FISHERY RESEARCH

SNAKE RIVER SOCKEYE SALMON CAPTIVE BROODSTOCK PROGRAM HATCHERY ELEMENT

ANNUAL PROGRESS REPORT
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Snake River Sockeye Salmon Captive Broodstock Program Hatchery Element

Project Progress Report

2014 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 Sockeye Salmon included the establishment of a captive broodstock program at the Idaho Department of Fish and Game Eagle Fish Hatchery. Sockeye Salmon broodstock and culture responsibilities are shared with the National Oceanic and Atmospheric Administration at two locations 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 of captive broodstock program fish releases (annual report to the Bonneville Power Administration for the research element of the program) are also reported separately. Captive broodstock program activities conducted between January 1, 2014 and December 31, 2014 for the hatchery element of the program are presented in this report.

A total of 1,516 anadromous Sockeye Salmon returned to traps in the Sawtooth Valley between July 22 and October 6, 2014. The Sawtooth FH weir on the upper Salmon River intercepted 34 Sockeye Salmon adults, the Redfish Lake Creek trap intercepted 1,479 Sockeye Salmon, and three Sockeye Salmon were trapped at the East Fork Salmon River trap. Sixty-three additional Sockeye Salmon were observed but not trapped in the Sawtooth Valley (not included in trap count). The adult Sockeye Salmon (714 females, 801 males, and one unknown) originated from a variety of release strategies, as evidenced by mark types. Four hundred and thirty-two (220 females and 212 males) anadromous Sockeye Salmon remained at Eagle Fish Hatchery and were incorporated into the spawning matrix.

A total of 378 female Sockeye Salmon (220 anadromous females and 158 brood year 2011 captive females) were spawned at the Eagle Fish Hatchery in 2014. Spawn pairings produced approximately 607,198 eyed eggs with egg survival to eyed stage of development averaging 81.55%.

Smolts (296,389) and adults (2,171) were released into Sawtooth Valley waters in 2014. Reintroduction strategies involved releases to Redfish Lake, Pettit Lake, and Redfish Lake Creek.

During this reporting period, five broodstocks and seven unique production groups were in culture at Idaho Department of Fish and Game (Eagle Fish Hatchery, Springfield Fish Hatchery, and Sawtooth Fish Hatchery) and Oregon Department of Fish and Wildlife (Oxbow Fish Hatchery) facilities. Two of the five broodstocks were incorporated into the 2014 spawning design.

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INTRODUCTION

Numbers of Snake River Sockeye Salmon *Oncorhynchus nerka O. nerka* have declined dramatically in recent years. 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 carried out 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, and Baker et al. 2014).

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, 2014.

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 is now 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 remains flexible to accommodate culture activities ranging from spawning and incubation through adult rearing. Incubation capacity was increased to accommodate eyed egg requests for Springfield Fish Hatchery (Springfield FH). Egg incubation uses a combination of vertical stack incubators and small isolation upwellers. Thirty-six, eight tray vertical stack incubators will incubate up to 1,000,000 eggs. Each tray contains four smaller trays 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.

Several fiberglass tank sizes are used to culture Sockeye Salmon from fry to the adult stage. These include 1) 0.7 m diameter semisquare tanks (0.09 m^3); 2) 1.0 m diameter semisquare tanks (0.30 m^3); 3) 2.0 m diameter semisquare tanks (1.42 m^3); 4) 3.0 m diameter circular tanks (6.50 m^3); and 5) 4.0 m diameter semisquare tanks (17.6 m^3). 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/fish and to depot 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.

Sawtooth Fish Hatchery

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 have been utilized continuously since 1991 for various aspects of the Sockeye Salmon captive broodstock program, including 1) prespawn anadromous adult holding, 2) egg incubation, and 3) juvenile rearing for presmolt and smolt releases. In addition, hatchery personnel assist with many field activities, including 1) fish trapping and handling, and 2) fish transportation and release.

Eyed eggs, received at Sawtooth FH from Eagle FH and/or NOAA, are incubated in vertical stack incubators. Fry are ponded into concrete vats and reared on well water for one year. Juveniles are transferred to outdoor raceways in October and reared on river water through release as smolts the following May. Currently, juvenile Sockeye Salmon reared at Sawtooth FH are released as smolts. Prespawn anadromous adults captured at Redfish Lake Creek or Sawtooth FH weirs are transferred to Eagle FH, released to Redfish Lake (trapped at Sawtooth 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.

