FISHERY RESEARCH

SNAKE RIVER SOCKEYE SALMON CAPTIVE BROODSTOCK PROGRAM HATCHERY ELEMENT

2010 ANNUAL PROGRESS REPORT
January 1, 2010—December 31, 2010

Prepared by:

Dan J. Baker, Hatchery Manager II
Travis G. Brown, Assistant Hatchery Manager
Dan G. Green, Fish Culturist
and
Jeff A. Heindel, Conservation Hatchery Supervisor

IDFG Report Number 11-10
April 2011

Snake River Sockeye Salmon Captive Broodstock Program Hatchery Element

Project Progress Report

2010 Annual Report

By

Dan J. Baker
Travis G. Brown
Daniel G. Green
and
Jeff A. Heindel

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

To

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97283-3621

Project Number 2007-402-00
Contract Numbers 42983 & 47584

IDFG Report Number 11-10
April 2011

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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, 2010 and December 31, 2010 for the hatchery element of the program are presented in this report.

In 2010, 1,355 anadromous sockeye salmon returned to the Sawtooth Valley. The weir on the upper Salmon River at the Sawtooth Fish Hatchery intercepted 648 sockeye salmon adults while the Redfish Lake Creek trap intercepted 652 sockeye. Fish were captured between July 26 and October 7, 2010. Additionally, 19 sockeye were trapped at Lower Granite Dam and transported to Eagle FH (11 females, 8 males) between July 1 and July 15, 2010. An additional three sockeye were trapped at other facilities (two at the East Fork Salmon River and one at the Yankee Fork trap). The adult sockeye salmon (551 females, 771 males, 33 unknown) originated from a variety of release strategies, as evidenced by mark types. Ninety-seven (49 females and 48 males) anadromous sockeye remained at Eagle Fish Hatchery and were incorporated into the spawn matrices.

Forty-seven anadromous females, 87 brood year 2007, and one brood year 2006 captive females were spawned at the Eagle Fish Hatchery in 2010. Spawn pairings produced approximately 228,822 eyed eggs with egg survival to eyed stage of development averaging 84.11%.

Eyed eggs (59,683), presmolts (65,851), smolts (179,278), and adults (1,582) were planted or released into Sawtooth Valley waters in 2010. Reintroduction strategies involved releases to Redfish Lake, Alturas Lake, Pettit Lake, Redfish Lake Creek, and the upper Salmon River.

During this reporting period, six broodstocks and eight 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. Three of the six broodstocks were incorporated into the 2010 spawning design.

Authors:
Dan J. Baker
Hatchery Manager II

Dan G. Green
Fish Culturist

Travis G. Brown
Assistant Hatchery Manager

Jeff A. Heindel
Conservation Hatchery Supervisor

INTRODUCTION

Numbers of Snake River sockeye salmon *Oncorhynchus 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 & 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).

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, 2010.

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. A Hatchery Manager II position and residence was added in 2002. Three additional on-site residences occupied by IDFG hatchery personnel provide additional security by limiting public access.

Facility layout at Eagle FH remains flexible to accommodate culture activities ranging from spawning and incubation through adult rearing. Egg incubation capacity at Eagle FH is approximately 500,000 green eggs using current practices. Incubation is accomplished in small containers specifically designed for the program (Heindel et al. 2005) allowing for separation of individual subfamilies. Incubators are designed to distribute both upwelling and down-welling 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 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 (8.89 m^3). 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) 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) net pen fish rearing, 2) fish trapping and handling, and 3) fish transportation and release.

Eyed eggs, received at Sawtooth FH from Eagle FH or NOAA, are incubated in vertical-stack incubators. Fry are ponded into fiberglass troughs, juveniles are transferred to concrete vats, and overwinter smolts are reared in 200-foot raceways. Typically, juvenile sockeye salmon reared at Sawtooth FH are released as presmolts or smolts. Prespawn anadromous adults captured at Redfish Lake Creek or Sawtooth FH weirs are transferred from trap directly onto fish transport tanks and transferred to Eagle FH. Sockeye may by 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). Calendar year 2010 represents the seventh year that Oxbow FH personnel and facilities have been utilized for sockeye smolt rearing with the captive broodstock program.

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 participants at the SBSTOC level.

During 2010, fish were fed commercial diets produced by Skretting Inc. (Bio-Oregon) or EWOS® Canada LTD (EWOS). The BY06 and BY07 sockeye captive broodstock were fed Bio-Oregon feeds in 2010. The BY08 and BY09 sockeye captive broodstock were split into two identical 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, 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). Before 1994, adult sockeye returns were spawned at the Sawtooth FH (Johnson 1993). Spawning activities in 2010 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 was 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 2010, breeding plans relied on DNA microsatellite information versus pedigree information. Microsatellite data were generated from DNA samples at 13 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 Stanley Basin 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 and net pen fish transfers. 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 gallons/Liter (0.75 pounds/gallon).

