FISHERY RESEARCH

SNAKE RIVER SOCKEYE SALMON CAPTIVE BROODSTOCK PROGRAM HATCHERY ELEMENT

ANNUAL PROGRESS REPORT
January 1, 1999—December 31, 1999

Prepared by:

Dan J. Baker, Hatchery Manager II
Jeff A. Heindel, Assistant Hatchery Manager
Catherine C. Willard, Fisheries Research Biologist
and
Paul A. Kline, Principal Fisheries Research Biologist

IDFG Report Number 05-31
August 2005

Snake River Sockeye Salmon Captive Broodstock Program Hatchery Element

Project Progress Report

1999 Annual Report

By

Dan J. Baker
Jeff A. Heindel
Catherine C. Willard
Paul A. Kline

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 97028-3621

Project Number 91-72
Contract Number 00000167-00001

IDFG Report Number 05-31
August 2005

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

LIST OF APPENDICES

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 Marine Fisheries Service at two locations adjacent to Puget Sound in Washington State. Activities conducted by the Shoshone-Bannock Tribes and the National Marine Fisheries Service are reported under separate cover. Idaho Department of Fish and Game monitoring and evaluation activities of captive broodstock program fish releases are also reported under separate cover. Captive broodstock program activities conducted between January 1, 1999 and December 31, 1999 are presented in this report.

In 1999, seven anadromous sockeye salmon returned to the Sawtooth Valley and were captured at the adult weir located on the upper Salmon River. Four anadromous adults were incorporated in the captive broodstock program spawning design for year 1999. The remaining three adults were released to Redfish Lake for natural spawning. All seven adults were adipose and left ventral fin-clipped, indicating hatchery origin.

One sockeye salmon female from the anadromous group and 81 females from the captive broodstock group were spawned at the Eagle Fish Hatchery in 1999. Spawn pairings produced approximately 63,147 eyed-eggs with egg survival to eyed-stage of development averaging 38.97%.

Eyed-eggs (20,311), presmolts (40,271), smolts (9,718), and adults (21) were planted or released into Sawtooth Valley waters in 1999. Supplementation strategies involved releases to Redfish Lake, Redfish Lake Creek, upper Salmon River (below the Sawtooth Fish Hatchery weir), Alturas Lake, and Pettit Lake.

During this reporting period, four broodstocks and three production groups were in culture at the Eagle Fish Hatchery. Two of the four broodstocks were incorporated into the 1999 spawning design and one broodstock was terminated following the completion of spawning.

Authors:

Dan J. Baker
Hatchery Manager II

Jeff A. Heindel
Assistant Hatchery Manager

Catherine C. Willard
Fisheries Research Biologist

Paul A. Kline
Principal Fisheries Research Biologist

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 Yellow Belly) 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 Marine Fisheries Service (NMFS) received a petition from the Shoshone-Bannock Tribes (SBT) to protect Snake River sockeye under the Endangered Species Act (ESA) of 1973. On November 20, 1991, NMFS declared Snake River sockeye salmon endangered.

The Idaho Department of Fish and Game (IDFG) has established a management priority to re-establish sockeye salmon runs to historic areas, with emphasis placed on efforts to utilize Sawtooth Valley sockeye salmon resources. In 1991, the SBT, along with the 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 and 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. NMFS ESA Permit Nos. 1120, 1124, and 1233 authorize IDFG to conduct scientific research on listed Snake River salmon.

Initial steps by IDFG to recover the species involved the establishment of captive broodstocks at the Eagle Fish Hatchery in Idaho and at NMFS facilities in Washington State (Flagg and McAuley 1994; Johnson 1993; Johnson and Pravecek 1995; Johnson and Pravecek 1996; Pravecek and Johnson 1997; Pravecek and Kline 1998; Kline and Heindel 1999).

The participation of IDFG in the Sawtooth Valley Project falls under two general areas of effort: the sockeye salmon captive broodstock program (hatchery element) and Stanley Basin sockeye/kokanee monitoring and evaluation (research element). Activities associated with the captive broodstock program hatchery element are presented in this report.

PROGRAM GOALS

The ultimate goal of IDFG captive broodstock development efforts is to recover sockeye salmon runs in Idaho waters to self-sustaining levels that provide a degree of State and Tribal harvest opportunity. The immediate project goal is to maintain this unique sockeye salmon population through captive broodstock technology, conserve the population's genetics, and avoid species extinction.

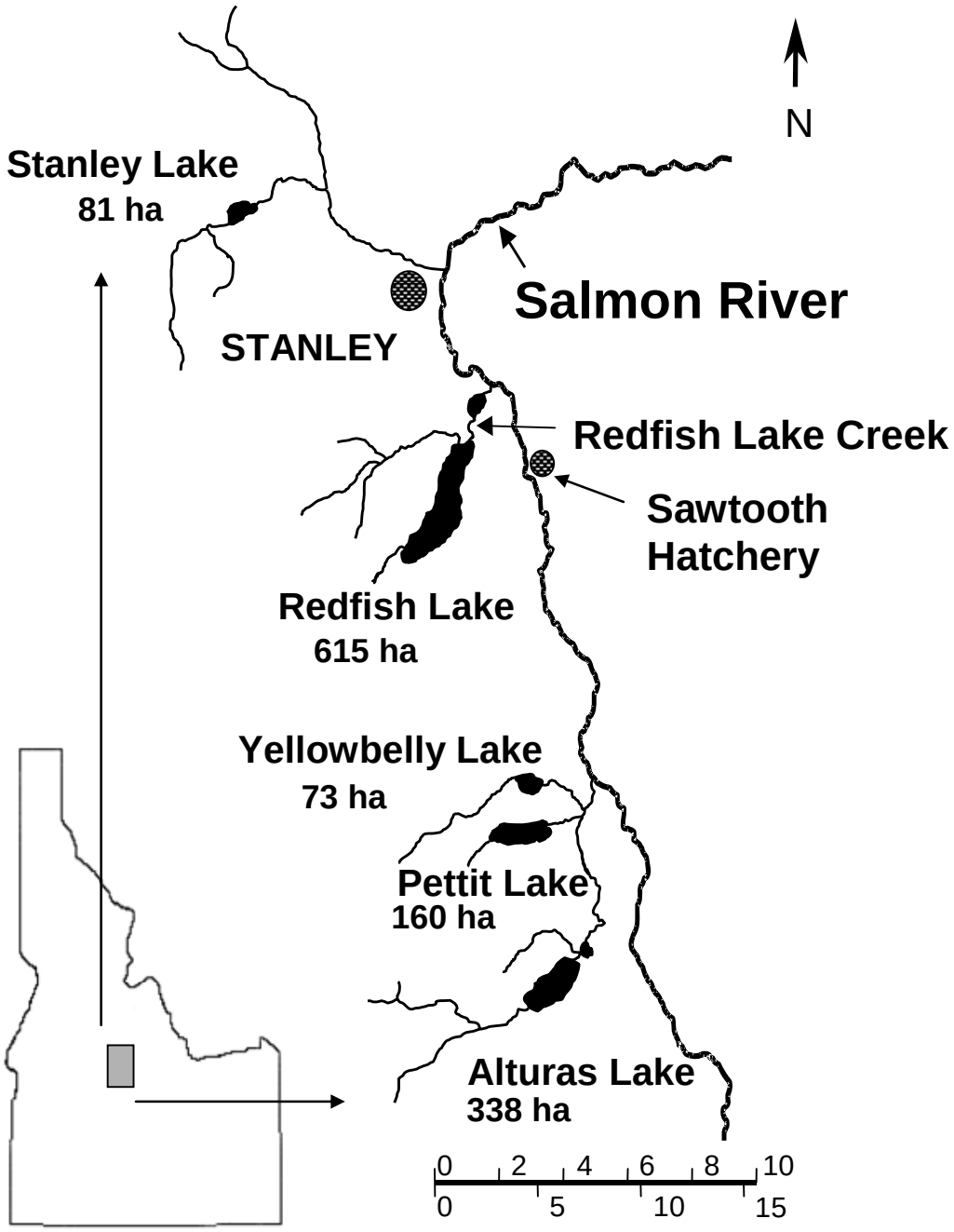

Figure 1. Sawtooth Valley study area.

