



**SNAKE RIVER SOCKEYE SALMON
CAPTIVE BROODSTOCK PROGRAM
HATCHERY ELEMENT**

**ANNUAL PROGRESS REPORT
January 1, 2015—December 31, 2015**



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**Snake River Sockeye Salmon
Captive Broodstock Program
Hatchery Element**

Project Progress Report

2015 Annual Report

By

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EXECUTIVE SUMMARY

On November 20, 1991, the National Marine Fisheries Service listed Snake River Sockeye Salmon *Oncorhynchus nerka* as endangered under the Endangered Species Act of 1973. In 1991, the Idaho Department of Fish and Game, the Shoshone-Bannock Tribes, and the National Marine Fisheries Service initiated efforts to conserve and rebuild populations in Idaho.

Initial steps to recover Snake River Sockeye Salmon included the establishment of a captive broodstock program at the Idaho Department of Fish and Game's Eagle Fish Hatchery. Broodstock and fish culture responsibilities for the listed stock are shared with the National Oceanic and Atmospheric Administration's Manchester Research Station and Burley Creek Hatchery adjacent to Puget Sound in Washington State. Activities conducted by the Shoshone-Bannock Tribes and the National Oceanic and Atmospheric Administration are reported separately. Idaho Department of Fish and Game monitoring and evaluation activities associated with captive broodstock program fish releases are also reported separately (in an annual report to the Bonneville Power Administration for the research element of the program). Captive broodstock program activities conducted between January 1, 2015 and December 31, 2015 for the hatchery element of the program are presented in this report.

Ninety-one anadromous Sockeye Salmon were trapped at Lower Granite Dam (35 adults) and in the Sawtooth Valley (56 adults) between July 13 and October 7, 2015. The Sawtooth Fish Hatchery weir on the upper Salmon River intercepted six Sockeye Salmon adults, the Redfish Lake Creek trap intercepted 50 Sockeye Salmon, and 35 Sockeye Salmon were trapped at the Lower Granite Dam trap and transported to Eagle Fish Hatchery. The adult Sockeye Salmon (47 females and 44 males) originated from a variety of release strategies, as evidenced by mark types. Seventy-seven anadromous Sockeye Salmon (37 females and 40 males) remained at Eagle Fish Hatchery and were incorporated into the spawning matrix.

Three hundred ninety-six female Sockeye Salmon (37 anadromous females, two BY11, three hundred fifty-six BY12, and one BY13 captive female) were spawned at the Eagle Fish Hatchery in 2015. Spawn pairings produced approximately 504,125 eyed eggs with egg survival to eyed stage of development averaging 77.39%.

Smolts (423,103) and adults (592) were released into Sawtooth Valley waters in 2015. Reintroduction strategies involved releases to Redfish Lake, Pettit Lake, and Redfish Lake Creek.

During this reporting period, five broodstocks and six unique production groups were in culture at Idaho Department of Fish and Game (Eagle Fish Hatchery and Springfield Fish Hatchery) and Oregon Department of Fish and Wildlife (Oxbow Fish Hatchery) facilities. Three of the five broodstocks were incorporated into the 2015 spawning design.

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INTRODUCTION

Numbers of Snake River Sockeye Salmon *Oncorhynchus nerka* *O. nerka* declined over the course of the 20th century, dramatically so from the 1950s until and subsequent to the 1991 ESA listing of the stock. In Idaho, only the lakes of the upper Salmon River (Sawtooth Valley) remain as potential sources of production (Figure 1). Historically, five Sawtooth Valley lakes (Redfish, Alturas, Pettit, Stanley, and Yellowbelly) supported Sockeye Salmon (Bjornn et al. 1968; Chapman et al. 1990). Currently, only Redfish Lake receives a remnant anadromous run.

On April 2, 1990, the National Oceanic and Atmospheric Administration Fisheries Service (NOAA, formerly National Marine Fisheries Service) received a petition from the Shoshone-Bannock Tribes (SBT) to list Snake River Sockeye Salmon as endangered under the United States Endangered Species Act (ESA) of 1973. On November 20, 1991, NOAA declared Snake River Sockeye Salmon endangered.

In 1991, the SBT, along with the Idaho Department of Fish and Game (IDFG), initiated the Snake River Sockeye Salmon Sawtooth Valley Project (Sawtooth Valley Project) with funding from the Bonneville Power Administration (BPA). The goal of this program is to conserve genetic resources and to rebuild Snake River Sockeye Salmon populations in Idaho. Coordination of this effort is conducted under the guidance of the Stanley Basin Sockeye Technical Oversight Committee (SBSTOC), a team of biologists representing the agencies involved in the recovery and management of Snake River Sockeye Salmon. National Oceanic and Atmospheric Administration Fisheries Service ESA Permit Nos. 1454, 1124, and Fishery Management and Evaluation Plan (FMEP) authorize IDFG to conduct scientific research on listed Snake River Sockeye Salmon.

Initial steps to recover the species involved the establishment of captive broodstocks at the Eagle Fish Hatchery (Eagle FH) in Idaho and at NOAA facilities in Washington State (for a review, see Flagg 1993; Johnson 1993; Flagg and McAuley 1994; Kline 1994; Johnson and Pravecek 1995; Kline and Younk 1995; Flagg et al. 1996; Johnson and Pravecek 1996; Kline and Lamansky 1997; Pravecek and Johnson 1997; Pravecek and Kline 1998; Kline and Heindel 1999; Hebdon et al. 2000; Flagg et al. 2001; Kline and Willard 2001; Frost et al. 2002; Hebdon et al. 2002; Hebdon et al. 2003; Kline et al. 2003a; Kline et al. 2003b; Willard et al. 2003a; Willard et al. 2003b; Baker et al. 2004; Baker et al. 2005; Willard et al. 2005; Baker et al. 2006; Plaster et al. 2006; Baker et al. 2007; Peterson et al. 2008; Baker and Green 2009a; Baker et al. 2009b; Peterson et al. 2010; Baker et al. 2011a; Baker et al. 2011b; Baker et al. 2012; Baker et al. 2013; Baker et al. 2014; and Baker et al. 2015).

PROGRAM GOALS

The immediate goal of the program is to utilize captive broodstock technology to conserve the population's unique genetics. Long-term goals include increasing the number of individuals in the population to address delisting criteria and to provide sport and treaty harvest opportunity.

Objectives and Tasks

1. Develop captive broodstocks from Redfish Lake Sockeye Salmon; culture broodstocks and produce progeny for reintroduction.

2. Determine the contribution hatchery-produced Sockeye Salmon make toward avoiding population extinction and increasing population abundance.
3. Describe *O. nerka* population characteristics for Sawtooth Valley lakes in relation to carrying capacity and broodstock program reintroduction efforts.
4. Utilize genetic analysis to discern the origin of wild and broodstock Sockeye Salmon to provide maximum effectiveness in their utilization within the broodstock program.
5. Transfer technology through participation in the technical oversight committee process, provide written activity reports, and participate in essential program management and planning activities.

Idaho Department of Fish and Game's participation in the Snake River Sockeye Salmon Captive Broodstock Program includes two areas of effort: 1) Sockeye Salmon captive broodstock culture, and 2) Sockeye Salmon research and evaluations. Although objectives and tasks from both components overlap and contribute to achieving the same goals, work directly related to Sockeye Salmon captive broodstock research and enhancement will appear under a separate cover. Research and enhancement activities associated with Snake River Sockeye Salmon are permitted under NOAA permit numbers 1454, 1124, and the FMEP. This report details fish culture information collected between January 1 and December 31, 2015.

