitable areas upstream along Chamberlain Creek to camp when needed. Generally, the trails around the ranch and the nearby U.S. Forest Service Guard Station are in good condition. There is a well-maintained trail adjacent to Chamberlain Creek allowing for efficient travel to the upper reaches. Though much of the off-trail area contains large sections of fallen and burned trees, there was relatively easy access to the creek from the trail in several areas where the trail passed close to the creek or crossed the creek (Figure 3). Conducting surveys can be slow at times as Chamberlain Creek contains numerous large log jams, though most are passable with care. The West Fork Chamberlain was easier to access and is in close proximity to Stonebraker Ranch. The West Fork has numerous beaver ponds and wet meadows making travel slow in some areas. The appendix contains several photos showing the field conditions.

We used three primary data sources to plan the surveys: TRT intrinsic potential maps, 2011 snorkel data, and Google Earth™. The first two helped identify reaches in which we were likely to encounter spawning fish. We targeted reaches with high intrinsic potential where Chinook parr had been observed in 2011 (Kennedy et al. 2012). Recent high resolution aerial/satellite images on Google Earth™ were used to visualize areas and note likely obstacles (e.g. logjams and fallen trees). Pre-trip planning proved to be very helpful in maximizing time and resources once on site.

Spawning Ground Surveys

Redd survey methods used standardized procedures described in Hassemer (1993a). Trend transect boundaries were described in Hassemer (1993b): in Chamberlain Creek from the mouth of the West Fork upstream to Flossie Creek (transect WS-1a) and in West Fork Chamberlain Creek from the mouth upstream to Game Creek (transect WS-1). Trained observers walked the bank, scanning the stream substrate using polarized sunglasses, and identifying redds. Single-pass, peak-count surveys were made timed to coincide with the period of maximum spawning activity, based on historic observations (August 25). Redds observed during ground counts were assigned a unique number and location recorded using a global positioning system. Surveyors noted the presence of any adult Chinook salmon observed.

We collected data from Chinook salmon carcasses to determine their origin (general production hatchery or natural), ocean age, spawn status, and sex. Measurements collected included fork length and mid-eye to hypural plate length (nearest cm). We checked carcasses for fin clips, marks, tags, radio transmitters, and/or coded-wire tags (CWT). We collected dorsal fin rays for age determination and fin tissue for DNA analysis.

Data Analysis

In addition to surveying the trend transects on Chamberlain Creek (WS-1a) and West Fork Chamberlain (WS-1), ten additional stream segments were surveyed to assess the potential for additional spawning habitat in the area (Table 1 and Figure 4). Distances of each segment and survey times were measured. The number of redds per kilometer and the number of redds per hour were calculated to compare the relative redd abundance and effort involved for the various segments. Carcasses were collected during the redd surveys, as well as prior to and after the surveys along some of the stream segments.

An analysis of the carcass data, including estimated age, is in progress and was not available for this report.

RESULTS

We conducted surveys during August 19-22 and August 27-29, 2013 (Table 1). During the first period, WS-1 and WS-1a were surveyed only for carcasses because the peak count has traditionally been scheduled for the last week of August. The other areas surveyed during this field trip included reaches 1, 2, 4, and 6-11 (Table 1 and Figure 4). Many live fish (n = 113) were seen during the first trip. During the second trip, the trend transects (WS-1 and WS-1a) were surveyed along with two additional reaches in Chamberlain Creek (reaches 6 and 12). An additional pass was made to collect carcasses in reaches 8 and 9. Only nine live fish were seen during this trip, seven in WS-1a, and two between Flossie and No Name Creeks.

A total of 23.5 km was surveyed for redds, taking about 31 hours (Table 1). During this time, a total of 147 redds were observed. Within the trend transects, WS-1 and WS-1a, redd densities were 7.9 redds/km and 7.4 redds/km, respectively. In the upstream sections of Chamberlain from Moose Creek to Rim Creek redd densities were also high, varying from 5.6 redds/km to 13.6 redds/km, indicating there is comparable habitat in the upstream reaches of Chamberlain Creek. We observed redds through most of the reaches surveyed, although there were some short sections without suitable habitat and no redds (Figure 4).

In total, 101 carcasses were collected. Sixty carcasses were collected during the first week and forty-one during the second (Table 1). We noted that fewer carcasses were collected and fewer live fish were observed in the upstream reaches (Figure 5). Spawning in these areas may have been initiated sooner. We saw many indicators of bear activity (tracks and scat), so it is likely fish were removed from the stream either before they died or shortly thereafter.

DISCUSSION

We found that spawning ground surveys done upstream of the current transects could be done safely and efficiently. Upstream areas of Chamberlain Creek had good spawning and rearing habitat with minimal human influence. A large number of redds were counted and carcasses collected in the extended survey areas. Of redds observed during the 2013 survey, 59% were not in one of the trend transects. We conclude that the extended surveys were a worthwhile endeavor.