Generally, well water supplies water flow for incubation, rearing, and holding. Well water temperature varies by time of year from approximately 4.0°C minimum in March and April to 10.0°C maximum in September and October. When Sockeye Salmon are held for smolt releases, they may be moved to outside raceways that receive water from the Salmon River. Salmon River water temperature varies by time of year from approximately 2.0°C in January and February to 20.0°C in August and September. Backup and redundancy water systems are in place. Rearing protocols are established cooperatively between IDFG personnel and reviewed at the SBSTOC level.

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 1,135.5 liters

per minute (300 gpm) in the summer and fall. Water rights for Oxbow FH are 3.30 cubic meters per second (116.51 cfs).

Eyed eggs, received at Oxbow FH from Eagle FH or NOAA, 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 (Springfield FH) was completed in 2013 from funding provided by Bonneville Power Administration through the Idaho Fish Accords and is located near Springfield, Idaho. Springfield FH facilities are designed to rear up to one million Sockeye Salmon smolts annually for release to the Stanley Basin.

Eyed eggs, received at Springfield FH from Eagle FH and NOAA Fisheries, are incubated in vertical stack incubators. 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 to Redfish Lake Creek. No adult holding or spawning is planned at Springfield FH.

Springfield FH is supplied with artesian spring water. The facility uses seven pumps to supply water to the facility. During peak production, a total of 50 CFS of water is available for fish production. Spring water remains constant at approximately 10.0°C. The pumped artesian water is degassed before entering production areas. All wells are backed-up with on-site generators in case of power failure. A chiller is available to chill incubation water from 10.0°C to 8.0°C assisting in synchronizing timing of first feeding. Rearing protocols are established cooperatively between IDFG personnel and reviewed at the SBSTOC level.

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 2014, fish were fed commercial diets produced by Skretting Inc. (Bio-Oregon) or EWOS® Canada LTD (EWOS). The BY10, BY11, and BY12 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. 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^3. Age-3 and age-4 rearing densities were maintained at levels not exceeding 14.0 kg/m^3.

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. Broodstock Sockeye Salmon 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, landfilled, or rendered.

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 snorkel surveys and again at approximately 0300 hrs to ensure that no adult Sockeye Salmon (program releases) were trapped.

Spawning Activities

Spawning 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; and Baker et al. 2014). Before 1994, adult Sockeye Salmon returns were spawned at the Sawtooth FH (Johnson 1993). Spawning activities in 2014 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 2014, 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 d. 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 prior to facility incubation.

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*, furunculous *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 2014, Sockeye Salmon were reintroduced to Sawtooth Valley waters as smolts and prespawn adults.

Sockeye Salmon smolts were distributed to Sawtooth Valley waters using truck-mounted transportation tanks. In 2014, Sockeye Salmon smolts were released in the outlet of 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 seven production groups were in culture at IDFG facilities representing brood years 2010, 2011, 2012, 2013, and 2014. 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 appear abbreviated (e.g., BY10 refers to brood year 2010).

BY10 Broodstock

One hundred thirty-five females and 143 males were spawned at Eagle FH between October 1 and November 15, 2010 to generate 272,039 green eggs. Four hundred one unique subfamilies were developed from BY10 spawn crosses at the Eagle FH. To simplify tracking, families were grouped under one production group title: BY10. The BY10 production group was developed using male Sockeye Salmon from the BY06 (one male) and BY07 (90 males) captive broodstock, and 42 anadromous males that returned to the Sawtooth Valley (ANH10). Female Sockeye Salmon represented in spawn crosses for 2010 included captive broodstock from BY06 (one female), BY07 (87 females), and 47 anadromous females (ANH10) that returned to the Sawtooth Valley in 2010. Specific crosses performed to develop this production group included: 1) ANH10 females x ANH10 males, 2) ANH10 females x BY07 males, 3) BY06 females x BY07 males, 4) BY07 females x ANH10 males, 5) BY07 females x BY06 males, and 6) BY07 females x BY07 males. Spawn crosses produced approximately 272,039 green and 228,822 eyed eggs. Brood year 2007 female fecundity averaged 1,596 green eggs per female and ANH10 female fecundity averaged 2,799 green eggs per female. Egg survival to the eyed stage of development for the BY10 production group averaged 84.11% (median 94.21%, Table 3). In 2010, of the 89 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, 37 Sockeye Salmon (four females and 33 males) tested positive for infectious hematopoietic necrosis virus (IHNV). Eyed eggs from positive IHNV crosses will remain at Eagle FH for a presmolt production group.

