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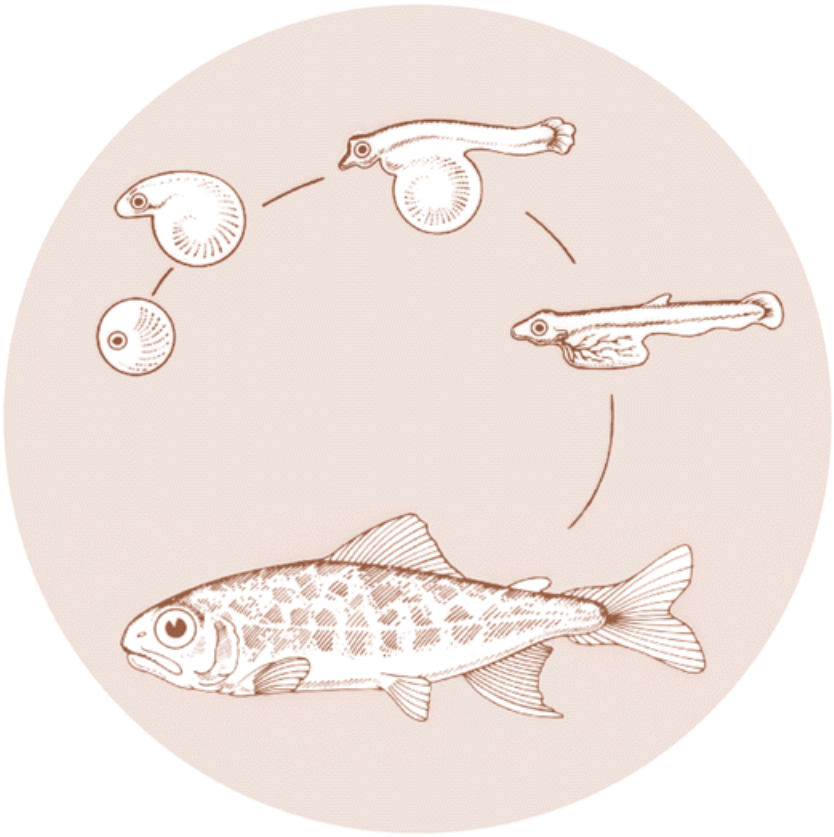
SNAKE RIVER SOCKEYE SALMON CAPTIVE BROODSTOCK PROGRAM HATCHERY ELEMENT

Annual Progress Report:
January 1, 1998 - December 31, 1998

Annual Report 1998



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SNAKE RIVER SOCKEYE SALMON CAPTIVE BROODSTOCK PROGRAM HATCHERY ELEMENT

ANNUAL PROGRESS REPORT JANUARY 1, 1998 - DECEMBER 31, 1998

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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 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, 1998 and December 31, 1998 are presented in this report.

On August 18, 1998, one male sockeye salmon was captured at the adult weir on Redfish Lake Creek. This fish was transferred to the Eagle Fish Hatchery where he was held until spawning.

Twenty-seven female sockeye salmon from one captive broodstock group were spawned at the Eagle Fish Hatchery in 1998. Successful spawn pairings produced approximately 15,580 eyed-eggs with a cumulative mean survival to eyed-egg rate of 48.1%.

Approximately 223,500 juvenile sockeye salmon were supplemented to Stanley Basin waters in 1998. Supplementation strategies included age-0 and age-1 fish and involved releases to Redfish Lake, Redfish Lake Creek, Alturas Lake, Pettit Lake and the Salmon River.

During this reporting period, four broodstocks and three unique production groups were in culture at the Eagle Fish Hatchery. Two of the four broodstocks were incorporated into the 1998 spawning design and one broodstock was terminated following the completion of spawning.

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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 (Stanley Basin) remain as potential sources of production (Figure 1). Historically, five Stanley Basin 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 list Snake River sockeye salmon as endangered under the Endangered Species Act (ESA) of 1973. On November 20, 1991, NMFS declared Snake River sockeye salmon endangered. Section 4(f) of the ESA requires the development and implementation of a recovery plan for listed species. At the time of this writing, a team (appointed by NMFS) is in the process of preparing the final draft of this document.

The Idaho Department of Fish and Game (IDFG), as part of its Five-Year Management Plan, is charged with the responsibility of reestablishing sockeye salmon runs to historic areas, with emphasis placed on efforts to utilize Stanley Basin sockeye salmon and kokanee resources (IDFG 1996). In 1991, SBT, along with 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. The NMFS ESA Permit Nos. 1120, 1124, and 844 authorize IDFG to conduct scientific research on listed Snake River salmon.

Initial steps by IDFG to recover the species include the establishment of captive broodstocks at the Eagle Fish Hatchery in Eagle, Idaho. To date, 22 broodstocks have been established from Redfish Lake out-migrants, anadromous adults, and residual adults. Nine of these broodstocks have completed their life cycle and spawned. In addition to these broodstocks, 18 distinct genetic groups have been developed and released to Stanley Basin waters from the program (Flagg and McAuley 1994; Johnson 1993; Johnson and Pravecek 1995; Johnson and Pravecek 1996; Pravecek and Johnson 1997; Pravecek and Kline 1998).

Idaho Department of Fish and Game participation in the Sawtooth Valley Project falls under two general areas of effort: the sockeye salmon captive broodstock program and Stanley Basin sockeye/kokanee fisheries research. Activities associated with the captive broodstock program are presented in this report.