The main reason this survey was begun was to see if the current expansion factor used for ESA assessments was reasonable. We used several additional pieces of information to get at this question. Schrader et al. (2013) estimated that there were 551 fish (95% CI 364-794) from Chamberlain Creek that crossed Lower Granite Dam in 2011. That year there were 114 redds counted in Chamberlain Creek in the trend transects (IDFG, unpublished data). Using the fish per redd value in Ford et al. (2010) of 1.82 fish/redd, there should have been 207 fish spawning in the trend transects in 2011. Expanding by the proportion of redds we observed in the trend transects (41%) yields an estimate of 506 fish in the portions of Chamberlain Creek we surveyed, which is consistent with the Schrader et al. estimate. Expanding by 16% (the Ford et al. expansion factor) yields an estimate of 1,297 fish, which is significantly higher than Schrader et al.'s 2013 estimate. We also note that the largest portion habitat with high intrinsic potential is in the upper reaches of Bargamin Creek, yet the 2011 snorkel survey of that basin found few Chinook parr near the confluence with the Salmon River (Kennedy et al. 2012). From this, we conclude that it is likely we have surveyed the majority of the reaches occupied by the Chamberlain Creek population and that the current expansion factor may not be reasonable. Further work may be needed to confirm this inference.

We recommend that at least part of the expanded surveys be completed in the future. The following additional observations should be taken into consideration when planning future surveys. 1) Suitable spawning substrate was found from Moose Creek upstream to Rim Creek. No suitable habitat was found in Game Creek and the first quarter mile below the confluence of the West Fork. There was little habitat between Flossie Creek and Moose Creek. The upstream-most redd was found near the upper end of the Upper Red Top Meadows area, where the valley floor narrows and the stream habitat changes. 2) If additional carcass data is needed, a survey should be made the week before the trend surveys because of spawn timing and predator activity. 3) The hike to the upstream camp site took between 2 and 3 hours, depending on amount of gear (i.e. overnight gear vs. day hiking). These observations will help tailor surveys to program objectives.

ACKNOWLEDGEMENTS

Lance Hebdon and Emanuel Ziolkowski assisted with field work. Transportation was provided by Arnold Aviation.

LITERATURE CITED

Ackerman, M., and M. Campbell. 2012. Chinook and steelhead genotyping for genetic stock identification at Lower Granite Dam. July 1, 2011 to June 30, 2012 annual progress report. Idaho Department of Fish and Game Report 12-15. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 2010-026-00. Portland, Oregon.

Ford, M. J., A. Albaugh, K. Barnas, T. Cooney, J. Cowen, J. Hard, R. Kope, M. M. McClure, P. McElhany, J. Myers, N. Sands, D. Teel, and L. A. Weitkamp. 2010. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. US Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-113.

Hassemer, P. 1993a. Draft manual of standardized procedures for counting Chinook salmon redds. Idaho Department of Fish and Game, Boise.

Hassemer, P. 1993b. Salmon spawning ground surveys, 1989-1992. Idaho Department of Fish and Game. Project F-73-R-15. Pacific Salmon Treaty Program Award No. NA17FP0168-02. 32 p. plus appendices.

ICBTRT (Interior Columbia Basin Technical Recovery Team). 2003. Independent populations of Chinook, steelhead, and sockeye for listed evolutionarily significant units within the interior Columbia River domain, July 2003 working draft. Available at http://www.nwfsc.noaa.gov/trt. (May 2004).

Kennedy, P., T. Copeland, J. Johnson, K. A. Apperson, J. Flinders, R. Hand, and M. Corsi. 2012. Idaho natural production monitoring and evaluation, 2011 annual report. Idaho Department of Fish and Game Report 12-18. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project 1991-073-00. Portland, Oregon.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonids populations and the recovery of evolutionarily significant units. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-42.

Schrader, W. C., T. Copeland, P. Kennedy, M. W. Ackerman, K. K. Wright, and M. R. Campbell. 2012. Wild adult steelhead and Chinook salmon abundance and composition at Lower Granite Dam, spawn year 2010. Idaho Department of Fish and Game Report 12-16. Annual report 2010, BPA Projects 1990-055-00, 1991-073-00, 2010-026-00.

Schrader, W. C., M. P. Corsi, P. Kennedy, M.W. Ackerman. M. R. Campbell, K. K. Ellsworth, T. Copeland. 2013. Wild adult steelhead and Chinook salmon abundance and composition at Lower Granite Dam, spawn year 2011. Idaho Department of Fish and Game Report 13-15. Annual report 2011, BPA Projects 1990-055-00, 1991-073-00, 2010-026-00.

Table 1. Summary of surveys. Supplemental carcass collections are denoted by a superscript in the Carcasses column.