Eyed Egg and Fish Supplementation

In 2010, sockeye salmon were reintroduced to Sawtooth Valley waters as eyed eggs, presmolts, smolts, and prespawn adults.

Eyed eggs were distributed to egg boxes manufactured by IDFG personnel specifically for this program. Plastic light baffle grids and plastic mesh netting partitioned egg box chambers and prevented eggs from falling into the biofilter ring medium until after hatch. Plastic mesh netting surrounded all egg boxes and allowed fish to volitionally emigrate following yolk absorption. Individual egg boxes accommodated approximately 3,000 eggs. Following loading, egg boxes were lowered to the lake substrate in approximately 3 m of water over known or suspected areas of lakeshore spawning.

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 and net pen introductions. 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 2010, sockeye salmon smolts were released in the outlet of Redfish Lake Creek downstream of the juvenile out-migrant weir and in the Salmon River upstream of the Sawtooth FH weir. Transport tanks were tempered to receiving water temperatures prior to the release of fish.

Prespawn adult sockeye salmon were distributed to Sawtooth Valley waters using truck-mounted transportation tanks. Adults have been introduced to Redfish Lake, Alturas Lake, and

Pettit Lake. To minimize stress, all prespawn adult releases were conducted at public access points at dusk. Transport tanks were tempered to receiving water temperatures prior to the release of fish.

RESULTS AND DISCUSSION

Fish Culture

During this reporting period, six broodstock and eight production groups were in culture at IDFG facilities representing brood years 2005, 2006, 2007, 2008, 2009, and 2010. 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., BY05 refers to brood year 2005).

BY05 Broodstock

Three hundred fifty-five unique subfamilies representing 121 females and 195 males were developed from BY05 spawn crosses at Eagle FH. To simplify tracking, families were grouped under one production group title: BY05. The BY05 production group was developed using male sockeye salmon from the BY01, BY02, and BY03 captive broodstock, female sockeye salmon from BY02 captive broodstock, as well as three anadromous males and two anadromous females (ANH05) that returned to the Sawtooth Valley in 2005. Specific crosses performed to develop this production group included: 1) BY02 females x BY01 males, 2) BY02 females x BY02 males, 3) BY02 females x BY03 males, 4) BY02 females x ANH05 males, 5) ANH05 females x BY02 males, and 6) ANH05 females x ANH05 males. Spawn crosses produced approximately 208,014 green and 145,207 eyed eggs. Brood year 2002 female fecundity was 1,706 green eggs per female and ANH05 female fecundity averaged 2,450 green eggs per female. Egg survival to the eyed stage of development for the BY05 production group averaged 69.81% (median 88.33%). In 2005, the six anadromous adults transferred to Eagle FH and incorporated into the spawning matrix were all found to be negative for infectious hematopoietic necrosis virus (IHNV).

Approximately 1,212 eyed eggs (three identical groups of 404 eyed eggs; one group of 404 was later transferred to Burley Creek Fish Hatchery) were segregated from production groups described above to create the BY05 broodstock representing 115 unique females and 179 unique males. Starting inventory at Eagle FH was one fish. There was no mortality during 2010, no fish matured. Ending inventory of BY05 broodstock at Eagle FH was one fish (Table 1).

BY06 Broodstock

One hundred eighty-one females and 177 males were spawned at Eagle FH between October 5 and November 2, 2006 to generate 332,675 green eggs. Five hundred forty unique subfamilies were developed from BY06 spawn crosses at the Eagle FH. To simplify tracking, families were grouped under one production group title: BY06. The BY06 production group was developed using male sockeye salmon from the BY02, BY03, and BY04 captive broodstock and one anadromous male that returned to the Sawtooth Valley (ANH06), female sockeye salmon from the BY03 captive broodstock and two anadromous females that returned to the Sawtooth

Valley in 2006 (ANH06). Specific crosses performed to develop this production group included: 1) BY03 females x BY02 males, 2) BY03 females x BY03 males, 3) BY03 females x BY04 males, 4) BY03 females x ANH06 males, and 5) ANH06 females x BY03 males. Spawn crosses produced approximately 332,675 green and 258,342 eyed eggs. Brood year 2003 female fecundity was 1,833 green eggs per female and ANH06 female fecundity averaged 2,248 green eggs per female. Egg survival to the eyed stage of development for the BY06 production group averaged 77.66% (median 90.78%). In 2006, the three anadromous adults transferred to Eagle FH and incorporated into the spawning matrix were all found to be negative for infectious hematopoietic necrosis virus (IHNV).

Approximately 1,200 eyed eggs representing 540 subfamilies (181 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 (800 total) remaining at Eagle FH and the third group (400 total) transferred to NOAA's Burley Creek FH. Starting inventory at Eagle FH was eight fish. There were two mortalities during 2010, four fish matured (two females and two males). Two (one female and one male) were released to Redfish Lake and the remaining mature sockeye (one female and one male) were incorporated into the spawning matrix. Ending inventory of BY06 broodstock at Eagle FH was two fish (Table 1).

