



**SNAKE RIVER SOCKEYE CAPTIVE PROPAGATION
PROJECT #2007-402-00
IDFG SPRINGFIELD HATCHERY SOCKEYE PRODUCTION**

**Contract Completion Report No. 84045 REL 3
October 1, 2022 – September 30, 2023**



Prepared by:

**Brandon Filloon, Fish Hatchery Manager II
Ross Stadt, Fish Hatchery Assistant Manager
and
Bryan Grant, Fish Hatchery Complex Manager**

**IDFG Report Number 24-101
January 2024**

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By

**Brandon Filloon
Ross Stadt
and
Bryan Grant**

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

To

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

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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 Snake River Sockeye Salmon included the establishment of a captive broodstock program at the Idaho Department of Fish and Game's Eagle Fish Hatchery. Brood Year 2021 and 2022 broodstock and fish culture responsibilities for the listed stock were shared among: the National Oceanic and Atmospheric Administration's Manchester Research Station and Burley Creek Hatchery adjacent to Puget Sound in Washington State; and the Idaho Department of Fish and Game's Eagle Fish Hatchery and Springfield Fish Hatchery. The Shoshone-Bannock Tribes are responsible for limnology work in the Sawtooth Basin and out-migration monitoring in Pettit and Alturas lakes.

In the 2008 Federal Columbia River Power System Biological Opinion (NOAA Fisheries 2008), National Oceanic and Atmospheric Administration Fisheries established a juvenile Sockeye Salmon smolt production target of up to 1,000,000 smolts. It is anticipated that releasing up to 1,000,000 smolts annually should consistently return a minimum of 5,000 anadromous adults annually.

The Springfield Fish Hatchery was constructed in 2012-2013 to address the smolt production phase of the Snake River Sockeye Salmon Captive Broodstock program. The annual production target for the facility is up to 1,000,000 smolts at an average size of 10-20 fish per pound. To accommodate the increased spawning and incubation activities associated with supplying large numbers of eyed eggs to the Springfield Fish Hatchery, the Eagle Fish Hatchery expansion project was completed in June 2008.

Funding for this program is provided by The Bonneville Power Administration in association with the 2008 Idaho Fish Accords.

Authors:

Brandon Filloon
Springfield Fish Hatchery Manager II

Ross Stadt
Springfield Fish Hatchery Assistant Manager

Bryan Grant
Fish Hatchery Complex Manager, Eastern Idaho

INTRODUCTION

Numbers of Snake River Sockeye Salmon *Oncorhynchus nerka* declined over the course of the 20th century, dramatically so from the 1950's until and subsequent to the 1991 ESA listing of the stock. In Idaho, only the lakes of the upper Salmon River in the Sawtooth Valley remain as potential sources of production. Historically, five Sawtooth Valley lakes (Redfish, Alturas, Pettit, Stanley, and Yellowbelly) supported Sockeye Salmon (Bjornn et al. 1968; Chapman et al. 1990). At the time of listing, the only Sawtooth Valley lake receiving a remnant anadromous run was Redfish Lake.

On April 2, 1990, National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries – also known as National Marine Fisheries Service) received a petition from the Shoshone-Bannock Tribes (SBT) to list Snake River Sockeye Salmon as endangered under the United States Endangered Species Act (ESA) of 1973. On November 20, 1991, NOAA Fisheries declared Snake River Sockeye Salmon endangered.

In 1991, the SBT, along with the Idaho Department of Fish and Game (IDFG), initiated the Snake River Sockeye Salmon Sawtooth Valley Project with funding from the Bonneville Power Administration (BPA). The goal of this program is to conserve genetic resources and to rebuild Snake River Sockeye Salmon populations in Idaho. Coordination of this effort is carried out under the guidance of the Stanley Basin Sockeye Technical Oversight Committee (SBSTOC), a team of biologists representing the agencies involved in the recovery and management of Snake River Sockeye Salmon. The NOAA Fisheries ESA Permit Nos. 1120, 1124, and 1481 authorize IDFG to conduct scientific research on listed Snake River Sockeye Salmon.

