

# FISHERY RESEARCH



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

**ANNUAL PROGRESS REPORT  
January 1, 2016—December 31, 2016**



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

**Project Progress Report**

**2016 Annual Report**

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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 Monitoring and Evaluation element of the program). Captive broodstock program activities conducted between January 1, 2016 and December 31, 2016 for the hatchery element of the program are presented in this report.

Five hundred seventy-two anadromous Sockeye Salmon were trapped in the Sawtooth Valley between July 19 and October 5, 2016. The Sawtooth Fish Hatchery weir on the upper Salmon River intercepted 42 Sockeye Salmon adults, the Redfish Lake Creek trap intercepted 529 Sockeye Salmon, and one fish was trapped at the Yankee Fork Salmon River weir. The adult Sockeye Salmon (309 females and 263 males) originated from a variety of release strategies, as evidenced by mark types. Two hundred forty-one anadromous Sockeye Salmon (121 females and 120 males) remained at Eagle Fish Hatchery and were incorporated into the spawning matrix.

Five hundred one female Sockeye Salmon (121 anadromous females, one BY12, 369 BY13, and ten BY14 captive females) were spawned at the Eagle Fish Hatchery in 2016. Spawn pairings produced approximately 671,377 eyed eggs with egg survival to eyed stage of development averaging 79.17%.

Smolts (635,021) and adults (1,212) were released into Sawtooth Valley waters in 2016. Reintroduction strategies involved releases to Redfish Lake, Pettit Lake, and Redfish Lake Creek.

During this reporting period, six broodstocks and three unique production groups were in culture at Idaho Department of Fish and Game (Eagle Fish Hatchery and Springfield Fish Hatchery) facilities. One additional production group was reared at Oregon Department of Fish and Wildlife's Oxbow Fish Hatchery. Three of the six broodstocks were incorporated into the 2016 spawning design.

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## INTRODUCTION

Numbers of Snake River Sockeye Salmon *Oncorhynchus nerka* (*O. nerka*) declined over the course of the 20<sup>th</sup> 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; Baker et al. 2015; and Baker et al. 2016).

## 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 monitoring and evaluation. Although objectives and tasks from both components overlap and contribute to achieving the same goals, work directly related to Sockeye Salmon captive broodstock monitoring and evaluation will appear under a separate cover. Monitoring and Evaluation 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, 2016.

## **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 semi-square tanks (0.09 m<sup>3</sup>); 2) 1.0 m diameter semi-square tanks (0.30 m<sup>3</sup>); 3) 2.0 m diameter semi-square tanks (1.42 m<sup>3</sup>); 4) 3.0 m diameter circular tanks (6.50 m<sup>3</sup>); and, 5) 4.0 m diameter semi-square tanks (17.6 m<sup>3</sup>). 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 supply the hatchery building, but can 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 2016 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 daily by Sockeye Program personnel during the 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 2016, fish were fed a commercial diet 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/m<sup>3</sup>. Age-3 and age-4 rearing densities were maintained at levels not exceeding 14.0 kg/m<sup>3</sup>.

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 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; Baker et al. 2015; and Baker et al. 2016). Before 1994, adult Sockeye Salmon returns were spawned at the Sawtooth FH (Johnson 1993). Spawning activities in 2016 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 2016, 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), 9,463 L (2,500 gallon), and 18,926 L (5,000 gallon) capacities. Transport density guidelines were in place not to exceed 89 grams/liter (0.75 pounds/gallon).

## **Eyed Egg and Fish Supplementation**

In 2016, 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 2016, 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, six broodstock and four production groups were in culture at IDFG facilities representing brood years 2011, 2012, 2013, 2014, 2015, and 2016. 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 four adults. There were four mortalities during 2016. Ending inventory for the BY11 broodstock group was zero fish (Table 1).