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 439 fish. There were 46 mortalities during 2010; three hundred seventy-eight fish matured (173 females and 205 males). One hundred seventy-two (75 females and 97 males) were released to Redfish Lake and the remaining mature sockeye were incorporated into the spawning matrix (98 females and 108 males). Ending inventory of BY07 broodstock at Eagle FH was 15 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 758 fingerlings. During 2010, 14 males matured (10 incorporated into the spawning matrix) and there were 16 mortalities. The ending inventory of BY08 broodstock at Eagle FH was 728 fingerlings (Table 1).

BY08 Production

Spawning activities at Burley Creek FH and Eagle FH in 2008 produced 420,703 eyed eggs, which were distributed or released to represent the BY08 production and broodstock groups.

Initial inventory at Sawtooth FH was 99,789 fingerlings. Sawtooth FH released smolts to Redfish Lake Creek (99,392 at 16.1 g/fish) in May 2010. Ending inventory at Sawtooth FH was zero fish (Table 2).

Initial inventory at Oxbow FH was 80,209 fingerlings. A total of 79,886 smolts, averaging 42.4 g/fish, were released to Redfish Lake Creek in May 2010. Ending inventory at Oxbow FH was zero fish (Table 2).

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 eight-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 1,531 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 (988 total) remaining at Eagle FH and the third group (494 total) transferred to NOAA Fisheries.

Starting inventory for the BY09 broodstock group was 1,031 eyed eggs/developing fry. There were 267 mortalities during 2010. Ending inventory for BY09 brood at Eagle FH was 770 fingerlings (Table 2).

BY09 Production

Initial inventory for the BY09 production group at Sawtooth FH was 218,844 eyed eggs/developing fry. Presmolts were released on October 7, 2010 to Redfish Lake (31,413 fish averaging 2.9 grams/fish) and Pettit Lake (18,075 fish averaging 2.9 grams/fish). All presmolts released were adipose fin-clipped before release. Ending inventory at Sawtooth FH was 139,638 fingerlings (Table 2).

Initial inventory for the BY09 production group at Oxbow FH was 104,963 eyed eggs/developing fry. A failure in a valve in the rearing raceway resulted in a loss of approximately 40,000 fish. Ending inventory for this production group at Oxbow FH was 54,538 fingerlings (Table 2).

Initial inventory for the BY09 production group at Eagle FH was 19,820 eyed eggs/developing fry. Presmolts were released to Alturas Lake (16,363 fish averaging 11.4 grams/fish) on July 27, 2010. All presmolts were adipose fin-clipped and 1,319 presmolts were PIT tagged before release. Ending inventory at Eagle FH was zero fish (Table 2).

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. If juveniles remain negative for IHNV, presmolts will be released in July 2011.

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.

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 BY10 broodstock will be determined by utilizing microsatellite DNA markers. Ending inventory for BY10 broodstock at Eagle FH was 1,048 eyed eggs/developing fry (Table 1). Spawn crosses represented in the Eagle FH BY10 broodstock are presented in Table 4.

BY10 Production

Eagle FH transferred 98,857 BY10 production eggs to Sawtooth FH and NOAA Fisheries transferred 64,647 eyed eggs to Sawtooth FH for presmolt and smolt production. Ending inventory at Sawtooth FH was 163,504 eyed eggs (Table 3).

A total of 94,428 BY10 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 2012. Ending inventory for this production group at Oxbow FH was 94,428 eyed eggs/developing fry (Table 3).

Eagle FH maintained a production group for a late summer presmolt release. A total of 54,562 eyed eggs remain in culture at Eagle FH to represent this BY10 presmolt group (Table 2).

Eyed eggs were released to Alturas Lake on December 1, 8, and 16, 2010. Alturas Lake received a total of 59,683 BY10 eyed eggs (2,916 from NOAA Fisheries and 56,767 from Eagle FH) during 2010.

Due to the presence of IHNV in the anadromous sockeye broodstock, no eyed eggs were shipped to NOAA Fisheries for future captive broodstock. NOAA Fisheries' BY10 captive broodstock was sourced from spawn crosses made at their own facility. Results for BY10 spawn crosses conducted at NOAA Fisheries will be reported under a separate cover by that agency.

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 10 to October 12, 2010. The second trap is located on the upper Salmon River at the Sawtooth FH weir and was operated from June 3 to September 20, 2010.