Objectives and Tasks

Objective 1. Develop captive broodstocks from Redfish Lake anadromous sockeye salmon.

- Task 1. Develop the technology for captive broodstock propagation to meet program needs.
- Task 2. Trap returning anadromous adults, juvenile out-migrants, and residual sockeye salmon.
- Task 3. Quantify survival, maturation rates, age-at-maturity, sex ratio, and gamete quality of captive sockeye salmon.

Objective 2. Maximize genetic diversity within captive sockeye salmon broodstocks.

- Task 1. Establish spawning matrices in consultation with NMFS and the program technical oversight committee.
- Task 2. Produce genetically-defined progeny for use in multiple release strategies to Stanley Valley lakes.
- Task 3. Take samples for genetic analysis from all wild sockeye salmon incorporated in the program.

Objective 3. Determine the efficacy of cryopreservation as a tool for meeting program goals.

- Task 1. Cryopreserve milt from specific wild and broodstock sockeye salmon.
- Task 2. Conduct fertilization trials using cryopreserved milt from captive broodstock adults.
- Task 3. Maintain cryopreserved archives at three locations to spread the risk of loss from catastrophic events.
- Task 4. Produce “designer broodstocks” from cryopreserved milt to broaden the genetic base in future brood years.

Objective 4. Technology transfer.

- Task 1. Participate in the technical oversight committee process.
- Task 2. Network with technical experts on issues related to culture and broodstock techniques, genetics, pathology, and monitoring and evaluations.
- Task 3. Continue efforts to develop a program management plan.
- Task 4. Coordinate public information transfer with project cooperators.
- Task 5. Provide written activity reports to satisfy the needs and requirements of IDFG, the technical oversight committee, NMFS, and BPA.

METHODS

Fish Culture Facilities

Eagle Fish Hatchery

Eagle Fish Hatchery is the primary Idaho site for the sockeye salmon captive broodstock program. Artesian water from five wells is currently in use. Artesian flow is augmented by four separate pump/motor systems. Water temperature remains a constant 13.3°C and total dissolved gas averages 100% after degassing. Water chilling capability was added at Eagle Fish Hatchery in 1994. 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. Nine water level alarms are in use and linked through an emergency service contractor. Additional security is provided by limiting public access and by the presence of three on-site residences occupied by IDFG hatchery personnel.

Facility layout at Eagle Fish Hatchery remains flexible to accommodate culture activities ranging from spawning and incubation through adult rearing. Egg incubation capacity at Eagle Fish Hatchery is approximately 180,000 eggs. Incubation is accomplished in small containers specifically designed for the program. Incubators are designed to distribute both up-welling and down-welling flow to accommodate pre- and post-hatch stages.

Several fiberglass tank sizes are used to culture sockeye salmon from fry to the adult stage including: 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 1.0 g weight. Two and three meter tanks are used to rear juveniles to approximately 10.0 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 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 Fish Hatchery personnel and facilities have been used continuously since 1991 for various aspects of the sockeye salmon captive broodstock program including: 1) prespawn anadromous adult holding; 2) egg incubation; and 3) juvenile rearing for presmolt and smolt releases. In addition, hatchery personnel assist with many field activities including: 1) net pen fish rearing; 2) fish trapping and handling; and 3) fish transportation and release.

Eyed-eggs, received at Sawtooth Fish Hatchery from Eagle Fish Hatchery or NMFS, are incubated in vertical trays. Fry are ponded to 0.7 m fiberglass tanks. Juvenile sockeye salmon (>1.0 g) are held in vats or in a series of 2.0 m fiberglass tanks installed in 1997. Typically, juvenile sockeye salmon reared at Sawtooth Fish Hatchery are released as subyearlings or

yearlings. Prespawn anadromous adults captured at Redfish Lake Creek or Sawtooth Fish Hatchery weirs are held in vats until release for natural spawning or transfer to the Eagle Fish Hatchery for spawning. All incubation, rearing, and holding occurs on well water. Water temperature varies by time of year from approximately 2.5°C in January/February to 11.1°C in August/September. Backup and redundancy systems are in place. Rearing protocols are established cooperatively between IDFG personnel and reviewed at the SBSTOC level.

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; Bromage and Roberts 1995; McDaniel et al. 1994; Pennell and Barton 1996). Considerable coordination takes place between NMFS and IDFG culture experts and at the SBSTOC level.

Fish are fed a commercial diet produced by Bio-Oregon (Warrenton, Oregon) or Moore-Clark (Bellingham, Washington). Rations are weighed daily and follow suggested feeding rates provided by the manufacturer(s). Bio-Oregon developed a custom broodstock diet that includes elevated levels of vitamins, minerals, and pigments. Palatability and levels of natural pigments are enhanced by the addition of natural flavors from fish and krill. Through approximately 100 g weight, fish receive a standard Bio-Oregon semimoist formulation or Moore-Clark dry diet. Beyond 100 g weight, fish receive the Moore-Clark salmon broodstock diet or the Bio-Oregon custom broodstock diet.

Fish sample counts are conducted as needed to ensure that actual growth tracks with projected growth. In general, fish are handled as little as possible. Age-1 and age-2 sockeye salmon rearing densities are maintained at levels not to exceed 8 kg/m^3. Age-3 and age-4 rearing densities are maintained at levels not to exceed 14 kg/m^3.

Incubation and rearing water temperature is maintained between 10.0°C and 13.3°C. Chilled water (9.0°C to 11.0°C) may be used during incubation and early rearing to even out development and growth differences that may result from a protracted spawning period. Sockeye salmon greater than age-1 are generally maintained on chilled water. Rearing water temperature varies as a function of demand, but is generally maintained between 10.0°C and 12.0°C.

Passive integrated transponder (PIT) tags are used to evaluate the overwinter survival and out-migration success of production groups released to Sawtooth Valley waters. PIT tags are also used to track sockeye salmon retained in the program as broodstock fish. Production and broodstock sockeye salmon are PIT tagged at approximately six months of age. PIT tag procedures follow accepted, regional protocols (Prentice et al. 1990).

Chemical therapeutants are used prophylactically and for the treatment of infectious diseases. Prior to effecting treatments, the use of chemical therapeutants is discussed with an IDFG fish health professional. Fish necropsies are performed on all program mortalities that satisfy minimum size criteria for the various diagnostic or inspection procedures performed. Carcasses are either incinerated, land filled, or rendered.

Anadromous and Residual Adult 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. The second trap is located on the upper Salmon River at the Sawtooth Fish Hatchery weir.

A floating Merwin trap is used to capture residual sockeye salmon adults in Redfish Lake when they are incorporated into the captive broodstock program. When used, the trap is installed in October on the west side of the lake at the north end of Sockeye Beach.

Spawning Activities

Spawning has occurred at Eagle Fish Hatchery each year since 1994. Prior to 1994, adult sockeye salmon returns were spawned at the Sawtooth Fish Hatchery (Johnson 1993; Johnson and Pravecek 1995; Johnson and Pravecek 1996; Pravecek and Johnson 1997; Pravecek and Kline 1998; Kline and Heindel 1999). Spawning follows accepted, standard practices as described by McDaniel et al. (1994) and Erdahl (1994). Idaho Department of Fish and Game is required by NMFS Permit No. 1120 to discuss proposed broodstock spawning matrices prior to conducting activities (Appendix A). In general, eggs produced at spawning are divided into three subfamilies (by female) and fertilized with sperm from three males (factorial design). Male contribution is subsequently equalized as each male is used to fertilize eggs from three different females (on average). Eggs are incubated by subfamily on water temperatures determined to meet program goals for reintroduction via different release strategies and to produce fish to meet future broodstock needs.