Initial steps to recover the species involved the establishment of captive broodstocks at the Eagle Fish Hatchery (Eagle FH) in Idaho and at NOAA Fisheries facilities in Washington State (for a review, see Flagg 1993; Johnson 1993; Flagg and McAuley 1994; Kline 1994; Johnson and Pravecek 1995; Kline and Younk 1995; Flagg et al. 1996; Johnson and Pravecek 1996; Kline and Lamansky 1997; Pravecek and Johnson 1997; Pravecek and Kline 1998; Kline and Heindel 1999; Hebdon et al. 2000; Flagg et al. 2001; Kline and Willard 2001; Frost et al. 2002; Hebdon et al. 2002; Hebdon et al. 2003; Kline et al. 2003a; Kline et al. 2003b; Willard et al. 2003a; Willard et al. 2003b; Baker et al. 2004; Baker et al. 2005; Willard et al. 2005; Baker et al. 2006; Plaster et al. 2006; Baker et al. 2007; Peterson et al. 2008; Baker and Green 2009a; Baker et al. 2009b; Peterson et al. 2010; Baker et al. 2011a; and Baker et al. 2011b).

The NOAA Fisheries 2008 Biological Opinion (NOAA Fisheries 2008) established a hatchery smolt production target of up to 1,000,000 Sockeye Salmon smolts. This level of hatchery production, combined with natural production, is expected to achieve the adult production criterion required for delisting this species. The interim delisting criteria is for a population of 2,000 adult Sockeye Salmon, of which 1,000 must be produced in Redfish Lake, and 500 in each of two additional lakes.

PROGRAM GOALS

The biological goal of the program is to increase the number of adults spawning naturally in the system. Springfield Fish Hatchery (Springfield FH) smolt releases are expected to produce returning adults in excess of broodstock needs that will contribute to the program goal. Over time, the objective is to have an average adult escapement of 2,000 fish over two generations. To meet

the NOAA Fisheries interim recovery criteria, 1,000 of these fish must be produced in Redfish Lake and 500 each produced in two additional lakes.

The conservation goal of the program is to conserve the unique genetics of the Snake River Sockeye Salmon, ensuring the long-term persistence of a viable, healthy, and harvestable population of this stock. The captive broodstock program is designed to assist in the recovery of the Snake River Evolutionary Significant Unit by protecting the remaining genetic resources of the species and by providing the juveniles and adults needed to restore natural production in Redfish Lake, Alturas Lake, and Pettit Lake. As natural production increases, the conservation program will be converted to an integrated conservation-type program following recommendations published by the Hatchery Scientific Review Group in 2004 (HSRG 2004). This program would serve as a safety net in case of future poor survival periods.

The program has a secondary goal of providing harvest opportunities to tribal and sport fishers in the Snake and Salmon rivers. This goal is not expected to be attained for at least another decade or more.

Objectives and Tasks

The primary focus this contract period was to conduct routine hatchery operations and management, along with traditional fish culture activities. Eyed egg incubation, early rearing, adipose clipping and subsequent transfer to the outdoor raceways for Brood Year 2021 (BY21) occurred during the previous contract period. Subsequent final rearing in the outdoor raceways, pre-release acclimation at Sawtooth Fish Hatchery (Sawtooth FH) and release of the BY21 production group occurred during this contract period. Brood Year 2022 (BY22) fish culture activities began during this contract period.

Key tasks associated with the culture of BY21 and BY22 Sockeye Salmon production groups at Springfield FH during this contract period include the following:

1. Implement final rearing of the BY21 Sockeye Salmon production group in outdoor raceways to achieve an average target acclimation transfer size of 12 fish per pound (fpp).
2. Implement Passive Integrated Transponder (PIT) tagging plan for the BY21 Sockeye Salmon production group.
3. Transfer BY21 Sockeye Salmon to Sawtooth FH for pre-release acclimation.
4. Following acclimation at Sawtooth FH, transport and release BY21 Sockeye Salmon smolts into Redfish Lake Creek.
5. Incubate BY22 Sockeye Salmon eyed eggs at Springfield FH.
6. Implement early rearing of BY22 Sockeye Salmon at Springfield FH.
7. Move BY22 Sockeye Salmon to outdoor raceways and initiate final rearing.
8. Document problems encountered and corrective actions taken as necessary.

FACILITY DESCRIPTION AND OPERATION

Facility Overview

Springfield FH is located in Bingham County, Idaho near the town of Springfield. Construction of the facility was completed in 2013 from funding provided by BPA through the Idaho Fish Accords. The facility is located on a 73-acre parcel which is made up of two smaller parcels, a 43-acre northern parcel and a 30-acre southern parcel. The northern parcel supports all existing facilities. Three on-site residences provide housing for full-time hatchery personnel and a dormitory is available to house temporary staff.