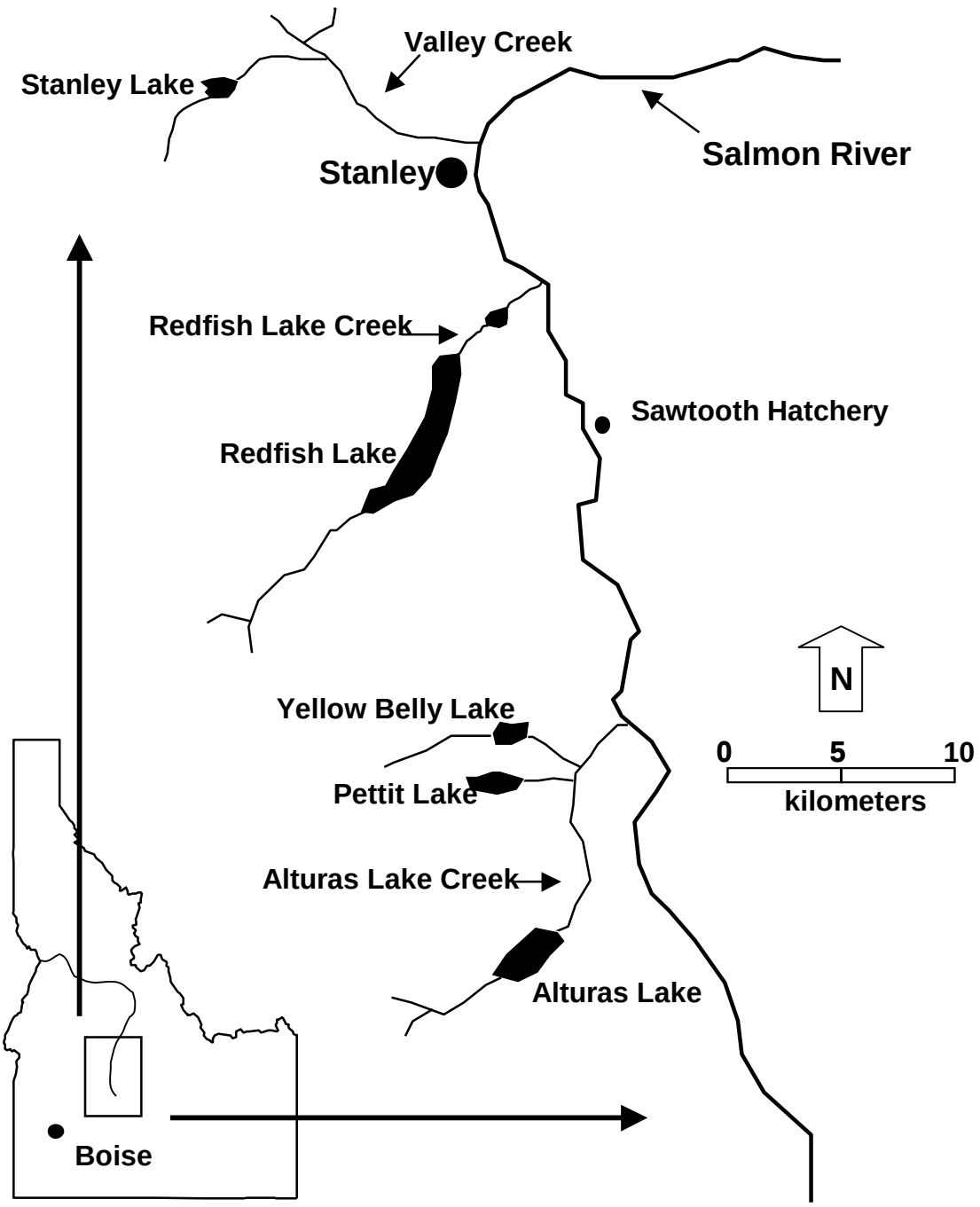

Figure 1. Stanley Basin Study Area

OBJECTIVES AND GOALS

The ultimate goal of the IDFG sockeye salmon recovery effort is to reestablish sockeye salmon runs to Stanley Basin waters and provide for the utilization of sockeye salmon and kokanee resources. The immediate project goal is to maintain Stanley Basin sockeye salmon through captive broodstock supplementation and avoid species extinction.

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 Basin 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 captive broodstock program. Artesian water from five wells is currently in use. Artesian flow is augmented through the use of 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 operator. 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 from fry to the adult stage including: 1) 0.7 m diameter semi-square tanks (0.91 m^3); 2) 1 m diameter semi-square tanks (0.30 m^3); 3) 2 m diameter semi-square tanks (1.42 m^3); 4) 3 m diameter circular tanks (6.50 m^3); and 5) 4 m diameter semi-square tanks (8.89 m^3). Typically, 0.7 m and 1 m tanks are used for rearing fry from ponding to approximately 1 g weight. Two and three meter tanks are used to rear juveniles to approximately 10 g and to depot and group fish by lineage or release strategy prior to distribution to Stanley Basin 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 captive broodstock program including: 1) pre-spawn anadromous adult holding; 2) egg incubation; and 3) juvenile rearing for pre-smolt 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 Heath trays. Fry are ponded to 0.7 m fiberglass tanks. Juvenile sockeye (>1 g) are held in vats or in a series of 2 m fiberglass tanks installed in 1997. Typically, juvenile sockeye salmon

reared at Sawtooth Fish Hatchery are released as sub-yearlings or yearlings. Pre-spawn anadromous adults captured at Redfish Lake Creek or Sawtooth Fish Hatchery weirs are held in vats until their 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. Back-up 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). Rations are weighed daily and follow suggested feeding rates provided by the manufacturer. Through approximately 100 g weight, fish receive the manufacturer's standard semi-moist formulation. Beyond 100 g weight, fish receive the manufacturer's customized brood diet. Elevated levels of vitamins, minerals, and pigments have been included in the brood diet to improve egg quality and reproductive success. Palatability of the brood diet is also enhanced with natural flavors from fish and krill.