Milt Cryopreservation

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

Fish Health Investigations

The Eagle Fish Health Laboratory operated by IDFG processes samples for diagnostic and inspection purposes from captive broodstock sockeye salmon, production sockeye salmon, and anadromous sockeye salmon. Routine fish necropsies include investigations for viral pathogens (infectious pancreatic necrosis virus and infectious hematopoietic necrosis virus), and various bacterial pathogens (e.g., bacterial kidney disease *Renibacterium salmoninarum*, bacterial gill disease *Flavobacterium branchiophilum*, coldwater disease *Flavobacterium psychrophilum*, and motile aeromonad septicemia *Aeromonas* spp.). In addition to the above, anadromous adult sockeye salmon are screened for the causative agent of whirling disease *Myxobolus cerebralis*, Furunculosis *Aeromonas salmonicida* and the North American strain of viral hemorrhagic septicemia virus. All laboratory diagnostic and inspection procedures follow protocols described by Thoesen (1994).

Juvenile Fish Quality Assessment

In 1999, the SBSTOC recommended applying assessments of fish quality to juvenile sockeye salmon produced in this program to provide additional perspective on factors that may affect fish survival from outplanting through out-migration. General parameters considered for investigation included: 1) proximate body composition analysis, 2) Organosomatic Index, and 3) fish health.

To determine proximate body composition, sampled fish were dried, ground, and analyzed using standardized methods for proximate composition from AOAC (1990). Sample protein content was analyzed using a LECO FP 28 nitrogen analyzer. Crude lipid content in samples was analyzed using a LECO TFE 2000 super-critical CO2 extractor (both are from LECO Corp., St. Joseph, Missouri).

The Organosomatic Index in this context is a measure of fish health developed as part of the Autopsy-Based Fish Health/Condition Assessment System (Goede and Houghton 1987) and is an ordered observation of fish tissues/organs carried out to assess the relative health and condition of wild and cultured fish populations.

Eyed-Egg and Fish Transfers

Eggs are shipped at the eyed-stage between NMFS and IDFG facilities using a commercial air service. Iodophor-disinfected (100 ppm) eggs are packed at a conservative density in perforated tubes, then capped and labeled. Tubes are wrapped with hatchery water-saturated cheesecloth and packed in small coolers. Ice chips are added to ensure proper temperature maintenance and coolers are sealed with packing tape. Idaho Department of Fish and Game and NMFS personnel are responsible for shuttling coolers to air terminals.

Fry may be transferred between IDFG and NMFS facilities. If fry transfers occur, a commercial air service is used as described above. Fish are transported in plastic fish transfer bags containing 10°C water. Oxygen is added to the bags prior to sealing. Bags are placed in coolers containing ice chips to ensure an appropriate temperature environment. Coolers are sealed with packing tape and accompanied by IDFG personnel on the aircraft.

Containers used to transport fish vary by task. In all cases, containers of the proper size and configuration are used for the task at hand. Fish are maintained in water of the proper quality (temperature, oxygen, chemical composition) as much as is possible during the handling and transfer phases of transportation. Containers vary 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, are available to the program with 300 gal (1,136 L), 1000 gal (3,785 L), and 2,500 gal (9,463 L) capacities. Transport guidelines are in place to not exceed 89 g/L (0.75 lb/gal).

Eyed-Egg and Fish Supplementation

Sockeye salmon have been reintroduced to Sawtooth Valley waters as eyed-eggs, subyearlings, yearlings, and prespawn adults.

Eyed-eggs are distributed to egg boxes manufactured by IDFG personnel specifically for this program. Plastic light baffle grids and plastic mesh netting partition and prevent eggs from falling into the biofilter ring medium until after hatch. Plastic mesh netting surrounding egg boxes allows fish to emigrate volitionally following yolk absorption. Egg boxes accommodate approximately 5,000 eggs each. Following loading, egg boxes are lowered to the lake substrate in approximately 3 m of water over known or suspected areas of lakeshore spawning.

Subyearling sockeye salmon are distributed to Sawtooth Valley lakes in truck-mounted transportation tanks. Fish are transferred from truck-mounted tanks to 250 gal (946 L) barge-mounted tanks for pelagic releases and net pen introductions. Adequate water temperature tempering occurs prior to the release of fish.

Yearling sockeye salmon (smolts) are distributed to Sawtooth Valley waters using truck-mounted transportation tanks. To date, yearling sockeye salmon have only been introduced to the outlet of Redfish Lake Creek downstream of the juvenile out-migrant weir and to the Salmon River downstream of the Sawtooth Fish Hatchery weir. Adequate water temperature tempering occurs prior to the release of fish.

Prespawn adult sockeye salmon are distributed to Sawtooth Valley waters using truck-mounted transportation tanks. To date, adults have been introduced to Redfish Lake, Alturas Lake, and Pettit Lake. Fish are released at public access points at dusk. Adequate water temperature tempering occurs prior to the release of fish.

RESULTS AND DISCUSSION

Fish Culture

During this reporting period, four broodstock and three production groups were in culture at IDFG facilities representing brood years 1996, 1997, 1998, and 1999. A summary of losses while in culture during this reporting period is presented in Tables 1 and 2. Culture groups developed to meet future spawning needs are designated as “broodstock” groups. Culture groups developed primarily for supplementation to Sawtooth Valley waters are designated as “production” groups. The year of development for specific culture groups may appear abbreviated (e.g., BY96 refers to brood year 1996).

BY96 Broodstock

Two primary culture groups were developed in 1996 to meet future broodstock needs. The first group (ANBY96) consists of first generation progeny of the single female sockeye salmon that returned to Redfish Lake Creek in 1996 (AN96). Males crossed with this female included first generation progeny of the two female and six male sockeye salmon that returned to Redfish Lake Creek in 1993 (ANBY93) and one 1993 Redfish Lake out-migrant (OM93). The second group (BY96) consists of first generation progeny produced from two ANBY93 and one OMBY93 females crossed with cryopreserved milt from the single male sockeye salmon that returned to Redfish Lake Creek in 1992 (AN92). All fish were combined post-PIT tagging and reared collectively as BY96 broodstock. Initial inventory for the BY96 broodstock was 233 fish. One hundred thirteen fish (92 females and 21 males) matured at age-3 in 1999. Eighteen mature fish (ten females and eight males) were released into Redfish Lake on September 15, 1999 for volitional spawning. Eighty-one females and eight males were utilized for spawn

crosses in 1999. In addition, one female and five males were culled due to lack of gonadal development. At the end of the reporting period, 68 ANBY96 broodstock fish remained in culture at Eagle Fish Hatchery (Table 1).

Table 1. Summary of losses and magnitude of mortality for four captive sockeye salmon broodstocks reared at IDFG facilities in 1999.

	Broodstocks			
	BY96	**BY97**	**BY98**	**BY99**
Starting Inventory (January 1, 1999)	233	344	597[a]	1,019[b]
Eyed-Egg to Fry				
Undetermined	n/a	n/a	52[c]	0
Mechanical Loss				
Handling	0	0	0	n/a
Jump-out	0	0	0	n/a
Human Error	0	0	0	n/a
Noninfectious				
Lymphosarcoma	0	1	0	n/a
Other	47[d]	11[d]	42[d]	n/a
Infectious				
Bacterial	5	0	1	n/a
Viral	0	0	0	n/a
Other	0	0	0	n/a
Maturation				
Mature Males	13	7	0	n/a
Mature Females	82	0	0	n/a
Other	0	0	0	n/a
Relocation				
Transferred In	0	0	0	0
Transferred Out	0	0	0	594[e]
Planted/Released	18[f]	0	0	0
Ending Inventory (December 31, 1999)	68	325	502	425

[a] December 1998 eyed-egg numbers. Inventory adjustment from previous report (see test).
[b] December 1999 eyed-egg numbers.
[c] Typical egg to fry mortality includes non-hatching eggs, abnormal fry, and swim-up loss.
[d] Includes culling associated with cultural abnormalities, and all undetermined, noninfectious mortality.
[e] Transferred from IDFG Eagle Fish Hatchery to NMFS for broodstock rearing.
[f] Redfish Lake release of prespawn adult sockeye salmon broodstock.