### **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 2016 inventory for BY12 captive broodstock at Eagle FH was 13 adults. There were seven mortalities and two maturing Sockeye during the year. Of the maturing Sockeye, one female was incorporated into the spawning matrix and one female was released. Ending inventory for the BY12 broodstock group was four 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 2016 inventory for BY13 captive broodstock at Eagle FH was 1,269 adults. Mortality for the year was 126 fish and 1,133 Sockeye Salmon matured during the year. Of the maturing Sockeye Salmon, 330 males and 369 females were incorporated into the spawning matrix, and 11 adults were culled as unproductive. Additionally, 423 maturing Sockeye Salmon broodstock were released to Redfish Lake for volitional spawning. Ending inventory for the BY13 broodstock group was ten immature fish (Table 1).

### **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 2016 inventory for BY14 broodstock at Eagle FH was 1,399 fish. Mortality for the year was 75 fish. Eighty-one BY14 Sockeye matured (71 males and ten females) during 2016 and incorporated into the spawning matrix. Ending inventory for the BY14 captive broodstock was 1,243 fish (Table 1).

### **Brood Year 2014 Production**

Starting inventory for the BY14 smolt production group at Oxbow FH was 94,506 fingerlings. Smolts were released on May 10, 2016. The BY14 smolt production group reared at Oxbow FH was PIT tagged in March. A total of 94,356 smolts were released leaving an ending inventory for the BY14 smolt group at Oxbow FH of zero fish (Table 2).

Starting inventory for the BY14 smolt production group at Springfield FH was 541,506 fingerlings. Smolts were released from May 9 through 20, 2016. The BY14 smolt production group reared at Springfield FH was PIT tagged in January. A total of 540,665 smolts were released leaving an ending inventory for the BY14 smolt group at Springfield FH of zero fish (Table 2).

### **Brood Year 2015 Broodstock**

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).

Starting 2016 inventory for BY15 broodstock at Eagle FH was 1,500 eyed eggs/fry. Mortality for the year was 246 fish. Ending inventory for the BY15 captive broodstock was 1,254 fish (Table 1).



## **Brood Year 2015 Production**

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. Ending inventory for this production group at Springfield FH was 735,642 fish (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 July 13 to October 12, 2016. The second trap is located on the upper Salmon River at the Sawtooth FH weir and was operated from June 15 to September 16, 2016.

Five hundred seventy-two anadromous Sockeye Salmon returned to traps in the Sawtooth Valley between July 19 and October 5, 2016. The weir on the upper Salmon River at the Sawtooth FH intercepted 42 Sockeye Salmon, the Redfish Lake Creek trap intercepted 529 Sockeye Salmon, and one adult was collected at the Yankee Fork Salmon River weir. Adult Sockeye Salmon captured at traps in 2016 originated from a variety of release strategies, as evidenced by mark types (Table 4).

Residual Sockeye Salmon trapping activities were not conducted during 2016.

In 2016, two anadromous Chinook Salmon adults were trapped at the Redfish Lake Creek trap. Both Chinook were released above the weir for natural spawning.

### **2016 Spawning Activities**

Results from 2016 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).

Five hundred one females and 518 males were spawned at Eagle FH between September 20 and November 9, 2016, yielding 847,975 green eggs. Nine hundred ninety-eight unique subfamilies were developed from BY16 spawn crosses at Eagle FH. To simplify tracking, families were grouped under one production group title: BY16. The BY16 captive broodstock group was developed using male Sockeye Salmon from the BY13 (330 males), BY14 (68 males) captive broodstocks, and 120 anadromous males that were collected during 2016 trapping activities (ANH16). Female Sockeye Salmon represented in spawn crosses for 2016 included captive broodstock from BY12 (one female), BY13 (369 females), BY14 (ten females), and 121 anadromous females (ANH16) that were collected during trapping activities in 2016. Specific crosses performed to develop this production group included: 1) ANH16 females x ANH16 males; 2) ANH16 females x BY13 males; 3) ANH16 females x BY14 males; 4) BY12 females x BY14 males; 5) BY13 females x ANH16 males; 6) BY13 females x BY13 males; 7) BY13 females x BY14 males; 8) BY14 females x ANH16 males; 9) BY14 females x BY13 males; and 10) BY14 females X BY14 males (Table 3). Spawn crosses produced approximately 847,975 green and 671,377 eyed eggs. Brood year 2013 female fecundity averaged 1,556 green eggs per female and ANH16 female fecundity averaged 2,570 green eggs per female. Egg survival to the eyed