FACILITIES

Eagle Fish Hatchery

Eagle FH is the primary Idaho site for the Sockeye Salmon captive broodstock program. Artesian water from three wells is currently in use. Artesian flow is augmented with three separate pump/motor systems. Water temperature remains a constant 13.5°C and total dissolved gas averages 100% after degassing. The main captive broodstock building receives water from wells #1 and #2 (up to 1,000 gallons per minute). Up to 300 gallons per minute (gpm) can be chilled to 8°C allowing the program to rear at a variety of water temperatures. Rearing capacity for the main building is approximately 1,600 fish per brood year. Isolated holding and spawning of anadromous Sockeye Salmon is conducted in the original hatchery building. Backup and system redundancy is in place for degassing, pumping, and power generation. An automated alarm system monitors flow at seven locations with two alarms tied to the chiller operations. Mountain Alarm provides alarm service for the facility. Three on-site residences provide housing for full-time hatchery personnel. A dormitory is available to house temporary staff.

Facility layout at Eagle FH accommodates culture activities ranging from spawning and incubation through adult rearing. Incubation capacity was increased to provide eyed eggs to the Springfield Fish Hatchery (Springfield FH) beginning in 2013. Egg incubation uses a combination of vertical stack incubators and small isolation upwellers. Thirty-six vertical stack incubators, each holding eight trays, will incubate up to 1,000,000 green eggs. Each tray contains four smaller baskets to maintain family group separation during incubation. An additional 250,000 green eggs are reared using isolated upwellers. Incubation in these small containers specifically designed for the program (Heindel et al. 2005) allow for separation of individual subfamilies. These incubators are designed to distribute both upwelling and downwelling flow to accommodate pre- and post-hatch life stages.

Fiberglass tanks of several sizes are used to culture Sockeye Salmon from fry to adult life stages, including: 1) 0.7 m diameter semisquare tanks (0.09 m³); 2) 1.0 m diameter semisquare tanks (0.30 m³); 3) 2.0 m diameter semisquare tanks (1.42 m³); 4) 3.0 m diameter circular tanks (6.50 m³); and, 5) 4.0 m diameter semisquare tanks (17.6 m³). Typically, 0.7 m and 1.0 m tanks are used for rearing fry from ponding to approximately 10.0 g fish. Two-meter tanks are used to rear juveniles to approximately 50.0 g and group fish by lineage or release strategy prior to distribution to Sawtooth Valley waters. Three- and four-meter tanks are used to rear fish to maturity for future broodstock production (spawning). Flows to all tanks are maintained at no less than 1.5 exchanges per hour. Shade covering (70%) and jump screens are used where appropriate. Discharge standpipes are external on all tanks and assembled in two sections (“half-pipe” principle) to prevent tank dewatering during tank cleaning.

Oxbow Fish Hatchery

The Oregon Department of Fish and Wildlife's (ODFW) Oxbow Fish Hatchery (Oxbow FH) was originally constructed in 1913 and was operated as a state-funded hatchery until 1952. In 1952, the facility was modified and expanded using funding from the Mitchell Act, a Columbia River Fisheries Development Program set up to enhance declining fish runs in the Columbia River basin. Oxbow FH receives 7.2°C water through gravity flow from Oxbow Springs. Flow rate is highly variable depending on the time of year with the lowest flows reaching 300 gpm in the summer and fall to a maximum of 116 cubic feet per second (cfs) in the spring.

Eyed eggs, which are received by Oxbow FH from NOAA Fisheries, are incubated in vertical-stack incubators. Fry are ponded to fiberglass troughs. Juvenile Sockeye Salmon (>1 g) are held in larger fiberglass troughs (4.53 cubic meters). Sockeye Salmon are transferred to outside raceways (133 cubic meters) for final rearing to the smolt stage. Juvenile Sockeye Salmon reared at Oxbow FH are transferred back to Idaho and released as smolts into Redfish Lake Creek. Rearing protocols are established cooperatively between IDFG and ODFW personnel and reviewed at the SBSTOC level.

Springfield Fish Hatchery

Springfield Fish Hatchery is located in Bingham County, Idaho near the town of Springfield. Construction of the facility was completed in 2013 from funding provided by BPA through the Idaho Fish Accords. A confined aquifer underlying the Springfield FH site supplies high quality groundwater for hatchery operations. The facility has a water right for 50 cfs. There are nine artesian wells located on the northern parcel. Six of the wells (wells 5, 7, 8, 10, 11, and 12) supply groundwater for hatchery production operations. These six wells feature a dual-head design that allows water delivery by both artesian flow and pumping. Due to elevation differences, artesian flow cannot be delivered to the hatchery building, but may supply outdoor raceways. The remaining three wells (wells 4, 6, and 9) have discharge heads with valves that can be opened or closed to allow artesian flow to Crystal Springs Pond, a public fishing pond located on the 43-acre northern parcel. The ambient water temperature remains a constant 9.9°C and ambient temperature total dissolved gas (TDG) levels currently range from 100% - 101% after aeration and degassing. Additionally, a chiller supplies up to 110 gpm of water chilled to 5.0°C for use in incubation or early rearing. Backup and system redundancy is in place for degassing, pumped water delivery, chilled water supply, and power generation. Springfield FH facilities are designed to rear up to one million Sockeye Salmon smolts annually for release to the Stanley basin. Rearing protocols are established cooperatively between IDFG personnel and reviewed at the SBSTOC level.

Eyed eggs, received by Springfield FH from Eagle FH and NOAA Fisheries, are incubated in vertical stack incubators. Swim-up fry are ponded into fiberglass vats and reared on well water for five to six months. Juveniles are transferred to outdoor raceways in July and reared on pumped artesian spring water through release as smolts the following May. Juvenile Sockeye Salmon reared at Springfield FH are released as smolts into Redfish Lake Creek. No adult holding or spawning is planned at Springfield FH.

Sawtooth Fish Hatchery / Trap

Construction of the Sawtooth Fish Hatchery (Sawtooth FH) was completed in 1985 as part of the U.S. Fish and Wildlife Service Lower Snake River Compensation Plan and is located on the Salmon River, 3.5 km upstream from the confluence of Redfish Lake Creek. Sawtooth FH personnel and facilities were utilized continuously from 1991 through 2015 for various aspects of the Sockeye Salmon captive broodstock program, including 1) prespawm anadromous adult holding, 2) egg incubation, and 3) juvenile rearing for presmolt and smolt releases. Sawtooth FH personnel assist with many field activities, including 1) fish trapping and handling, and 2) fish transportation and release.

Prespawm anadromous adults captured at the Sawtooth FH trap are transferred to Eagle FH or released to the Salmon River approximately two miles above the Sawtooth FH intake. Sockeye Salmon may be temporarily held (two days maximum) in adult holding facilities at Redfish Lake Creek prior to transfer to the Eagle FH.

Redfish Lake Creek Trap

The Redfish Lake Creek trap is located approximately 1.4 km downstream from the lake outlet. It is operated for adult trapping from early July through mid-October. The trap is staffed by Sockeye Program personnel daily during trapping season. On-site personnel provide security at the site and are responsible for transporting anadromous Sockeye to Eagle FH.

Prespawm anadromous adults captured at Redfish Lake Creek trap are transferred to Eagle FH or released to Redfish Lake Creek above the weir. Sockeye Salmon may be temporarily held (two days maximum) in adult holding facilities at Redfish Lake Creek prior to transfer to the Eagle FH.

METHODS

Fish Culture

Fish culture methods used in the captive broodstock program follow accepted, standard practices (for an overview of standard methods, see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; McDaniel et al. 1994; Bromage and Roberts 1995; Pennell and Barton 1996; Wedemeyer 2001) and conform to the husbandry requirements detailed in ESA Section 10 Propagation Permit Number 1454 for IDFG rearing of ESA-listed Snake River Sockeye Salmon. Additionally, considerable coordination was carried out between NOAA and IDFG culture experts, as well as program cooperators at the SBSTOC level.

During 2015, fish were fed commercial diets produced by Skretting Inc. (Bio-Oregon) or EWOS® Canada LTD (EWOS). Brood Year 2011, BY12, and BY13 Sockeye Salmon captive

broodstock were split into two similar groups with one group receiving Bio-Oregon feed and the second group receiving EWOS feed. Rations were weighed daily and followed suggested feeding rates provided by the manufacturer. Bio-Oregon developed a custom broodstock diet that included elevated levels of vitamins, minerals, and pigments. The product's palatability and levels of natural pigments were enhanced by the addition of natural flavors from fish and krill.