Fish sample counts are conducted as needed to ensure that actual growth tracks with projected growth. Chemical therapeutants are used as needed for prophylactic and treatment purposes. In general, fish are handled as little as possible in the program. Juvenile rearing densities are maintained at levels not to exceed 8 kg/m^3. Mortalities are examined by a fish pathologist to determine cause of death. Carcasses are either incinerated, landfilled, or rendered.

Anadromous and Residual Adult Sockeye Salmon Trapping

The anadromous adult trap on Redfish Lake Creek is located approximately 1.4 km downstream from the outlet of Redfish Lake. In 1998, the trap was operated from July 20 to October 14 and checked daily by IDFG personnel.

A floating Merwin trap is used to capture residual sockeye salmon adults in Redfish Lake. When used, the trap is installed in October on the west side of the lake at the north end of Sockeye Beach. In 1998, the residual adult trap was not installed.

Pre-Spawn Adult Time on Chilled Water

Chilled water capability at Eagle Fish Hatchery was added in 1994. Beginning in that same year, adult broodstock sockeye salmon were moved to 10°C water from ambient 13°C water for part of their final maturation year. These efforts were continued in maturation years 1995 through 1997 to address water temperature affects on egg development, egg quality, fertilization rate, and percent maturation. In 1998, rearing time on 10°C water was extended permanently to include all post-incubation broodstocks at Eagle Fish Hatchery. A complete description of specific broodstocks follows.

Spawning Activities

Spawning has occurred at Eagle Fish Hatchery each year since 1994. Prior to 1994, adult sockeye returns were spawned at the Sawtooth Fish Hatchery (Johnson 1993; Johnson and Pravecek 1995; Johnson and Pravecek 1996). 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 two lots (by female) and fertilized with sperm from two males. Eggs are incubated by lot at different water temperatures to yield lineage-specific size groups for supplementation under different strategies and for future broodstock purposes.

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.

In 1998, fresh milt produced from ANBY94 and ANBY96 male sockeye salmon was cryopreserved at the Eagle Fish Hatchery. In addition to Eagle Fish Hatchery, cryopreservation responsibilities are shared with Washington State University (WSU) and University of Idaho (UI) facilities to spread the risk associated with storage system failure. Similar techniques are adhered to at each facility.

In 1998, cryopreserved milt from OMBY93 broodstock sockeye salmon was used to fertilize sub-lots of eggs produced from three ANBY96 broodstock females.

Fish Health Investigations

In 1998, the Eagle Fish Health Laboratory, operated by IDFG, processed samples for diagnostic and inspection purposes from captive broodstock sockeye salmon, production sockeye salmon juveniles reared at Eagle and Sawtooth fish hatcheries, and one wild anadromous adult sockeye salmon. Diagnostic cases totaled 54 accessions. Fifteen accessions were generated from spawning activities. Routine fish necropsies included investigations for viral pathogens (infectious pancreatic necrosis and infectious hematopoietic necrosis) in 110 fish samples, bacterial kidney disease *Renibacterium salmoninarum* (BKD) by Enzyme-Linked Immunosorbent Assay (ELISA) in 113 fish samples, and motile aeromonad septicemia (MAS) in four fish samples.

Eyed-Egg and Fish Transfers

Eggs are shipped at the eyed stage between NMFS and IDFG facilities using a commercial air service. Iodophor- (100 ppm) disinfected 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 insure 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.

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 in long distance (or duration) 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 densities guidelines are in place to not exceed 89 g/L (0.75 lb/gal).

Eyed-Egg and Fish Supplementation

To date, sockeye salmon have been reintroduced to Stanley Basin waters as eyed eggs, sub-yearlings, yearlings, and pre-spawn 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 bio-filter ring medium until after hatch. Plastic mesh netting surrounding egg boxes allows fish to volitionally emigrate 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.

Sub-yearling sockeye salmon are distributed to Stanley Basin 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 Stanley Basin waters using truck-mounted transportation tanks. To date, yearling sockeye 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.

Pre-spawn adult sockeye salmon are distributed to Stanley Basin 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, three production groups and four broodstocks were in culture at IDFG facilities representing brood years 1994, 1996, 1997, and 1998. A summary of losses while in culture during this reporting period is presented in Tables 1 and 2. Broodstocks developed primarily for supplementation to Stanley Basin waters are designated as "production" groups. Broodstocks developed to meet future spawning needs are designated as "broodstock" groups.

ANBY94 Broodstock

First generation progeny of the single female sockeye salmon that returned to Redfish Lake Creek in 1994 (AN94). Males used for spawning crosses in brood year (BY) 1994 included first generation progeny of the one female and three male sockeye salmon that returned to Redfish Lake Creek in 1991 (ANBY91) and 1991 Redfish Lake out-migrants (OM91). Initial inventory for the reporting period was 283 fish. One hundred sixty-one males matured in 1998, of which 27 and 4 were used for spawning and milt cryopreservation, respectively. One hundred thirty mature males and 65 females were culled following 1998 spawning activities. No age-4 females produced viable gametes in 1998. As of December 31, 1998, no fish from this broodstock remained in culture (Table 2).