stage of development for the BY16 production group averaged 79.17% (median 85.23%, Table 3). In 2016, of the 241 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, infectious hematopoietic necrosis virus (IHNv) was detected in 134 anadromous spawners.

Approximately 1,500 eyed eggs representing 991 subfamilies (496 unique females and 516 unique males) were selected from specific spawn crosses described. Due to IHNv positive anadromous spawners, broodstock eyed eggs were not selected for the NOAA Fisheries program.

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 BY16 broodstock will be determined by utilizing microsatellite DNA markers. Spawn crosses represented in the Eagle FH BY16 broodstock are presented in Table 5.

A total of 1,037,308 BY16 eyed eggs were transferred to Springfield FH for smolt production rearing. Production spawn crosses at Eagle FH provided 668,097 eyed eggs, and Burley Creek FH provided 369,211 eyed eggs. Egg incubation and juvenile rearing for the BY16 production group will continue at Springfield FH until smolts are released in May 2018.

#### **Milt Cryopreservation**

During 2016, no milt was cryopreserved and no cryopreserved milt from previous years was used in BY16 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. One hundred ninety-two laboratory accessions involving 2,201 individual fish were processed in 2016. Laboratory accessions included samples from Eagle FH (151 accessions), Springfield FH (four accessions), Redfish Lake Creek (RFLC) out-migrant trap (one accession), Pettit Lake Creek out-migrant trap (one accession), NOAA Fisheries (34 accessions), and Lower Granite Juvenile Collection (one accession). Total fish sampled (2,201) included: 1,185 fish from Eagle FH (one BY12, 813 BY13, 125 BY14 and 246 ANH16); 83 fish from Springfield FH (73 BY14 and 10 BY15); 20 fish from the RFLC trap (BY14 out-migrant smolts); 18 fish from Pettit Lake Creek trap (BY14 out-migrant smolts); 775 fish from NOAA Fisheries; and, 120 fish from Lower Granite Juvenile Collection (BY14 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 (captive broodstocks, production groups, or natural out-migrants) during calendar year 2016. Infectious Hematopoietic Necrosis (IHN) was detected in the anadromous adults sampled at Eagle Fish Health Lab from anadromous

fish spawned in 2016. Of the 246 anadromous Sockeye Salmon adults sampled, 134 adults tested positive for the IHN virus. Eagle Fish Health Lab began sampling NOAA Fisheries Captive Broodstock in 2015 (previously these samples were collected and analyzed by NOAA Fisheries staff) and continued sampling in 2016. Samples were collected from spawned captive broodstock at Burley Creek FH representing BY12 and BY13 (721 fish sampled) and from Manchester Research Station representing BY11, BY12, BY13, and BY14 (54 fish sampled). Two production groups from Springfield FH were sampled (73 fish across both Springfield groups) and analyzed at Eagle Fish Health Lab in 2016. All virology samples from these production groups resulted in negative detection of viral pathogens for 2016. Twenty BY14 out-migrating smolts from the Redfish Lake Creek trap and 18 BY14 out-migrating smolts from the Pettit 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 2,201 fish from calendar year 2016 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. Two of 246 anadromous Sockeye tested were positive in 2016 (ELISA values = 0.136 [male] and 0.337 [female]). Based on the test results from the anadromous female spawned at Eagle FH, all eggs were culled from this female following program protocols. Sockeye smolts from Springfield Fish Hatchery were sampled prior to release, and out-migrating smolts from Redfish and Pettit lakes were sampled. Bacterial Kidney Disease was not detected in these smolt groups during 2016.