BY97 Production

This group consists of second generation progeny of ANBY94 female and ANBY93 male sockeye salmon spawn crosses performed at the Eagle Fish Hatchery in 1997. The majority of the BY97 production group was supplemented to Sawtooth Valley waters as age-0 presmolts in 1998. At the beginning of this reporting period, 10,043 fish were in culture at the IDFG Sawtooth Fish Hatchery. In May of 1999, approximately 9,718 fish from this production group were split evenly (4,859) and released in the upper Salmon River and Redfish Lake Creek as age-1 smolts. In addition, 310 fish were transferred to the Big Beef Creek Hatchery in Washington State for continued culture and rearing to prespawn adult age. Maturing fish from this group will return to Idaho in the fall of 2000 (age-3) and 2001 (age-4) for prespawn adult supplementation to Sawtooth Valley waters and/or incorporation into captive broodstock spawning. At the end of this reporting period, no fish from this production group remained in culture at IDFG facilities (Table 2).

BY97 Broodstock

This group consists of progeny from ANBY94 females and cryopreserved milt from 1991 Redfish Lake out-migrant males (OM91), 1992 Redfish Lake out-migrant males (OM92), and the single male sockeye salmon that returned to Redfish Lake in 1992 (AN92). Initial inventory for BY97 broodstock was 344 fish. Seven males matured at age-2 in 1999 and were utilized in hatchery spawn crosses. In addition, milt from two of the seven males was cryopreserved to provide future broodstock options. At the end of the reporting period, 325 BY97 broodstock remained in culture at the Eagle Fish Hatchery (Table 1).

BY98 Production

Two primary culture groups were produced for supplementation in brood year 1998. The first culture group was developed at the Big Beef Creek Hatchery in Washington State from second generation females (ANBY91) produced from the four anadromous adults that returned to Redfish Lake Creek in 1991 (AN91). Males used for spawn crosses included first generation progeny (ANBY94) from the single female that returned to Redfish Lake Creek in 1994 (AN94) and first generation progeny (ANBY96) from the single female that returned to Redfish Lake Creek in 1996 (AN96). The second culture group was developed at the Eagle Fish Hatchery from first generation females (ANBY96) produced from the single female that returned to Redfish Lake Creek in 1996 (AN96) and first generation males (ANBY94) produced from the single female that returned to Redfish Lake Creek in 1994 (AN94). All BY98 production crosses produced at both NMFS and IDFG Eagle facilities were transferred to the IDFG Sawtooth Fish Hatchery in November and December 1998. Initial inventory for this reporting period was 49,703 eyed-eggs. This starting inventory reflects a reduction of approximately 12,300 eyed-eggs from the number reported in 1998 (Permit No. 1120 Annual Report). This discrepancy was associated with the process of estimating eyed-egg numbers at spawning and was corrected after fish were ponded. In October 1999, 40,271 age-0 presmolts from this production group were released to Redfish (23,886), Alturas (12,955), and Pettit (3,430) lakes as part of a fall direct-lake release strategy. At the end of this reporting period, no fish from this production group remained in culture (Table 2).

Table 2. Summary of losses and magnitude of mortality for three captive sockeye salmon production groups reared at IDFG facilities in 1999.

	Production Groups		
	BY97	**BY98**	**BY99**
Starting Inventory (January 1, 1999)	10,043	49,703[a]	63,147[b]
Eyed-Egg to Fry			
Undetermined	n\a	6,041[c]	4,545[c]
Mechanical Loss			
Handling	0	0	n/a
Jump-out	0	0	n/a
Human Error	0	0	n/a
Noninfectious			
Lymphosarcoma	0	0	n/a
Other	15[d]	3,391[d]	n/a
Infectious			
Bacterial	0	0	n/a
Viral	0	0	n/a
Other	0	0	n/a
Maturation			
Mature Males	0	0	n/a
Mature Females	0	0	n/a
Other	0	0	n/a
Relocation			
Transferred In	0	0	47,573[e]
Transferred Out	310[f]	0	1,019[g]
Planted/Released	9,718	40,271	20,311
Ending Inventory (December 31, 1999)	0	0	84,845

[a] December 1998 eyed-egg numbers. Inventory adjustment from previous report (see text).
[b] December 1999 eyed-egg numbers.
[c] Typical egg to fry mortality includes non-hatching eggs, abnormal fry, and swim-up loss.
[d] Includes culling associated with cultural abnormalities and all undetermined noninfectious mortality.
[e] Transferred from NMFS to IDFG Sawtooth Fish Hatchery for production rearing.
[f] Transferred from IDFG Sawtooth Fish Hatchery to NMFS for production rearing to adult.
[g] Transferred from IDFG production to IDFG broodstock.

BY98 Broodstock

Three primary culture groups were developed in 1998 to meet future broodstock needs. The first group (produced at the Big Beef Creek Hatchery and transferred to the Eagle Fish Hatchery in November 1998) was developed from second generation females (ANBY91) produced from the four anadromous adults that returned to Redfish Lake Creek in 1991 (AN91) and the single anadromous male that returned to Redfish Lake Creek in 1998 (AN98). The second culture group was developed from first generation females (ANBY96) produced from the single female that returned to Redfish Lake Creek in 1996 (AN96). Males used for spawn crosses included first generation males (ANBY94) produced from the single female that returned to Redfish Lake Creek in 1994 (AN94), the single anadromous male that returned to Redfish Lake Creek in 1998 (AN98), and cryopreserved milt from first generation progeny (OMBY93) of female 1991 Redfish Lake out-migrants (OM91) and the six male sockeye salmon that returned to Redfish Lake Creek in 1993 (AN93). The third culture group was developed from first generation females and males (ANBY96) produced from the single female that returned to Redfish Lake Creek in 1996 (AN96). Initial inventory of 437 sac-fry from groups one (126) and two (311) was increased in 1999; 160 fry from group three were incorporated to meet future program requirements. Initial inventory for all BY98 broodstock groups was 597 fry. At the end of this reporting period, 502 fish were in culture at the Eagle Fish Hatchery (Table 1).

BY99 Production

Twelve families, represented by 30 unique subfamilies, were developed from brood year 1999 production spawn crosses at the Eagle Fish Hatchery. To simplify tracking, families were grouped under two production group titles: BY99 and ANHBY99. The BY99 production group was developed using male and female sockeye salmon from the ANBY96, BY96, and BY97 broodstocks (described above). Specific crosses performed to develop this production group included: 1) ANBY96 females x BY97 males, 2) ANBY96 females x ANBY96 males, 3) ANBY96 females x BY96 males, 4) BY96 females x ANBY96 males, 5) BY96 females x BY96 males, and 6) BY96 females x BY97 males. Approximately 59,446 eyed-eggs were produced from BY99 spawn crosses. The ANHBY99 production group was developed using male and female sockeye salmon from ANBY96, BY96, BY97 broodstocks, and four of the seven anadromous adults that returned to the Sawtooth Fish Hatchery in 1999 (ANH99). Specific crosses performed to develop this production group included: 1) ANBY96 females x ANH99 males, 2) BY96 females x ANH99 males, 3) ANH99 female x ANBY96 males, 4) ANH99 female x BY96 males, 5) ANH99 female x BY97 males, and 6) ANH99 female x cryopreserved milt from the single male sockeye salmon that returned to Redfish Lake Creek in 1998 (AN98). Approximately 3,701 eyed-eggs were produced from ANHBY99 spawn crosses. The majority of BY99 production eggs (33,785) were transferred from the Eagle Fish Hatchery to the Sawtooth Fish Hatchery in November 1999. In addition, approximately 47,573 eyed-eggs were transferred from the Big Beef Creek Hatchery to the Sawtooth Fish Hatchery in November 1999. On November 18, 1999, an estimated 20,311 eyed-eggs were transferred from the Eagle Fish Hatchery to incubation boxes in Pettit Lake. At the end of this reporting period, approximately 77,451 and 7,394 eyed-eggs and developing fry were on station at the Sawtooth and Eagle fish hatcheries, respectively (Table 2).