BY96 Production

Two primary lineage groups were produced for supplementation in BY 1996. The majority of supplementation progeny were second generation fish produced from ANBY93 male and female parents. The second lineage group consisted of second generation fish produced from OMBY93 female and ANBY93 male parents. In addition, progeny of one BY 1993 residual sockeye salmon female and two BY 1992 residual males were produced in BY 1996. The majority of the BY96 production group was supplemented to Stanley Basin waters as age-0 pre-smolts in 1997. However, a portion of this broodstock was held at the Sawtooth Fish Hatchery for an age-1 smolt release in 1998. Initial inventory for this reporting period was 14,351 fish. In May 1998, 14,217 fish were released at two Stanley Basin locations. At the end of this reporting period, no fish from this production group remained in culture (Table 1).

Table 1. Summary of losses and magnitude of mortality for three captive sockeye salmon production groups reared at IDFG facilities in 1998.

	Production Groups		
	BY96	BY97	BY98
Starting Inventory (January 1, 1998)	14,351	148,781[a]	15,126[b]
Eyed-Egg to Fry			
Undetermined	n/a	20,809[c]	4,511[c]
Mechanical Loss			
Handling	0	44	n/a
Jump-out	0	0	n/a
Human Error	0	0	n/a
Non-infectious			
Lymphosarcoma	0	0	n/a
Other	134[d]	10,172[d]	n/a
Infectious			
Bacterial	0	3,594[e]	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	37,752[f]	46,915[g]
Transferred Out	0	0	0
Planted/Released	14,217	141,871	n/a
Ending Inventory (December 31, 1998)	0	10,043	57,530

[a] December 1997 eyed-egg numbers.
[b] December 1998 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, non-infectious mortality.
[e] Mortality associated with motile aeromonas septicemia (MAS).
[f] Transferred to IDFG from NMFS.
[g] 46,898 transferred to IDFG from NMFS. Seventeen transferred from Eagle Fish Hatchery BY98 broodstock program to Sawtooth Fish Hatchery BY98 production groups.

Table 2. Summary of losses and magnitude of mortality for four captive sockeye salmon broodstocks reared at IDFG facilities in 1998.

	Broodstocks			
	ANBY94	BY96	BY97	BY98
Starting Inventory (January 1, 1998)	283	367	376[a]	454[b]
Eyed-Egg to Fry				
Undetermined	n/a	n/a	16[c]	71[c]
Mechanical Loss				
Handling	0	0	0	n/a
Jump-out	0	1	0	n/a
Human Error	20	0	0	n/a
Non-infectious				
Lymphosarcoma	3	1	0	n/a
Other	34[d]	40[d]	16[d]	n/a
Infectious				
Bacterial	0	1	0	n/a
Viral	0	0	0	n/a
Other	0	0	0	n/a
Maturation				
Mature Males	161	63	0	n/a
Mature Females	0	28	0	n/a
Other	65	0	0	n/a
Relocation				
Transferred In	0	0	0	127[e]
Transferred Out	0	0	0	73[f]
Planted/Released	0	0	0	0
Ending Inventory (December 31, 1998)	0	233	344	437

[a] December 1997 eyed-egg numbers.
[b] December 1998 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, non-infectious mortality.
[e] Transferred to IDFG from NMFS.
[f] Fifty-six transferred from IDFG to NMFS. Seventeen transferred to Sawtooth Fish Hatchery to be included with BY98 production group.

BY96 Broodstock

Two primary culture groups were developed in 1996 to meet future broodstock needs. The first group (ANBY96) consisted 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 Cryo) consisted 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). Initial inventory for the ANBY96 broodstock was 332 fish. Ninety fish (63 males and 27 females) matured at age-2 in 1998. Twenty-six females were utilized in spawn pairings, with one female culled due to cultural anomalies. Milt from four of the 63 mature males was cryopreserved to preserve future broodstock options. To avoid full and half-sibling spawn crosses, the remaining 59 mature males were not incorporated in the 1998 spawning matrix. At the end of the reporting period, 200 ANBY96 broodstock fish remained in culture at Eagle Fish Hatchery (Table 3). Initial inventory for the BY96 Cryo broodstock was 35 fish. One age-2 female matured in 1998 and was incorporated in the spawning design. At the end of the reporting period, 33 fish from this broodstock remained in culture at the Eagle Fish Hatchery (Table 2).

BY97 Production

Second generation progeny of ANBY94 female and ANBY93 male broodstock sockeye salmon. Approximately 186,533 eyed-eggs were distributed between Eagle and Sawtooth fish hatcheries from this group. The majority of this production group (141,871) was released to Stanley Basin lakes in 1998 as age-0 pre-smolts. The remaining balance is currently being held at the Sawtooth Fish Hatchery for a 1999 smolt release. Ending inventory for this reporting period was 10,043 fish (Table 1).

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). Approximately 625 eyed-eggs were produced from the above spawn crosses in 1997. Two hundred ninety-six eyed-eggs were transferred to the NMFS Big Beef Creek facility in December 1997. Initial IDFG Eagle Fish Hatchery inventory for this reporting period was 376 fry. At the end of the reporting period, 344 BY97 broodstock remained in culture at the Eagle Fish Hatchery (Table 2).