*Aeromonas salmonicida*, the causative agent of furunculosis, was not detected in anadromous adults in 2016. 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 are routinely examined for *M. cerebralis*. Results from juvenile *O. nerka* sampled in 2016 tested for *M. cerebralis* via pepsin/trypsin digest (PTD) and polymerase chain reaction (PCR) were negative. Thirty-eight juvenile *O. nerka* were sampled for *M. cerebralis* during 2016. Positive results have been confirmed in returning anadromous adults tested for *M. cerebralis* via PTD testing; this is consistent with positive detections in 13 of the last 15 return years. In 2016, six (five fish pools) tested positive (246 total samples) for *M. cerebralis*.

In 2016, 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 after arrival at Eagle FH and three times per week during holding at Eagle FH.

### **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 and NOAA Fisheries transferred 1,037,308 eyed eggs to Springfield FH for 2018 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 2016. The first shipment of 99,591 eyed eggs was transferred on November 14, 2016 from Eagle FH production. The second shipment was transferred to Springfield FH on November 23, 2016 totaling 327,977 eyed-eggs (190,703 from Eagle FH and 137,274 from Burley Creek FH). The third shipment was transferred to Springfield FH on November 30, 2016 totaling 195,145 eyed eggs from Eagle FH production. The fourth shipment of eyed eggs to Springfield FH was transferred on December 7, 2016 totaling 295,007 eyed eggs (111,765 from Eagle FH and 183,213 from Burley Creek FH). The final shipment was transferred to Springfield FH on December 21, 2016 totaling 119,649 eyed eggs (70,893 from Eagle FH and 48,724 from Burley Creek FH). Eagle FH transferred 668,097 and Burley Creek FH transferred 369,272 eyed eggs during 2016 (Table 2).

### **Eyed Egg and Fish Reintroductions**

Sockeye Salmon eyed eggs and fish were transferred and/or released to various locations in 2016. 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 2016 (Table 6). All Sockeye Salmon juveniles and adults released to Sawtooth Valley waters in 2016 were marked/tagged prior to release.

#### **Adult Releases**

In September, maturing Sockeye Salmon from captive rearing programs at Eagle FH and Burley Creek FH were released to Redfish Lake and Pettit Lake for volitional spawning. One hundred captive reared Sockeye Salmon (NOAA Fisheries' Burley Creek Hatchery) were released (50 females and 50 males) on September 13, 2016 to Pettit Lake. Additional captive reared Sockeye Salmon from Burley Creek FH (NOAA Fisheries) were released on September 13, 2016 to Redfish Lake; three hundred sixty-two (190 females and 172 males) captive reared Sockeye were released (mean weight 0.971 kg/fish). Four hundred twenty-four (249 females and 175 males) captive reared Sockeye Salmon from IDFG's Eagle FH were released to Redfish Lake (mean weight 1.280 kg/fish).

Anadromous Sockeye Salmon were released to Upper Salmon River, Redfish Lake Creek, and Redfish Lake (Table 6). Fifteen anadromous Sockeye Salmon trapped at the Sawtooth FH trap were released approximately two miles above Sawtooth FH to continue upstream to Pettit and Alturas lakes. These adults were PIT tagged (if not previously tagged) for detection at upstream PIT tag arrays. Radio telemetry was also used to monitor the migration of four of these fish. These fish were implanted with a transmitter following trapping and released with a radio tag approximately two miles upstream of the Sawtooth FH.

Releases were a combination of direct releases (15 fish) to the Upper Salmon River, direct releases to Redfish Lake Creek above the trap (75 fish), Sockeye collected from below the

Sawtooth FH trap and weir (23 fish) and released to Redfish Lake, and Sockeye that were temporarily held at Eagle FH and returned to Redfish Lake for release (213 fish).