In 2010, 1,355 anadromous sockeye salmon returned to the Sawtooth Valley. The weir on the upper Salmon River at the Sawtooth Fish Hatchery intercepted 648 sockeye salmon adults while the Redfish Lake Creek trap intercepted 652 sockeye. Fish were captured between July 26 and October 7, 2010. Additionally, 19 sockeye were trapped at Lower Granite Dam and transported to Eagle FH (11 females, 8 males) between July 1 and July 15, 2010. An additional three sockeye were trapped at other facilities (two at the East Fork Salmon River and one at the Yankee Fork trap). The adult sockeye salmon (551 females, 771 males, 33 unknown) originated from a variety of release strategies, as evidenced by mark types (Table 3).

Residual sockeye trapping activities were not conducted in 2010 at Redfish Lake. Snorkeling to enumerate residual sockeye salmon spawners in Redfish Lake was conducted weekly from October 12 to October 25, 2010. There were no residuals counted on the south end of the lake. The peak residual count for Sockeye Beach sites occurred on October 18, 2010 when two residuals were observed.

Two Chinook salmon *O. tshawytscha* adults were captured at the Redfish Lake Creek trap in 2010. These fish were transferred to Sawtooth FH to be included with the hatchery broodstock.

Year 2010 Spawning Activities

Results from 2010 Eagle FH spawning activities are reviewed below. Results from spawning activities conducted by NOAA personnel at Washington State facilities will appear separately by that agency. The year of development for specific broodstocks may appear abbreviated (e.g., BY05 refers to brood year 2005).

During the fall of 2010, two age-4 fish (one female, one male) from BY06 broodstock and 177 age-3 fish (87 females and 90 males) from the BY07 broodstock matured at the Eagle FH and were incorporated into the spawning matrix; an additional two BY06 (one female and one male) age-4 sockeye and 172 (75 females and 97 males) age-3 sockeye matured and were released to Redfish Lake. In addition, 89 anadromous sockeye salmon (47 females, 42 males) that returned to the Sawtooth Valley in 2010 (ANH10) were transferred to the Eagle FH and were incorporated into the spawning design.

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.

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 BY10 broodstock will be determined by utilizing microsatellite DNA markers. Spawn crosses represented in the Eagle FH BY10 broodstock are presented in Table 5.

Milt Cryopreservation

During 2010, no milt was cryopreserved.

Fish Health Investigations

The IDFG Eagle Fish Health Laboratory 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 seventeen laboratory accessions involving 594 individual fish were processed in 2010. Laboratory accessions included samples from Eagle Fish Hatchery (109 accessions), Sawtooth Fish Hatchery (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 (two accessions). Total fish sampled (594) included 423 fish from Eagle FH (two BY06, 218 BY07, 26 BY08, 65 BY09, and 112 ANH10), 120 fish from Sawtooth FH (60 BY08, 60 BY09), 20 fish from the RFLC trap (BY08 out-migrant smolts), 20 fish from Pettit Lake Creek trap (BY08 out-migrant smolts), and 11 fish from the Alturas Lake screw trap (BY08 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 laboratory 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 detected in the anadromous sockeye broodstock group tested at Eagle FH in 2010. A total of 266 fish from calendar year 2010 broodstock crosses (BY06, BY07, BY08, and ANH10 spawners) were sampled, with INHV detected in 40 of the 112 anadromous adults sampled. Additionally, two production sockeye groups reared at Sawtooth FH on both well water and Salmon River water were tested for viral pathogens in 2010. Sixty fish from the BY08 overwinter smolt release group (Salmon River rearing) and 60 fish from the BY09 fall presmolt release group (well water rearing) were tested in conjunction with standardized, prerelease fish health sampling protocols. All virology samples from Sawtooth FH production sockeye groups resulted in negative detection of viral pathogens for 2010. Twenty BY08 out-migrating smolts from the Redfish Lake Creek trap, 20 BY08 out-migrating smolts from the Pettit Lake Creek trap, and 11 BY08 out-migrating smolts from the Alturas Lake Creek screw trap were also sampled with no viral pathogens detected.

Of the 112 anadromous returning adults that were tested at Eagle in 2010, 40 sockeye tested positive for IHNV. Anadromous sockeye were kept in isolation from captive sockeye to reduce the risk of infecting the captive broodstock. Eggs from positive male or female sockeye crosses will remain in isolated rearing at Eagle FH. Mortalities will be monitored throughout the rearing cycle. If juveniles remain negative for IHNV, the sockeye will be released as presmolts in July 2011 to Stanley Basin lakes. Calendar year 2010 marks the second year in which anadromous adults tested positive for IHNV; calendar year 2004 marked the first detection of a viral pathogen in the Redfish Lake sockeye salmon stock when IHNV was detected in 17 of 24 anadromous adults that were trapped in 2004.

