

FISHERY RESEARCH



SNAKE RIVER SOCKEYE SALMON CAPTIVE BROODSTOCK PROGRAM HATCHERY ELEMENT

**2012 ANNUAL PROGRESS REPORT
January 1, 2012—December 31, 2012**



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

Project Progress Report

2012 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 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, 2012 and December 31, 2012 for the hatchery element of the program are presented in this report.

In 2012, 257 anadromous sockeye salmon returned to the Sawtooth Valley. The weir on the upper Salmon River at the Sawtooth Fish Hatchery intercepted 135 sockeye salmon adults while the Redfish Lake Creek trap intercepted 107 sockeye. Fish were captured between July 25 and September 20, 2012. The adult sockeye salmon (112 females, 130 males, 15 unknown) originated from a variety of release strategies, as evidenced by mark types. Sixty-three (31 females and 32 males) anadromous sockeye remained at Eagle Fish Hatchery for incorporation into the spawning matrix.

Thirty anadromous females, two brood year 2010, 88 brood year 2009, and one brood year 2008 captive females were spawned at the Eagle Fish Hatchery in 2012. Spawn pairings produced approximately 211,954 eyed eggs with egg survival to eyed stage of development averaging 87.14%.

Presmolts (11,354), smolts (166,652), and adults (796) were planted or released into Sawtooth Valley waters in 2012. Reintroduction strategies involved releases to Redfish Lake and Redfish Lake Creek.

During this reporting period, six broodstocks and seven unique production groups were in culture at Idaho Department of Fish and Game (Eagle Fish Hatchery and Sawtooth Fish Hatchery) and Oregon Department of Fish and Wildlife (Oxbow Fish Hatchery) facilities. Four of the six broodstocks were incorporated into the 2012 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. 1120, 1124, and 1481 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; and Baker et al. 2011b).

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 1120, 1124, and 1481. This report details fish culture information collected between January 1 and December 31, 2012.

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. The water system was modified in 2002; three of the five wells were abandoned. A new well was developed and brought online in April of 2003. 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. In 2008, construction on a new captive broodstock building and modifications to the water delivery system from wells #1 and #2 was completed. The new building allows the captive broodstock to double (from 400 to 800 per year class) and provide isolated holding for anadromous sockeye adults. Water chilling capability was added at Eagle FH in 1994 with a second chiller added in 2008. Chiller capacity accommodates incubation, a portion of fry rearing, and a portion of adult holding needs. Backup and system redundancy is in place for degassing, pumping, and power generation. The alarm system was modified in 2008 and currently includes seven alarms tied to the water system and two alarms tied to chiller operation, with alarms linked through an emergency service contractor. 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 has increased to accommodate future eyed egg requests for Springfield Fish Hatchery (Springfield FH). Thirty-six, eight tray vertical stack incubators were added in 2011, which can hold approximately 1,000,000 green eggs. 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 from fry to the adult stage. These include 1) 0.7 m diameter semisquare tanks (0.09 m³); 2) 1.0 m diameter semisquare tanks (0.30 m³); 3) 2.0 m diameter semisquare tanks (1.42 m³); 4) 3.0 m diameter circular tanks (6.50 m³); and 5) 4.0 m diameter semisquare tanks (8.89 m³). Typically, 0.7 m and 1.0 m tanks are used for rearing fry from ponding to approximately 10.0 g weight. Two-meter tanks are used to rear juveniles to approximately 50.0 g 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 captive broodstock program, including 1) prespawm 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. Typically, juvenile sockeye salmon reared at Sawtooth FH are released as presmolts or smolts. Prespawm 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 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 (>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 and the Salmon River. Rearing protocols are established cooperatively between IDFG and ODFW 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 1120 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 2012, fish were fed commercial diets produced by Skretting Inc. (Bio-Oregon) or EWOS® Canada LTD (EWOS). A third starter feed developed by Abernathy Fish Research Center was fed to part of the BY11 fry to address feed palatability issues. The BY07 sockeye captive broodstock were fed Bio-Oregon feeds in 2012. The BY08, BY09, and BY10 sockeye 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/m³. Age-3 and age-4 rearing densities were maintained at levels not exceeding 14.0 kg/m³.