### **Smolt Releases**

Brood year 2014 Sockeye Salmon smolts were released to the Salmon River drainage from May 9 through 20, 2016. A total of 635,021 BY14 smolts were released below the smolt trap on Redfish Lake Creek. Brood year 2014 smolts were reared at ODFW's Oxbow FH (94,356) and Springfield FH (540,665). All smolts reared at Oxbow FH and Springfield FH were adipose fin clipped. A smolt survival study initiated in 2009 continued in 2016, maintaining an increased number of PIT-tagged fish in the Springfield FH release group. A total of 2,033 smolts were tagged at Oxbow FH and 50,776 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 2016.

	<b>Captive Broodstock Groups</b>					
	<b>BY11</b>	<b>BY12</b>	<b>BY13</b>	<b>BY14</b>	<b>BY15</b>	<b>BY16</b>
Starting Inventory (January 1, 2016)	4	13	1,269	1,399	1,500	1,500
<u>Eyed egg to Fry</u> Undetermined <sup>b</sup>	n/a	n/a	n/a	n/a	195	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 <sup>c</sup>	4	7	126	75	51	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 Spawners</u>						
Mature Males	0	0	330	68	0	n/a
Mature Females	0	1	369	10	0	n/a
<u>Maturation Nonspawners</u>						
Mature Males	0	0	6	3	0	n/a
Mature Females	0	0	5	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	0	1	423	0	0	n/a
Ending Inventory (December 31, 2016)	0	4	10	1,243	1,254	1,500 <sup>a</sup>

<sup>a</sup> December 2016 developing fry and egg numbers.

<sup>b</sup> Typical egg to fry mortality includes nonhatching eggs, abnormal fry, and swim-up loss.

<sup>c</sup> 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 2016.

	Culture Groups			
	BY14 Oxbow	BY14 Springfield	BY15 Springfield	BY16 Springfield
Starting Inventory (January 1, 2016)	94,506	541,506	862,398	1,037,308
<u>Eyed egg to Fry</u> Undetermined <sup>b</sup>	n/a	n/a	73,275	n/a
<u>Mechanical Loss</u>				
Handling	0	0	0	n/a
Jump-out	0	0	0	n/a
Transportation	0	0	0	n/a
<u>Noninfectious</u>				
Lymphosarcoma	0	0	0	n/a
Nephroblastoma	0	0	0	n/a
Other <sup>c</sup>	150	841	53,481	n/a
<u>Infectious</u>				
Bacterial	0	0	0	n/a
Viral	0	0	0	n/a
Other	0	0	0	n/a
<u>Maturation</u>				
Mature Males	0	0	0	n/a
Mature Females	0	0	0	n/a
Other	0	0	0	n/a
<u>Relocation</u>				
Transferred In	0	0	0	n/a
Transferred Out	0	0	0	n/a
Planted/Released	94,356	540,665	0	n/a
Ending Inventory (December 31, 2016)	0	0	735,642	1,037,308 <sup>a</sup>

<sup>a</sup> December 2016 developing fry and egg numbers (combined NOAA and Eagle numbers).

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

<sup>c</sup> Culling associated with cultural abnormalities, fish health sampling, and all undetermined, noninfectious mortality.

<sup>d</sup> Starting inventory number adjusted to reflect actual number released in May.

Table 3. Summary information for 2016 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				
ANH16	ANH16	219,214	195,190	89.04%	95.33%
ANH16	BY13	50,688	45,851	90.46%	94.20%
ANH16	BY14	31,520	26,893	85.32%	96.41%
BY12	BY14	320	3	0.94%	0.94%
BY13	ANH16	34,154	24,962	73.09%	74.73%
BY13	BY13	442,483	334,552	75.61%	82.63%
BY13	BY14	54,221	35,461	65.40%	71.12%
BY14	ANH16	1,609	1,149	71.41%	71.70%
BY14	BY13	10,011	5,258	52.52%	74.19%
BY14	BY14	3,755	2,058	54.81%	78.28%
<b>TOTALS</b>		<b>847,975</b>	<b>671,377</b>	<b>79.17%</b>	<b>85.23%</b>

Note:\* ANH16 refers to anadromous adults returning in 2016.  
 BY12 refers to captive adults produced in spawn year 2012.  
 BY13 refers to captive adults produced in spawn year 2013.  
 BY14 refers to captive adults produced in spawn year 2014.