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 276 (135 females, 141 males) fish from calendar year 2010 broodstock crosses (BY06, BY07, BY08, and ANH10 spawners) at Eagle FH were sampled for BKD via enzyme-linked immunosorbent assay (ELISA) techniques in 2010. All Eagle FH captive broodstock spawners were sampled finding one of 187 positive for BKD (Low) and 25 of the 89 anadromous broodstock tested positive for the presence of this pathogen (12 low, one moderate, and 12 high). Eggs were culled from seven anadromous females that tested in the high range for BKD. Prerelease inspections were completed on 60 BY08 smolts and 60 BY09 presmolts reared at Sawtooth FH with no pathogens detected. Wild/natural and hatchery out-migrants were sampled at Redfish, Alturas, and Pettit lakes in 2010. Bacterial Kidney Disease was detected in one of two (five fish) pools sampled representing hatchery out-migrant sockeye smolts from Redfish Lake and one of two (five fish) pools sampled representing wild/natural out-migrant sockeye smolts from Redfish Lake. The Redfish Lake hatchery out-migrant five fish pools had an ELISA optical density value of 0.102 and the second pool was negative; the Redfish Lake wild/natural out-migrant pools had an ELISA optical density value of 0.110 and the second pool was negative. The Alturas Lake hatchery out-migrants, the Alturas Lake wild/natural out-migrants, the Pettit Lake hatchery out-migrants, and the Pettit Lake wild/natural out-migrants all tested negative for bacterial kidney disease.

Aeromonas spp. and/or *Flavobacterium* spp. were detected in nine of 35 anadromous adult sockeye salmon sampled in 2010. *Aeromonas salmoncida*, the causative agent of furunculosis, was not detected in anadromous adults in 2010. 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 and trawl efforts in Redfish, Pettit, and Alturas lakes are routinely examined for *M. cerebralis*. Results from juvenile *O. nerka* sampled in 2010 tested for *M. cerebralis* via pepsin/trypsin digest (PTD) and polymerase chain reaction (PCR) testing methods were negative for *M. cerebralis* (zero of 51 samples). Positive results have been confirmed in returning anadromous adults tested for *M. cerebralis* via PTD testing; this is consistent with positive detections in eight of the last ten return years. Six of seventy-eight anadromous sockeye tested were positive for *M. cerebralis*.

The myxosporean parasite *Parvicapsula minibicornis* was detected in three of 21 anadromous adult sockeye salmon sampled during 2010. Detection of *P. minibicornis* was made by PCR at the Eagle Fish Health Laboratory. Ninety-seven of the 389 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. *Parvicapsula minibicornis* has been demonstrated to be contracted in the estuary before adult sockeye salmon enter the Columbia River main stem.

In 2010, all anadromous adult sockeye salmon were examined for the presence of *Ceratomyxa shasta* and all results were negative for the pathogen, indicating that the *C. shasta* lifecycle has not become established in the upper Salmon River.

In 2010, 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 did not transfer eyed eggs to NOAA Fisheries in 2010, due to the presence of IHNV in the anadromous sockeye spawners.

Eagle FH transferred 98,857 BY10 production eggs to the Sawtooth FH on December 16, 2010 and January 4, 2011. NOAA's Burley Creek FH transferred 64,647 BY10 production eggs to Sawtooth FH on December 1 and 16, 2010. Fish that result from these transfers will be used for 2011 presmolt and 2012 smolt release strategies in Sawtooth Valley lakes and rivers.

A total of 94,428 eyed eggs were transferred from NOAA's Burley Creek FH to ODFW's Oxbow FH for a 2012 smolt release (Table 2).

Eyed Egg and Fish Reintroductions

Sockeye salmon eyed eggs and fish were transferred and/or released to various locations in 2010. 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 carryout all production releases of sockeye salmon made in 2010 (Table 6). All sockeye salmon juveniles and captive-reared adults released to Sawtooth Valley waters in 2010 were adipose fin-clipped prior to release.

Adult Releases

Maturing adult sockeye salmon were released to Redfish Lake in September 2010 for volitional spawning. Anadromous adults were released to Redfish Lake between August 11 and October 7, 2010. A total of 1,210 anadromous adults (mean weight 1.56 kg/fish) were released. On September 8 and 16, 198 sockeye reared at NOAA Fisheries were released (mean weight 1.12 kg/fish). Eagle FH released 174 sockeye from the captive broodstock program (mean weight 1.22 kg/fish) on September 15 and 17, 2010. Efforts were made to release fish of equal sex ratios.

Smolt Releases

Smolts were released to the Salmon River on May 4, 2010. A total of 118,780 BY08 smolts were released above the Sawtooth FH weir and 60,498 BY08 smolts were released below the smolt trap on Redfish Lake Creek. Rearing of these smolts was split between ODFW's Oxbow FH (79,886) and Sawtooth FH (99,392). All smolts reared at Oxbow FH and Sawtooth FH were coded-wire-tagged. A smolt survival study funded by the US Army Corps of Engineers continued in 2010 (began 2009) and dramatically increased the number of PIT tagged fish in the Oxbow FH and Sawtooth FH release groups. A total of 11,945 smolts were tagged at Oxbow FH and 51,661 smolts were tagged at Sawtooth FH (Table 6).