Incubation and rearing water temperature was maintained between 7.0°C and 13.5°C. Chilled water (7.0°C to 10.0°C) was used during incubation and early rearing to equalize development and growth differences that resulted from a protracted spawning period. Rearing water temperature varied as a function of demand, but was generally maintained between 10.0°C and 12.0°C throughout much of the age-2, age-3, age-4, and age-5 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; and Baker et al. 2011b). Before 1994, adult sockeye returns were spawned at the Sawtooth FH (Johnson 1993). Spawning activities in 2012 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. 1120 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 2012, 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 *Parvicapsula minibicornis* and 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.

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 2012, sockeye salmon were reintroduced to Sawtooth Valley waters as presmolts, smolts, and prespaw adult.

Sockeye salmon presmolts were distributed to Sawtooth Valley lakes in truck-mounted transportation tanks. Fish were transferred from truck-mounted tanks to oxygenated tanks mounted on watercraft for pelagic releases. Transport tanks were tempered to receiving water temperatures prior to the release of fish.

Sockeye salmon smolts were distributed to Sawtooth Valley waters using truck-mounted transportation tanks. In 2012, 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 prespaw 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 seven production groups were in culture at IDFG facilities representing brood years 2007, 2008, 2009, 2010, 2011, and 2012. 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., BY07 refers to brood year 2007).

BY07 Broodstock

One hundred forty-six females and 148 males were spawned at Eagle FH between October 4 and November 6, 2007 to generate 236,393 green eggs. Four hundred thirty-nine unique subfamilies were developed from BY07 spawn crosses at the Eagle FH. To simplify tracking, families were grouped under one production group title: BY07. The BY07 production group was developed using male sockeye salmon from the BY03, BY04, and BY05 captive broodstock, and the two anadromous males that returned to the Sawtooth Valley (ANH07). Female sockeye salmon represented in spawn crosses for 2007 included captive broodstock from BY03 (one female), BY04 (143 females), and the two anadromous females (ANH07) that returned to the Sawtooth Valley in 2007. Specific crosses performed to develop this production group included: 1) BY03 females x BY04 males, 2) BY04 females x BY03 males, 3) BY04 females x BY04 males, 4) BY04 females x BY05 males, 5) BY04 females x ANH07 males, 6) ANH07 females x BY04 males, and 7) ANH07 females x CRYO males.

Approximately 1,199 eyed eggs representing 382 subfamilies (146 unique females and 148 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 (799 total) remaining at Eagle FH and the third group (400 total) transferred to NOAA's Burley Creek FH. Starting inventory at Eagle FH was four fish. During 2012, there were three mortalities and one male sockeye matured. This fish was incorporated into the spawning matrix. Ending inventory of BY07 broodstock at Eagle FH was zero fish (Table 1).

BY08 Broodstock

One hundred fifteen females and 180 males were spawned at Eagle FH between October 2 and November 6, 2008 to generate 241,220 green eggs. Three hundred forty-five unique subfamilies were developed from BY08 spawn crosses at the Eagle FH. To simplify tracking, families were grouped under one production group title: BY08. The BY08 production group was developed using male sockeye salmon from the BY04 (two males) and BY05 (144 males) captive broodstock and 34 anadromous males that returned to the Sawtooth Valley (ANH08). Female sockeye salmon represented in spawn crosses for 2008 included captive broodstock from BY04 (one female), BY05 (75 females), and 39 anadromous females (ANH08) that returned to the Sawtooth Valley in 2008. Specific crosses performed to develop this production group included: 1) BY04 females x BY05 males, 2) BY05 females x BY04 males, 3) BY05 females x BY05 males, 4) BY05 females x ANH08 males, 5) ANH08 females x ANH08 males, and 6) ANH08 females x BY05 males. Spawn crosses produced approximately 241,220 green and 220,334 eyed eggs. Brood year 2004 female fecundity averaged 1,896 green eggs per female, BY05 female fecundity averaged 1,807 eggs per female, and ANH08 female

fecundity averaged 2,661 green eggs per female. Egg survival to the eyed stage of development for the BY08 production group averaged 91.34% (median 97.48%). In 2008, of the 73 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, all were found to be negative for infectious hematopoietic necrosis virus (IHNV).