Table 4. Calendar year 2016 anadromous Snake River Sockeye Salmon adult return summary.

<b>Summary category</b>	<b>Total number trapped</b>	<b>Number trapped at RFLC<sup>a</sup> weir</b>	<b>Number trapped at SFH<sup>b</sup> weir</b>	<b>Number trapped at other<sup>c</sup> traps</b>
All anadromous adults	572	529	42	1
Anadromous males	263	242	21	0
Anadromous females	309	287	21	1
Unmarked adults <sup>d</sup>	33	33	0	0
AD-clipped adults <sup>e</sup>	533	490	42	1
AD-clipped/CWT adults <sup>e</sup>	6	6	0	0

<sup>a</sup> RFLC = Redfish Lake Creek.

<sup>b</sup> SFH = Sawtooth Fish Hatchery.

<sup>c</sup> Other = East Fork Salmon River Trap, Yankee Fork Trap, Hell's Canyon Dam adult trap.

<sup>d</sup> Includes unmarked adults that shed coded wire tags.

<sup>e</sup> AD = adipose fin clip; RV = right ventral fin clip; and CWT = coded wire tag.

Table 5. Parent family and number of Snake River Sockeye Salmon eyed eggs retained for brood year 2016 captive broodstock development at Eagle Fish Hatchery.

<b>Family Cross*</b>		<b>No. of Eyed eggs Retained for Eagle Broodstock</b>
<b>Female</b>	<b>Male</b>	
ANH16	ANH16	245
ANH16	BY13	66
ANH16	BY14	46
BY12	BY14	3
BY13	ANH16	96
BY13	BY13	887
BY13	BY14	126
BY14	ANH16	3
BY14	BY13	20
BY14	BY14	8
<b>TOTAL</b>		<b>1,500</b>

Note:\* ANH16 refers to anadromous adults returning in spawn year 2016.  
 BY12 refers to captive adults produced in spawn year 2012.  
 BY13 refers to captive adults produced in spawn year 2013.  
 BY14 refers to captive adults produced in spawn year 2014.



Table 6. Snake River Sockeye Salmon releases made to Sawtooth Valley waters in 2016.

Release Location	Strategy (Brood Year)	Release Date	Number Released	Number PIT Tagged	Marks <sup>a</sup>	Release Weight (g)	Rearing Location
Redfish Lake Cr	smolt (2014)	5/9 – 5/20/16	540,665	50,776	Ad	45.1	IDFG Springfield FH
Redfish Lake Cr	smolt (2014)	5/10/16	94,356	2,033	Ad	24.0	ODFW Oxbow FH
Redfish Lake	adult (2011)	9/13/16	1	1	Ad	1,389	NOAA Burley Cr.
	(2012)	9/13/16	40	40	Ad	1,892	NOAA Burley Cr.
	(2013)	9/13/16	321	321	Ad	856	NOAA Burley Cr.
	(2012)	9/13/16	1	1	Ad	1,881	IDFG Eagle FH
	(2013)	9/12 – 9/13/16	423	423	Ad	1,280	IDFG Eagle FH
	(ANH16) <sup>b</sup>		314	46	Ad	1,269	Anadromous
Pettit Lake	adult (2012)	9/13/16	21	21	Ad	1,806	NOAA Burley Cr.
	(2013)	9/13/16	79	79	Ad	873	NOAA Burley Cr.
Upper Salmon R	adult (ANH16) <sup>b</sup>		15	3	Ad	1,228	Anadromous

<sup>a</sup> Ad = adipose fin clip; CWT = Coded Wire Tag.

<sup>b</sup> ANH16 refers to anadromous returning Sockeye Salmon in 2016; representing brood years 2011, 2012, and 2013.