Presmolt Releases

Presmolt releases to Sawtooth Valley lakes were conducted in July and October 2010 at mid-lake (pelagic) locations with the aid of the IDFG trawl boat and specially-built tank. All presmolts were from BY09 and were reared at IDFG's Eagle and Sawtooth fish hatcheries. Presmolts from Eagle FH were released to Alturas Lake on July 27, 2010. A total of 16,363 presmolts averaging 11.4 grams/fish were released (1,319 were PIT tagged). On October 7, 2010, Pettit Lake received 18,075 presmolts reared at the Sawtooth FH. Fish from this group were adipose fin-clipped and had a mean weight of 2.9 grams per fish. On October 7, 2010, an additional 31,413 adipose fin-clipped presmolts (mean weight 2.9 grams/fish) were released to Redfish Lake (Table 6).

Eyed egg Planting

Program egg boxes were used to plant eyed eggs in Alturas Lake in 2010. Egg box trays were loaded with approximately 3,000 eyed eggs per unit and transferred to release sites in water-filled coolers. On December 1, 2010, approximately 17,751 eyed eggs were transferred to eyed egg boxes and planted in Alturas Lake (15,296 eyed eggs from Eagle FH and 2,455 eyed eggs from NOAA Fisheries). A second group of eyed eggs was released to Alturas Lake on December 8, 2010 (31,708 eyed eggs from Eagle FH). A third group of eyed eggs was released to Alturas Lake on December 16, 2010 (9,763 eyed eggs from Eagle FH and 461 eyed eggs from NOAA Fisheries; Table 6).

ACKNOWLEDGMENTS

We wish to thank the members of the Stanley Basin Sockeye Technical Oversight Committee for their involvement and input throughout the year. We would also like to thank Brent Snider and the entire staff at the Sawtooth FH and the staff from Oxbow FH (ODFW) for their assistance and support. Special thanks to Cheryl Zink for her technical assistance assembling the final document.

Table 1. Summary of losses and magnitude of mortality for six captive sockeye salmon broodstock groups during 2010.

	Broodstock Groups					
	BY05	**BY06**	**BY07**	**BY08**	**BY09**	**BY10**
Starting Inventory (January 1, 2010)	1	8	439	758	1,031	1,048[a]
Eyed egg to Fry						
Undetermined[b]	n/a	n/a	n/a	n/a	239	n/a
Mechanical Loss						
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
Non-infectious						
Lymphosarcoma	0	0	0	0	0	n/a
Nephroblastoma	0	0	0	0	0	n/a
Other[c]	0	2	46	16	28	n/a
Infectious						
Bacterial	0	0	0	0	0	n/a
Viral	0	0	0	0	0	n/a
Other	0	0	0	0	0	n/a
Maturation Spawners						
Mature Males	0	1	90	10	0	n/a
Mature Females	0	1	87	0	0	n/a
Maturation Non-Spawners						
Mature Males	0	0	18	4	0	n/a
Mature Females	0	0	11	0	0	n/a
Relocation						
Transferred In	0	0	0	0	0	n/a
Transferred Out	0	0	0	0	0	n/a
Planted/Released	0	2	172	0	0	n/a
Ending Inventory (December 31, 2010)	1	2	15	728	770	1,048

[a] December 2010 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 2010.

	Culture Groups							
	BY08 Sawtooth	**BY08 Oxbow**	**BY09 Sawtooth**	**BY09 Oxbow**	**BY09 Eagle**	**BY10 Sawtooth**	**BY10 Oxbow**	**BY10 Eagle**
Starting Inventory (January 1, 2010)	99,789	80,209	218,844	104,963	19,820	163,504[a]	94,428[a]	54,562[a]
Eyed egg to Fry								
Undetermined[b]	n/a	n/a	24,593	9,838	2,761	n/a	n/a	n/a
Mechanical Loss								
Handling	0	0	0	39,234	0	n/a	n/a	n/a
Jump-out	0	0	0	0	0	n/a	n/a	n/a
Transportation	0	0	0	0	0	n/a	n/a	n/a
Non-infectious								
Lymphosarcoma	0	0	0	0	0	n/a	n/a	n/a
Nephroblastoma	0	0	0	0	0	n/a	n/a	n/a
Other[c]	397	323	5,125	1,353	696	n/a	n/a	n/a
Infectious								
Bacterial	0	0	0	0	0	n/a	n/a	n/a
Viral	0	0	0	0	0	n/a	n/a	n/a
Other	0	0	0	0	0	n/a	n/a	n/a
Maturation								
Mature Males	0	0	0	0	0	n/a	n/a	n/a
Mature Females	0	0	0	0	0	n/a	n/a	n/a
Other	0	0	0	0	0	n/a	n/a	n/a
Relocation								
Transferred In	0	0	0	0	0	n/a	n/a	n/a
Transferred Out	0	0	0	0	0	n/a	n/a	n/a
Planted/Released	99,392	79,886	49,488	0	16,363	n/a	n/a	n/a
Ending Inventory (December31, 2010)	0	0	139,638	54,538	0	163,504	94,428	54,562

[a] December 2010 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.