ID	Date	Segment	Length (km)	Redds	Redds per km	Time (hrs)	Redds per hour	Carcasses
1	8/19	Game Creek	0.59	0	0	0.3	0	0
2	8/19	West Fork: Game-upstream trail crossing	1.34	2	1.5	1.5	1.3	1
3	8/28	West Fork (WS-1)	3.56	28	7.9	4.8	5.8	9[a]
4	8/22	Chamberlain downstream of West Fork	0.33	0	0	0.5	0	1
5	8/28	Chamberlain (WS-1A)	4.35	32	7.4	6.3	5.1	23[b]
6	8/27	Chamberlain: Flossie - No Name	2.3	9	3.9	3.7	2.5	2
7	8/21	Chamberlain: No Name - Moose	2.21	7	3.2	3	2.3	0[c]
8	8/21	Chamberlain: Moose - lower trail crossing	0.95	13	13.6	2.3	5.8	5[d]
9	8/21	Chamberlain: between trail crossings	1.46	12	8.2	2	6	4[e]
10	8/20	Chamberlain: Upper trail crossing – Fish Creek	3.28	23	7	3.2	7.1	1
11	8/20	Chamberlain: Fish - upper unnamed creek	1.91	14	7.3	2.1	6.7	2
12	8/29	Chamberlain: unnamed creek to Rim Creek	1.25	7	5.6	1.1	6.5	0
		Total		**147**		**30.7**		**48**

[a] 8/19 27 Carcasses
[b] 8/22 19 Carcasses
[c] 8/29 2 Carcasses
[d] 8/29 3 Carcasses
[e] 8/29 2 Carcasses

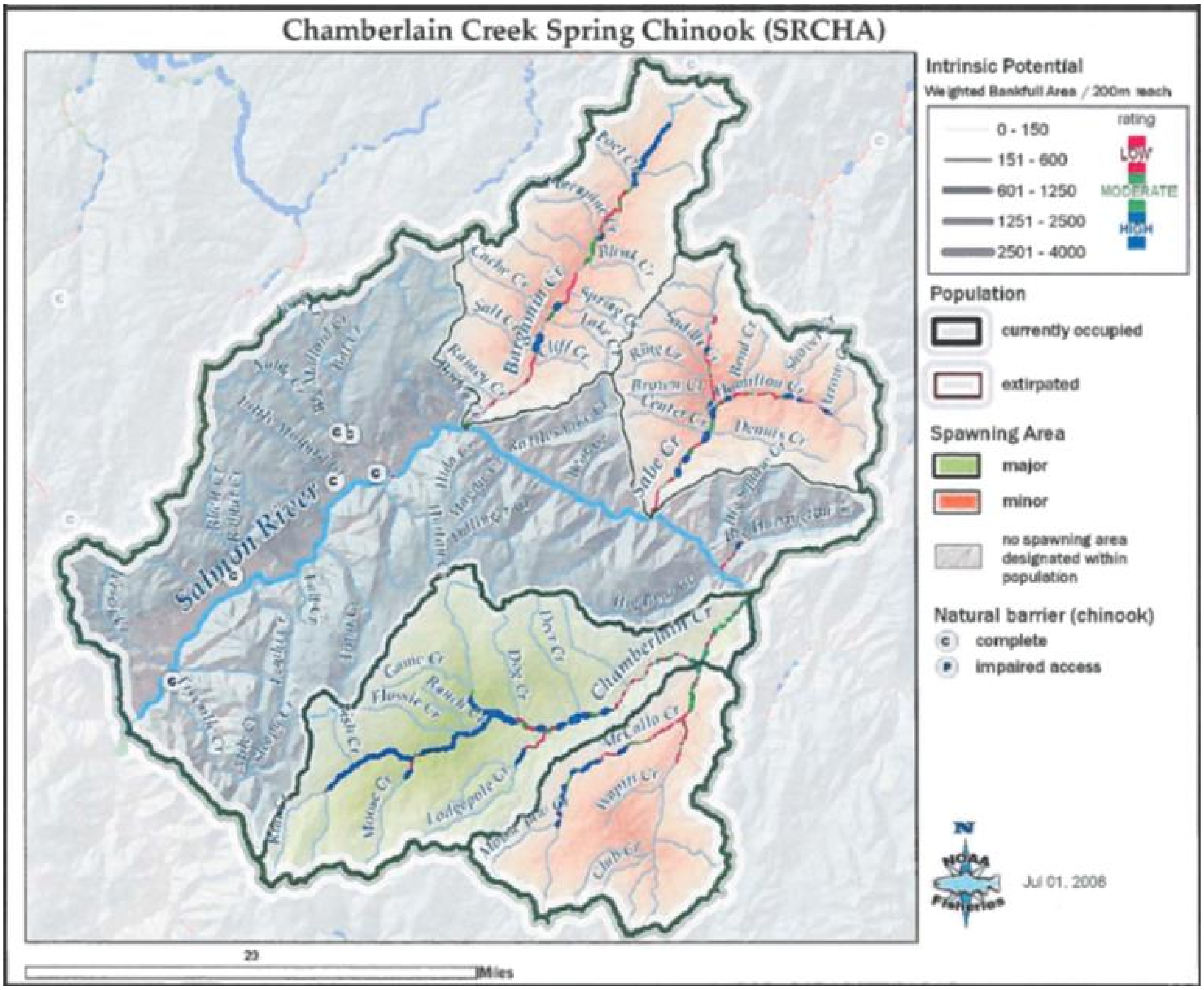


Figure 1. Chamberlain Creek spring Chinook salmon population showing intrinsic spawning potential (from Ford et al. 2010).