Approximately 1,482 eyed eggs representing 340 subfamilies (115 unique females and 178 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 (988 total) remaining at Eagle FH and the third group (494 total) transferred to NOAA Fisheries. Starting inventory at Eagle FH was 13 fish. During 2012, there were five mortalities and eight sockeye matured (three females and five males). Of the sockeye that matured, three (one female and two males) were incorporated into the spawning matrix and five (two females and three males) were released to Redfish Lake for volitional spawning. Ending inventory of BY08 broodstock at Eagle FH was zero fish (Table 1).

BY09 Broodstock

One hundred sixty-two females and 217 males were spawned at Eagle FH between September 18 and November 9, 2009 to generate 326,309 green eggs. Four hundred eighty-six unique subfamilies were developed from BY09 spawn crosses at the Eagle FH. To simplify tracking, families were grouped under one production group title: BY09. The BY09 production group was developed using male sockeye salmon from the BY05 (three males) and BY06 (147 males) captive broodstock and 67 anadromous males that returned to the Sawtooth Valley (ANH09). Female sockeye salmon represented in spawn crosses for 2009 included captive broodstock from BY06 (105 females) and 57 anadromous females (ANH09) that returned to the Sawtooth Valley in 2009. Specific crosses performed to develop this production group included: 1) ANH09 females x ANH09 males, 2) ANH09 females x BY05 males, 3) ANH09 females x BY06 males, 4) BY06 females x ANH09 males, 5) BY06 females x BY05 males, and 6) BY06 females x BY06 males. Spawn crosses produced approximately 326,309 green and 290,968 eyed eggs. Brood year 2006 female fecundity averaged 1,616 green eggs per female and ANH09 female fecundity averaged 2,749 green eggs per female. Egg survival to the eyed stage of development for the BY09 production group averaged 89.17% (median 95.65%). In 2009, of the 124 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, all were found to be negative for infectious hematopoietic necrosis virus (IHNV).

Approximately 1,546 eyed eggs representing 476 subfamilies (159 unique females and 215 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 (1,031 total) remaining at Eagle FH and the third group (515 total) transferred to NOAA Fisheries. Starting inventory at Eagle FH was 732 fish. During 2012, there were 189 mortalities and 539 sockeye matured (240 females and 299 males). Of the sockeye that matured, 173 (88 females and 85 males) were incorporated into the spawning matrix and 366 (152 females and 214 males) were released to Redfish Lake for volitional spawning. Ending inventory of BY09 broodstock at Eagle FH was four fish (Table 1).

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 4). In 2010, of the 89 anadromous adults transferred to Eagle FH and incorporated into the spawning matrix, 37 sockeye (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 the BY10 broodstock group was 581 fingerlings. There were 14 mortalities and 37 maturing sockeye. Two females and 32 males were incorporated into the spawning matrix during 2012 and three mature males were not used for spawning. Ending inventory for BY10 broodstock at Eagle FH was 530 fish (Table 1).

BY10 Production

Initial inventory for the BY10 smolt production group at Sawtooth FH was 80,733 fingerlings. On May 10, 2012, smolts were released to Redfish Lake Creek (80,130 smolts averaging 8.9 grams/fish). All smolts released were coded-wire tagged and 52,167 smolts were PIT tagged. Ending inventory at Sawtooth FH was zero fish (Table 2).

Initial inventory for the BY10 production group at Oxbow FH was 86,326 fingerlings. On May 10, 2012, smolts were released to Redfish Lake Creek (85,741 smolts averaging 51.3 grams/fish). All smolts were coded-wire tagged and 10,551 were PIT tagged. Ending inventory at Oxbow FH was zero fish (Table 2).

NOAA Fisheries released an additional 781 smolts that were in excess of broodstock and adult release production needs. Smolts averaged 100.0 grams/fish. All smolts were ad clipped and PIT tagged.

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 4). 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 1,237 eyed eggs/developing fry (Table 1). Mortality for the year was 85 fry. Ending inventory for the BY11 broodstock group was 1,152 fingerlings.

BY11 Production

Eagle FH transferred 191,689 BY11 production eggs to Sawtooth FH and NOAA Fisheries transferred 32,737 eyed eggs to Sawtooth FH for presmolt and smolt production. Ending inventory at Sawtooth FH was 175,151 fish (Table 2).