Table 3. Calendar year 2010 anadromous sockeye salmon adult return summary.

Summary category	Total number trapped	Number trapped at RFLC[b] weir	Number trapped at SFH[a] weir	Number trapped at GRA[c] weir
All anadromous adults	1,319	652	648	19
Anadromous males	771	375	388	8
Anadromous females	548	277	260	11
Unmarked adults	178	148	28	2
AD-clipped adults[d]	91	54	37	0
AD-clipped/CWT adults[d]	394	334	50	10
AD/RV-clipped adults[d]	1	1	0	0
AD/LV-clipped adults[d]	39	1	38	0
AD/LV/CWT adults[d]	546	46	493	7
AD/RV/CWT adults[d]	70	68	2	0

[a] SFH = Sawtooth Fish Hatchery.
[b] RFLC = Redfish Lake Creek.
[c] AD = adipose fin clip; LV = left ventral fin clip; RV = right ventral fin clip; and CWT = coded wire tag.

Table 4. Summary information for 2010 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**				
ANH10	ANH10	63,312	62,651	98.96%	99.47%
ANH10	BY07	64,994	49,699	76.47%	98.50%
ANH10	BY08	3,267	3,251	99.51%	99.57%
BY06	BY07	1,032	947	91.76%	92.20%
BY07	ANH10	14,151	13,023	92.03%	95.62%
BY07	BY06	1,483	1,024	69.05%	95.42%
BY07	BY07	108,945	86,746	79.62%	89.04%
BY07	BY08	14,855	11,481	77.29%	92.40%
	TOTALS	**272,039**	**228,822**	**84.11%**	**94.21%**

Note:* ANH10 refers to anadromous adults returning in 2010.
BY06 refers to captive adults produced in spawn year 2006.
BY07 refers to captive adults produced in spawn year 2007.
BY08 refers to captive adults produced in spawn year 2008.

Table 5. Parent family and number of eyed eggs retained for brood year 2010 captive broodstock development at Eagle Fish Hatchery.

Family Cross*		No. of Eyed eggs Retained for Eagle Broodstock
Female	**Male**	
ANH10	ANH10	54
ANH10	BY07	108
ANH10	BY08	0
BY06	BY07	12
BY07	ANH10	20
BY07	BY06	12
BY07	BY07	754
BY07	BY08	88
TOTAL		**1,048**

Note:* ANH10 refers to anadromous adults returning in spawn year 2010.
BY06 refers to captive adults produced in spawn year 2006.
BY07 refers to captive adults produced in spawn year 2007.
BY08 refers to captive adults produced in spawn year 2008.

Table 6. Sockeye salmon releases made to Sawtooth Valley waters in 2010.

Release Location	Strategy (Brood Year)	Release Date	Number Released	Number PIT Tagged	Marks [a]	Release Weight (g)	Rearing Location
Salmon River (above SFH weir)	smolt (2008)	5/4/10	73,513	25,810	CWT	16.2	IDFG Sawtooth FH
Salmon River (above SFH weir)	smolt (2008)	5/4/10	45,267	5,983	CWT	42.4	ODFW Oxbow FH
Redfish Lake Cr	smolt (2008)	5/4/10	25,879	25,851	CWT	16.1	IDFG Sawtooth FH
Redfish Lake Cr	smolt (2008)	5/4/10	34,619	5,962	CWT	42.4	ODFW Oxbow FH
Alturas Lake (direct lake)	presmolt (2009)	7/27/10	16,363	1,319	Ad	11.4	IDFG Eagle FH
Pettit Lake (direct lake)	presmolt (2009)	10/7/10	18,075	0	Ad	2.9	IDFG Sawtooth FH
Redfish Lake (direct lake)	presmolt (2009)	10/7/10	31,413	0	Ad	2.9	IDFG Sawtooth FH
Redfish Lake	adult (2005)	9/8/10	10	10	Ad	3,243	NOAA Burley Creek FH
	(2006)	9/8/10	1	1	Ad	2,162	NOAA Burley Creek FH
	(2007)	9/8 & 9/16/10/10	187	187	Ad	1,009	NOAA Burley Creek FH
Redfish Lake	adult (2006)	9/15/10	2	2	Ad	926	IDFG Eagle FH
	(2007)	9/15 – 9/17/10	172	172	Ad	1,227	IDFG Eagle FH
	(ANH10)[b]	8/11 – 10/7/10	1,210	NA	Mix	1,565	Anadromous Release
Alturas Lake	eyed egg (2010)	12/1/10	2,455	-	-	-	NOAA Burley Creek FH
	(2010)	12/1/10	15,296	-	-	-	IDFG Eagle FH
	(2010)	12/8/10	31,708	-	-	-	IDFG Eagle FH
	(2010)	12/16/10	461				NOAA Burley Creek FH
	(2010)	12/16/10	9,763	-	-	-	IDFG Eagle FH

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

[b] ANH10 refers to anadromous returning sockeye salmon in 2010; representing brood years 2005, 2006, and 2007.