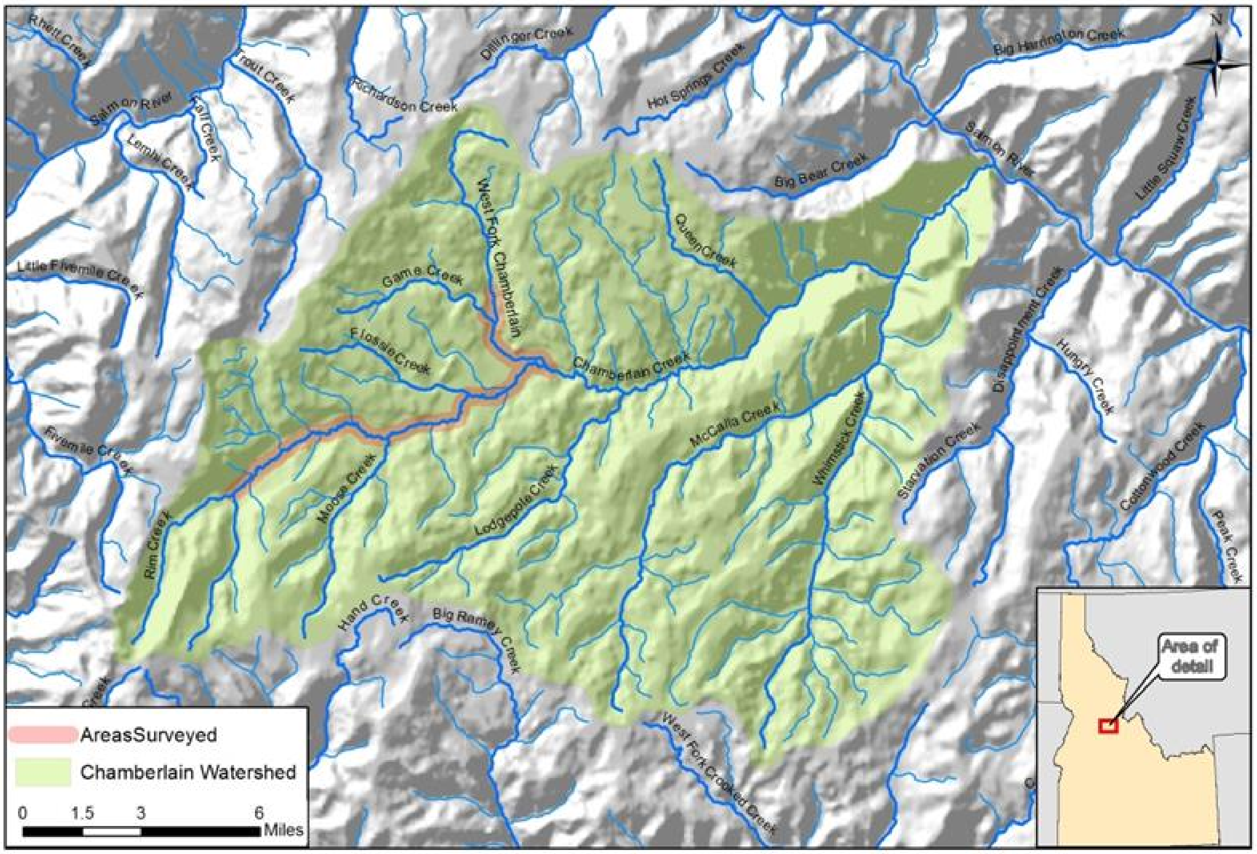


Figure 2. Stream reaches surveyed in Chamberlain Creek watershed during 2013.