BY98 Production

Two primary culture groups were produced for supplementation in BY 1998. The majority of supplementation progeny were produced from second generation females (ANBY91) 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 above culture groups were produced at the NMFS Big Beef Creek facility in Washington State. Approximately 46,898 eyed-eggs were

transferred to the IDFG Sawtooth Fish Hatchery. Ending inventory for this reporting period was 43,429 fry (Table 1). The second culture group was produced at the Eagle Fish Hatchery from first generation females (ANBY96) from the single female that returned to Redfish Lake Creek in 1996 (AN96) and first generation males (ANBY94) from the single female that returned to Redfish Lake Creek in 1994 (AN94). Approximately 15,126 eyed-eggs were produced from these spawn pairings and transferred to the Sawtooth Fish Hatchery. In addition, 17 eyed-eggs from one Eagle Fish Hatchery ANBY96 x OMBY93 Cryo broodstock sub-family were transferred to the Sawtooth Fish Hatchery to be included in the BY98 production group. At the end of this reporting period, approximately 14,101 fry were in culture at Sawtooth Fish Hatchery from Eagle Fish Hatchery spawn crosses (Table 1). No BY98 production fish remained in culture at the Eagle Fish Hatchery. Progeny from these crosses will be released throughout the summer and fall of 1999. Pending the development of a final release plan, a portion may be held for a 2000 smolt release.

BY98 Broodstock

Two primary culture groups were developed in 1998 to meet future broodstock needs. The first group (produced at the NMFS Big Beef Creek facility) was produced from second generation females (ANBY91) 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). Approximately 127 eyed-eggs produced from these spawn pairings were transferred to the IDFG Eagle Fish Hatchery for co-culture and to guard against catastrophic loss. Additional production remained in culture at the NMFS Big Beef Creek facility. At the end of this reporting period, approximately 126 fry were in culture at the Eagle Fish Hatchery (Table 2). The second culture group was produced from first generation females (ANBY96) from the single female that returned to Redfish Lake Creek in 1996 (AN96). Males used for spawn crosses included first generation males (ANBY94) 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). Approximately 454 eyed-eggs were produced from these spawn pairings. Fifty-six eyed-eggs from ANBY96 x AN98 crosses were transferred to the NMFS Big Beef Creek facility for co-culture and to guard against catastrophic loss. Seventeen eyed-eggs from ANBY96 x OMBY93 Cryo crosses were transferred to the Sawtooth Fish Hatchery to be included in 1999 production releases. At the end of this reporting period, 311 fry were in culture at the IDFG Eagle Fish Hatchery (Table 2).

Anadromous and Residual Sockeye Salmon Trapping

On August 18, 1998, one male anadromous sockeye salmon was captured and transferred to the IDFG Sawtooth Fish Hatchery for temporary holding. The fish measured 58 cm in fork-length and had one external injury on the dorsal surface of the caudal peduncle. No external marks or PIT tag were detected for this fish, suggesting that it was of wild origin. On September 11, 1998, the single male was transferred to the Eagle Fish Hatchery using a standard transportation tank and auxiliary water as specified in NMFS Permit No. 1120. The male was held with maturing ANBY94 broodstock adults until spawning. In 1998, no adult chinook salmon *O. tshawytscha* were captured at the Redfish Lake Creek adult sockeye trap.

No attempts were made to capture residual sockeye salmon during the 1998 season.

Pre-Spawn Adult Time on Chilled Water

Several investigators have suggested upper temperature limits for rearing salmonids to produce high quality eggs and fry. Erdahl (1994) suggested that, for rainbow trout *O. mykiss* broodstock, rearing temperatures not exceed 12°C for at least six months prior to spawning. Swanson (1995) stated that successful reproduction of salmonids in the wild diminishes when water temperature exceeds 13°C. To date, pre-spawn rearing of Eagle Fish Hatchery broodstocks in 10°C water has failed to result in statistically significant differences in gamete quality. Despite past results, this practice remains an integral component of sockeye salmon broodstock culture at the Eagle Fish Hatchery.

Broodstock transfers to 10°C rearing were delayed in 1998 due to facility modifications. Brood year 1994 (ANBY94) and 1996 (ANBY96) adult sockeye were transferred from 13°C to 10°C water on August 12, 1998, approximately two months prior to spawning. Brood year 1997 (BY97) juveniles were moved from 13°C to 10°C water on November 11, 1998. ANBY94 adults completed their rearing cycle in 1998 and were terminated following the completion of spawning. At the end of the reporting period, ANBY96 and BY97 broodstocks were being reared on 10°C water and will continue to be reared at this temperature through maturation and spawning.

Spawning Activities

The Idaho Department of Fish and Game is required by NMFS Permit #1120 to discuss proposed broodstock spawning matrices with NMFS Coastal Zone and Estuarine Studies Division genetics staff. In 1998, this was accomplished by providing a proposed spawning design to Dr. Robin Waples of NMFS and to the Stanley Basin Sockeye Technical Oversight Committee (SBSTOC), (Appendix A).

In 1998, 27 ANBY96 female broodstock sockeye salmon matured and spawned at the Eagle Fish Hatchery between October 9 and October 26. Results from 1998 Eagle Fish Hatchery spawning activities are reviewed below. Progeny developed for supplementation to Stanley Basin waters are designated “BY98 Production” and progeny developed to meet future spawning needs are designated “BY98 Broodstock.” Results from spawning activities conducted by NMFS at Washington State facilities will appear under separate cover by that agency.