A confined aquifer underlying the Springfield FH site supplies high quality pathogen free groundwater for hatchery operations. The facility has a water right for 50 cfs. There are nine artesian wells located on the northern parcel. Six of the wells (wells 5, 7, 8, 10, 11, and 12) supply groundwater for hatchery production operations. These six wells feature a dual-head design that allows water delivery by both artesian flow and pumping. Due to elevation differences, artesian flow cannot be delivered to the hatchery building, but may supply outdoor raceways. The remaining three wells (wells 4, 6, and 9) have discharge heads with valves that can be opened or closed to allow artesian flow to Crystal Springs Pond, a public fishing pond located on the 43-acre northern parcel. The ambient water temperature remains a constant 10°C and total dissolved gas (TDG) levels currently range from 100% - 102% after aeration and degassing. Additionally, a chiller supplies up to 100 gpm of water chilled to 5°C for use in incubation or early rearing.

Backup and system redundancy is in place for degassing, pumped water delivery, chilled water supply, and power generation. An automated alarm system monitors pump operation at all six production well locations, head box water levels, and flows to the early rearing and incubation water supply piping. The alarm system also monitors the backup generators and the chilled water supply system.

Eyed eggs are placed in vertical flow incubators upon receipt and remain in these units through hatch and development to the swim-up fry stage. There are 48 incubator stacks (8 rows of 6 stacks), each stack holds eight incubator trays. Each row and/or stack can be supplied with ambient temperature water, chilled water or a mixture of the two.

Early rearing takes place inside the hatchery building in linear fiberglass tanks. A total of 22 tanks are available for indoor early rearing. Each unit has a maximum useable volume of 455 cu. ft. (51.5 ft. length x 41 in. width x 31 in. depth). When the Sockeye Salmon pre-smolts reach a target size of approximately 90 - 100 fpp, they are transferred to Mass Automated Marking System (MATS) marking units via an electric fish pump. The fish are adipose fin clipped, enumerated and measured inside the MATS units, then immediately discharged to the outdoor raceways. This typically occurs in early-July. The fish then begin the final rearing phase of their production cycle, which ends with smoltification, transfer to Sawtooth FH for pre-release acclimation and subsequent release into Redfish Lake Creek.

Final rearing takes place in linear concrete outdoor raceways. A total of 22 raceways are available. Each unit has a maximum useable volume of 2,560 cu. ft. (80 ft. length x 8 ft. width x 4 ft. depth). Fish remain in these rearing units until they are transported to Sawtooth FH for pre-release acclimation and subsequent release into Redfish Lake Creek.

METHODS

Fish Culture

Fish culture methods used in the captive broodstock and smolt production programs follow accepted, standard practices (for an overview of standard methods, see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; McDaniel et al. 1994; Bromage and Roberts 1995; Pennell and Barton 1996; Wedemeyer 2001) and conform to the husbandry requirements detailed in ESA Section 10 Propagation Permit Number 1454 for IDFG rearing of ESA-listed Snake River Sockeye Salmon. Additionally, considerable coordination is carried out between NOAA and IDFG culture experts, as well as program cooperators at the SBSTOC level.

Two brood years of Sockeye Salmon, BY21 and BY22, were in culture at Springfield FH during the contract period. All Sockeye Salmon were fed a commercial diet produced by EWOS® Canada LTD (EWOS). Hatchery personnel followed suggested feeding rates provided by the manufacturer to achieve desired overall target fish sizes for marking and release.

Indoor rearing tanks and outdoor raceways were swept daily to remove bio-solids, which settle out immediately downstream of the tail screens and are conveyed to a single cell pollution abatement pond. On a daily basis, mortalities were removed, enumerated, recorded on a hatchery tracking form, and placed in a chest freezer for later disposal.

During both indoor and outdoor phases of the rearing cycle, containment tail screens in the tanks and raceways were moved as the fish grew in order to maintain density indices at or below 0.3 (where $DI = (\text{pounds of fish}) / (\text{fish length in inches} \times \text{volume of rearing unit in cu. ft})$). Water flows were increased as the fish grew in order to maintain flow indices at or below 1.0 (where $FI = (\text{pounds of fish}) / (\text{fish length in inches} \times \text{water inflow in gpm})$).