Fish sample counts were conducted as needed to ensure that actual growth tracked with projected growth. In general, fish were handled as little as possible. Age-1 and age-2 Sockeye Salmon rearing densities were maintained at levels not exceeding 8.0 kg/m³. Age-3 and age-4 rearing densities were maintained at levels not exceeding 14.0 kg/m³.

Incubation and rearing water temperature was maintained between 7.0°C and 13.5°C. Chilled water (7.0°C to 10.0°C) was used during incubation and early rearing to equalize development and growth differences that resulted from a protracted spawning period. Rearing water temperature varied as a function of demand, but was generally maintained between 10.0°C and 12.0°C throughout much of the age-2, age-3, and age-4 culture history.

Passive integrated transponder (PIT) tags were used to evaluate the overwinter survival and out-migration success of production groups released to Sawtooth Valley waters. These PIT tags were also used to track Sockeye Salmon retained in the program as broodstock fish; these fish were PIT tagged at approximately 15 months of age. The PIT tag procedures followed accepted, regional protocols (Prentice et al. 1990).

Chemical therapeutants may be used for the treatment of infectious diseases. Before initiating treatments, the use of chemical therapeutants was discussed with an IDFG fish health professional. Fish necropsies were performed on all program mortalities that satisfied minimum size criteria for the various diagnostic or inspection procedures performed. Carcasses were either incinerated, deposited in a landfill, or delivered to a rendering plant.

Anadromous and Residual Sockeye Salmon Trapping

Two adult traps were used to capture returning anadromous Sockeye Salmon in the Sawtooth Valley. The first trap was located on Redfish Lake Creek approximately 1.4 km downstream from the lake outlet. The second trap was located on the upper Salmon River at the Sawtooth FH weir.

Residual Sockeye Salmon trapping activities may be conducted in basin lakes. When necessary, trapping efforts consist of setting a series of trap nets along areas of known residual spawning activity. Nets are set in the late afternoon prior to snorkeling activities. Nets are checked while conducting evening snorkel surveys and again at approximately 0300 hrs to ensure that no adult Sockeye Salmon (program releases) were trapped.

Spawning Activities

Hatchery spawning of Snake River Sockeye Salmon has occurred at Eagle FH each year since 1994 (Johnson and Pravecek 1995; Johnson and Pravecek 1996; Pravecek and Johnson 1997; Pravecek and Kline 1998; Kline and Heindel 1999; Kline and Willard 2001; Kline et al. 2003a; Kline et al. 2003b; Willard et al. 2003a; Baker et al. 2004; Baker et al. 2005; Baker et al. 2006; Baker et al. 2007; Baker and Green 2009a; Baker et al. 2009b; Baker et al. 2011a; Baker et al. 2011b; Baker et al. 2013; Baker et al. 2014; and Baker et al. 2015). Before 1994, adult Sockeye Salmon returns were spawned at the Sawtooth FH (Johnson 1993). Spawning

activities in 2015 followed accepted, standard practices as described by Erdahl (1994) and McDaniel et al. (1994). Prior to spawning adults at Eagle FH, the Idaho Department of Fish and Game is required by Permit No. 1454 to discuss proposed broodstock spawning matrices with NOAA Northwest Fisheries Science Center (NWFSC) genetics staff.

Historically, the broodstock program used pedigree information to pool eyed eggs developed from hatchery spawning into broodstock rearing groups. Identification of familial groups was maintained by tank segregation until they were large enough to PIT tag. In 2015, breeding plans relied on DNA microsatellite information versus pedigree information. Microsatellite data were generated from DNA samples at 16 loci. Kinship coefficients and mean kinship coefficients were used to determine relative founder contribution in the population, genetic importance, and relative relatedness. Spawning plans also considered heterozygosity and genetic diversity among and within individuals. Genetic-based spawning plans provide a higher level of resolution than was possible with pedigree information, which can minimize the loss of heterozygosity and inbreeding.

Milt Cryopreservation

Cryopreservation of milt from male donors has been conducted in the captive broodstock program since 1991 with techniques described by Cloud et al. (1990) and Wheeler and Thorgaard (1991). Beginning in 1996, cryopreserved milt was used to produce lineage-specific broodstocks for use in future spawn years. “Designer broodstocks” produced in this manner provided increased genetic variability for use in future brood years.

Fish Health Investigations

When required, the captive broodstock rearing program has utilized various disinfectants, antibiotics, vaccinations, and antifungal treatments to control pathogens. When used, the dosage, purpose of use, and method of application were as follows:

- 1) Antibiotic therapies: Erythromycin treatments are administered orally in feed to produce a dose of 100 mg/kg of bodyweight for up to 28 days. When oral administration is not feasible, as with anadromous adults, an intraperitoneal injection of erythromycin is given to fish at a dose of 20 mg/kg of body weight. In addition, fish may be fed oxytetracycline as needed to control outbreaks of pathogenic myxobacteria, as well as aeromonad and pseudomonad bacteria.
- 2) Egg disinfection: Newly fertilized eggs are water hardened in 100 mg/L solution of buffered Iodophor for 20 minutes to inactivate viral and bacterial pathogens on the egg surface and in the perivitelline space. In addition, eyed eggs transferred to IDFG facilities are disinfected in a 100 mg/L buffered Iodophor solution for ten minutes upon receipt, prior to loading of incubators.
- 3) Anadromous adult formalin treatments: Anadromous adults transferred from the Sawtooth Valley are treated with formalin in a static bath for one hour at 167 parts per million (ppm) to control *Ichthyophthirius* spp. In addition, formalin treatments are administered as required to control *Saprolegnia*.
- 4) Egg formalin treatments: Developing eggs are treated three times per week with formalin to control *Saprolegnia*. This is a flow-through treatment administered at 1,667 ppm for 20 minutes.

Spawning adults were analyzed for common bacteria (bacterial kidney disease *Renibacterium salmoninarum*, bacterial gill disease *Flavobacterium branchiophilum*, Coldwater disease *Flavobacterium psychrophilum*, and motile aeromonad septicemia *Aeromonas* spp.) and viral pathogens (infectious pancreatic necrosis virus and infectious hematopoietic necrosis virus). In addition to the above, anadromous adult Sockeye Salmon were screened for the causative agent of whirling disease *Myxobolus cerebralis*, furunculosis *Aeromonas salmonicida*, and the North American strain of viral hemorrhagic septicemia. Tissue samples were collected from the kidney and spleen of each fish and the Eagle Fish Health Laboratory collected ovarian fluid samples from each female for analysis. Results of fish health analysis of spawners were used by IDFG and the SBSTOC to determine disposition of eggs and subsequent juveniles.

Fish health was monitored daily by observing feeding response, external condition, and behavior of fish in each tank as initial indicators of developing problems. In particular, fish culturists looked for signs of lethargy, spiral swimming, side swimming, jumping, flashing, unusual respiratory activity, body surface abnormalities, or unusual coloration. Presence of any of these behaviors or conditions was immediately reported to the program fish pathologist.

Presence of moribund fish was immediately reported to the fish pathologist for blood and parasite sampling; the fish pathologist routinely monitors captive broodstock mortalities to try to determine cause of death. American Fisheries Society (AFS) "Bluebook" procedures were employed to isolate bacterial or viral pathogens and to identify parasite etiology (Thoesen 1994). Moribund fish were routinely analyzed for common bacterial and viral pathogens (e.g., bacterial kidney disease, infectious hematopoietic necrosis virus, etc.). When a treatable pathogen was either detected or suspected, the program fish pathologist prescribed appropriate therapeutic drugs to control the problem. Select carcasses were appropriately preserved for pathology, genetic, and other analyses. After necropsy, carcasses that were not vital to further analysis were disposed of as per language contained in the ESA Section 10 permit for the program.