A total of 106,967 BY11 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 2013. Ending inventory for this production group at Oxbow FH was 101,417 fish (Table 2).

Initial inventory for the BY11 production group at Eagle FH was 12,624 eyed eggs/developing fry. Presmolts were released to Redfish Lake (11,354 fish averaging 7.0 grams/fish) on July 13, 2012. All presmolts were adipose fin-clipped and 1,502 presmolts were PIT tagged before release. Ending inventory at Eagle FH was zero fish (Table 2).

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 4). 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).

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. Future genetic identification of BY12 broodstock will be determined by utilizing microsatellite DNA markers. Starting inventory for BY12 broodstock at Eagle FH was 974 eyed eggs/developing fry (Table 1).

BY12 Production

Eagle FH transferred 209,485 BY12 production eggs to Sawtooth FH for smolt production. Ending inventory at Sawtooth FH was 209,485 eyed eggs (Table 2).

A total of 135,663 BY12 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 2014. Ending inventory for this production group at Oxbow FH was 135,663 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 12 to October 17, 2012. The second trap is located on the upper Salmon River at the Sawtooth FH weir and was operated from July 2 to September 14, 2012.

A total of 257 anadromous sockeye salmon returned to the Sawtooth Valley between July 25 and October 13, 2012. The weir on the upper Salmon River at the Sawtooth FH intercepted 135 sockeye salmon adults while the Redfish Lake Creek trap intercepted 107 sockeye (15 anadromous sockeye salmon were observed but not trapped in the Sawtooth Valley). Adult sockeye salmon captured in the Sawtooth Valley originated from a variety of release strategies, as evidenced by mark types (Table 3).

Residual sockeye trapping activities were not conducted in 2012 at Redfish Lake. Snorkeling to enumerate residual sockeye salmon spawners in Redfish Lake was conducted on October 8, October 15, and October 22, 2012. There were 12 residual sockeye salmon counted on the south end of the lake and two residual sockeye salmon counted on the Sockeye Beach transect during the 2012 observations.

In 2012, three anadromous Chinook salmon adults were observed at the Redfish Lake Creek trap. Two jack Chinook salmon were observed post spawn above the weir and one natural (un-marked) female Chinook salmon was trapped and released unharmed, upstream of the Redfish Lake Creek trap.

Year 2012 Spawning Activities

Results from 2012 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., BY07 refers to brood year 2007).

During the fall of 2012, one age-5 fish (one male) from BY07 broodstock, three age-4 fish (two males and one female) from BY08 broodstock, 173 age-3 fish (85 males and 88 females) from the BY09 broodstock, and 34 age-2 fish (32 males and two females) from BY10 broodstock matured at the Eagle FH and were incorporated into the spawning matrix; an additional one BY07 (one male) age-5 sockeye, an additional one BY08 (one male) age-4 sockeye, and 365 (214 males and 151 females) age-3 sockeye matured and were released to Redfish Lake. In addition, 59 anadromous sockeye salmon (29 males and 30 females) that returned to the Sawtooth Valley in 2012 (ANH12) were transferred to the Eagle FH and were incorporated into the spawning design.

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).

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 BY12 broodstock will be determined by utilizing microsatellite DNA markers. Spawn crosses represented in the Eagle FH BY12 broodstock are presented in Table 5.

Milt Cryopreservation

During 2012, no milt was cryopreserved.

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. One hundred thirty-five laboratory accessions involving 645 individual fish were processed in 2012. Laboratory accessions included samples from Eagle FH (128 accessions), Sawtooth FH (two accessions), Redfish Lake Creek (RFLC) out-migrant trap