BY21 Sockeye Salmon

Smolts reared at Springfield FH were in culture in 22 outdoor raceways during this contract period until their transport to Sawtooth FH for acclimation. Production water temperature was a constant 10°C. To ensure proper fish size at release, sample counts were conducted at the end of each month throughout the rearing cycle during this contract period. Per the previous contract period, a sub-sample of 200 fish were also individually measured each month to obtain weight and length in order to calculate a condition factor.

BY22 Sockeye Salmon

Eyed eggs were received from Eagle FH and NOAA during the months of November and December 2022. To minimize differences in swim-up timing resulting from a protracted spawning period at Eagle FH and the NOAA facilities, a combination of ambient and chilled water was used for incubation. Incubation water temperatures were maintained between 5.2° - 10°C.

Captive brood and anadromous brood fry were transferred from incubators to fiberglass early rearing tanks at 950 and 1,050 Celsius temperature units (CTU), respectively. Following transfer to early rearing tanks, initiation of exogenous feeding typically occurred at 980 CTU for captive brood progeny and at 1,080 CTU for anadromous brood progeny. Shade covers, which cover approximately 80% of a tank, were used on all indoor rearing units. Production water temperature in all rearing units was a constant 10°C.

Hatchery personnel began size sampling of BY22 fry at the end of March 2023. Samples were taken at the end of each month thereafter to ensure that actual growth aligned with projections. A sub-sample of 200 fish was also individually measured each month beginning in July to calculate and obtain a condition factor.

On July 10-11, 2023, hatchery staff moved BY22 directly to outdoor raceways via fish pump. This brood year was not adipose clipped (additional information provided in the Fish Marking sections of this report). Feed and growth projections were then established to align with an average target acclimation transfer size of 38 grams per fish (12 fpp).

Egg Transfers

BY22 Sockeye Salmon

Eyed eggs were shipped from Eagle FH (captive and anadromous brood) and the NOAA Burley Creek facility (captive brood). Individual egg tubes were loaded with approximately 2,500 eggs per tube. Included with each shipment was CTU tracking information for each lot. Eggs were transported to Springfield FH in 40-quart coolers by vehicle. Ice was added to all coolers in order to mimic Springfield FH incubation temperatures necessary for a given lot.

Upon arrival at Springfield FH, the eggs were disinfected in a 100 mg/L buffered iodophor solution for ten-minutes prior to placement in incubation trays. The iodophor solution was prepared with chilled water to match the temperature of the incoming eggs. After the ten-minute disinfection period, the iodophor solution was slowly rinsed out with incubation supply water at the desired incubation temperature for each lot.

Incubation trays were loaded at the rate of approximately 5,000 eggs per tray and each tray contained two designated egg tubes. Data was recorded on a hatchery incubation log form. In order to maintain Parental Based Tagging integrity, eyed eggs from individual tubes were not divided between trays. Survival data was tracked separately for both the Eagle FH and NOAA groups to the swim-up stage of development. In order to align swim-up timing of the resulting fry, Eagle FH and NOAA groups were combined as needed during initial ponding.

Fish Marking

BY21 Sockeye Salmon

BY21 Sockeye Salmon reared at Springfield FH were adipose fin clipped by Pacific States Marine Fisheries Commission (PSMFC) personnel using a MATS trailer in the previous contract period. The fish were transferred from the indoor early rearing tanks to the MATS unit with a 4" electric fish pump. The MATS unit measures the total length of each fish during the marking process. Fish were discharged from the trailer into outdoor rearing raceways immediately after marking. Because Springfield FH has 22 indoor rearing tanks and 22 outdoor raceways, fish from a single indoor rearing tank are ponded into a corresponding single outdoor raceway.

BY22 Sockeye Salmon

Due to PSMFC staffing constraints, BY22 fish were not adipose fin clipped. Hatchery staff moved BY22 fish to outdoor raceways using an Aqualife BP-40 electric fish pump. Because Springfield FH has 22 indoor rearing tanks and 22 outdoor raceways, fish from a single indoor rearing tank are ponded into a corresponding single outdoor raceway.

Prior to release, approximately 50,000 fish per brood year receive PIT tags to evaluate the downstream survival and travel time through the hydro system. The PIT tag procedures follow accepted regional protocols (Prentice et al. 1990). The PIT tag codes recovered from mortality and shed tags are recorded and sent to Nampa Fisheries Research personnel for removal from the PIT tag database.