Approximately 1,048 eyed eggs representing 284 subfamilies (111 unique females and 112 unique males) were selected from specific spawn crosses described above and incubated for future broodstock needs. Eyed eggs were selected in duplicate with two groups (1,048 total) remaining at Eagle FH. No eyed eggs were shipped to NOAA Fisheries for replacement broodstock due to the presence of IHNV in the anadromous population.

Starting inventory for BY10 broodstock at Eagle FH was eight fish. There were four mortalities, three immatures (culled/unproductive), and one maturing Sockeye Salmon released to Redfish Lake in September. Ending inventory for the BY10 broodstock group was zero fish (Table 1).

BY11 Broodstock

One hundred thirty-eight females and 163 males were spawned at Eagle FH between September 26 and November 16, 2011 to generate 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 the 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%, Table 3). 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 1,237 eyed eggs representing 360 subfamilies (125 unique females and 158 unique males) were selected from specific spawn crosses described above and incubated for future broodstock needs. Eyed eggs were selected in triplicate with two groups (1,237 total) remaining at Eagle FH. Two groups were transferred to NOAA Fisheries; the first group will be used for captive broodstock and adult releases (1,179 eyed eggs), and the second group will be used for an early life history study (1,173 eyed eggs).

Starting inventory for BY11 broodstock at Eagle FH was 1,083 fingerlings. There were 48 mortalities and 1,022 maturing Sockeye. Six hundred and ninety-four Sockeye (412 females and 282 males) were released on September 10, 2014.Of the remaining 328 mature Sockeye (158 females and 158 males) were incorporated into the spawning matrix for 2014 and twelve (4 females and 8 males) were culled as unproductive/nonspawners (Table 1). Ending inventory for the BY11 broodstock group was 13 fish.

BY12 Broodstock

One hundred twenty-one females and 149 males were spawned at Eagle FH between September 25 and November 9, 2012 to generate 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%, Table 3). 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 974 eyed eggs representing 234 subfamilies (117 unique females and 146 unique males) were selected from specific spawn crosses described above and incubated for future broodstock needs. Eyed eggs were selected in duplicate with two groups (974 total) remaining at Eagle FH. Two groups were transferred to NOAA Fisheries; the two groups will be used for captive broodstock and adult releases (1,495 eyed eggs).

Starting 2014 inventory for BY12 broodstock at Eagle FH was 900 fingerlings. There were 30 mortalities and 58 maturing Sockeye during the year. Of the maturing Sockeye, 23 males were released to Redfish Lake on September 10, 32 males were incorporated into the spawning matrix, and three males were culled as unproductive. Ending inventory for the BY12 broodstock group was 812 fingerlings (Table 1).

BY12 Production

Initial 2014 inventory for the BY12 smolt production group at Sawtooth FH was 173,086 fingerlings. On May 9, 2014, smolts were released to Redfish Lake Creek (172,702 smolts averaging 22.7 grams/fish). Survival for the BY12 smolt group (from eyed egg to smolt) was 82.4%. All smolts released were adipose fin clipped; 50,333 smolts were PIT tagged. (Survival from PIT tagging to release was 99.91%). Ending inventory at Sawtooth FH was zero fish (Table 2).

Initial 2014 inventory for the BY12 production group at Oxbow FH was 122,660 fingerlings. On May 8, 2014, smolts were released to Redfish Lake Creek (122,397 smolts averaging 36.0 grams/fish). Survival for the BY12 smolt production group (from eyed egg to smolt) was 90.2%. All smolts were adipose fin clipped; 2,440 were PIT tagged. (Survival from PIT tagging to release was 99.90%). Ending inventory at Oxbow FH was zero fish (Table 2).

BY13 Broodstock

Two hundred twenty-four females and 200 males were spawned at Eagle FH between September 24 and November 5, 2013 to generate 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%, Table 3). 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 1,497 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 duplicate with two groups (1,497 total) remaining at Eagle FH. Two groups were transferred to NOAA Fisheries; the two groups will be used for captive broodstock and adult releases (1,493 eyed eggs).