Eyed Egg and Fish Transfers

Eggs were shipped at the eyed stage between NOAA and IDFG facilities using a commercial air service. Iodophor-disinfected (100 ppm) eggs were packed at a conservative density in perforated tubes, then capped and labeled. Tubes were wrapped with hatchery water-saturated cheesecloth and packed in small coolers. Ice chips were added to ensure proper temperature maintenance, and coolers were sealed with packing tape. Personnel from IDFG and NOAA were responsible for shuttling coolers to and from air terminals. Eyed eggs destined for production at Springfield FH were placed in egg shipping tubes at approximately 1,500 eggs per tube. Eyed eggs are then placed in 40-quart transport coolers and tempered to 8°Celsius. Ice is added to the cooler to keep eggs cool during transport to production facilities.

Containers used to transport fish varied by task. In all cases, containers of the proper size and configuration were used. Appropriate temperature, oxygen, and chemical composition were maintained during the handling and transfer phases of transportation. Containers varied from five-gallon plastic buckets and coolers for short-term holding and inventory needs to barge-mounted holding tanks for mid-lake (pelagic) fish releases. Truck-mounted tanks, used for long distance transfers, were available to the program with 946 L (250 gallon), 3,785 L (1,000 gallon), and 9,463 L (2,500 gallon) capacities. Transport density guidelines were in place not to exceed 89 grams/liter (0.75 pounds/gallon).

Eyed Egg and Fish Supplementation

In 2015, Sockeye Salmon were reintroduced to Sawtooth Valley waters as hatchery-reared smolts and as both returning anadromous and hatchery captive-reared prespawn adults.

Sockeye Salmon smolts were distributed to Sawtooth Valley waters using truck-mounted transportation tanks. In 2015, Sockeye Salmon smolts were released to Redfish Lake Creek downstream of the juvenile out-migrant weir. Transport tanks were tempered to receiving water temperatures prior to the release of fish.

Prespawn adult Sockeye Salmon were distributed to Sawtooth Valley waters using truck-mounted transportation tanks. Adults have been introduced to Redfish Lake, Alturas Lake, and Pettit Lake. To minimize stress, all prespawn adult releases were conducted at public access points at dusk. Transport tanks were tempered to receiving water temperatures prior to the release of fish.

RESULTS AND DISCUSSION

Fish Culture

During this reporting period, five broodstock and six production groups were in culture at IDFG facilities representing brood years 2011, 2012, 2013, 2014, and 2015. Summaries of losses while in culture during this reporting period are presented in Tables 1 and 2. Culture groups developed to meet future spawning needs are designated as “broodstock” groups. Culture groups developed primarily for reintroduction to Sawtooth Valley waters are designated as “production” groups. The year of development for specific culture groups may be abbreviated (e.g., BY11 refers to brood year 2011).

Brood Year 2011 Broodstock

One hundred thirty-eight females and 163 males were spawned at Eagle FH between September 26 and November 16, 2011, yielding 314,396 green eggs. Four hundred thirteen unique subfamilies were developed from BY11 spawn crosses at the Eagle FH. To simplify tracking, families were grouped under one production group title: BY11. The BY11 production group was developed using male Sockeye Salmon from BY07 (five males), BY08 (93 males), and BY09 (15 males) captive broodstocks, and 50 anadromous males that returned to the Sawtooth Valley (ANH11). Female Sockeye Salmon represented in spawn crosses for 2011 included captive broodstock from BY07 (four females), BY08 (82 females), and 52 anadromous females (ANH11) that returned to the Sawtooth Valley in 2011. Specific crosses performed to develop this production group included: 1) ANH11 females x ANH11 males; 2) ANH11 females x BY07 males; 3) ANH11 females x BY08 males; 4) BY07 females x BY07 males; 5) BY07 females x BY08 males; 6) BY07 females x BY09 males; 7) BY07 females x ANH11 males; 8) BY08 females x BY07 males; 9) BY08 females x BY08 males; 10) BY08 females x BY09 males; and, 11) BY08 females x ANH11 males. Spawn crosses produced approximately 314,396 green and 249,522 eyed eggs. Brood year 2008 female fecundity averaged 2,017 green eggs per female and ANH11 female fecundity averaged 2,749 green eggs per female. Egg survival to the eyed stage of development for the BY11 production group averaged 79.4% (median 92.37%). In 2011, of the 102 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, all samples were negative for infectious hematopoietic necrosis virus (IHNV).

Approximately 3,589 eyed eggs representing 360 subfamilies (125 unique females and 158 unique males) were selected from specific spawn crosses described above and dedicated to three purposes: a group of 1,237 eyed eggs was retained at Eagle FH to serve as future broodstock; a group of 1,179 eyed eggs was transferred to NOAA Fisheries to be used for captive broodstock and adult releases; and, a group of 1,173 eyed eggs was transferred to NOAA Fisheries to be used for an early life history study.

Starting inventory for BY11 captive broodstock at Eagle FH was 13 adults. There were four mortalities and five maturing Sockeye in 2015. Four maturing Sockeye (2 females and 2 males) were incorporated into the spawning matrix for 2015 and one female was culled as unproductive/nonspawners (Table 1). Ending inventory for the BY11 broodstock group was four immature fish.

Brood Year 2012 Broodstock

One hundred twenty-one females and 149 males were spawned at Eagle FH between September 25 and November 9, 2012, yielding 243,223 green eggs. Two hundred forty-two unique subfamilies were developed from BY12 spawn crosses at the Eagle FH. To simplify tracking, families were grouped under one production group title: BY12. The BY12 production group was developed using male Sockeye Salmon from the BY07 (one male), BY08 (two males), BY09 (85 males), and BY10 (32 males) captive broodstocks, and 29 anadromous males that returned to the Sawtooth Valley (ANH12). Female Sockeye Salmon represented in spawn crosses for 2012 included captive broodstock from BY08 (one female), BY09 (88 females), BY10 (two females), and 30 anadromous females (ANH12) that returned to the Sawtooth Valley in 2012. Specific crosses performed to develop this production group included: 1) ANH12 females x ANH12 males; 2) ANH12 females x BY08 males; 3) ANH12 females x BY09 males; 4) ANH12 females x BY10 males; 5) BY08 females x BY09 males; 6) BY09 females x BY07 males; 7) BY09 females x BY08 males; 8) BY09 females x BY09 males; 9) BY09 females x BY10 males; 10) BY09 females x ANH12 males; and, 11) BY10 females x BY10 males. Spawn crosses produced approximately 243,223 green and 211,954 eyed eggs. Brood year 2009 female fecundity averaged 1,762 green eggs per female and ANH12 female fecundity averaged 2,766 green eggs per female. Egg survival to the eyed stage of development for the BY12 production group averaged 87.14% (median 95.83%). In 2012, of the 59 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, all samples were negative for infectious hematopoietic necrosis virus (IHNV).

Approximately 2,460 eyed eggs representing 234 subfamilies (117 unique females and 146 unique males) were selected from specific spawn crosses described above and incubated for future captive broodstock program needs. Eyed eggs were selected in four similar groups with two groups (514 and 460 eyed eggs) remaining at Eagle FH. Two groups were transferred to NOAA Fisheries (749 and 746 eyed eggs).

Starting 2015 inventory for BY12 captive broodstock at Eagle FH was 812 adults. There were 111 mortalities and 688 maturing Sockeye during the year. Of the maturing Sockeye, 356 females and 299 males were incorporated into the spawning matrix. Thirty females and three males were culled as unproductive. Ending inventory for the BY12 broodstock group was 13 immature fish (Table 1).