(two accessions), Pettit Lake Creek out-migrant trap (two accessions), and Alturas Lake Creek screw trap (one accessions). Total fish sampled (645) included 523 fish from Eagle FH (one BY07, four BY08, 327 BY09, 44 BY10, 79 BY11, and 68 ANH12), 70 fish from Sawtooth FH (60 BY10 and 10 BY11), 24 fish from the RFLC trap (BY10 out-migrant smolts), 21 fish from Pettit Lake Creek trap (BY10 out-migrant smolts), and five fish from the Alturas Lake Creek screw trap (BY10 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 either presmolts or 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 2012. A total of 523 fish from calendar year 2012 captive broodstock (BY07, BY08, BY09, BY10, BY11) and ANH12 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 in 2012. Sixty fish from the BY10 overwinter smolt release group (Salmon River rearing) were tested in conjunction with standardized, prerelease fish health sampling protocols. Ten fish from the BY11 sockeye smolt group were sampled. All virology samples from these production sockeye groups resulted in negative detection of viral pathogens for 2012. Twenty-four BY10 out-migrating smolts from the Redfish Lake Creek trap, 21 BY10 out-migrating smolts from the Pettit Lake Creek trap, and five BY10 out-migrating smolts from the Alturas Lake Creek screw 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 270 (121 females, 149 males) fish from calendar year 2012 broodstock crosses (BY07, BY08, BY09, BY10, and ANH12 spawners) at Eagle FH were sampled for BKD via enzyme-linked immunosorbent assay (ELISA) techniques in 2012. Eagle FH captive broodstock was negative for BKD (211 sampled) and one of the 59 anadromous broodstock spawners tested positive for the presence of this pathogen (optical density 0.110). Prerelease inspections were completed on 60 BY10 reared at Sawtooth FH with no pathogens detected. Natural and hatchery out-migrants were sampled at Redfish, Alturas, and Pettit lakes in 2012. Bacterial Kidney Disease was detected in one of three (five fish) pools sampled representing natural out-migrant sockeye smolts from Redfish Lake (optical density 0.203), one of one (five fish) pool sampled representing natural out-migrant sockeye smolts from Alturas Lake (optical density 0.120), and one of two (five fish and six fish) pools sampled representing natural out-migrant smolts from Pettit Lake (optical density 0.156). Bacterial Kidney Disease was detected in two of two (four fish and five fish) pools sampled representing hatchery out-migrant sockeye smolts from Redfish Lake (optical density 0.106 and 0.319) and one of two (five fish) pools sampled representing hatchery out-migrant smolts from Pettit Lake (optical density 0.113).

Aeromonas salmonicida, the causative agent of furunculosis, was not detected in anadromous adults in 2012. 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, smolt release groups from Sawtooth FH are routinely examined for *M. cerebralis*. Results from juvenile *O. nerka* sampled in 2012 tested for *M. cerebralis* via pepsin/trypsin digest (PTD) and polymerase chain reaction (PCR) testing methods were negative with the exception of one five fish pool from the Pettit Lake out-migrant smolt sample. A total of 110 juvenile *O. nerka* were sampled for *M. cerebralis* during 2012. Positive results have been confirmed in returning anadromous adults tested for *M. cerebralis* via PTD testing; this is consistent with positive detections in nine of the last eleven return years. In 2012, ten of 60 anadromous sockeye tested were positive for *M. cerebralis*.

The myxosporean parasite *Parvicapsula minibicornis* was sampled in 60 anadromous adult sockeye salmon during 2012. Detection of *P. minibicornis* was made by PCR at the EFHL. Two of 60 anadromous sockeye tested positive for the parasite. Ninety-nine of the 449 anadromous adults sampled since 2002 (initiation of sampling) have tested positive for this parasite. Detections of *P. minibicornis* in the Redfish Lake stock of anadromous sockeye salmon are consistent with results obtained by Dr. Jones for sockeye salmon of the Fraser River in British Columbia, Canada. *P. minibicornis* has been demonstrated to be contracted in the estuary before adult sockeye salmon enter the Columbia River mainstem.

In 2012, eggs and adult anadromous sockeye were treated 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 two groups of eyed eggs to NOAA Fisheries in 2012. The first group was transferred on November 28, 2012 (441 eyed eggs) and the second group was transferred on December 7, 2012 (1,054 eyed eggs). Eyed eggs were selected in two similar groups to represent future captive broodstock and adult release groups.

Eagle FH transferred 209,485 BY12 production eggs to the Sawtooth FH on November 28 and December 11, 2012. Fish that result from these transfers will be used for 2014 smolt release strategies in the Sawtooth Valley.

A total of 135,663 eyed eggs were transferred from NOAA's Burley Creek FH to ODFW's Oxbow FH for a 2014 smolt release (Table 2).