BY99 Broodstock

Approximately 1,019 eyed-eggs representing 11 unique families (30 subfamilies) produced from 1999 spawning at the Eagle Fish Hatchery were segregated from production groups described above to create the BY99 broodstock. Approximately 594 eyed-eggs were transferred to NMFS facilities where they will remain through maturation. The majority of BY99 broodstock adults produced at NMFS facilities will contribute to future spawning designs. A portion of adults produced from this NMFS broodstock will be released for volitional spawning in Sawtooth Valley lakes in 2002 and 2003. Inventory reporting for these fish will appear under separate cover by NMFS. At the end of this reporting period, 425 developing fry were in culture at the Eagle Fish Hatchery (Table 1).

Anadromous and Residual Sockeye Salmon Trapping

In 1999, the Redfish Lake Creek weir was operated from July 15 to October 13 and the Sawtooth Fish Hatchery weir was operated from June 26 to October 14. Seven anadromous sockeye salmon returned to the Sawtooth Valley in 1999. Traps on Redfish Lake Creek and the upper Salmon River at the Sawtooth Fish Hatchery intercepted zero and seven adults, respectively. Fish were captured between August 12 and September 3, 1999. All sockeye salmon captured were marked with adipose and left ventral fin clips. Four of the anadromous males and the single female all contained coded-wire tags. All returning adults originated from a hatchery release of smolts to the upper Salmon River and to Redfish Lake Creek on April 28 and May 4, 1998. Fish were produced from spawn crosses performed at Big Beef Creek Hatchery (NMFS–Manchester, Washington) in 1996 with resulting eyed-eggs transferred to the Oregon Department of Fish and Wildlife Bonneville Fish Hatchery for hatch and rearing to release age. A summary of adult returns is presented in Table 3.

No adult Chinook salmon *O. tshawytscha* were captured at the Redfish Lake Creek trap during the 1999 trapping season.

A floating Merwin trap was operated at Sockeye Beach in Redfish Lake from October 7 to November 8, 1999 to collect tissue samples for genetic analysis of residual sockeye salmon. No residual sockeye salmon were captured in 1999.

Spawning Matrices

The Idaho Department of Fish and Game is required by Permit No. 1120 to discuss proposed broodstock spawning matrices with NMFS Northwest Fisheries Science Center (NWFSC) genetics staff. In 1999, this was accomplished by distributing and discussing a proposed spawning matrix at the Stanley Basin Sockeye Technical Oversight Committee (SBSTOC) meeting held on June 16, 1999 in Fort Hall, Idaho (Appendix A). Representatives from NMFS Conservation Biology and Resource Enhancement and Utilization Technologies divisions (NWFSC) were present at this meeting. No objections to the proposed spawning design were aired.

Table 3. Year 1999 anadromous sockeye salmon adult return summary.

Summary Category	Total Number Trapped	Number Trapped at Redfish Lake Cr.	Number Trapped at Sawtooth Hatchery
All Anadromous Adults	7	0	7
Anadromous Males	6	0	6
Anadromous Females	1	0	1
Unmarked Adults[1]	0	0	0
Adipose-Clipped Adults[2]	0	0	0
Adipose-Clipped and Left Ventral-Clipped Adults[3]	7	0	7

[1] Unmarked adults are presumably the result of eyed-egg and prespawn adult release strategies conducted in Redfish Lake in 1996. Unmarked adults could also be progeny of Redfish Lake residual sockeye salmon.

[2] Adipose-clipped adults are the result of presmolt and smolt release strategies conducted in 1997 and 1998, respectively. All juveniles released with an adipose clip (only) were reared at IDFG facilities.

[3] Adipose and left ventral-clipped adults are the result of smolt releases conducted in 1998. All juveniles released with adipose and left ventral clips were reared at the Oregon Department of Fish and Wildlife's Bonneville Fish Hatchery.

BROOD YEAR 1999 SPAWNING ACTIVITIES

Results from 1999 Eagle Fish Hatchery spawning activities are reviewed below. Results from spawning activities conducted by NMFS 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., BY96 refers to brood year 1996).

During the fall of 1999, 113 fish (92 females and 21 males) from BY96 broodstocks (age-3) and seven age-2 males from the BY97 broodstock matured at the Eagle Fish Hatchery. Ten BY96 maturing females and eight maturing males were released to Redfish Lake in September 1999 for volitional spawning. One mature female (BY96) and five mature males (BY96) produced nonviable gametes and were not incorporated in the 1999 spawning design. In addition to these maturing broodstocks, four of the seven anadromous adults (ANH99) that returned to the Sawtooth Fish Hatchery in 1999 (one female and three males) were transferred to the Eagle Fish Hatchery and incorporated in the spawning design. Eggs from crosses performed with anadromous adults contributed to both production and broodstock program needs.

1999 Production Spawning

Eighty-two females and 15 males were spawned between October 1 and November 2, 1999 to generate 162,056 green eggs (Figure 2). To avoid inbreeding, an effort was made to outcross fish from different brood years (e.g., BY96 females spawned with BY97 males). When this was not possible, within brood year spawn crosses were made based on a desirability matrix designed to avoid or minimize inbreeding.

Twelve families, represented by 30 unique subfamilies, were developed from brood year 1999 production spawn crosses at the Eagle Fish Hatchery. To simplify tracking, families were grouped under two production group titles: BY99 and ANHBY99. The BY99 production group was developed using male and female sockeye salmon from the ANBY96, BY96, and BY97 broodstocks. Specific crosses performed to develop this production group included: 1) ANBY96 females x BY97 males, 2) ANBY96 females x ANBY96 males, 3) ANBY96 females x BY96 males, 4) BY96 females x ANBY96 males, 5) BY96 females x BY96 males, and 6) BY96 females x BY97 males. Spawn crosses produced approximately 151,678 green and 59,446 eyed-eggs. Fecundity for BY96 females averaged 1,976 eggs. Egg survival to the eyed-stage of development for the above groups ranged from 0.0% to 99.1% and averaged 39.2% (Table 4).

The ANHBY99 production group was developed using male and female sockeye salmon from ANBY96, BY96, BY97, and four of the seven anadromous adults that returned to the Sawtooth Fish Hatchery in 1999 (ANH99). Specific crosses performed to develop this production group included: 1) ANBY96 females x ANH99 males, 2) BY96 females x ANH99 males, 3) ANH99 female x ANBY96 males, 4) ANH99 female x BY96 males, 5) ANH99 female x BY97 males, and 6) ANH99 female x cryopreserved milt from the single male sockeye salmon that returned to Redfish Lake Creek in 1998 (AN98). Spawn crosses produced approximately 10,378 green and 3,701 eyed-eggs. The single anadromous female that returned the Sawtooth Fish Hatchery in 1999 produced 1,619 green eggs. The majority of her eggs (1,469) were divided into subfamilies and crossed with milt from BY96, BY97 and ANH99 males. Egg survival to the eyed-stage of development for these crosses averaged 93.3%. One hundred fifty green eggs from the anadromous female were crossed with cryopreserved milt from the single male sockeye salmon that returned to Redfish Lake Creek in 1998 (AN98); egg survival to the eyed-stage of development averaged 4.0%. Overall egg survival to the eyed-stage of development for the ANHBY99 production group averaged 35.7% (Table 4).