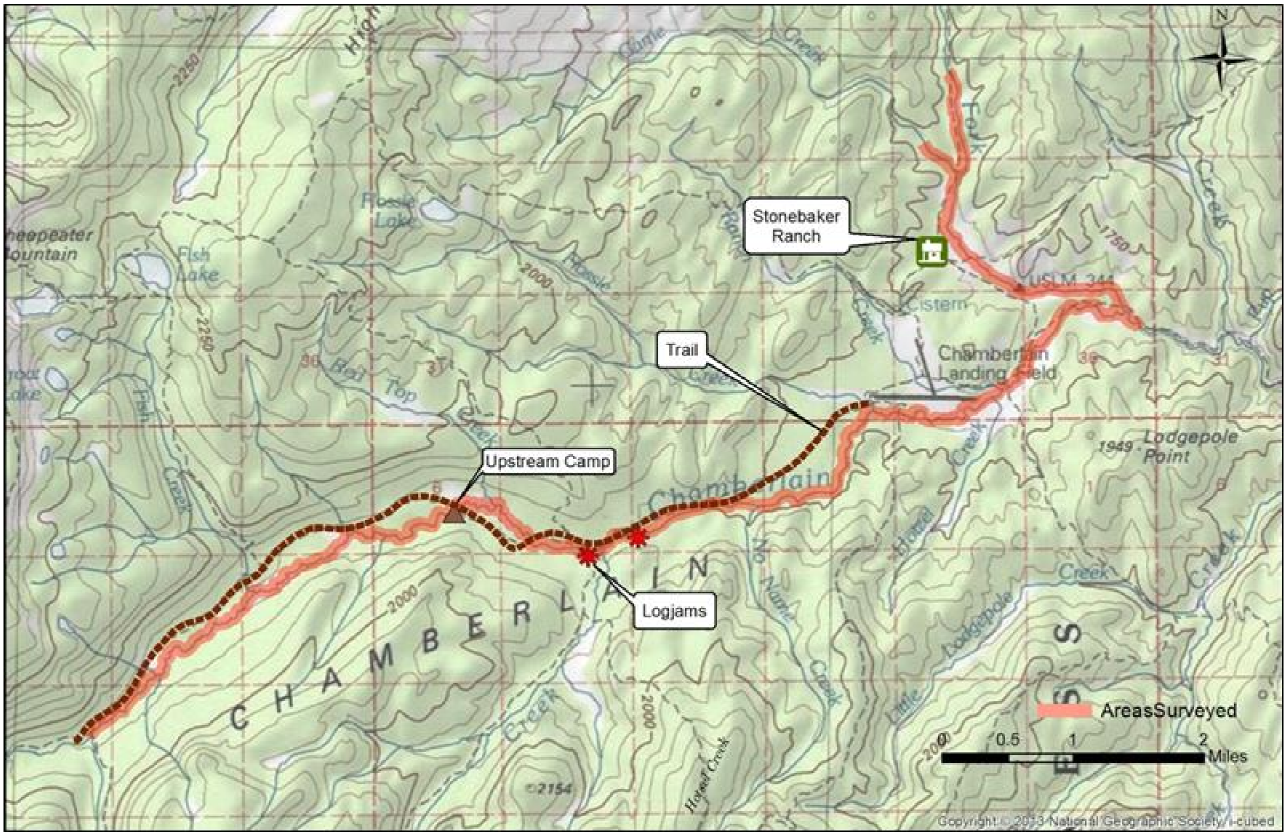


Figure 3. Factors important in conducting surveys in the Chamberlain Creek watershed in 2013. Logjams depicted in the appendix are indicated.

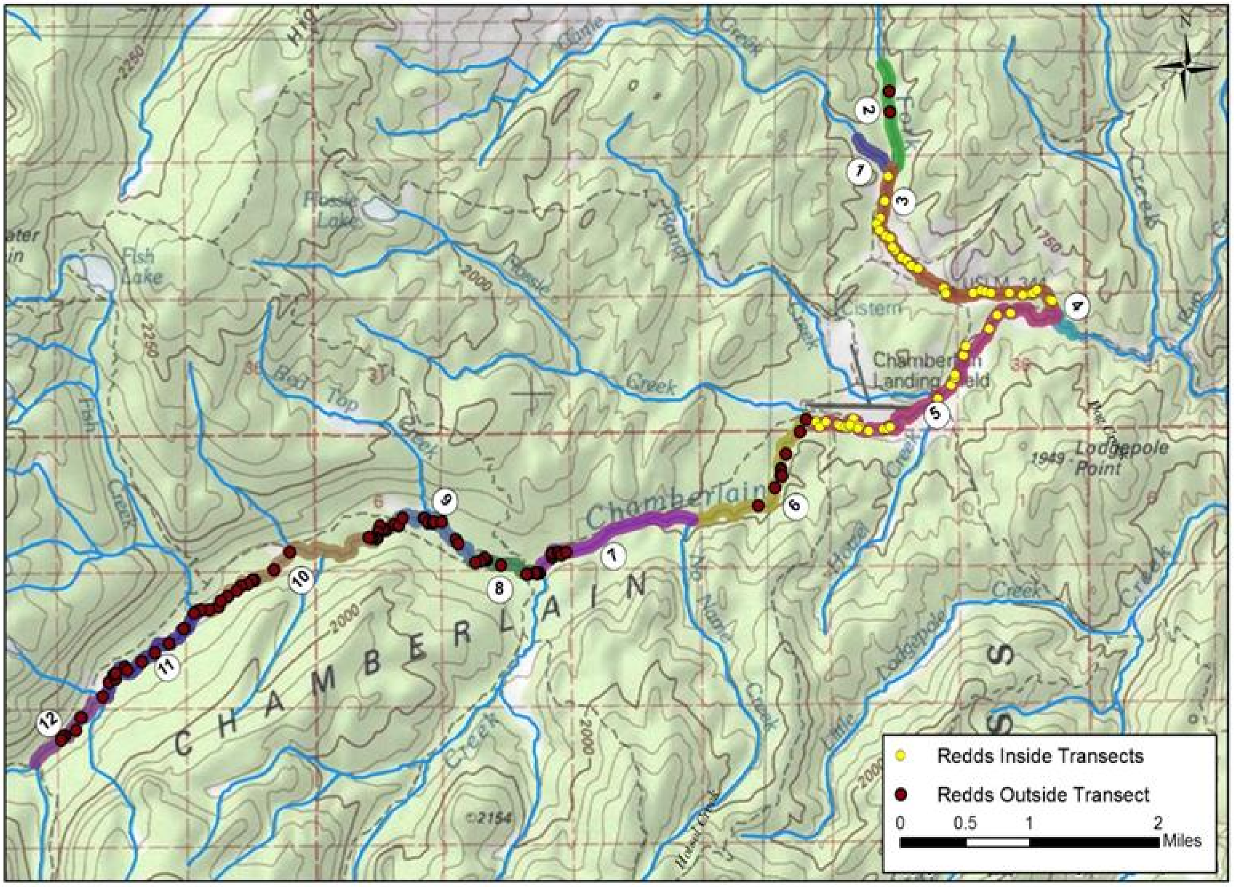


Figure 4. Locations of redds observed in the Chamberlain Creek watershed in 2013. Numbers correspond to reaches defined in Table 1.