BY98 Production

During the fall of 1998, 90 fish from the ANBY96 broodstock (age-2) and 161 fish from the ANBY94 broodstock (age-4) matured at the Eagle Fish Hatchery. To avoid half-sibling spawn crosses, F_1 male progeny from the ANBY94 broodstock were crossed with F_1 ANBY96 females. Twenty-six females were spawned to generate approximately 28,162 green eggs. In most cases, each ANBY96 female was spawned with two ANBY94 males (representing different sub-family lineage) to produce 32 unique sub-families. Mean fecundity averaged 1,199 eggs per female. Egg survival to the eyed-stage ranged from 0.2% to 96.2% and averaged 53.7%. Approximately 15,126 eyed-eggs were produced from the above crosses. All production eggs were transferred to the Sawtooth Fish Hatchery for final incubation and rearing to release. At the end of this reporting period, approximately 14,101 fry were in culture at that facility. Final release plans will be developed by the SBSTOC.

BY98 Broodstock

Eagle Fish Hatchery broodstock spawn crosses were generated from first generation females (ANBY96) from the single female that returned to Redfish Lake Creek in 1996 (AN96). Males used in spawn crosses included first generation males (ANBY94) 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).

Sub-lots of eggs from eight ANBY96 females were spawned with milt from the 1998 anadromous male (AN98) to generate approximately 2,947 green eggs. Egg survival to the eyed-stage ranged from 2.2% to 28.4% and averaged 13.1%. Approximately 387 eyed-eggs were produced from ANBY96 x AN98 crosses. Fifty-six eyed-eggs from this broodstock were transferred to the NMFS Big Beef Creek facility. At the end of the reporting period, approximately 279 fry were in culture at the Eagle Fish Hatchery.

Sub-lots of eggs from one ANBY96 female were spawned with milt from four ANBY94 males to generate approximately 965 green eggs. Egg survival to the eyed stage ranged from 0.5% to 5.9% and averaged 2.7%. Approximately 26 eyed-eggs were produced from these crosses. At the end of the reporting period, 11 fry remained in culture at the Eagle Fish Hatchery.

Sub-lots of eggs from three ANBY96 females were spawned with cryopreserved milt from OMBY93 males to generate approximately 301 green eggs. Egg survival to the eyed stage ranged from 0.0% to 24.0% and averaged 13.6%. Forty-one eyed-eggs were produced from these crosses (only two of the three sub-lots yielded eyed-eggs). Seventeen eyed-eggs (total number of eyed-eggs from one of the two ANBY96 females) were transferred to the Sawtooth Fish Hatchery to be incorporated in production outplants. At the end of this reporting period, 21 fry from these crosses (one sub-family) remained in culture at the Eagle Fish Hatchery.

Milt Cryopreservation

Cryopreserving sperm from donor males has been used in fish culture for many years to preserve gametes for future use. In the captive broodstock program at Eagle Hatchery, cryopreservation has been successfully used since the inception of the project in 1991. On October 28, 1998, milt from four unique ANBY94 and four unique ANBY96 broodstock male sockeye salmon was cryopreserved at the Eagle Hatchery. This effort produced 120 and 109, 0.5 ml straws for ANBY94 and ANBY96 broodstocks, respectively. Milt from the single anadromous male that returned to Redfish Lake Creek in 1998 was cryopreserved on October 22 and 28, 1998, at the Eagle hatchery. Seventy, 0.5 ml straws were produced from this effort. On October 22, 1998, additional milt (approximately 3.0 ml) was harvested from the anadromous male and shipped to NMFS for use in the development of 1998 broodstocks.

On October 22, 1998, cryopreserved milt from OMBY93 broodstock sockeye salmon was used to fertilize three sub-lots of eggs produced from three ANBY96 broodstock females. Egg numbers averaged approximately 100 per sub-lot. Egg survival to the eyed stage ranged from 0.0% to 24.0% and averaged 13.6%. Forty-one eyed-eggs were produced from these crosses. Progeny produced in this fashion will contribute to the enhancement of genetic variability in future brood years.

Fish Health Investigations

Cause of mortality and magnitude of loss for all sockeye salmon broodstocks and production groups maintained at Eagle and Sawtooth Fish Hatcheries during the term of the reporting period are presented in Tables 1 and 2.

In 1998, a total of 110 sockeye salmon were sampled without detection of any viruses. These results have been consistent since the inception of the program in 1991 and indicate that fish culture efforts have not introduced infectious pancreatic necrosis virus (IPNV) or infectious hematopoietic necrosis virus (IHNV) into this population. Monitoring for bacterial kidney disease *Renibacterium salmoninarum* (BKD) in adults and juveniles has been routinely conducted using the Enzyme-Linked Immunosorbent Assay (ELISA) technique. Of the 113 fish examined in 1998, only one sockeye (BY96) exhibited an elevated ELISA optical density value (0.96). This broodstock population will continue to be carefully monitored. In 1998, Eagle Fish Hatchery continued its participation in the University of Idaho's Investigational New Animal Drug (INAD) program to continue to have access to Erythromycin (ERY). Periodic prophylactic treatments with ERY-medicated feed occurred in 1998.

The only significant disease agent detected in 1998 was motile aeromonas septicemia (MAS). Detected in BY 1997 juvenile sockeye salmon, approximately 2.2 percent of the population was lost from this disease between April and July while in culture at the Eagle Fish Hatchery. Mortality continued into September following the transfer of fish to Redfish Lake net pens. During net pen culture, an additional 3.5 percent of the population was lost as a result of this infection. Treatment with Oxytetracycline was effective in controlling loss. Mortality dropped off significantly prior to the October 1, 1998 release of net pen fish to Redfish Lake.