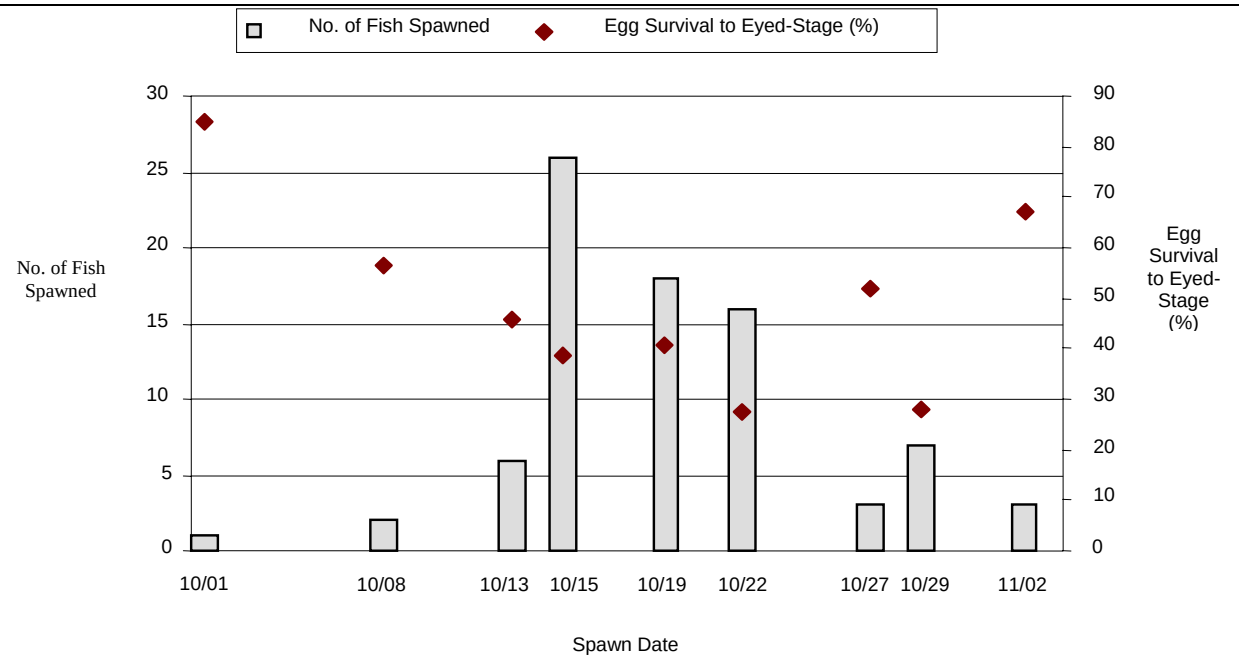

Figure 2. Number of sockeye salmon spawned and corresponding egg survival to the eyed-stage of development for 1999 spawning at Eagle Fish Hatchery.

Table 4. Summary information for 1999 sockeye salmon spawning activities at Eagle Fish Hatchery.

Spawning Cross*		No. of Green	No. of	Mean Egg Survival to	Median Egg Survival to
Female	**Male**	**Eggs Taken**	**Eyed-Eggs**	**Eyed-Stage**	**Eyed-Stage**
ANBY96	BY97	30,980	12,755	41.2%	44.1%
ANBY96	BY96	59,856	23,073	38.6%	34.7%
ANBY96	ANBY96	23,617	9,621	40.7%	36.0%
BY96	BY97	23,929	9,775	40.9%	23.0%
BY96	BY96	2,836	2,253	79.4%	79.4%
BY96	ANBY96	10,460	1,969	18.8%	5.28%
	BY99 Totals	**151,678**	**59,446**	**39.2%**	
ANBY96	ANH99	7,399	1,868	25.3%	20.9%
BY96	ANH99	1,360	457	33.6%	33.6%
ANH99	BY97	526	454	86.3%	86.3%
ANH99	ANH99	467	452	96.8%	96.8%
ANH99	ANBY96	476	464	97.5%	97.5%
ANH99	AN98[a]	150	6	4.0%	4.0%
	ANHBY99 Totals	**10,378**	**3,701**	**35.7%**	
Group Totals	**162,056**	**63,147**	**38.97%**	**35.4%**	

[a] Cryopreserved milt from the single male sockeye salmon that returned to Redfish Lake Creek in 1998.

1999 Broodstock Spawning

Approximately 425 eyed-eggs representing 11 unique families (30 subfamilies) were selected from specific spawn crosses described above and incubated separately for future broodstock needs. Spawn crosses represented in the Eagle broodstock are presented in Table 5.

Milt Cryopreservation

On November 9, 1999, milt from one BY96 and two unique BY97 sockeye salmon was cryopreserved at the Eagle Fish Hatchery. This effort produced 30 and 60 0.5 ml straws for BY96 and BY97 broodstocks, respectively. Milt from three of the six anadromous males that returned to the Sawtooth Fish Hatchery in 1999 was cryopreserved on October 8 and 29 and November 2, 1999 at the Eagle Fish Hatchery. Ninety-seven 0.5 ml straws were produced from this effort.

Fish Health Investigations

The Eagle Fish Health Laboratory, operated by IDFG, processed samples for diagnostic and inspection purposes from adult broodstock sockeye salmon, juvenile production sockeye

salmon, and four anadromous adults retained for broodstock use. Eighty-four laboratory cases were made from these sources during 1999 and involved 247 individual fish examined.

No evidence of virus was detected for 247 sockeye salmon examined. This has been consistent with the findings of previous years. No clinical bacterial kidney disease (BKD) was discovered in 244 fish examined. However, Enzyme-Linked Immunosorbent Assay (ELISA) optical density (OD) values for 29 individuals were above the negative cutoff value (0.100). Of these, only one sample was above the low/moderate cutoff (0.200). This indicates that BKD continues to be effectively contained through quarantine efforts. Motile aeromonad septicemia was diagnosed in five of 14 cases examined, but not at a level that required treatment.

Four neoplasms were detected in sockeye salmon captive broodstocks during 1999. This continues the trend observed in previous years in this program at the Eagle Fish Hatchery. Two of the tumors were fibromas of liver and kidney. The condition in the kidney involved fibrous, lymphatic, and melanomacrophage cell types. The other two neoplasms were thymic lymphomas, with one found in a sexually mature female. Histological examination of the lymphosarcoma demonstrated the tumor was regressing with many foci of fibrocytes of erythroblast origin.

Table 5. Parent family and number of eyed-eggs retained for brood year 1999 captive broodstock development at Eagle Fish Hatchery.

Family Cross*		No. of Eyed-eggs
Female	**Male**	**Retained for Eagle Broodstock**
ANBY96	BY97	44
ANBY96	BY96	74
ANBY96	ANBY96	44
BY96	BY97	29
BY96	ANBY96	12
ANBY96	ANH99	43
BY96	ANH99	44
ANH99	BY97	44
ANH99	ANH99	44
ANH99	ANBY96	44
ANH99	AN98[a]	3
	TOTAL	**425**

[a] Cryopreserved milt from the single male sockeye salmon that returned to Redfish Lake Creek in 1998.

Four of the seven anadromous adult sockeye salmon that returned to the Sawtooth Fish Hatchery weir in 1999 were sampled for pathogens after spawning. This sampling represented our first opportunity to examine anadromous adults for pathogens that originated from the captive broodstock program. No evidence of virus was detected; one male had clinical levels of BKD by ELISA and three of four were found to carry *Myxobolus cerebralis* (an infection likely contracted as smolts during migration in the Salmon River). These results indicate that this program may have to be prepared for a substantial number of BKD-infected adults in the future. Plans for managing this situation should be identical to those used successfully for Chinook

salmon at IDFG hatcheries (e.g., Erythromycin injection of adults, sampling all adults for BKD by ELISA, culling eggs from females with ELISA OD values above 1.0, segregation rearing of progeny based on ELISA OD values of females, and two treatments of progeny with Erythromycin).