Starting 2014 inventory for BY13 broodstock at Eagle FH was 1,497 eyed eggs/developing fry. Mortality for the year was 119 fry. Ending inventory for the BY13 broodstock group was 1,378 fingerlings (Table 1).

BY13 Production

A total of 203,201 BY13 eyed eggs from production spawn crosses at Eagle FH were transferred to Sawtooth FH. Egg incubation and juvenile rearing for this production group will continue at Sawtooth FH until smolt releases in 2015. Ending inventory at Sawtooth FH was 134,834 fish (Table 2).

A total of 92,656 BY13 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 2015. Ending inventory for this production group at Oxbow FH was 76,205 fish (Table 2).

A total of 248,972 BY13 eyed eggs from production spawn crosses at Eagle FH Burley Creek FH were transferred to Springfield FH. Egg incubation and juvenile rearing for this production group will continue at Springfield FH until smolt releases in 2015. Ending inventory for this production group at Springfield FH was 215,104 fish (Table 2).

BY14 Broodstock

A total of 378 females and 393 males were spawned at Eagle FH between September 25 and November 18, 2014 to generate 744,538 green eggs. A total of 754 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%, Table 4). 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 1,493 eyed eggs representing 735 subfamilies (371 unique females and 398 unique males) were selected from specific spawn crosses described above and incubated for future broodstock needs. Eyed eggs were selected in duplicate with two groups (1,493 total) remaining at Eagle FH. Two groups were transferred to NOAA Fisheries; the two groups will be used for captive broodstock and adult releases (1,476 total).

Until 2004, 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. From 2005 to present, genetic identification of captive broodstocks was determined by utilizing microsatellite DNA markers.

BY14 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. Ending inventory for this production group at Springfield FH was 658,974 eyed eggs/fry (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. Ending inventory for this production group at Oxbow FH was 120,070 eyed eggs/fry (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 11 to October 23, 2014. The second trap is located on the upper Salmon River at the Sawtooth FH weir and was operated from June 10 to October 2, 2014.

A total of 1,516 anadromous Sockeye Salmon returned to traps in the Sawtooth Valley between July 22 and October 6, 2014. The weir on the upper Salmon River at the Sawtooth FH intercepted 34 Sockeye Salmon adults, the Redfish Lake Creek trap intercepted 1,479 Sockeye, and three Sockeye Salmon were trapped at the East Fork Salmon River trap. Adult Sockeye Salmon captured in the Sawtooth Valley originated from a variety of release strategies, as evidenced by mark types (Table 4).

Residual Sockeye Salmon trapping activities were not conducted during 2014.

In 2014, three anadromous Chinook Salmon adults were trapped at the Redfish Lake Creek trap. This included one unmarked female, an unmarked male, and one unmarked male (jack). All were released unharmed above the Redfish Lake Creek weir.

Year 2014 Spawning Activities

Results from 2014 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 appear abbreviated (e.g., BY11 refers to brood year 2011).

During the fall of 2014, 316 age-3 fish (158 females and 158 males) from the BY11 broodstock, and 32 age-2 fish (all males) from BY12 broodstock matured at the Eagle FH and were incorporated into the spawning matrix. In addition, 432 anadromous Sockeye Salmon (220 females and 212 males) that returned to the Sawtooth Valley in 2014 (ANH14) were transferred to the Eagle FH and were incorporated into the spawning design.

Approximately 1,493 eyed eggs representing 735 subfamilies (371 unique females and 398 unique males) were selected from specific spawn crosses described above and incubated for future broodstock needs. Eyed eggs were selected in four similar groups. Two groups (1,493 total) remained at Eagle FH for replacement captive broodstock and two groups (1,476 total) were transferred to NOAA Fisheries for replacement captive broodstock.

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 BY14 broodstock will be determined by utilizing microsatellite DNA markers. Spawn crosses represented in the Eagle FH BY14 broodstock are presented in Table 5.