Brood Year 2013 Broodstock

Two hundred twenty-four females and 200 males were spawned at Eagle FH between September 24 and November 5, 2013, yielding 465,878 green eggs. Four hundred forty-eight unique subfamilies were developed from BY13 spawn crosses at the Eagle FH. To simplify tracking, families were grouped under one production group title: BY13. The BY13 captive broodstock group was developed using male Sockeye Salmon from the BY09 (one male), BY10 (150 males), BY11 (nine males) captive broodstocks, and 40 anadromous males that returned to the Sawtooth Valley (ANH13). Female Sockeye Salmon represented in spawn crosses for 2013 included captive broodstock from BY10 (181 females), BY11 (one female), and 42 anadromous females (ANH13) that returned to the Sawtooth Valley in 2013. Specific crosses performed to develop this production group included: 1) ANH13 females x ANH13 males; 2) ANH13 females x BY10 males; 3) BY10 females x BY09 males; 4) BY10 females x BY10 males; 5) BY10 females x BY11 males; 6) BY10 females x ANH13 males; and 7) BY11 females x BY10 males. Spawn crosses produced approximately 465,878 green and 382,301 eyed eggs. Brood year 2010 female fecundity averaged 1,990 green eggs per female and ANH13 female fecundity averaged 2,496 green eggs per female. Egg survival to the eyed stage of development for the BY13 production group averaged 82.06% (median 93.33%). In 2013, of the 82 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, all samples were negative for infectious hematopoietic necrosis virus (IHNV).

Approximately 2,990 eyed eggs representing 380 subfamilies (190 unique females and 186 unique males) were selected from specific spawn crosses described above and incubated for future broodstock needs. Eyed eggs were selected in four similar groups with two groups (752 and 745 eyed eggs) remaining at Eagle FH. Two groups (749 and 744 eyed eggs) were transferred to NOAA Fisheries for captive rearing.

Starting 2015 inventory for BY13 captive broodstock at Eagle FH was 1,378 fingerlings. Mortality for the year was 19 fish and 90 Sockeye Salmon matured during the year. Of the maturing Sockeye Salmon, 86 males and one female were incorporated into the spawning matrix, and three males were culled as unproductive. Ending inventory for the BY13 broodstock group was 1,269 immature fish (Table 1).

Brood Year 2013 Production

Initial 2015 inventory for the BY13 smolt production group at Sawtooth FH was 134,834 fingerlings. IDFG staff released 134,660 smolts averaging 24.0 g into Redfish Lake Creek on May 4 - 5, 2015. Survival for the Sawtooth FH BY13 smolt group (from eyed egg to smolt) was 66.27%. All smolts released were adipose fin clipped; 49,772 smolts were released with PIT tags. Survival from PIT tagging to release was 99.85% (includes shed tags). Ending inventory at Sawtooth FH was zero fish (Table 2).

Initial 2015 inventory for the BY13 production group at Oxbow FH was 77,336 fingerlings. IDFG staff released 77,238 smolts averaging 41.9 g into Redfish Lake Creek on May 7, 2015. Survival for the Oxbow FH BY13 smolt production group (from eyed egg to smolt) was 83.36%. All smolts were adipose fin clipped; 2,010 were released with PIT tags. Survival from PIT tagging to release was 99.95% (includes shed tags). Ending inventory at Oxbow FH was zero fish (Table 2)

Initial 2015 inventory for the BY13 smolt production group at Springfield FH was 215,104 fingerlings. IDFG staff released 211,205 smolts averaging 45.4 g into Redfish Lake Creek on

May 6 - 7, 2015. Survival for the Springfield FH BY13 smolt group (from eyed egg to smolt) was 84.83%. All smolts released were adipose fin clipped; 49,307 smolts were released with PIT tags. Survival from PIT tagging to release was 98.65% (includes shed tags). Ending inventory at Springfield FH was zero fish (Table 2).

Brood Year 2014 Broodstock

Three hundred seventy-eight females and 393 males were spawned at Eagle FH between September 25 and November 18, 2014 yielding 744,538 green eggs. Seven hundred fifty-four unique subfamilies were developed from BY14 spawn crosses at Eagle FH. To simplify tracking, families were grouped under one production group title: BY14. The BY14 captive broodstock group was developed using male Sockeye Salmon from the BY11 (158 males) and BY12 (32 males) captive broodstocks, and 212 anadromous males that returned to the Sawtooth Valley (ANH14). Female Sockeye Salmon represented in spawn crosses for 2013 included captive broodstock from BY11 (158 females) and 220 anadromous females (ANH14) that returned to the Sawtooth Valley in 2014. Specific crosses performed to develop this production group included: 1) ANH14 females x ANH14 males; 2) ANH14 females x BY11 males; 3) ANH14 females x BY12 males; 4) BY11 females x BY11 males; 5) BY11 females x BY12 males; and, 6) BY11 females x ANH14 males (Table 3). Spawn crosses produced approximately 744,538 green and 607,198 eyed eggs. Brood year 2011 female fecundity averaged 1,420 green eggs per female and ANH14 female fecundity averaged 2,365 green eggs per female. Egg survival to the eyed stage of development for the BY14 production group averaged 81.55% (median 91.85%). In 2014, of the 432 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, all samples were negative for infectious hematopoietic necrosis virus (IHNV).

Approximately 2,969 eyed eggs representing 735 subfamilies (371 unique females and 398 unique males) were selected from specific spawn crosses described above and incubated for future captive broodstock program needs. Eyed eggs were selected in four similar groups with two groups (747 and 746 eyed eggs) remaining at Eagle FH. Two groups (739 and 737 eyed eggs) were transferred to NOAA Fisheries for captive rearing.

Starting 2015 inventory for BY14 broodstock at Eagle FH was 1,493 eyed eggs/developing fry. Mortality for the year was 94 fry. Ending inventory for the BY14 captive broodstock was 1,399 fingerlings (Table 1).

Brood Year 2014 Production

A total of 658,974 BY14 eyed eggs from production spawn crosses at Eagle FH (604,229 eyed eggs) and Burley Creek FH (54,745 eyed eggs) were transferred to Springfield FH. Egg incubation and juvenile rearing for this production group will continue at Springfield FH until smolts are released in May 2016. The 2015 year-end inventory for this production group at Springfield FH was 541,506 fingerlings (Table 2).

A total of 120,070 BY14 eyed eggs from production spawn crosses at Burley Creek FH were transferred to Oxbow FH. Egg incubation and juvenile rearing for this production group will continue at Oxbow FH until smolt transfer to Idaho in 2016. The 2015 year-end inventory for this production group at Oxbow FH was 94,506 fingerlings (Table 2).

Anadromous and Residual Sockeye Salmon Trapping

Two adult traps are used to capture returning anadromous Sockeye Salmon in the Sawtooth Valley. The first trap is located on Redfish Lake Creek, approximately 1.4 km downstream from the lake outlet and was operated from June 23 to October 14, 2015. The second trap is located on the upper Salmon River at the Sawtooth FH weir and was operated from June 8 to September 24, 2015. In 2015, NOAA Fisheries and IDFG declared a fish passage emergency at Lower Granite Dam. An emergency trap and haul operation was implemented to collect adult Sockeye Salmon from the Lower Granite Dam trap. Emergency trap and haul was conducted from July 13 through August 13, 2015 (Johnson et al. in Prep.).

Fifty-six anadromous Sockeye Salmon returned to traps in the Sawtooth Valley between July 27 and October 7, 2015. The weir on the upper Salmon River at the Sawtooth FH intercepted six Sockeye Salmon and the Redfish Lake Creek trap intercepted 50 Sockeye. An additional 51 Sockeye were collected at Lower Granite Dam during Emergency Trap and Haul operations. Thirty-five of these fish were incorporated into the Sockeye captive broodstock, while 16 were found to be from the Upper Columbia Sockeye stock and culled from the program. Adult Sockeye Salmon captured at traps in 2015 originated from a variety of release strategies, as evidenced by mark types (Table 4).

Residual Sockeye Salmon trapping activities were not conducted during 2015.

In 2015, six anadromous Chinook Salmon adults were trapped at the Redfish Lake Creek trap. All six Chinook were transferred to Sawtooth FH and incorporated into their trapping protocols.