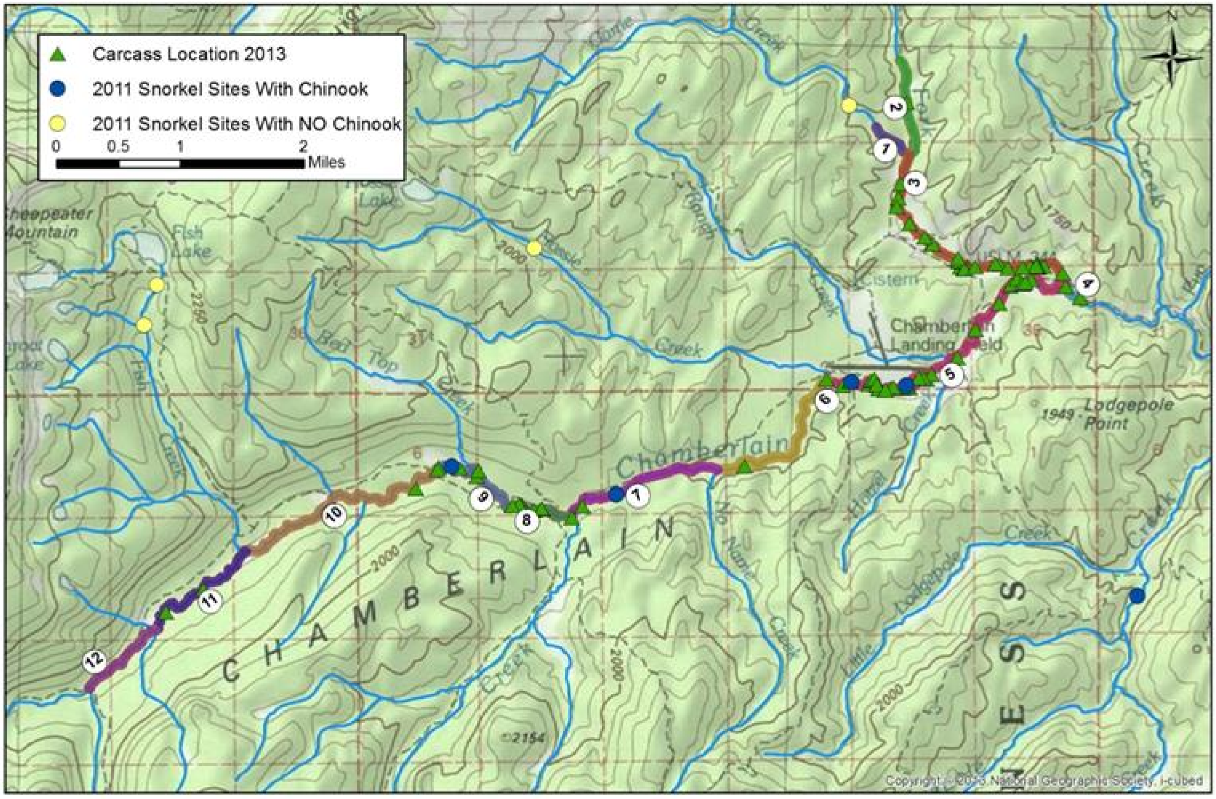
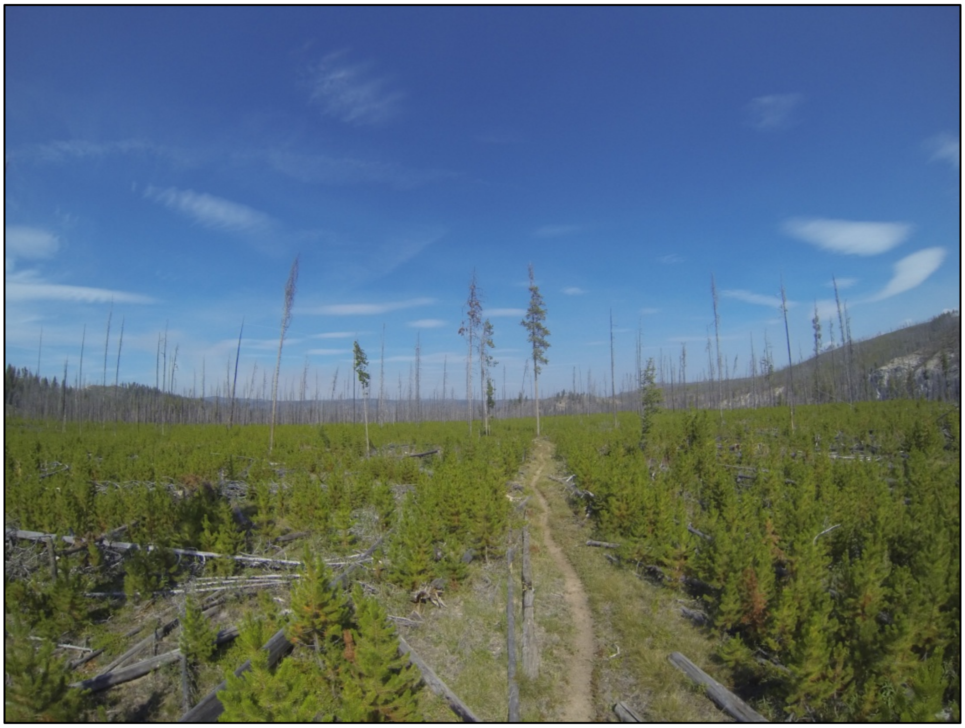