Milt Cryopreservation

During 2014, no milt was cryopreserved or used in 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; anadromous adult Sockeye Salmon that were retained for hatchery spawning; and Sockeye Salmon smolts obtained from out-migrant traps. A total of 122 laboratory accessions involving 1,007 individual fish were processed in 2014. Laboratory accessions included samples from Eagle FH (115 accessions), Springfield FH (three accessions), Sawtooth FH (two accessions), Redfish Lake Creek (RFLC) out-migrant trap (one accession), and Pettit Lake Creek out-migrant trap (one

accession). Total fish sampled (1,007) included 877 fish from Eagle FH (386 BY11, 45 BY12, and 446 ANH14), 30 fish from Springfield FH (BY13), 70 fish from Sawtooth FH (60 BY12 and 10 BY13), 15 fish from the RFLC trap (BY12 out-migrant smolts), and 15 fish from Pettit Lake Creek trap (BY12 out-migrant smolts). 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 import and transport permits.

Viral Pathogens

Viral pathogens were not detected in anadromous Sockeye Salmon used for broodstock at Eagle FH in 2014. A total of 532 fish from calendar year 2014 captive broodstock (BY11 and BY12) and ANH14 anadromous Sockeye were sampled. Additionally, two production Sockeye groups reared at Sawtooth FH on well water and Salmon River water were tested for viral pathogens and one production group of Sockeye from Springfield FH was tested at Eagle FH in 2014. All virology samples from these production Sockeye groups resulted in negative detection of viral pathogens for 2014. Fifteen BY12 out-migrating smolts from the Redfish Lake Creek trap and 15 BY12 out-migrating smolts from the Pettit Lake Creek trap were also 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 780 (378 females, 402 males) fish from calendar year 2014 broodstock (BY11, BY12, and ANH14 spawners) at Eagle FH were sampled for BKD via enzyme-linked immunosorbent assay (ELISA) techniques in 2014. Eagle FH captive broodstock was negative for BKD (348 sampled) and four of the 432 anadromous broodstock spawners tested positive for the presence of this pathogen (no positive females). In 2014, no eggs were culled due to positive ELISA results. Sockeye out-migrants were sampled at Redfish and Pettit lakes in 2014. Bacterial Kidney Disease was not detected in the out-migrants during 2014.

Aeromonas salmonicida, the causative agent of furunculosis, was not detected in anadromous adults in 2014. 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; trawl efforts in Redfish, Pettit, and Alturas lakes; and smolt release groups from Sawtooth FH are routinely examined for *M. cerebralis*. Results from juvenile *O. nerka* sampled in 2014 tested for *M. cerebralis* via pepsin/trypsin digest (PTD) and polymerase chain reaction (PCR) were negative. Thirty juvenile *O. nerka* were sampled for *M. cerebralis* during 2014. Positive results have been confirmed in returning anadromous adults tested for *M.*

cerebralis via PTD testing; this is consistent with positive detections in 11 of the last 13 return years. In 2014, 17 pools of five samples (85 total samples) tested positive for *M. cerebralis,* the remaining 363 fish that were sampled tested negative.

In 2014, eggs and adult anadromous Sockeye 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 shipping. Specific details, by date, for all transfers are described below.

Eagle FH transferred three groups of eyed eggs to NOAA Fisheries in 2014. The first group was transferred on November 25, 2014 (501 eyed eggs), the second group was transferred on December 10, 2014 (554 eyed eggs), and the third group was transferred on December 18, 2014 (421 eyed eggs). Eyed eggs were selected and grouped into two identical groups to represent future captive broodstock and adult release groups.

Eagle FH and NOAA Fisheries transferred 658,974 eyed eggs to Springfield FH for 2016 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 four shipments of eyed eggs in 2014. The first shipment transferred on November 25, 2014 from Eagle FH produced eyed eggs totaling 147,717. The second shipment was transferred to Springfield FH on December 9, 2014 totaling 254,754 eyed-eggs produced at Eagle FH. The third shipment was transferred to Springfield FH on December 17, 2014 totaling 206,797 eyed eggs (152,052 from Eagle FH production and 54,745 from NOAA Fisheries production). The final shipment of eyed eggs to Springfield FH were transferred on December 23, 2014 totaling 49,706 eyed eggs from Eagle FH production. Eagle FH transferred 604,229 and NOAA Fisheries transferred 54,745 eyed eggs during 2014.

A total of 120,070 eyed eggs were transferred from NOAA's Burley Creek FH to ODFW's Oxbow FH for a 2016 smolt release (Table 2).