Fish Releases

BY21 Sockeye Salmon

Based on the results of the smolt physiology and water chemistry research performed in previous contract years which indicated that significant water chemistry differences between Springfield FH and Redfish Lake Creek were the cause of post-release mortality (Trushenski et al. 2019), pre-release acclimation occurred at Sawtooth FH. The anticipated release plan for BY21 was to release smolts reared at Springfield FH into Redfish Lake Creek in May 2022 following a 10-to-14-day acclimation period at Sawtooth FH.

Five IDFG fish transport trucks and IDFG personnel were used for BY21 transport activities. For acclimation transfer, the truck tanks were filled at Springfield FH using a combination of chilled and ambient water to mimic receiving water temperatures at Sawtooth FH. An Aqualife BP-60 electric fish pump with a trailer mounted harvester was used to transfer the smolts from outdoor raceways into transport trucks. Transport density guidelines with maximum hauling densities of 95.87 g/L (0.8 pounds/gallon) were followed. The required fish transport permits were acquired before transport activities.

Fish Health Investigations

When required, the Springfield FH Sockeye Salmon smolt production program has utilized various disinfectants and will utilize various disinfectants, antibiotics, vaccinations, and antifungal treatments to control pathogens. The dosage, purpose of use, and method of application are as follows:

- 1) Antibiotic therapies: Erythromycin, Oxytetracycline, or Florfenicol treatments will be administered orally, by feed, based on the pathogen identified by IDFG Fisheries Pathology personnel. Erythromycin will be fed as needed at a dose of 100 mg/kg of body weight for up to 28 days to control outbreaks of bacterial kidney disease *Renibacterium salmoninarum*. Oxytetracycline or Florfenicol will be fed as needed at a dose of 3.75 g/100 lb. of body weight for up to 10 days to control outbreaks of pathogenic *myxobacteria*, as well as *aeromonad* and *pseudomonad* bacteria.

2) Egg disinfection: To prevent transmission of bacterial or viral pathogens resulting from egg transfers, eyed eggs received at Springfield FH are disinfected in a 100 mg/L buffered iodophor solution for ten minutes prior to incubation at the facility.

3) Egg formalin treatments: The current operating protocol is for eggs to be received in the eyed stage of development. Dead eggs will be removed by hand picking and no formalin treatments will be needed. If programmatic changes dictate receipt of green eggs, developing eggs would be treated three times per week with formalin to control *Saprolegnia*. This would be a flow-through treatment administered at 1,667 ppm for 15 minutes.

4) Egg iodophor treatments: Soft egg chorions, also known as 'soft-shell disease', and egg clumping is regularly seen in NOAA egg lots. To mitigate this, eggs are treated three times weekly with a buffered iodophor solution. Each egg stack receives 500ml as a flow-through treatment. The 500ml of buffered iodophor solution is poured into the top egg tray and then flows downward through the entire stack of egg trays before being discharged.

Fish health is monitored daily by observing feeding response, external condition, and behavior of fish in each rearing unit as initial indicators of developing problems. In particular, hatchery staff observes fish in every rearing unit for signs of lethargy, spiral swimming, side swimming, jumping, flashing, unusual respiratory activity, body surface abnormalities, or unusual coloration. The presence of any of these behaviors, conditions, or elevated daily mortality levels is immediately reported to the Hatchery Manager for subsequent referral to the eagle fish health pathologist for diagnostics and appropriate therapeutic treatment.

Fish health inspections are conducted quarterly. A sample of fish is euthanized and analyzed for common bacterial and viral pathogens. After necropsy, carcasses that are not vital to further analysis are disposed of as per language contained in the ESA Section 10 permit for the program.

A pre-liberation fish health inspection is conducted annually. A 60 fish sample is euthanized and analyzed for common bacterial and viral pathogens. Additionally, the gut contents of these fish are checked for the presence of New Zealand Mud Snails (NZMS) per language in the Idaho Department of Agriculture transport permit for Springfield FH.