Eyed Egg and Fish Reintroductions

Sockeye salmon eyed eggs and fish were transferred and/or released to various locations in 2012. In all cases, the required state transfer permits were acquired prior to

shipping. Additionally, pursuant to Special Condition B. 9. of Permit No. 1120, IDFG received authorization from NOAA to conduct all production releases of sockeye salmon made in 2012 (Table 6). All sockeye salmon juveniles and adults released to Sawtooth Valley waters in 2012 were marked/tagged prior to release.

Adult Releases

Maturing adult sockeye salmon were released to Redfish Lake in September and October for volitional spawning. Anadromous adults were released to Redfish Lake between September 4 and October 13, 2012. A total of 173 anadromous adults (mean weight 1.35 kg/fish) were released. On September 19, 252 sockeye reared at NOAA Fisheries were released (mean weight 1.19 kg/fish). Eagle FH released 371 sockeye from the captive broodstock program (mean weight 1.38 kg/fish) on September 14, 2012 (Table 6). Efforts were made to release fish of equal sex ratios.

Smolt Releases

Smolts were released to the Salmon River on May 10, 2012. A total of 166,652 BY10 smolts were released below the smolt trap on Redfish Lake Creek. Brood year 2010 smolts were reared at ODFW's Oxbow FH (85,741), Sawtooth FH (80,130), and NOAA Fisheries Burley Creek FH (781). All smolts reared at Oxbow FH and Sawtooth FH were coded-wire tagged. A smolt survival study continued in 2012 (began 2009) by the U.S. Army Corps of Engineers, increasing the number of PIT-tagged fish in the Oxbow FH and Sawtooth FH release groups. A total of 10,551 smolts were tagged at Oxbow FH and 52,167 smolts were tagged at Sawtooth FH (Table 6).

Presmolt Releases

Presmolt releases to Sawtooth Valley lakes were conducted in July 2012 at mid-lake (pelagic) locations with the aid of the IDFG trawl boat and specially built tank. All presmolts were from BY11 and were reared at IDFG's Eagle FH. Presmolts from Eagle FH were released to Redfish Lake on July 13, 2012. A total of 11,354 presmolts averaging 7.0 grams/fish were released (1,502 were PIT tagged; Table 6).

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Table 1. Summary of losses and magnitude of mortality for seven captive sockeye salmon broodstock groups during 2012.

	Captive Broodstock Groups					
	BY07	BY08	BY09	BY10	BY11	BY12
Starting Inventory (January 1, 2012)	4	13	732	581	1,237	974 ^a
<u>Eyed egg to Fry</u> Undetermined ^b	n/a	n/a	n/a	n/a	64	n/a
<u>Mechanical Loss</u>						
Handling	0	0	0	0	0	n/a
Jump-out	0	0	0	0	0	n/a
Transportation	0	0	0	0	0	n/a
<u>Noninfectious</u>						
Lymphosarcoma	0	0	0	0	0	n/a
Nephroblastoma	0	0	0	0	0	n/a
Other ^c	2	4	178	14	21	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	1	2	85	32	0	n/a
Mature Females	0	1	88	2	0	n/a
<u>Maturation Nonspawners</u>						
Mature Males	0	1	8	3	0	n/a
Mature Females	0	0	3	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	1	5	366	0	0	n/a
Ending Inventory (December 31, 2012)	0	0	4	530	1,152	974

^a December 2012 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 2012.

	Culture Groups						
	BY10 Sawtooth	BY10 Oxbow	BY11 Sawtooth	BY11 Oxbow	BY11 Eagle	BY12 Sawtooth	BY12 Oxbow
Starting Inventory (January 1, 2012)	80,733	86,326	195,608	106,967	12,624	209,485 ^a	135,663 ^a
<u>Eyed egg to Fry</u> Undetermined ^b	n/a	n/a	6,263	3,602	1,051	n/a	n/a
<u>Mechanical Loss</u>							
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
<u>Noninfectious</u>							
Lymphosarcoma	0	0	0	0	0	n/a	n/a
Nephroblastoma	0	0	0	0	0	n/a	n/a
Other ^c	603	585	14,194	1,948	219	n/a	n/a
<u>Infectious</u>							
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
<u>Maturation</u>							
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
<u>Relocation</u>							
Transferred In	0	0	0	0	0	n/a	n/a
Transferred Out	0	0	0	0	0	n/a	n/a
Planted/Released	80,130	85,741	0	0	11,354	n/a	n/a
Ending Inventory (December 31, 2012)	0	0	175,151	101,417	0	209,485	135,663

^a December 2012 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. Calendar year 2012 anadromous sockeye salmon adult return summary.