Eyed Egg and Fish Reintroductions

Sockeye Salmon eyed eggs and fish were transferred and/or released to various locations in 2014. 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 (Appendix B) to conduct all production releases of Sockeye Salmon made in 2014 (Table 6). All Sockeye Salmon juveniles and adults released to Sawtooth Valley waters in 2014 were marked/tagged prior to release.

Adult Releases

Maturing adult Sockeye Salmon were released to Redfish Lake from August through October for volitional spawning. Anadromous adults were released to Redfish Lake between August 7 and October 6, 2014. A total of 1,073 anadromous adults (mean weight 1.09 kg/fish) were released. On September 16, 282 Sockeye reared at NOAA Fisheries were released (mean

weight .94 kg/fish). Eagle FH released 718 Sockeye from the captive broodstock program (mean weight 1.03 kg/fish) on September 10, 2014 (Table 6).

Maturing Sockeye Salmon were released to Pettit Lake on September 16, 2014. These adults were reared at NOAA Fisheries facilities. A total of 98 captive reared Sockeye Salmon were released (mean weight 1.01kg/fish).

Smolt Releases

Smolts were released to the Salmon River drainage on May 8 and 9, 2014. A total of 296,389 BY12 smolts were released below the smolt trap on Redfish Lake Creek. Brood year 2011 smolts were reared from ODFW's Oxbow FH (122,397), Sawtooth FH (172,702), and NOAA Fisheries' Burley Creek FH (1,290). All smolts reared at Oxbow FH, Sawtooth FH, and NOAA Fisheries were adipose fin clipped. A smolt survival study (initiated in 2009) continued in 2014, maintaining the increased number of PIT-tagged fish in the Sawtooth FH release groups. A total of 2,440 smolts were tagged at Oxbow FH and 50,333 smolts were tagged at Sawtooth FH (Table 6).

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Table 1. Summary of losses and magnitude of mortality for five captive Sockeye Salmon broodstock groups during 2014.

	Captive Broodstock Groups				
	BY10	**BY11**	**BY12**	**BY13**	**BY14**
Starting Inventory (January 1, 2014)	8	1,083	900	1,497	1,493[a]
Eyed egg to Fry					
Undetermined[b]	n/a	n/a	n/a	98	n/a
Mechanical Loss					
Handling	0	0	0	0	n/a
Jump-out	0	0	0	0	n/a
Transportation	0	0	0	0	n/a
Noninfectious					
Lymphosarcoma	0	0	0	0	n/a
Nephroblastoma	0	0	0	0	n/a
Other[c]	7	48	30	21	n/a
Infectious					
Bacterial	0	0	0	0	n/a
Viral	0	0	0	0	n/a
Other	0	0	0	0	n/a
Maturation Spawners					
Mature Males	0	158	32	0	n/a
Mature Females	0	158	0	0	n/a
Maturation Nonspawners					
Mature Males	0	4	3	0	n/a
Mature Females	0	8	0	0	n/a
Relocation					
Transferred In	0	0	0	0	n/a
Transferred Out	0	0	0	0	n/a
Planted/Released	1	694	23	0	n/a
Ending Inventory (December 31, 2014)	0	13	812	1,378	1,493[a]

[a] December 2014 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 for three brood years of captive Sockeye Salmon production groups during 2014.

	Culture Groups						
	BY12 Sawtooth	**BY12 Oxbow**	**BY13 Sawtooth**	**BY13 Oxbow**	**BY13 Springfield**	**BY14 Oxbow**	**BY14 Springfield**
Starting Inventory (January 1, 2014)	173,106	122,660	203,201	92,656	248,972	120,070[a]	658,974[a]
Eyed egg to Fry							
Undetermined[b]	n/a	n/a	67,225	22,830	31,610	n/a	n/a
Mechanical Loss							
Handling	0	0	0	0	0	n/a	n/a
Jump-out	0	0	0	0	0	n/a	n/a
Transportation	0	0	0	0	0	n/a	n/a
Noninfectious							
Lymphosarcoma	0	0	0	0	0	n/a	n/a
Nephroblastoma	0	0	0	0	0	n/a	n/a
Other[c]	404	263	1,142	0	2,258	n/a	n/a
Infectious							
Bacterial	0	0	0	0	0	n/a	n/a
Viral	0	0	0	0	0	n/a	n/a
Other	0	0	0	0	0	n/a	n/a
Maturation							
Mature Males	0	0	0	0	0	n/a	n/a
Mature Females	0	0	0	0	0	n/a	n/a
Other	0	0	0	0	0	n/a	n/a
Relocation							
Transferred In	0	0	0	0	0	n/a	n/a
Transferred Out	0	0	0	0	0	n/a	n/a
Planted/Released	172,702	122,397	0	0	0	n/a	n/a
Ending Inventory (December 31, 2014)	0	0	134,834	76,205	215,104	120,070	658,974