2015 Spawning Activities

Results from 2015 Eagle FH spawning activities are reviewed below. Results from spawning activities conducted by NOAA personnel at Washington State facilities will appear under separate cover by that agency. The year of development for specific broodstocks may be abbreviated (e.g., BY12 refers to brood year 2012).

Three hundred ninety-six females and 427 males were spawned at Eagle FH between September 18 and November 12, 2015, yielding 651,399 green eggs. Seven hundred ninety unique subfamilies were developed from BY15 spawn crosses at Eagle FH. To simplify tracking, families were grouped under one production group title: BY15. The BY15 captive broodstock group was developed using male Sockeye Salmon from the BY11 (two males), BY12 (299 males), BY13 (86 males) captive broodstocks, and 40 anadromous males that were collected during 2015 trapping activities (ANH15). Female Sockeye Salmon represented in spawn crosses for 2015 included captive broodstock from BY11 (two females), BY12 (356 females), BY13 (one female), and 37 anadromous females (ANH15) that were collected during trapping activities in 2015. Specific crosses performed to develop this production group included: 1) ANH15 females x ANH15 males; 2) ANH15 females x BY12 males; 3) ANH15 females x BY13 males; 4) BY11 females x BY12 males; 5) BY12 females x ANH15 males; 6) BY12 females x BY11 males; 7) BY12 females x BY12 males; 8) BY12 females x BY13 males; and, 9) BY13 females x BY12 males (Table 3). Spawn crosses produced approximately 651,399 green and 504,125 eyed eggs. Brood year 2012 female fecundity averaged 1,569 green eggs per female and ANH15 female fecundity averaged 2,693 green eggs per female. Egg survival to the eyed stage of development for the BY15 production group averaged 77.39% (median 85.98%, Table

3). In 2015, of the 77 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, all samples were negative for infectious hematopoietic necrosis virus (IHNV).

Approximately 3,002 eyed eggs representing 782 subfamilies (395 unique females and 426 unique males) were selected from specific spawn crosses described. These eggs were split into duplicate groups, with one group (1,500 eggs) remaining at Eagle FH for future broodstock needs and the other (1,502 eggs) transferred to NOAA Fisheries for future captive broodstock and adult releases (1,502 total).

Historically, broodstock families were kept separated in individual tanks until PIT tagging and then pedigree information for the familial line was utilized to make spawn crosses. Genetic identification of BY15 broodstock will be determined by utilizing microsatellite DNA markers. Spawn crosses represented in the Eagle FH BY15 broodstock are presented in Table 5.

A total of 862,398 BY15 eyed eggs were transferred to Springfield FH for smolt production rearing. Production spawn crosses at Eagle FH provided 499,803 eyed eggs, and Burley Creek FH provided 362,595 eyed eggs. Egg incubation and juvenile rearing for the BY15 production group will continue at Springfield FH until smolts are released in May 2017.

Milt Cryopreservation

During 2015, no milt was cryopreserved and no cryopreserved milt from previous years was used in BY15 spawn crosses.

Fish Health Investigations

The IDFG Eagle Fish Health Laboratory (EFHL) processed samples for diagnostic and inspection purposes from broodstock and production groups of Sockeye Salmon, including anadromous adults that were retained for hatchery spawning and smolts obtained from out-migrant traps. Two hundred nine laboratory accessions involving 1,862 individual fish were processed in 2015. Laboratory accessions included samples from Eagle FH (169 accessions), Springfield FH (four accessions), Sawtooth FH (one accession), Redfish Lake Creek (RFLC) out-migrant trap (one accession), Alturas Lake Creek out-migrant trap (one accession), NOAA Fisheries (32 accessions), and Lower Granite Juvenile Collection (one accession). Total fish sampled (1,862) included: 1,031 fish from Eagle FH (four BY11, 721 BY12, 105 BY13 and 102 ANH15); 85 fish from Springfield FH (60 BY13 and 25 BY14); 60 fish from Sawtooth FH (60 BY13); 13 fish from the RFLC trap (BY13 out-migrant smolts); 16 fish from Alturas Lake Creek trap (BY13 out-migrant smolts); 651 fish from NOAA Fisheries; and, six fish from Lower Granite Juvenile Collection (BY13 out-migrants). Observations made from previous years prioritized the pathogens that were most important for these examinations. All adults used for broodstock purposes were examined for viruses and bacterial kidney disease (BKD). Anadromous adults were examined for a broad array of pathogens, since these pose the greatest threat of introduction of an exotic pathogen to the captive broodstock program. All production lots were examined prior to release as full-term smolts. The EFHL also summarized pathology findings to satisfy the needs of adjacent state agencies for issuance of Sockeye Salmon transport permits.

Viral Pathogens

Viral pathogens were not detected in Sockeye Salmon (anadromous, captive broodstocks, production groups, or natural out-migrants) during calendar year 2015. Nine hundred twenty-nine fish from Eagle FH captive broodstock (BY11, BY12, and BY13) and 102

ANH15 anadromous Sockeye were sampled. Eagle Fish Health Lab began sampling NOAA Fisheries Captive Broodstock in 2015 (previously these samples were collected and analyzed by NOAA Fisheries staff). Samples were collected from spawned captive broodstock at Burley Creek FH representing BY11, BY12, and BY13 (637 fish sampled) and from Manchester Research Station representing BY11, BY12, and BY13 (eight fish sampled). One production group reared at Sawtooth FH on both well water and Salmon River water was tested for viral pathogens (60 fish sample) and two production groups from Springfield FH were sampled (85 fish across both Springfield groups) and analyzed at Eagle Fish Health Lab in 2015. All virology samples from these production groups resulted in negative detection of viral pathogens for 2015. Thirteen BY13 out-migrating smolts from the Redfish Lake Creek trap and 16 BY13 out-migrating smolts from the Alturas Lake Creek trap were sampled with no viral pathogens detected.

Bacterial Pathogens

Fish health sampling for *Renibacterium salmoninarum*, the causative agent for bacterial kidney disease (BKD), is a standard fish health sampling protocol for broodstock, production, and out-migrant groups of Redfish Lake Sockeye Salmon. A total of 1,799 fish from calendar year 2015 were sampled for BKD via enzyme-linked immunosorbent assay (ELISA) techniques at Eagle Fish Health Lab. Captive broodstocks at Eagle FH and NOAA Fisheries tested negative for BKD. One of 102 anadromous Sockeye tested was positive in 2015 (ELISA value = 2.339). Test results were from an anadromous female spawned at Eagle FH, all eggs were culled from this female following program protocols. Sockeye smolts from the Sawtooth and Springfield fish hatcheries were sampled prior to release, and out-migrating smolts from Redfish and Alturas lakes were sampled. Bacterial Kidney Disease was not detected in the smolts during 2015.

Aeromonas salmonicida, the causative agent of furunculosis, was not detected in anadromous adults in 2015. Furunculosis has been detected in anadromous adults in past return years indicating the continued need for oxytetracycline and erythromycin injections for adults at trapping.

Parasitic Pathogens

The myxosporean parasite *Myxobolus cerebralis*, the causative agent of whirling disease in salmonid fish, is present in the upper Salmon River. *Oncorhynchus nerka* samples obtained by emigrant smolt trapping, from trawl efforts in Redfish, Pettit, and Alturas lakes, and from Sawtooth FH smolt release groups are routinely examined for *M. cerebralis*. Results from juvenile *O. nerka* sampled in 2015 tested for *M. cerebralis* via pepsin/trypsin digest (PTD) and polymerase chain reaction (PCR) were negative. Twenty-nine juvenile *O. nerka* were sampled for *M. cerebralis* during 2015. Positive results have been confirmed in returning anadromous adults tested for *M. cerebralis* via PTD testing; this is consistent with positive detections in 12 of the last 14 return years. In 2015, one anadromous Sockeye tested positive (102 total samples) for *M. cerebralis*.

In 2015, eggs and adult anadromous Sockeye Salmon were treated with formalin to control Saprolegnia. Eggs were treated at 1,667 ppm for 20 minutes three times per week. Anadromous adults were treated at 167 ppm for one hour three times per week.