During this reporting period, two BY 1994 adult sockeye salmon developed lymphosarcomas and one developed a hepatic tumor. The frequency of these diseases is consistent with findings from past years.

Eyed-Egg and Fish Transfers

In 1998, approximately 46,898 and 14,692 eyed-eggs from BY 1998 production spawning crosses were transferred from the NMFS Big Beef Creek facility and the Eagle Fish Hatchery, respectively, to the Sawtooth Fish Hatchery. In addition, eyed-eggs from broodstock spawning crosses were transferred between the NMFS Big Beef Creek facility and the Eagle Fish Hatchery. In all cases, the required State transfer permits were acquired prior to shipping. Details by date are described below.

On November 24, 1998, the following transfers occurred: 1) approximately 15,548 eyed-eggs from production crosses transferred from NMFS to the Sawtooth Fish Hatchery, 2) approximately 127 eyed-eggs from broodstock crosses transferred from NMFS to the Eagle Fish Hatchery, and 3) approximately 12,054 eyed-eggs from production crosses transferred from the Eagle Fish Hatchery to the Sawtooth Fish Hatchery.

On December 3, 1998, 56 eyed-eggs from broodstock crosses were transferred from the Eagle Fish Hatchery to NMFS.

On December 4, 1998, the following transfers occurred: 1) approximately 23,503 eyed-eggs from production crosses transferred from NMFS to the Sawtooth Fish Hatchery, and 2) approximately 2,638 eyed-eggs from production crosses transferred from the Eagle Fish Hatchery to the Sawtooth Fish Hatchery.

On December 16, 1998, approximately 7,847 eyed-eggs from production crosses were transferred from NMFS to the Sawtooth Fish Hatchery.

Eyed-Egg and Fish Supplementation

Pursuant to Special Condition B. 9. of Permit 1120, IDFG received authorization from NMFS to carry out the following supplementation releases in 1998. A summary of 1998 releases is presented in Table 3.

On April 28 and May 4, 1998, 37,583 age-1 smolts were released directly to Redfish Lake Creek downstream of the out-migrant weir. Smolts in this release were of two separate origins: 1) 13,218 fish (BY 1996) reared at the Sawtooth Fish Hatchery, and 2) 24,365 fish (BY 1996) reared at the ODFW Bonneville Fish Hatchery. Sawtooth and Bonneville release groups averaged 26.5 g and 63.5 g per fish, respectively. All fish were adipose fin-clipped and a representative number from both groups were PIT tagged for evaluation purposes.

On April 27, 28, and May 4, 1998, 44,032 age-1 smolts were released directly to the Salmon River downstream of the Sawtooth Hatchery trap. Smolts in this release were of two separate origins: 1) 999 fish (BY 1996) reared at the Sawtooth Fish Hatchery, and 2) 43,033 fish (BY 1996) reared at the ODFW Bonneville Fish Hatchery. Sawtooth and Bonneville release groups averaged 26.5 g and 63.5 g per fish, respectively. All fish were adipose fin-clipped and a representative number from both groups were PIT tagged for evaluation purposes.

On July 30, 1998, 7,246 BY 1997 juvenile sockeye salmon (age-0) were released at a mid-lake location in Pettit Lake. All fish were adipose fin-clipped and 1,502 were PIT tagged for evaluation purposes. Mean length and weight at tagging were 93.0 mm and 8.7 g. A small number (<50) of these fish were detected passing the Sawtooth Fish Hatchery trap within a week of release; no PIT tag detections were recorded between Lower Granite and McNary dams. No estimates of early out-migration were made.

From July 6 through 9, 1998, a total of 58,408 BY 1997 juvenile sockeye salmon (age-0) were transferred to Redfish Lake net pens. All fish were adipose fin-clipped and 3,026 were PIT tagged for evaluation purposes. Mean length and weight at tagging (June 1998) were 89.0 mm and 7.9 g. On October 1, 1998, 55,830 (includes 2,958 with PIT tags) fish were released to Redfish Lake from net pens. Mean length and weight at release were 109.0 mm and 14.4 g.

On October 14, 1998, 39,418 BY 1997 juvenile sockeye salmon (age-0) were released at a mid-lake location in Redfish Lake. All fish were adipose fin-clipped and 1,206 were PIT tagged for evaluation purposes. Mean length and weight at tagging (Oct 8) were 101.3 mm and 10.8 g.

On October 14, 1998, 39,377 BY 1997 juvenile sockeye salmon (age-0) were released at a mid-lake location in Alturas Lake. All fish were adipose fin-clipped and 1,246 were PIT tagged for evaluation purposes. Mean length and weight at tagging (Oct 9) were 99.4 mm and 10.3 g.

No releases of pre-spawn broodstock adults or eyed-egg supplementation occurred during the 1998 season.

Table 3. Supplementation releases made to the Stanley Basin in 1998.