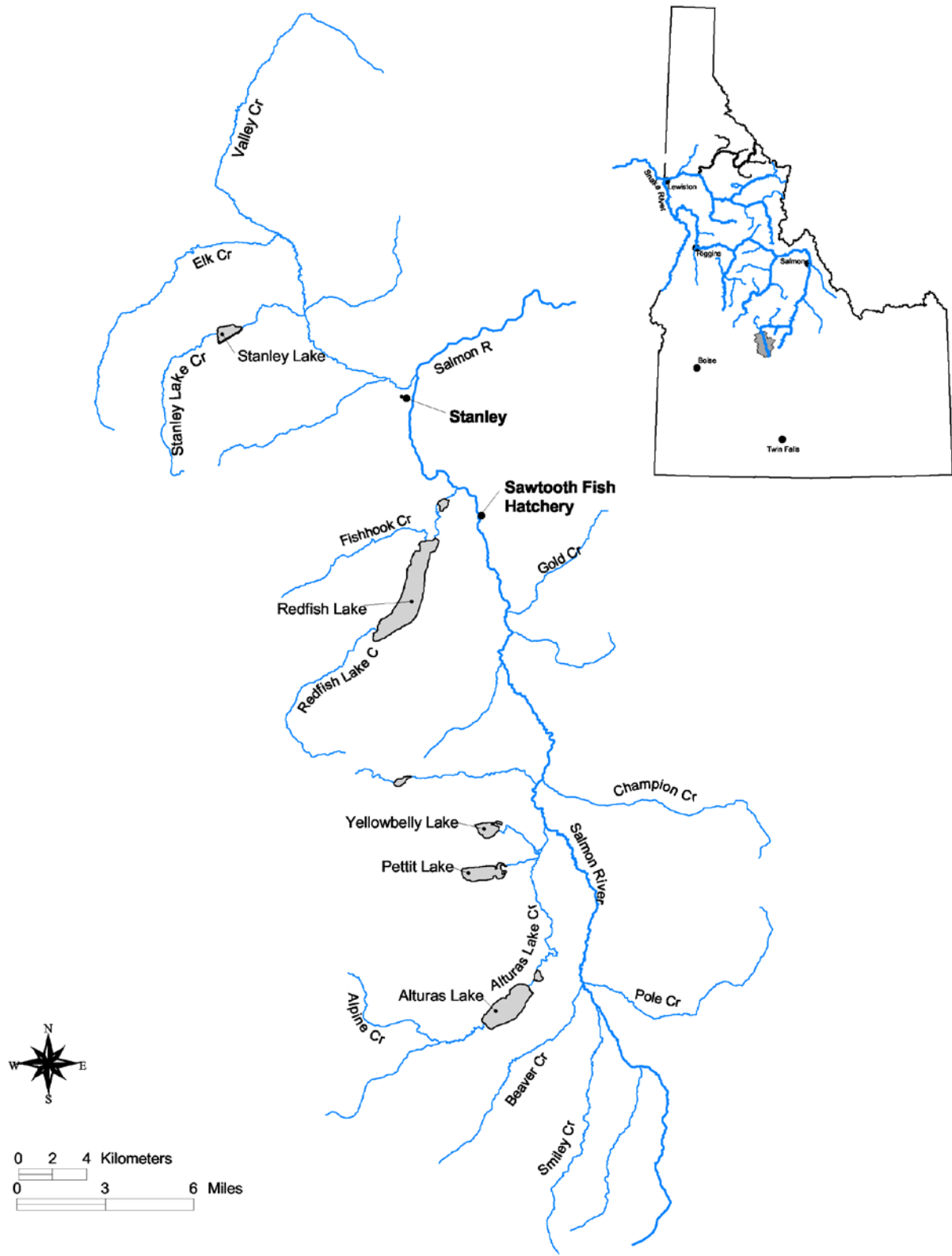


Figure 1. Sawtooth Valley study area.

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