Eyed Egg and Fish Transfers

In all cases, the required State transfer permits were acquired before transport of eggs or fish in the Snake River Sockeye Salmon program. Specific details, by date, for all transfers are described below.

Eagle FH transferred five groups of eyed eggs to NOAA Fisheries in 2015. The first group was transferred on November 19, 2015 (432 eyed eggs), the second group was transferred on November 24, 2015 (203 eyed eggs), the third group was transferred on December 2, 2015 (370 eyed eggs), the fourth group was transferred on December 8, 2015 (241 eyed eggs), and the fifth group was transferred on December 16, 2015 (256 eyed eggs). Eyed eggs were selected representing all females and males spawned at Eagle FH during 2015.

Eagle FH and NOAA Fisheries transferred 862,398 eyed eggs to Springfield FH for 2017 smolt release. Eyed eggs from NOAA Fisheries were first transferred to Eagle FH and then delivered the next day to Springfield FH with eyed eggs from Eagle FH. Springfield FH received five shipments of eyed eggs in 2015. The first shipment of 165,816 eyed eggs was transferred on November 18, 2015 from Eagle FH production. The second shipment was transferred to Springfield FH on November 25, 2015 totaling 146,376 eyed-eggs (76,660 from Eagle FH and 69,716 from NOAA). The third shipment was transferred to Springfield FH on December 2, 2015 totaling 118,774 eyed eggs from Eagle FH production. The fourth shipment of eyed eggs to Springfield FH was transferred on December 9, 2015 totaling 240,318 eyed eggs (71,737 from Eagle FH and 168,581 from NOAA). The final shipment was transferred to Springfield FH on December 17, 2015 totaling 191,114 eyed-eggs (66,816 from Eagle FH and 124,298 from NOAA). Eagle FH transferred 499,803 and NOAA Fisheries transferred 362,595 eyed eggs during 2015 (Table 2).

Eyed Egg and Fish Reintroductions

Sockeye Salmon eyed eggs and fish were transferred and/or released to various locations in 2015. In all cases, the required state transfer permits were acquired prior to shipping. Additionally, pursuant to Special Condition B. 13. of Permit No. 1454, IDFG received authorization from NOAA Fisheries to conduct all production releases of Sockeye Salmon made in 2015 (Table 6). All Sockeye Salmon juveniles and adults released to Sawtooth Valley waters in 2015 were marked/tagged prior to release.

Adult Releases

In September, maturing adult Sockeye Salmon were released to Redfish Lake and Pettit Lake for volitional spawning. Six anadromous Sockeye Salmon collected at Sawtooth FH were transferred to Eagle FH and temporarily held before releasing to Pettit Lake. Five Sockeye Salmon (four females and one male) were released on September 15, 2015. One mortality occurred during holding at Eagle FH from this group. Captive reared Sockeye Salmon from Burley Creek FH (NOAA Fisheries) were released to Redfish and Pettit lakes for volitional spawning. Four hundred and ninety-four captive reared Sockeye Salmon (272 females and 222 males; mean weight 0.922 kg/fish) were released to Redfish Lake and 93 (51 females and 42 males) captive reared Sockeye Salmon were released to Pettit Lake (51 females and 42 males); mean weight 1.131 kg/fish) on September 15, 2015 (Table 6).

Smolt Releases

Brood year 2013 Sockeye Salmon smolts were released to the Salmon River drainage from May 4 through 7, 2015. A total of 423,103 BY13 smolts were released below the smolt trap on Redfish Lake Creek. Brood year 2013 smolts were reared at ODFW's Oxbow FH (77,238), Sawtooth FH (134,660), and Springfield FH (211,205). All smolts reared at Oxbow FH, Sawtooth FH, and Springfield FH were adipose fin clipped. A smolt survival study initiated in 2009 continued in 2015, maintaining an increased number of PIT-tagged fish in the Sawtooth FH and Springfield FH release groups. A total of 2,010 smolts were tagged at Oxbow FH, 49,772 smolts were tagged at Sawtooth FH, and 49,307 smolts were tagged at Springfield FH (Table 6).

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Table 1. Summary of losses and magnitude of mortality for Snake River Sockeye Salmon captive broodstock at Eagle Fish Hatchery during 2015.

	Captive Broodstock Groups				
	BY11	BY12	BY13	BY14	BY14
Starting Inventory (January 1, 2015)	13	812	1,378	1,493	3,002
<u>Eyed egg to Fry</u> Undetermined ^b	n/a	n/a	n/a	75	n/a
<u>Mechanical Loss</u>					
Handling	0	0	0	0	n/a
Jump-out	0	0	0	0	n/a
Transportation	0	0	0	0	n/a
<u>Noninfectious</u>					
Lymphosarcoma	0	0	0	0	n/a
Nephroblastoma	0	0	0	0	n/a
Other ^c	4	111	19	19	n/a
<u>Infectious</u>					
Bacterial	0	0	0	0	n/a
Viral	0	0	0	0	n/a
Other	0	0	0	0	n/a
<u>Maturation Spawners</u>					
Mature Males	2	299	86	0	n/a
Mature Females	2	356	1	0	n/a
<u>Maturation Nonspawners</u>					
Mature Males	0	3	3	0	n/a
Mature Females	1	30	0	0	n/a
<u>Relocation</u>					
Transferred In	0	0	0	0	n/a
Transferred Out	0	0	0	0	1,502
Planted/Released	0	0	0	0	n/a
Ending Inventory (December 31, 2015)	4	13	1,269	1,399	1,500 ^a

^a December 2015 developing fry and egg numbers.

^b Typical egg to fry mortality includes nonhatching eggs, abnormal fry, and swim-up loss.

^c Includes culling associated with cultural abnormalities, nonmatures, and all undetermined noninfectious mortality.

Table 2. Summary of losses and magnitude of mortality Snake River Sockeye Salmon production groups during 2015.

	Culture Groups					
	BY13 Sawtooth	BY13 Oxbow	BY13 Springfield	BY14 Oxbow	BY14 Springfield	BY15 Springfield
Starting Inventory (January 1, 2015)	134,834	77,336 ^d	215,104	120,070	658,974	862,398
<u>Eyed egg to Fry</u> Undetermined ^b	n/a	n/a	n/a	16,697	112,493	n/a
<u>Mechanical Loss</u>						
Handling	0	0	0	0	0	n/a
Jump-out	0	0	0	0	0	n/a
Transportation	0	0	0	0	0	n/a
<u>Noninfectious</u>						
Lymphosarcoma	0	0	0	0	0	n/a
Nephroblastoma	0	0	0	0	0	n/a
Other ^c	174	98	3,899	8,867	4,975	n/a
<u>Infectious</u>						
Bacterial	0	0	0	0	0	n/a
Viral	0	0	0	0	0	n/a
Other	0	0	0	0	0	n/a
<u>Maturation</u>						
Mature Males	0	0	0	0	0	n/a
Mature Females	0	0	0	0	0	n/a
Other	0	0	0	0	0	n/a
<u>Relocation</u>						
Transferred In	0	0	0	0	0	n/a
Transferred Out	0	0	0	0	0	n/a
Planted/Released	134,660	77,238	211,205	0	0	n/a
Ending Inventory (December 31, 2015)	0	0	0	94,506	541,506	862,398 ^a

^a December 2015 developing fry and egg numbers (combined NOAA and Eagle numbers).

^b Typical egg to fry mortality includes nonhatching eggs, abnormal fry, and swim-up loss (April 1 inventory).

^c Culling associated with cultural abnormalities, fish health sampling, and all undetermined, noninfectious mortality.

^d Starting inventory number adjusted to reflect actual number released in May.

Table 3. Summary information for 2015 Snake River Sockeye Salmon spawning activities at Eagle Fish Hatchery.