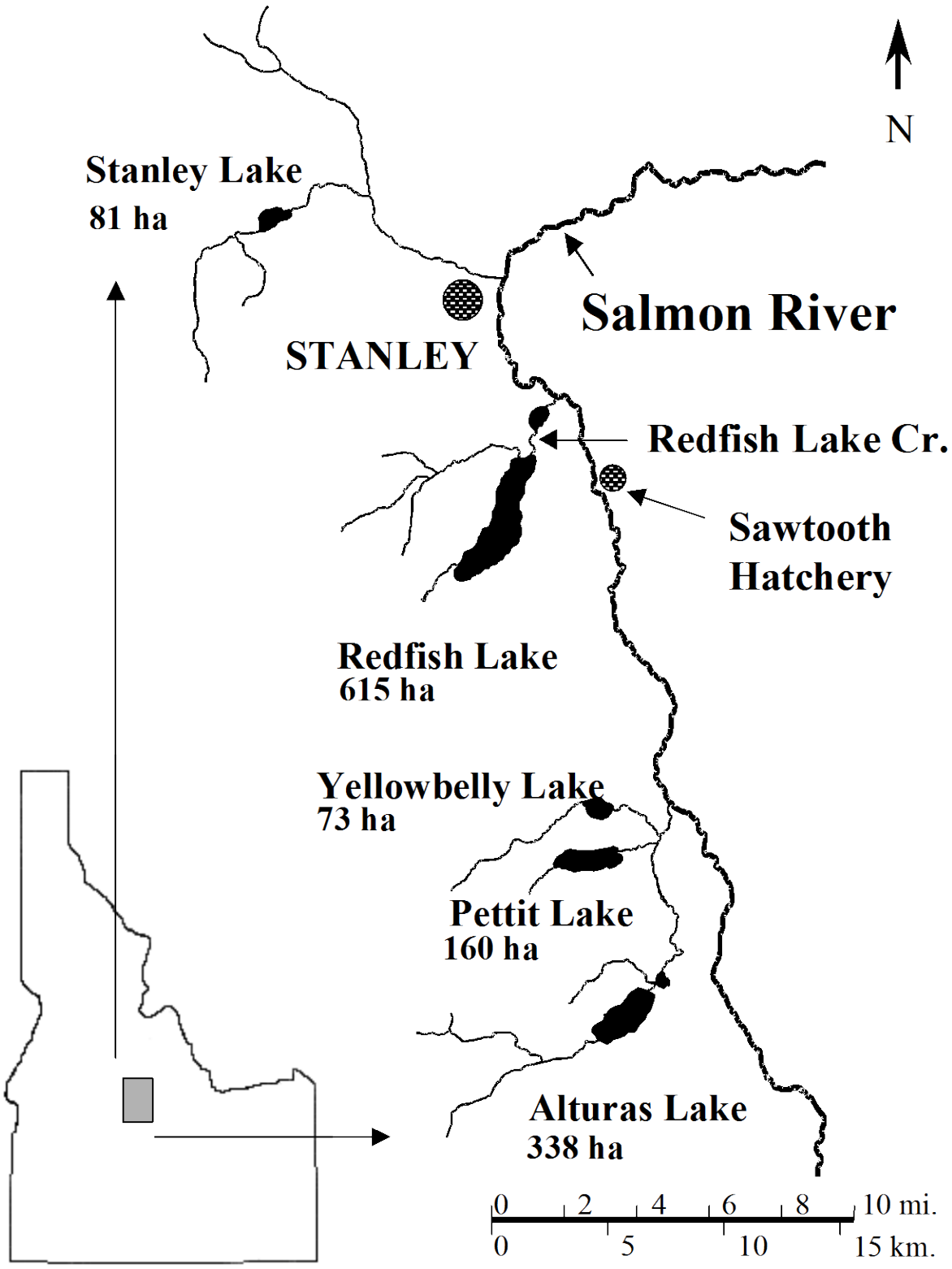

Figure 1. Sawtooth Valley study area.

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Prepared by:

Dan J. Baker
Hatchery Manager II

Travis G. Brown
Assistant Hatchery Manager

Dan G. Green
Fish Culturist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Jeff A. Heindel
Conservation Hatcheries Supervisor

Edward B. Schriever, Chief
Bureau of Fisheries