Juvenile Fish Quality Assessment

General parameters evaluated for juvenile fish quality assessment in 1999 were: 1) proximate body composition analysis, 2) organosomatic index, and 3) fish health. During sampling, tissue was also taken for DNA-based genetic analysis. In 1999, 202 fish were sacrificed for this testing. Groups sampled included: 1) wild/natural out-migrants from Redfish and Alturas lakes, 2) brood year 1997 hatchery produced out-migrants from Redfish and Alturas lakes, 3) brood year 1998 hatchery-produced fish reared at Sawtooth Fish Hatchery for 1999 presmolt release strategies, and 4) brood year 1997 hatchery-produced fish reared at Sawtooth Fish Hatchery for 1999 smolt release strategies. Groups one and two experienced natural lake conditions. Groups three and four were reared entirely in the hatchery. Sample dates for wild/natural and hatchery-produced out-migrants were May 4, 5, 26 & 27, 1999. Sample dates for brood year 1997 and 1998 fish reared entirely in the hatchery were May 4 and October 7, 1999, respectively.

Proximate analysis indicated greater total-body lipid for groups sampled directly from hatchery culture compared to those of natural origin and those released the previous October. All parameters associated with organosomatic index assessment fell within expected values for healthy smolts. Fish health samples were uniformly negative for virus, BKD, bacterial cultures, erythrocytic inclusion body syndrome (EIBS), and Myxobolus cerebralis. A few colonies of motile aeromonads were isolated but not considered significant.

Eyed-Egg and Fish Transfers

In 1999, 47,573 and 33,785 eyed-eggs from calendar year 1999 production spawning crosses were transferred from the NMFS Big Beef Creek Hatchery and the Eagle Fish Hatchery, respectively, to the Sawtooth Fish Hatchery. In addition, 594 eyed-eggs from broodstock spawning crosses were transferred from the Eagle Fish Hatchery to the Big Beef Creek Hatchery. In all cases, the required State transfer permits were acquired prior to shipping. Specific details, by date, for all transfers are described below.

On November 9, 1999, approximately 198 eyed-eggs from broodstock crosses were transferred to NMFS Big Beef Creek Hatchery. Fish that mature as a result of this transfer will be incorporated in future NMFS spawning designs.

On November 17, 1999, approximately 396 eyed-eggs from broodstock crosses were transferred from the Eagle Fish Hatchery to the NMFS Big Beef Creek Hatchery. Fish that mature as a result of this transfer will be incorporated in future NMFS spawning designs.

On November 23, 1999, approximately 30,372 eyed-eggs from production crosses were transferred from NMFS to Sawtooth Fish Hatchery.

On December 1, 1999, approximately 25,314 eyed-eggs from production crosses were transferred from Eagle Fish Hatchery to Sawtooth Fish Hatchery.

On December 9, 1999, the following transfers occurred: 1) approximately 17,201 eyed-eggs from production crosses were transferred from NMFS to Sawtooth Fish Hatchery, and 2) approximately 8,471 eyed-eggs from production crosses were transferred from Eagle Fish Hatchery to Sawtooth Fish Hatchery.

In 1999, milt harvested from the single male that returned to Redfish Lake Creek in 1998 (AN98) was transferred from Eagle Fish Hatchery to the University of Idaho (U of I) and Washington State University (WSU) for multifacility storage. Forty-four 0.5 ml straws (collected in spawn year 1998) were transferred to U of I (22) and WSU (22) on February 3, 1999. In addition, milt harvested from BY96 and BY97 sockeye salmon broodstocks was transferred from Eagle Fish Hatchery to NMFS to accommodate spawning needs. Milt transfers occurred on October 8, 1999 (6.93 ml and 3.64 ml from BY96 and BY97 males, respectively) and on October 14, 1999 (46.07 ml and 3.39 ml from BY96 and BY97 males, respectively).

Eyed-Egg and Fish Supplementation

Pursuant to Special Condition B. 9. Requirement D. 3. of Permit No. 1120, IDFG received authorization from NMFS to carry out the following production releases of sockeye salmon in 1999 (Table 6). All sockeye salmon released were adipose fin-clipped, and a portion were PIT tagged.

Smolt Releases

Age-1 sockeye salmon smolts (BY97) were released into Redfish Lake Creek (4,859) below the Redfish Lake Creek trap and into the upper Salmon River (4,859) downstream of the Sawtooth Fish Hatchery weir on May 4 & 5, 1999. All smolts were reared at Sawtooth Fish Hatchery. Eight hundred fish (400 from each release group) were PIT tagged to facilitate an evaluation of travel time and out-migration survival (Table 6).

Adult Releases

On September 15, 1999, 21 maturing adult sockeye salmon were released to Redfish Lake for volitional spawning. The 21 fish consisted of 10 brood year 1996 hatchery-produced females, eight brood year 1996 hatchery-produced males, and three brood year 1996 anadromous males that returned to the Sawtooth Fish Hatchery in 1999. Prior to release, six of the hatchery-produced males were implanted with ultrasonic transmitters. All fish released were of hatchery origin. Eighteen of the 21 adults were reared from hatch to adult release age at the Eagle Fish Hatchery. The three anadromous males were released from the captive broodstock program in 1998 as yearling smolts (Table 6).

Table 6. Sockeye salmon releases made to Sawtooth Valley waters in 1999.

Release Location	Release Strategy	Release Date	Number Released	Number PIT Tagged	Release Weight (g)
Redfish Lake Creek (downstream of weir)	Smolt (BY97)	5/4&5/99	4,859	400	25.4
Upper Salmon River (at Sawtooth weir)	Smolt (BY97)	5/4&5/99	4,859	400	25.4
Redfish Lake (boat ramp)	Adult (BY96)	9/15/99	21	—	—
Redfish Lake (direct lake)	Presmolt (BY98)	10/13/99	23,886	1,560	9.7
Pettit Lake (direct lake)	Presmolt (BY98)	10/13/99	3,430	2,009	10.4
Alturas Lake (direct lake)	Presmolt (BY98)	10/13/99	12,955	1,559	10.8
Pettit Lake (Eagle Fish Hatchery boxes)	Eyed-egg (BY99)	11/18/99	16,311	—	—
Pettit Lake (Scotty-Jordan boxes)	Eyed-egg (BY99)	11/18/99	4,000	—	—

Presmolt Releases

Presmolt releases were conducted on October 13, 1999 at mid-lake (pelagic) locations with the aid of a release barge on loan to IDFG from NMFS. Redfish Lake received 23,886 fish (1,560 fish were PIT tagged), Pettit Lake received 3,430 fish (2,009 fish were PIT tagged), and Alturas Lake received 12,955 fish (1,559 fish were PIT tagged). All presmolts were produced in brood year 1998 and were reared from hatch to release at the Sawtooth Fish Hatchery (Table 7).

Eyed-Egg Releases

Pettit Lake received 20,311 eyed-eggs from brood year 1999 spawning at the Eagle Fish Hatchery. At planting, eyed-eggs had accumulated between 350 and 375 Celsius temperature units. Eyed-eggs were placed into Scotty-Jordan boxes (4,000) and in Eagle Fish Hatchery egg boxes (16,311) on November 18, 1999. Scotty-Jordan boxes were buried in the lake substrate at the inlet end of the lake in water approximately 6.1 m deep. Eagle Fish Hatchery egg boxes were positioned on the substrate near the Scotty-Jordan boxes (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 Fish Hatchery for their continued assistance and support. Special thanks to Cheryl Leben for her technical assistance in assembling the final document.

LITERATURE CITED

AOAC. 1990. Official Methods of Analysis of the Association of Official Analytical Chemists, 15th ed. Association of Official Analytical Chemists, Inc., Arlington, Virginia. 1298 pp.

Bjornn, T. C., D. R. Craddock, and D. R. Corley. 1968. Migration and survival of Redfish Lake, Idaho, sockeye salmon, *Oncorhynchus nerka*. Transactions of the American Fisheries Society 97:360-373.