Summary category	Total number trapped	Number trapped at RFLC^a weir	Number trapped at SFH^b weir	Number trapped at Other^c traps
All anadromous adults	242	107	135	0
Anadromous males	130	43	87	0
Anadromous females	112	64	48	0
Unmarked adults	61	44	17	0
Unmarked/CWT adults ^d	153	54	99	0
AD-clipped adults ^d	16	9	7	0
AD-clipped/CWT adults ^d	12	0	12	0

^a RFLC = Redfish Lake Creek.

^b SFH = Sawtooth Fish Hatchery.

^c HCD = Hells Canyon Dam adult trap.

^d AD = adipose fin clip and CWT = coded wire tag.

Table 4. Summary information for 2012 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				
ANH12	ANH12	22,736	22,375	98.41%	98.71%
ANH12	BY08	1,636	1,611	98.47%	97.19%
ANH12	BY09	29,294	23,464	80.10%	97.58%
ANH12	BY10	29,323	27,952	95.32%	97.99%
BY08	BY09	3,495	3,039	86.95%	86.95%
BY09	BY07	2,048	2,014	98.34%	98.19%
BY09	BY08	1,763	1,010	57.29%	48.46%
BY09	BY09	109,465	93,135	85.08%	95.09%
BY09	BY10	10,636	9,282	87.27%	94.72%
BY09	ANH12	31,115	27,173	87.33%	93.87%
BY10	BY10	1,712	899	52.51%	62.47%
TOTALS		243,223	211,954	87.14%	95.83%

Note:* ANH12 refers to anadromous adults returning in 2012.
 BY07 refers to captive adults produced in spawn year 2007.
 BY08 refers to captive adults produced in spawn year 2008.
 BY09 refers to captive adults produced in spawn year 2009.
 BY10 refers to captive adults produced in spawn year 2010.

Table 5. Parent family and number of eyed eggs retained for brood year 2012 captive broodstock development at Eagle Fish Hatchery.

Family Cross*		No. of Eyed eggs Retained for Eagle Broodstock
Female	Male	
ANH12	ANH12	64
ANH12	BY08	10
ANH12	BY09	101
ANH12	BY10	105
BY08	BY09	8
BY09	BY07	8
BY09	BY08	6
BY09	BY09	490
BY09	BY10	46
BY09	ANH12	136
TOTAL		974

Note:* ANH12 refers to anadromous adults returning in spawn year 2012.
 BY07 refers to captive adults produced in spawn year 2007.
 BY08 refers to captive adults produced in spawn year 2008.
 BY09 refers to captive adults produced in spawn year 2009.
 BY10 refers to captive adults produced in spawn year 2010.

Table 6. Sockeye salmon releases made to Sawtooth Valley waters in 2012.

Release Location	Strategy (Brood Year)	Release Date	Number Released	Number PIT Tagged	Marks ^a	Release Weight (g)	Rearing Location
Redfish Lake Cr	smolt (2010)	5/10/12	79,673	51,710	CWT	8.9	IDFG Sawtooth FH
Redfish Lake Cr	smolt (2010)	5/10/12	85,161	9,971	CWT	51.3	ODFW Oxbow FH
Redfish Lake Cr	smolt (2010)	5/10/12	781	781	Ad	100.0	NOAA Burley Cr. FH
Redfish Lake Cr	smolt (2010)	5/10/12	457	457	CWT	45.4	IDFG Sawtooth FH
Redfish Lake Cr	smolt (2010)	5/10/12	580	580	CWT	40.3	ODFW Oxbow FH
Redfish Lake (direct lake)	presmolt (2011)	7/13/12	11,354	1,502	Ad	7.0	IDFG Eagle FH
Redfish Lake	adult (2007)	9/19/12	2	2	Ad	1,854	NOAA Burley Creek FH
	(2008)	9/19/12	55	55	Ad	1,676	NOAA Burley Creek FH
	(2009)	9/19/12	195	195	Ad	1,055	NOAA Burley Creek FH
Redfish Lake	adult (2008)	9/14/12	5	5	Ad	1,555	IDFG Eagle FH
	(2009)	9/14/12	366	366	Ad	1,381	IDFG Eagle FH
	(ANH12) ^b	NA	173	26	Mix	1,350	ANH12 Release

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

^b ANH12 refers to anadromous returning sockeye salmon in 2012; representing brood years 2007, 2008, and 2009.