Figure 5. Locations of carcasses recovered in the Chamberlain Creek watershed in 2013. Snorkel sites surveyed in 2011 are also shown, denoting whether Chinook parr were observed or not.

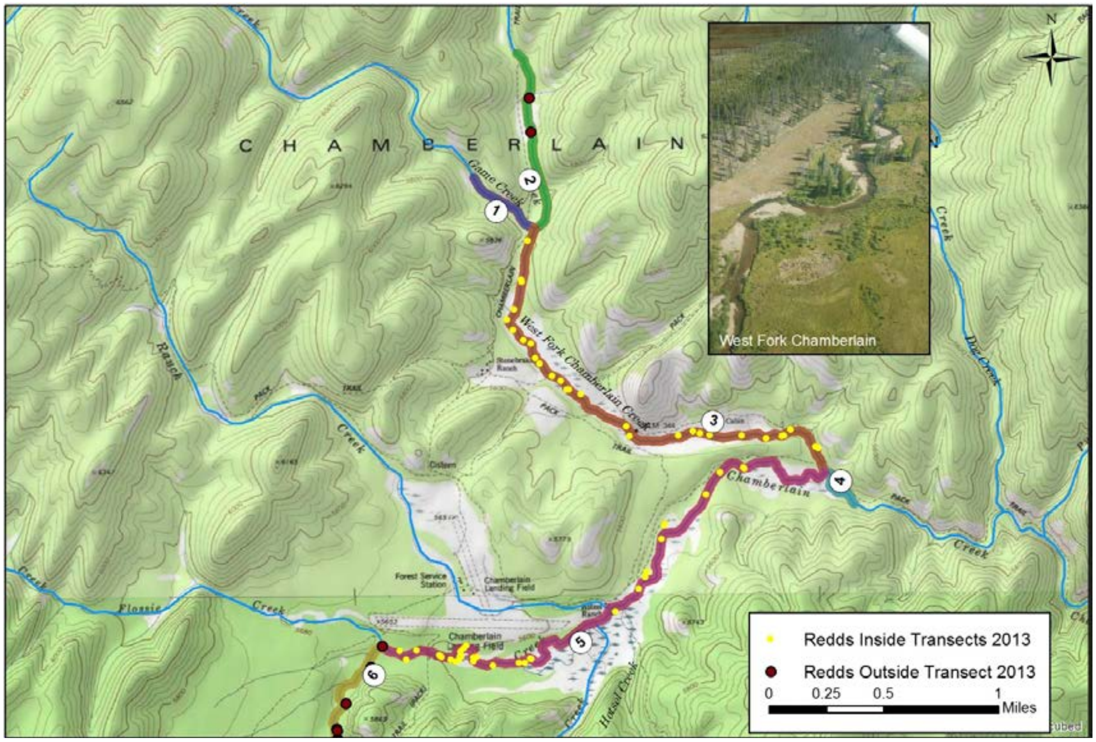
Appendix - Pictures and map details

Stonebraker Ranch

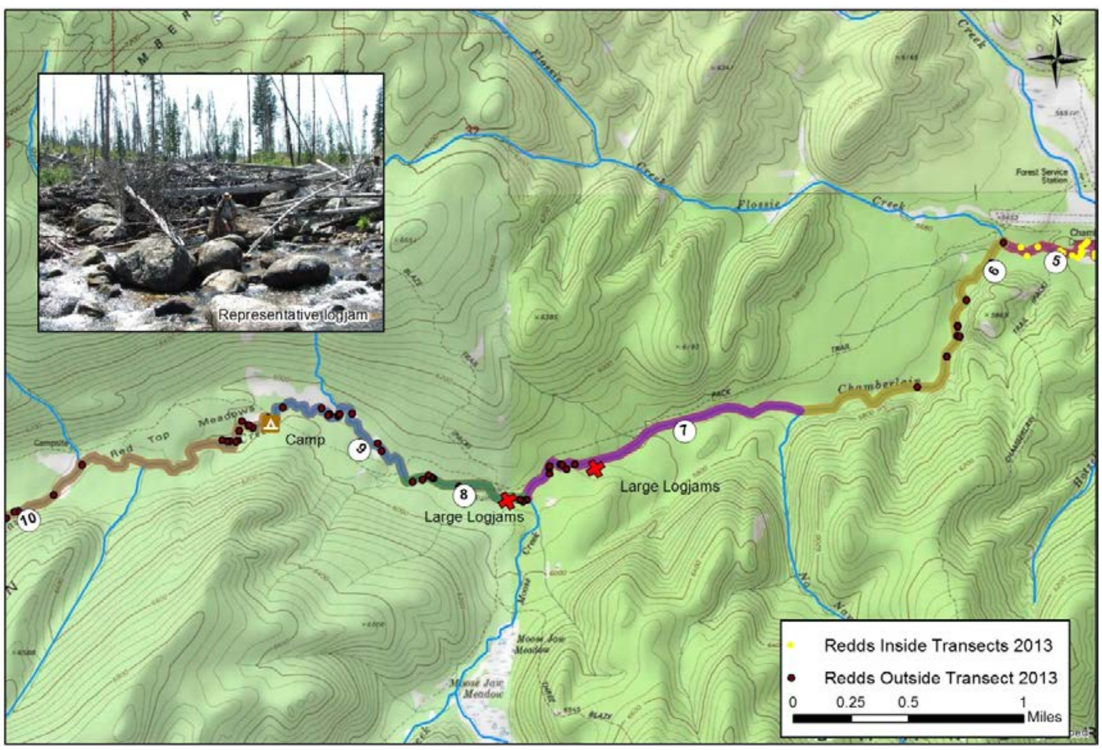
Log jam on Chamberlain Creek (downstream location of logjams in Figure 3).