Bromage, N. R., and R. J. Roberts. 1995. Broodstock Management and Egg and Larval Quality. Blackwell Science Ltd. Cambridge, Massachusetts.

Chapman, D. W., W. S. Platts, D. Park, and M. Hill. 1990. Status of Snake River sockeye salmon. Don Chapman Consultants, Inc. Boise, Idaho.

Cloud, J. G., W. H. Miller, and M. J. Levenduski. 1990. Cryopreservation of sperm as a means to store salmonid germ plasm and to transfer genes from wild fish to hatchery populations. The Progressive Fish Culturist 52:51-53.

Erdahl, D. A. 1994. Inland Salmonid Broodstock Management Handbook. United States Department of the Interior, Fish and Wildlife Service. 712 FW 1.

Flagg, T. A., and W. C. McAuley. 1994. Redfish Lake sockeye salmon captive broodstock rearing and research. Coastal Zone and Estuarine Studies Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration. Annual Report to the U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project No. 92-40, Contract No. DE-AI79-92BP41841. Portland, Oregon.

Goede, R. W., and S. Houghton. 1987. ASUM–A Computer Program for the Autopsy-Based Fish Health/Condition Assessment System. Utah Division of Wildlife Resources, Fisheries Experiment Station. 1465 West 200 North, Logan, Utah 84321.

Johnson, K. A. 1993. Research and recovery of Snake River sockeye salmon. Idaho Department of Fish and Game. Annual Report to the U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project No. 91-72, Contract No. DE-BI79-91BP21065. Portland, Oregon.

Johnson, K. A., and J. J. Pravecek. 1995. Research and recovery of Snake River sockeye salmon. Idaho Department of Fish and Game. Annual Report to the U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project No. 91-72, Contract No. DE-BI79-91BP21065. Portland, Oregon.

Johnson, K. A., and J. J. Pravecek. 1996. Research and recovery of Snake River sockeye salmon. Idaho Department of Fish and Game. Annual Report to the U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project No. 91-72, Contract No. DE-BI79-91BP21065. Portland, Oregon.

Kline, P. A., and J. A. Heindel. 1999. Snake River sockeye salmon captive broodstock program hatchery element. Annual Report to the U.S. Department of Energy, Bonneville Power

Administration, Division of Fish and Wildlife. Project No. 91-72, Contract No. DE-BI79-91BP21065. Portland, Oregon.

Leitritz, E., and R. C. Lewis. 1976. Trout and salmon culture (hatchery methods). California Department of Fish and Game Fish Bulletin 164.

McDaniel, T. R., K. M. Prett, T. R. Meyers, T. D. Ellison, J. E. Follett, and J. A. Burke. 1994. Alaska Sockeye Salmon Culture Manual. Special Fisheries Report No. 6. Alaska Department of Fish and Game, Juneau, Alaska.

Pennell, W., and B. A. Barton. 1996. Principles of Salmonid Aquaculture. Elsevier Science B. V. Amsterdam, The Netherlands.

Piper, G. R., I. B. McElwain, L. E. Orme, J. P. McCraren, L. G. Gowler, and J. R. Leonard. 1982. Fish Hatchery Management. U.S. Fish and Wildlife Service, Washington, D.C.

Pravecek, J. J., and K. A. Johnson. 1997. Research and recovery of Snake River sockeye salmon. Idaho Department of Fish and Game. Annual Report to the U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project No. 91-72, Contract No. DE-BI79-91BP21065. Portland, Oregon.

Pravecek, J. J., and P. A. Kline. 1998. Research and recovery of Snake River sockeye salmon. Idaho Department of Fish and Game. Annual Report to the U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project No. 91-72, Contract No. DE-BI79-91BP21065. Portland, Oregon.

Prentice, E. F., T. A. Flagg, and C. S. McCutcheon. 1990. Feasibility of using implanted passive integrated transponder (PIT) tags in salmonids. *In* N. C. Parker, A. E. Giorgi, R. C. Heidinger, D. B. Jester, Jr., E. D. Prince, and G. A. Winans (editors), Fish-marking techniques, International Symposium and Educational Workshop on Fish-marking Techniques. American Fisheries Society Symposium 7:317-322.

Thoesen, J. C. editor. 1994. Blue Book. Version 1. Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens. Fish Health Section, American Fisheries Society. Bethesda, Maryland.

Wheeler, P. A., and G. A. Thorgaard. 1991. Cryopreservation of rainbow trout semen in large straws. Aquaculture 93:95-100.

APPENDIX

Appendix A. Proposed brood year 1999 sockeye salmon spawning matrix.

IDAHO DEPARTMENT OF FISH AND GAME
EAGLE FISH HATCHERY
1800 TROUT ROAD, EAGLE ID 83616
(208)939-4114 fax (208)939-2415

June 5, 1999

M E M O R A N D U M

To: Steven Kalinowski, Matt Powell, SBSTOC

From: Keith Johnson and Paul Kline

Subject: Proposed Sockeye Salmon Spawning Matrix for 1999

The intention of this memo is to lay out the basis for the proposed sockeye salmon spawning matrix for brood year 1999. The genetic guidance remains as previously established: to minimize inbreeding and maximize diversity for production fish and "safety net" broodstocks.

The projected number of maturing sockeye salmon (both captive broodstock and anadromous return) are presented in the attached table along with their respective broodstock lineages. Sex ratios and maturation rates are based on previous program history.

The attached desirability table presents five levels of spawning cross preference based on our ability to identify relatedness among broodstocks. The first tier represents the lowest probability of inbreeding (in this case – none). Tiers two and three represent a very minor level of potential inbreeding while tiers four and five potentially involve half-sibling crosses.

Please review this information and be prepared to comment at the June 16, 1999 SBSTOC meeting in Fort Hall.

Thank you for your assistance.

Appendix A. Continued.

Proposed Desirability Table for Brood Year 1999 Production Spawn Crosses

Tier 1 Crosses

Female	Male	Preference	Comments
BY96 Eagle or NMFS	BY97 Eagle or NMFS	first	
BY95 Anad. Return	BY97 Eagle or NMFS	first	
BY96 Eagle or NMFS	BY96 NMFS F2	first	males ID'd
BY96 NMFS F2	BY96 Eagle or NMFS	first	males ID'd
Any Anadromous Return	BY97 Eagle or NMFS	first	
BY95 Anad. Return	BY96 Eagle or NMFS	first	
BY96 Eagle or NMFS	BY95 Anad. Return	first	
BY95 Anad. Return	BY96 NMFS F2	first	
BY96 NMFS F2	BY95 Anad. Return	first	
BY95 Anad. Return	BY96 Anad. Return	first	
BY96 Anad. Return	BY95 Anad. Return	first	

Tier 2 Crosses

Female	Male	Preference	Comments
BY96 Anad. Return	BY96 Eagle or NMFS	second	share AN93
BY96 Eagle or NMFS	BY96 Anad. Return	second	share AN93
BY96 Anad. Return	BY96 Eagle or NMFS	second	

Tier 3 Crosses

Female	Male	Preference	Comments
BY95 Anad. Return	BY95 Anad. Return	third	
BY96 Anad. Return	BY96 Anad. Return	third	share AN93

Tier 4 Crosses

Female	Male	Preference	Comments
BY96 Eagle or NMFS	BY96 Eagle or NMFS	fourth	share mother

Tier 5 Crosses

Female	Male	Preference	Comments
BY96 NMFS F2	BY96 NMFS F2	fifth	F2 now

Prepared by:

Dan J. Baker
Hatchery Manager II

Jeff A. Heindel
Assistant Hatchery Manager

Jeremy J. Redding
Fish Culturist

Paul A. Kline
Principal Fisheries Research Biologist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Virgil K. Moore, Chief
Bureau of Fisheries

Tom Rogers
Anadromous Fish Hatcheries Supervisor