RESULTS AND DISCUSSION

Fish Culture

BY21 Sockeye Salmon

The BY21 production group of Sockeye Salmon at Springfield FH commenced with receipt of 897,828 eyed eggs (Table 1). This eyed egg total is comprised of 493,762 from the IDFG Eagle FH and 404,066 from the NOAA Burley Creek facility. Incubation, early-rearing, automated marking, and transfer to outdoor raceways occurred during the previous contract period. A total of 849,784 Sockeye Salmon pre-smolts, averaging 39.05 fpp (4.35 inches total length) were on station in 22 outdoor raceways at the beginning of this contract period.

Hatchery personnel collected individual weight and length samples on a monthly basis. This provided the ability to obtain baseline condition factor data used for Sockeye Salmon growth

calculations and feed projections at Springfield FH. An average condition factor of $C = 0.00031$ (where $C = \text{weight} / \text{length}^3$) was measured consistently throughout the duration of outdoor rearing during this contract period.

The fish were fed a total of 53,027 pounds of feed during this contract period. Total feed consumed throughout their rearing cycle at Springfield FH was 71,192 pounds, yielding an overall feed conversion rate of 0.96.

For BY21, Springfield FH is evaluating four target release sizes: 57 grams (8 fpp), 45 grams (10 fpp), 38 grams (12 fpp), and 32 grams (14 fpp). This is the second year of a three-year study to evaluate potential differences in outmigration survival rates and smolt to adult return rates between the various release sizes. In addition, two low density rearing groups (max DI = 0.09) with a target release size of 38 grams (12 fpp) are being evaluated. In order to not exceed the desired target acclimation transfer sizes, the fish were placed on a reduced feed ration beginning September 2022. The feed ration was increased beginning in January 2023 and feed schedules were adjusted to achieve the desired target release size. Inventory and survival percentages by life stage through release for BY21 are summarized in Table 1.

Table 1. Brood Year 2021 Snake River Sockeye Salmon inventory and survival percentages by life stage through release at Springfield Fish Hatchery.

Pre-Marking	BY21 Totals/Avg.
Total eyed eggs received	897,828
Mortality to hatch	6,491
Number hatched	891,337
% survival from eyed eggs to hatch	99.3%
Mortality to swim-up	12,339
Number of swim-up fry	878,998
% survival from hatch to swim-up	98.6%
% survival from eyed egg to swim-up	97.9%
Estimated pre-marking inventory	862,732
Post-Marking	
Marking inventory (provided by MATS)	852,812
% survival from eyed egg to marking	95.0%
Mortality from marking to release	5,566
Smolt release inventory	847,246
% survival eyed egg to release	94.4%

BY22 Sockeye Salmon

The BY22 production cycle at Springfield FH commenced with receipt of 1,089,834 eyed eggs (Table 2). This eyed egg total is comprised of 533,395 eyed eggs from the IDFG Eagle FH and 556,439 eyed eggs from the NOAA Burley Creek facility. Eagle FH eggs were incubated separately from NOAA eggs. In order to align early development, unique lots of eggs were incubated at different temperatures using combinations of chilled and ambient water. Incubation

temperature differentiation was based on CTU accrued prior to arrival at Springfield FH. Survival from eyed egg to hatch averaged 99.2%.

At swim-up, fry were ponded in 22 early rearing tanks in the indoor production wing of the facility. Due to similar population numbers of fry, it was not necessary to combine Eagle FH and NOAA groups of fry for BY22. Fry were ponded in groups of approximately 48,000 fish per tank. Hatchery personnel performed routine end of month sampling to collect data for growth calculations, growth projections and feed projections.

For BY22, Springfield FH is continuing the evaluation of four target release sizes: (57 grams (8 fpp), 45 grams (10 fpp), 38 grams (12 fpp) and 32 grams (14 fpp)). This is the final year of a three-year study and will extend into the next contract period.

Hatchery staff transferred fish into 22 outdoor raceways for final rearing via pump where they will be reared to smolts. The fish responded well to the outdoor raceway environment and continued to meet growth projections. In order to not exceed the target release sizes, the fish were placed on a reduced feed ration beginning September 2023. The feed ration will be increased beginning in January 2024 and feed schedules will be adjusted to achieve the desired target release size. The fish were fed a total of 21,441 pounds of feed during this contract period yielding an overall feed conversion rate of 0.77.

At the end of the contract period, a total of 1,029,045 pre-smolts averaging 36.52 fpp (4.58 inches total length) remain on station. Inventory and survival percentages by life stage through marking for BY22 at Springfield FH are summarized in Table 2.