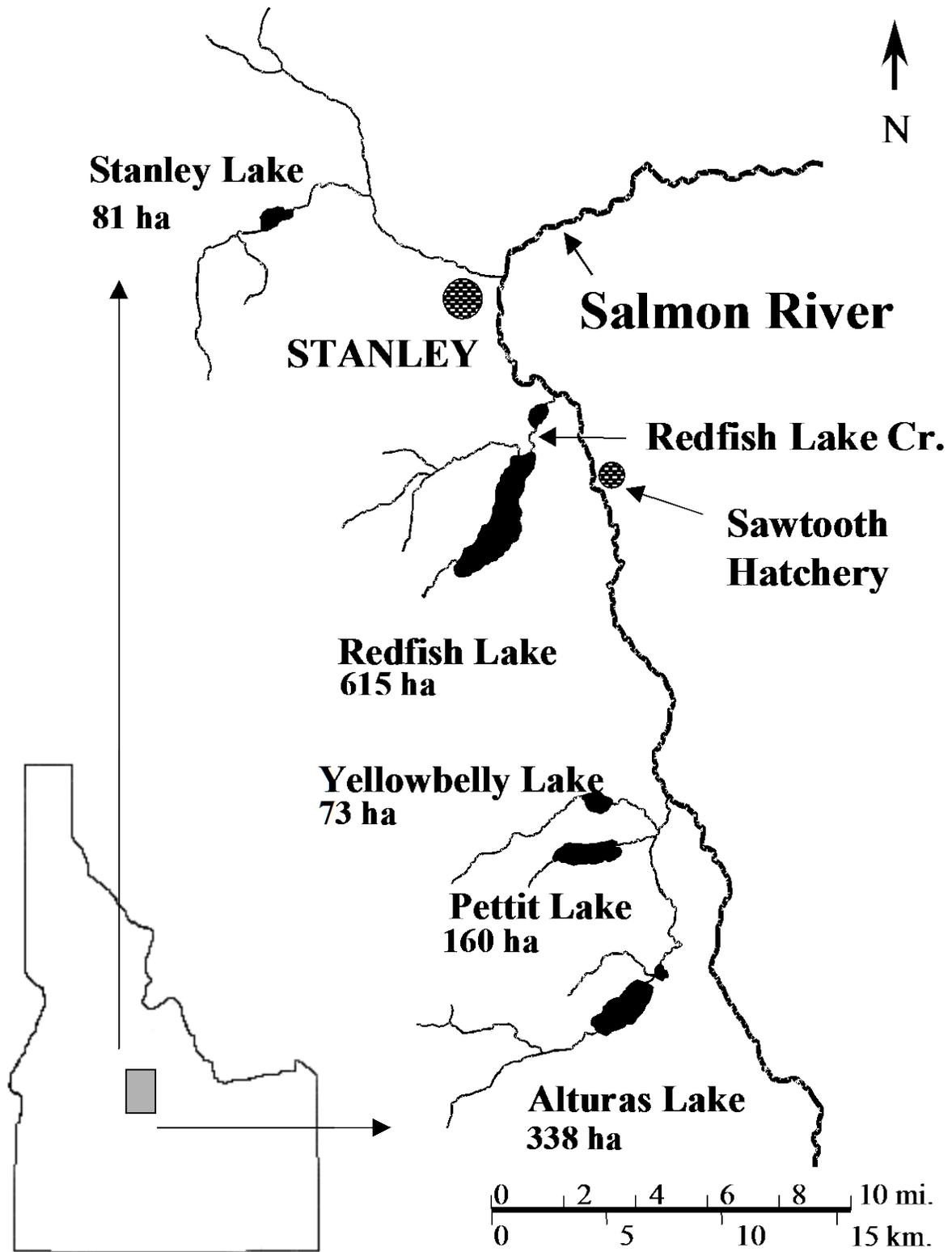


Figure 1. Sawtooth Valley study area.

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