Spawning Cross*		No. of Green Eggs Taken	No. of Eyed eggs	Mean Egg Survival to Eyed-Stage	Median Egg Survival to Eyed-Stage
Female	Male				
ANH15	ANH15	68,398	52,561	76.85%	82.94%
ANH15	BY12	15,180	10,147	66.84%	91.13%
ANH15	BY13	21,649	17,150	79.22%	92.86%
BY11	BY12	2,551	1,485	58.21%	62.05%
BY12	ANH15	7,482	5,827	77.88%	96.08%
BY12	BY11	3,407	3,155	92.60%	96.20%
BY12	BY12	475,129	369,393	77.75%	86.09%
BY12	BY13	72,644	57,245	78.80%	86.20%
BY13	BY12	1,302	103	7.91%	7.88%
TOTALS		651,399	504,125	77.39%	85.98%

Note:* ANH15 refers to anadromous adults returning in 2015.
 BY11 refers to captive adults produced in spawn year 2011.
 BY12 refers to captive adults produced in spawn year 2012.
 BY13 refers to captive adults produced in spawn year 2013.

Table 4. Calendar year 2015 anadromous Snake River Sockeye Salmon adult return summary.

Summary category	Total number trapped	Number trapped at RFLC^b weir	Number rapped at SFH^a weir	Number trapped at other^c traps
All anadromous adults	91	50	6	35
Anadromous males	44	25	1	18
Anadromous females	47	25	5	17
Anadromous Unk. sex	0	0	0	0
Unmarked adults ^e	14	8	3	3
Unmarked/CWT adults ^d	43	23	0	20
AD-clipped adults ^d	5	4	0	1
AD-clipped/CWT adults ^d	29	15	3	11
Unknown mark	0	0	0	0

^a SFH = Sawtooth Fish Hatchery.

^b RFLC = Redfish Lake Creek.

^c Other = East Fork Salmon River Trap, Yankee Fork Trap, Hell's Canyon Dam adult trap.

^d AD = adipose fin clip; RV = right ventral fin clip; and CWT = coded wire tag.

^e Includes unmarked adults that shed coded wire tags.

Table 5. Parent family and number of Snake River Sockeye Salmon eyed eggs retained for brood year 2015 captive broodstock development at Eagle Fish Hatchery.

Family Cross*		No. of Eyed eggs Retained for Eagle Broodstock
Female	Male	
ANH15	ANH15	154
ANH15	BY12	32
ANH15	BY13	15
BY11	BY12	8
BY12	ANH15	25
BY12	BY11	8
BY12	BY12	1,059
BY12	BY13	195
BY13	BY12	4
TOTAL		1,500

Note:* ANH15 refers to anadromous adults returning in spawn year 2015.
 BY11 refers to captive adults produced in spawn year 2011.
 BY12 refers to captive adults produced in spawn year 2012.
 BY13 refers to captive adults produced in spawn year 2013.

Table 6. Snake River Sockeye Salmon releases made to Sawtooth Valley waters in 2015.

Release Location	Strategy (Brood Year)	Release Date	Number Released	Number PIT Tagged	Marks ^a	Release Weight (g)	Rearing Location
Redfish Lake Cr	smolt (2013)	5/6 – 5/7/15	211,205	49,307	Ad	45.4	IDFG Springfield FH
Redfish Lake Cr	smolt (2013)	5/4 – 5/5/15	134,660	49,772	Ad	24.0	IDFG Sawtooth FH
Redfish Lake Cr	smolt (2013)	5/7/15	77,238	2,010	Ad	41.9	ODFW Oxbow FH
Redfish Lake	adult (2011)	9/15/15	6	6	Ad	1,938	NOAA Burley Cr.
	(2012)	9/15/15	488	488	Ad	910	NOAA Burley Cr.
Pettit Lake	adult (2011)	9/15/15	21	21	Ad	1,664	NOAA Burley Cr.
	(2012)	9/15/15	72	72	Ad	976	NOAA Burley Cr.
	(ANH15) ^b	9/15/15	5	1	Mix	1,505	ANH15 Anadromous

^a Ad = adipose fin clip; CWT = Coded Wire Tag.

^b ANH15 refers to anadromous returning Sockeye Salmon in 2015; representing brood years 2010, 2011, and 2012.

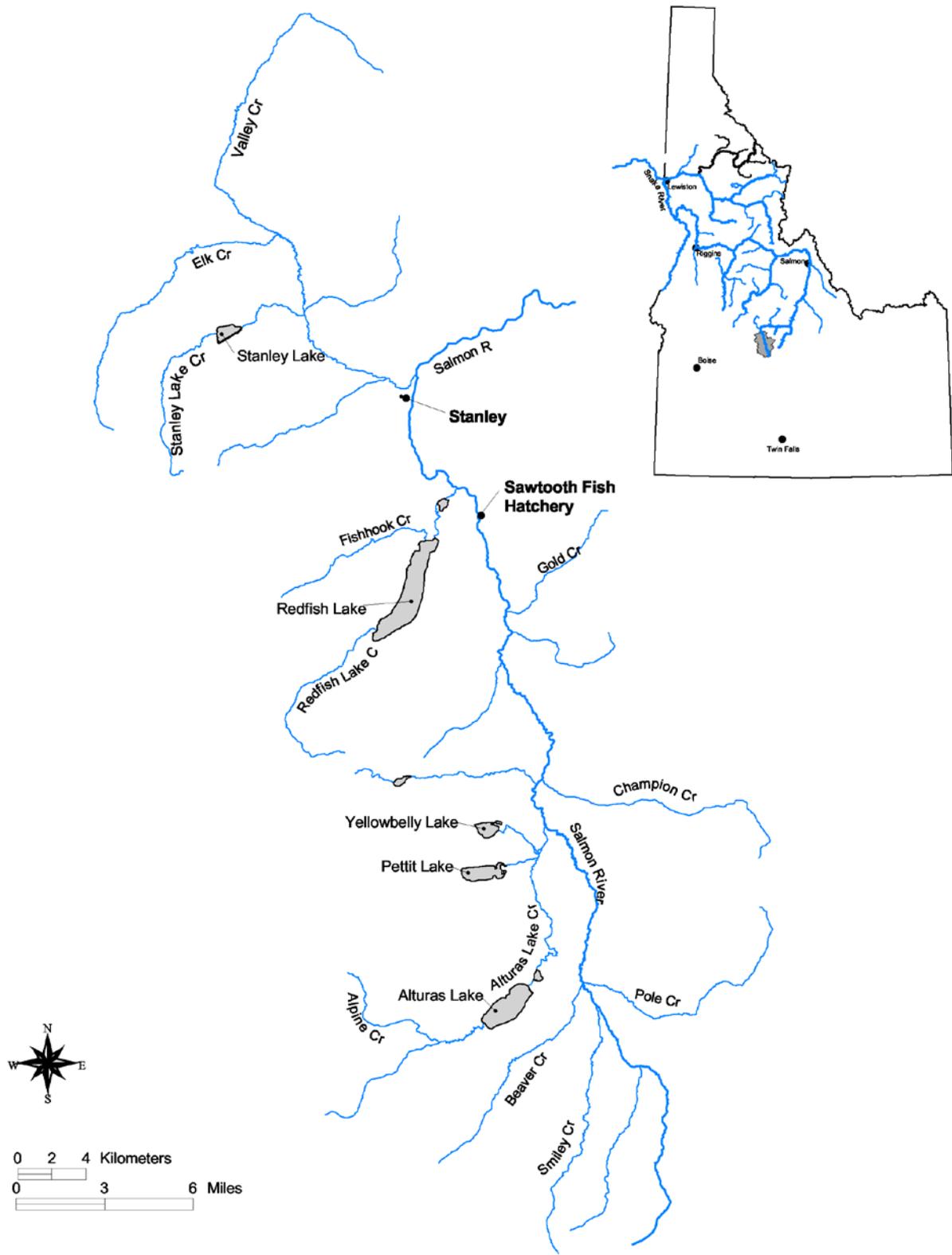


Figure 1. Sawtooth Valley study area.

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