Table 2. Brood Year 2022 Snake River Sockeye Salmon inventory and survival percentages by life stage through marking at Springfield Fish Hatchery.

Early Rearing (Indoor)	BY22 Totals/Avg.
Total eyed eggs received	1,089,834
Mortality to hatch	8,304
Number hatched	1,081,530
% survival from eyed eggs to hatch	99.2%
Mortality to swim-up	15,356
Number of swim-up fry	1,066,174
% survival from hatch to swim-up	98.6%
% survival from eyed egg to swim-up	97.8%
Estimated pre-marking inventory	1,050,020
Final Rearing (Outdoor)	
Transfer inventory	1,030,696
% survival from eyed egg to transfer	94.6%
Inventory at end of contract period	1,029,045

Fish Marking

BY21 Sockeye Salmon

During the previous contract period, all BY21 Sockeye Salmon were adipose clipped during transfer to the outdoor raceways. During this contract period, in October 2022, a total of 49,981 fish were PIT tagged by PSMFC.

BY22 Sockeye Salmon

Due to PSMFC staffing constraints, BY22 fish were not adipose clipped. Fish were transferred to outdoor raceways for final rearing via pump on July 10-11, 2023.

Fish Releases

BY21 Sockeye Salmon

Based on the results of the smolt physiology and water chemistry research performed in previous contract years, fish were acclimated at Sawtooth FH prior to final release. From April 18-24, 2023, a total of 848,235 smolts reared at Springfield FH were transferred to Sawtooth FH for pre-release acclimation (range of acclimation = 9 to 14 days). Fish were directly released into Redfish Lake Creek from May 2-3, 2023. Average size was 11.41 fpp (6.56 inches total length). Total release inventory for BY21 was 847,246 Sockeye Salmon smolts (Table 1).

BY22 Sockeye Salmon

All BY22 smolts are scheduled for pre-release acclimation at Sawtooth FH in mid-to-late April 2024 (range of acclimation = 10 to 15 days). Subsequent release into Redfish Lake Creek will occur in early May 2024. As previously mentioned, BY22 smolts will be released utilizing a variety of target release sizes which are being evaluated to determine their post-release effectiveness, including survival rates during outmigration and smolt to adult return rates.

Fish Health Investigations

BY21 Sockeye Salmon

Two fish health inspections were conducted during this contract period, for a total of four inspections conducted throughout the BY21 rearing cycle at Springfield FH. During this contract period, a quarterly inspection (10 fish) and a pre-liberation inspection (60 fish) occurred. During both inspections, fish were lethally sampled and examined for bacterial and viral pathogens. No pathogens were detected. The gut contents of all fish necropsied were examined for NZMS. No NZMS were detected.

BY22 Sockeye Salmon

Two fish health inspections were conducted on BY22 during this contract period. Both were quarterly inspections (10 fish). During both inspections, fish were lethally sampled and

examined for bacterial and viral pathogens. No pathogens were detected. The gut contents of all fish necropsied were examined for NZMS. No NZMS were detected.

ACKNOWLEDGMENTS

We wish to thank the members of the Stanley Basin Sockeye Technical Oversight Committee for their involvement and input. We sincerely thank IDFG staff members Gary Byrne, Beau Gunter, Cassie Sundquist, Dan Baker, John Powell, David Venditti, Eric Johnson, Nicole Walrath, Emily Underwood, Denys Chewning, Travis Brown, and Will Demien for their support and guidance.

We would also like to thank the following Springfield Hatchery staff for their contributions to routine hatchery operations: Paul Martin (Fish Culturist) and temporary staff, Jovani Pannell, Joshua Jaeger, and Anthony Garrett.

We truly appreciate IDFG staff members Kelly Farrens, Chad Henson, Kyle Loveless, Steve Stowell, Kenny Naillon and Gregg Sorrell for their assistance with fish transport operations. Thank you.

Finally, we say thank you to Jonathan McCloud and Brady Allen at BPA for their continued support and assistance.

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Prepared by:

IDAHO DEPARTMENT OF FISH AND GAME

Brandon Filloon
Springfield Fish Hatchery Manager II

Ross Stadt
Springfield Fish Hatchery Assistant Manager

Bryan Grant
Fish Hatchery Complex Manager, Eastern Idaho

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME



Lance Hebdon
Chief, Fisheries Bureau



Beau Gunter
State Fish Production Manager