[a] December 2014 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 2014 Sockeye Salmon spawning activities at Eagle Fish Hatchery.

Spawning Cross*		No. of Green	No. of	Mean Egg Survival	Median Egg Survival
Female	**Male**	**Eggs Taken**	**Eyed eggs**	**to Eyed-Stage**	**to Eyed-Stage**
ANH14	ANH14	388,801	324,834	83.55%	90.83%
ANH14	BY11	109,792	83,350	75.92%	91.13%
ANH14	BY12	21,649	17,150	79.22%	92.86%
BY11	ANH14	52,675	45,823	86.99%	94.30%
BY11	BY11	150,515	122,233	81.21%	94.09%
BY11	BY12	21,106	13,808	65.42%	87.87%
	TOTALS	**744,538**	**607,198**	**81.55%**	**91.85%**

Note:* ANH14 refers to anadromous adults returning in 2014.
BY10 refers to captive adults produced in spawn year 2010.
BY11 refers to captive adults produced in spawn year 2011.
BY12 refers to captive adults produced in spawn year 2012.

Table 4. Calendar year 2014 anadromous 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	1,516	1,479	34	3
Anadromous males	801	773	25	3
Anadromous females	714	705	9	0
Anadromous Unk. sex	1	1	0	0
Unmarked adults[e]	453	443	10	0
Unmarked/CWT adults[d]	1,023	1,007	13	3
AD-clipped adults[d]	14	8	6	0
AD-clipped/CWT adults[d]	25	20	5	0
Unknown mark	1	1	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 eyed eggs retained for brood year 2014 captive broodstock development at Eagle Fish Hatchery.

Family Cross*		No. of Eyed eggs Retained for Eagle Broodstock
Female	**Male**	
ANH14	ANH14	664
ANH14	BY11	178
ANH14	BY12	30
BY11	ANH14	152
BY11	BY11	415
BY11	BY12	54
	TOTAL	1,493

Note:* ANH14 refers to anadromous adults returning in spawn year 2014.
BY10 refers to captive adults produced in spawn year 2010.
BY11 refers to captive adults produced in spawn year 2011.
BY12 refers to captive adults produced in spawn year 2012.

Table 6. Sockeye Salmon releases made to Sawtooth Valley waters in 2014.

Release Location	Strategy (Brood Year)	Release Date	Number Released	Number PIT Tagged	Marks[a]	Release Weight (g)	Rearing Location
Redfish Lake Cr	smolt (2012)	5/9/14	172,090	49,881	Ad	22.7	IDFG Sawtooth FH
Redfish Lake Cr	smolt (2012)	5/8/14	121,881	2,047	Ad	36.0	ODFW Oxbow FH
Redfish Lake Cr	smolt (2012)	5/8/14	1,290	0	Ad	47.0	NOAA Burley Cr.
Redfish Lake Cr	smolt (2012)	5/8/14	612	452	Ad	25.5	IDFG Sawtooth FH
Redfish Lake Cr	smolt (2012)	5/8/14	516	396	Ad	28.3	ODFW Oxbow FH
Redfish Lake	adult (2010)	9/16/14	21	21	Ad	1,553	NOAA Burley Cr.
	(2011)	9/16/14	261	261	Ad	894	NOAA Burley Cr.
Redfish Lake	adult (2010)	9/10/14	1	1	Ad	1,200	IDFG Eagle FH
	(2011)	9/10/14	694	694	Ad	1,050	IDFG Eagle FH
	(2012)	9/10/14	23	23	Ad	400	IDFG Eagle FH
	(ANH14)[b]	NA	1,073	104	Mix	1,132	ANH14 Release
Pettit Lake	adult (2010)	9/16/14	10	10	Ad	1,370	NOAA Burley Cr.
	(2011)	9/16/14	88	88	Ad	965	NOAA Burley Cr.