Chamberlain Trail near Flossie-No Name segment

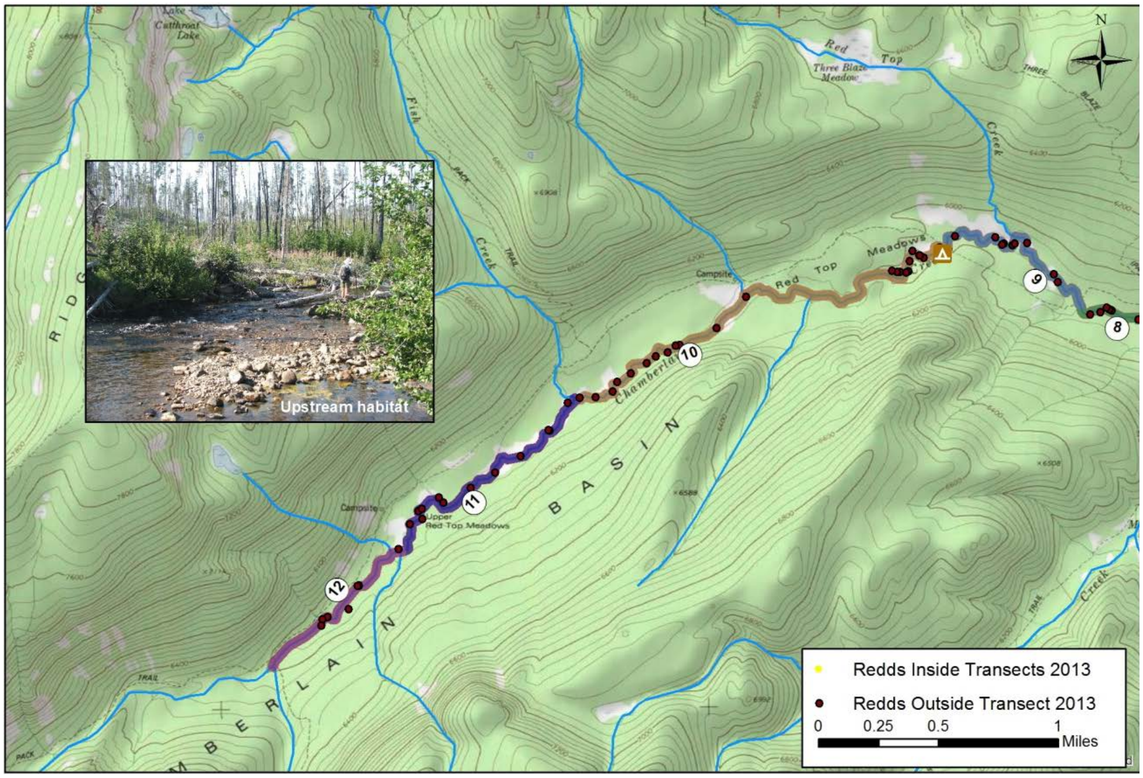

West Fork of Chamberlain (lower meadow)



Detail of redd locations near Stonebraker Ranch and Chamberlain airstrip



Detail of redd locations from Chamberlain airstrip to Red Top Meadows



Detail of redd locations from Red Top Meadows to the upstream limit of spawning

Prepared by:

Carl Stiefel
Regional Fisheries Biologist

Kimberly A. Apperson
Regional Fisheries Biologist

Matthew Belnap
Regional Fisheries Biologist

Timothy Copeland
Senior Fisheries Research Biologist

Matthew P. Corsi
Regional Fisheries Biologist

Robert Hand
Regional Fisheries Biologist

Patrick Kennedy
Senior Fishery Research Biologist

Jordan Messner
Regional Fisheries Biologist

Scott Putnam
Regional Fisheries Biologist

Kristin K. Wright
Fishery Research Biologist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Peter F. Hassemer
Anadromous Fish Manager

James P. Fredericks, Chief
Bureau of Fisheries