No. Released	No. Marked	Release Date	Weight (g)	% Marked
Summer Direct Release to Pettit Lake (BY 1997)				
7,246	1,504	Jul 30	8.7	20.7
Redfish Lake Net Pens (BY 1997)				
55,830	2,958	Oct 01	14.4	5.4
Fall Direct Release to Redfish Lake (BY 1997)				
39,418	1,206	Oct 14	10.8	3.1
Fall Direct Release to Alturas Lake (BY 1997)				
39,377	1,246	Oct 14	10.3	3.2
Sawtooth Hatchery-Reared Smolts (BY 1996)				
14,217	2,058	Apr 27, Apr 28, May 4	26.5	14.5
Bonneville Hatchery-Reared Smolts (BY 1996)				
67,398	1,994	Apr 28, May 4	63.5	3.0

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. The logistics of this project are sometimes a nightmare, and they make each trip (scheduled or spontaneous) much more enjoyable and productive.

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APPENDICES

Appendix A. Memorandum to SBSTOC regarding 1998 spawning matrix.

IDAHO DEPARTMENT OF FISH AND GAME
EAGLE FISH HEALTH LABORATORY
1800 TROUT ROAD
EAGLE, IDAHO 83616
ph. (208) 939-2413 Fax (208) 939-2415

MEMORANDUM: March 24, 1998

To: Sockeye SBSTOC Participants

From: Keith Johnson

Subject: 1998 Spawning Matrix

The intention of this memo is to lay the basis for establishing a spawning matrix for BY98. The genetic guidance remains as previously established: minimize inbreeding and maximize genetic diversity for production fish and in "safety net" broodstocks, if any are held. Adult returns for 1998 create a challenge different than we have dealt with in this regard, since we can only project lineage of two groups based on the proportion of smolts documented leaving the lake. Several issues need SBSTOC attention and will be presented following documentation of return numbers and proposals of how to integrate returning adults with those in captivity.

ADULTS RETURNING TO REDFISH LAKE CREEK TRAP

Assumptions were applied to projections of smolts that left the lake or were released below the weir as smolts in 1996. Projected adult return numbers are as follows:

LINEAGE	ORIGIN	MARKS	NUMBER	% BY LINEAGE
BY91xBY91BY94	EAG	AD	12	72
BY9BY91XBY914	BFH	RV/CWT	21	
OM91XBY91BY94	EAG	AD	12	26
WILD	RFL	NONE	1	2

ADULTS RETURNING TO PETTIT LAKE

LINEAGE	ORIGIN	MARKS	NUMBER
BY91xBY91BY94	EAG	AD	4

ADULTS RETURNING TO THE BONNEVILLE FISH HATCHERY

LINEAGE	ORIGIN	MARKS	NUMBER
BY91xBY91BY94	BFH	RV/CWT	90

MATURATION EXPECTED IN CAPTIVE BROODSTOCKS

LINEAGE	ORIGIN	ID	INVENTORY	MATURE
BY91xAN94	EAG	PIT	194	0♀, 60♂
OM91xAN94	EAG	PIT	84	0♀, 25♂
BY91xBY91sn	MAN	?	170	43♀, 43♂
BY91xAN94ID	MAY	PIT	265	26♀, 80♂

Appendix A. Continued.

PRIORITIZED MATINGS FOR ADULT RETURNS TO RFLC TRAP

1. Wild adult mated with OM91xAN94(EAG). Why? Number of unique males used from OM91 is greater than 3 AN males in 1991.
2. AD clipped adults (½ OM91xAN94 and ½ BY91xBY94). Why? Number of unique OM91 males and incorporate AN94 female in BY. Mated with OM91xAN94(EAG). Why? Reduce inbreeding, maximize diversity.
3. RV/CWT adults mated with OM91xAN94(EAG). Why? Not as preferred since BY91xBY91 origin used multiple times in broodstock, lacks diversity and BKD risk.

ISSUES

Permit limit of 29 adults. Should it be increased? Should we prefer more females (75%) brought into spawning matrix (e.g., 15 of 20 adults are females to get up release numbers). This may add consistency to release numbers but sacrifices "natural production" component of the program. We prefer to take the single wild adult, 16 AD clipped adults (♀ = 12, ♂ = 4) and 3 RV/CWT (♀ = 2, ♂ = 1).

RESOLUTION

Prefer combination of #1 and #2 above. Want some of #3 to see if BKD was transmitted and established; but balance risk of culling eggs. Sex ratio: 75% female to Eagle should yield about 40,000 progeny.

PRIORITIZED MATINGS FOR ADULT RETURNS TO PETTIT LAKE

Only four adults are projected and all are BY91xBY91 lineage. Preferred action would be to supplement with equal sex ratio of OM91xAN94 (EAG) unless males are in short supply (only 25 projected to mature). Tracking with sonic tags is anticipated to establish spawning location.

PRIORITIZED MATINGS FOR ADULT RETURNS TO BONNEVILLE FH

ISSUES

Should not mate within group since all share common, single female grandam and three grandsires. Milt preferred from BY91xAN94(ID) group at MAN (logistics issue). All adults used for spawning are 100% sampled for virus and BKD. Cull eggs of those virus positive and BKD ELISA > 0.4. Individual family incubation in quarantine. When to open trap? How are adults to be held during maturation (isolation, water supply)?

1. Select males from BY91xAN94 group to attain about 50% OM91 male lineage then with equal sub-family AN91 male lineage (A+N, B, C) for the remaining 50%.
2. BY91xAN94 milt from EAG would yield same result but logistics are more difficult.

PRIORITIZED MATINGS FOR ADULTS MATURING AT MANCHESTER

The safety net broodstock is all BY91xBY91, and females should be dealt with as the BFH returns by mating with BY91xAN94(ID) group with emphasis on OM91 males.

Submitted by:

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