[a] Ad = adipose fin clip; CWT = Coded Wire Tag

[b] ANH14 refers to anadromous returning Sockeye Salmon in 2014; representing brood years 2009, 2010, and 2011.

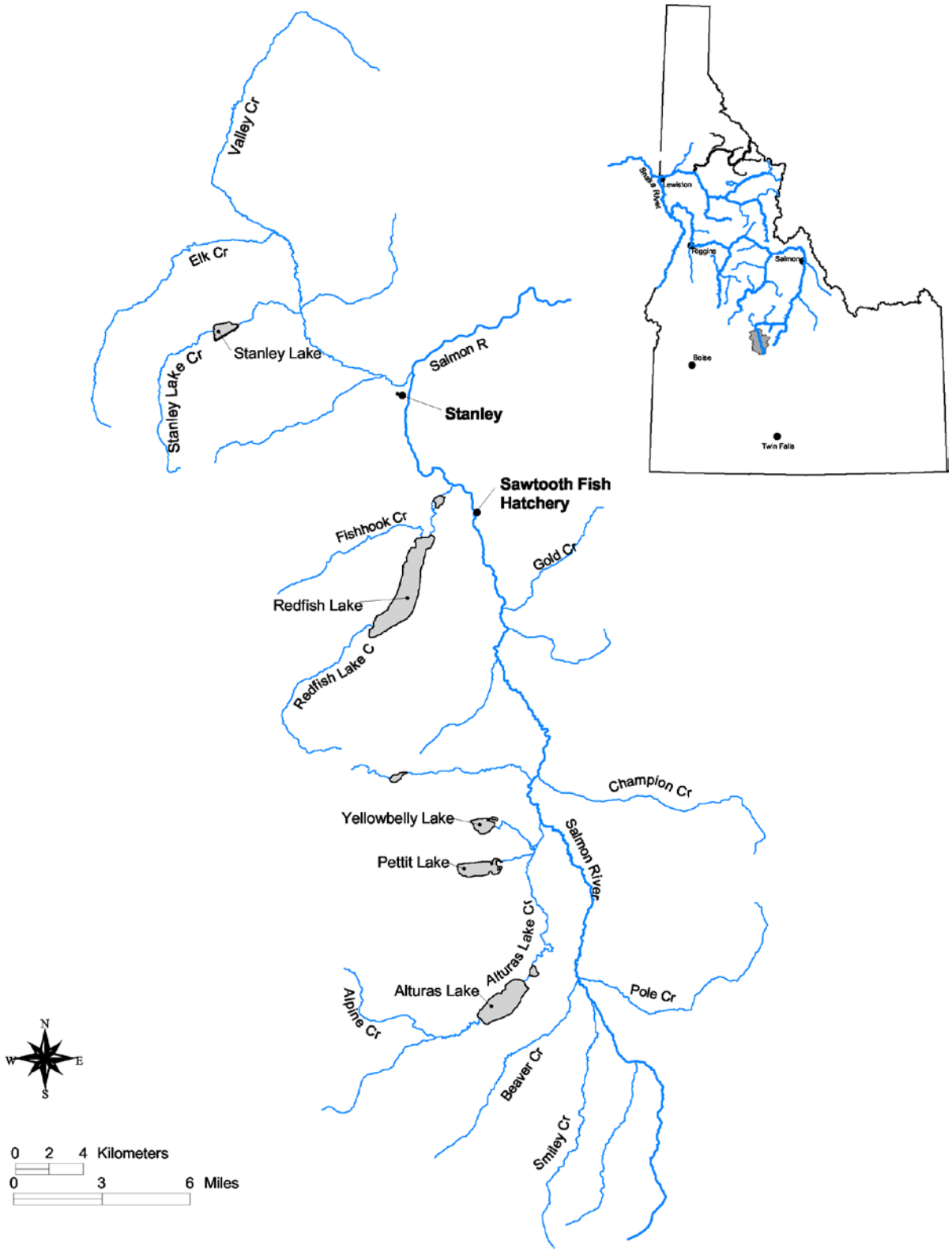

Figure 1. Sawtooth Valley study area.

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