Supplementation, Monitoring, and Evaluation Program

Annual Report

October 2006 – September 2007

Prepared by:

Lytle P. Denny and Kurt A. Tardy

Shoshone-Bannock Tribes
Fish and Wildlife Department
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United States Fish and Wildlife Service
Lower Snake River Compensation Plan
1387 S. Vinnell Way, Suite 343
Boise, Idaho 83709

Cooperative Agreement 141107J017

April 2008

EXECUTIVE SUMMARY

Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*) are cultural and social symbols for the Shoshone-Bannock Tribes (Tribes) and historically provided annual subsistence fisheries in the Columbia River basin. Despite the significance of these fish to the Tribes, there has been widespread and dramatic decline in abundance, distribution, genetic diversity, and productivity of chinook salmon and steelhead in the Salmon River sub-basin, resulting in both species being listed as threatened under the Endangered Species Act (ESA) in 1992 and 1997, respectively. In response to declining anadromous fish runs, the Tribes initiated several artificial propagation (i.e. supplementation) programs designed to improve runs, re-distribute fish, and improve natural populations so that Tribal fisheries can be maintained at higher than existing levels.

The Tribes acquired funding from the Lower Snake River Compensation Plan (LSRCP) in fiscal year 2007 for participation in planning activities associated with anadromous fish, utilization of supplementation as an artificial propagation strategy, monitoring and evaluation of supplementation activities, and development of future programs. Under Cooperative Agreement #141107J017, the Tribes achieved multiple goals by completing numerous objectives, tasks, and activities from October 1, 2006 through September 30, 2007.

Continuous coordination and planning between the Tribes and LSCRP is necessary to maximize efforts for chinook salmon and steelhead artificial propagation, fish health, harvest, and monitoring and evaluation. Cooperative efforts between the Tribes, LSRCP, and other agencies will ultimately promote the existence and recovery of ESA listed species in the Snake River Basin.

The Tribes maintain that supplementation can increase abundance, distribution, genetic diversity, and productivity of anadromous salmonids. Specific programs established to increase the aforementioned performance measures include: Yankee Fork Spring Chinook Supplementation Program; Dollar Creek Eggbox Program; Steelhead Smolt Supplementation Program; and Steelhead Streamside Incubation Program.

Supplementation projects were designed to utilize adaptive management to improve and guide future restoration activities. This report provides detailed information for each project funded by the LSRCP in FY 2007.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1. YANKEE FORK CHINOOK SALMON SUPPLEMENTATION PROGRAM

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ABSTRACT

The Shoshone-Bannock Tribes initiated a small-scale chinook salmon supplementation program on the Yankee Fork Salmon River (YF), a tributary in the Upper Salmon River, Idaho. The Yankee Fork Chinook Salmon Supplementation Program (YFCSS) was established to increase the number of threatened Snake River Spring/Summer Chinook Salmon (*Oncorhynchus tshawytscha*) returning to Yankee Fork through artificial propagation.

The program was initiated in April 2006 with the release of 135,934 broodyear 2004 smolts from Sawtooth Fish Hatchery (SFH). In 2007, the Tribes met with Idaho Department of Fish and Game (IDFG), LSRCP, and National Atmospheric and Oceanic Administration-National Marines Fisheries Service (NOAA-Fisheries) to obtain agreement to release SFH broodyear 2005 smolts in YF. Also in 2007, the Tribes coordinated with IDFG and LSRCP to obtain the South Fork Salmon River satellite facility picket weir. The Tribes were unsuccessful in reaching agreement with IDFG, LSRCP, and NOAA-Fisheries for smolt allocation or property transfer of the picket weir.

The Tribes completed a Hatchery Genetics Management Plan (HGMP) for the YF for ESA Section 7 consultation/authorization (Appendix B). The HGMP was submitted to the IDFG, LSRCP, and NOAA-Fisheries on February 16, 2007.

The Tribes initiated population monitoring and collection of baseline genetic samples from juvenile chinook salmon in Yankee Fork during the fall of 2006 and 2007. Juvenile chinook salmon were enumerated in 2006 (N=62) and 2007 (N=183) and tissue samples were transferred to Shaun Narum, Columbia River Inter-tribal Fish Commission (CRITFC) for genetic analysis (N=181). Extremely low densities of chinook salmon parr in 2006 (0.005 fish/m^2) and 2007 (0.008 fish/m^2) reveal a depressed population, further supporting the need to initiate supplementation and habitat restoration.

ACKNOWLEDGEMENTS

The Tribes thank Scott Marshall and staff at the LSRCP-Office for providing funding to further support this program. Special thanks to IDFG personnel including Sharon Kiefer, Bill Horton, Tom Rogers, Paul Kline, Dave Venditti, Tom Curet, and Brent Snider for their support. We especially thank Herb Pollard and Mike DeLarm for providing technical expertise and commitment to this program.

The Tribes provided the administrative framework for this project to be successful. We would like to thank the Fish and Wildlife Department personnel Chad Colter, Claudeo Broncho, Carlos Lopez, Rodney Burns, Jeremy Broncho, Mike Haddix, Andy Kohler, and Tyron Broncho for project operations and monitoring and evaluation. Thanks to Hal Hayball of the Shoshone-Bannock Tribes for furnishing maps. We especially thank several volunteers including Jared Moss and Garret Galloway for their assistance in the field.

INTRODUCTION

The YF historically supported large runs of anadromous salmonids, primarily spring/summer chinook salmon and steelhead. The decline of anadromous fish in the YF can be linked to the combined effects of downstream hydroelectric developments and local mining activities. The construction of dams on the Columbia River including Bonneville, The Dalles, McNary, and John Day and Lower Monumental (1969), Ice Harbor (1962), Little Goose (1970), and Lower Granite (1974) in the Snake River, all served to reduce the number of adults returning to the YF and the number of smolts successfully migrating to the ocean.

Congress authorized the LSRCP in 1976 to provide mitigation for lost salmon and steelhead harvest caused by the construction and operation of the four lower Snake River dams. The goals of the LSRCP program are to return 55,100 adult steelhead and 58,700 adult spring chinook above Lower Granite Dam, along with returning 18,300 fall chinook above Ice Harbor Dam (Heiberg 1975). SFH was constructed in 1985 to contribute to this end with a goal of returning approximately 19,445 adult spring chinook salmon. In order to help achieve the adult return goal for SFH, the Tribes initiated the YFCSS with an interim goal of returning > 1,000 adult spring chinook salmon (Appendix B).

The adult goal for SFH is the sum of the return of 11,310 to the SFH, 6,090 to the East Fork Salmon River (EFSR), and 2,045 to Valley Creek (all based on a smolt-to-adult return rate of 0.87%). Initial facility plans identified a production target of 2.3 million smolts: 1.3 million smolts released in the Salmon River at SFH, 700,000 smolts released in the EFSR, and 300,000 smolts released in Valley Creek. Valley Creek was never implemented and EFSF was terminated in 1998 due to low adult returns.

Production targets and adult return objectives are not being achieved at SFH. Survival assumptions used in initial planning were substantially overestimated, and furthermore, SFH's adult return goal is unrealistic. However, the Tribes do not believe an unrealistic goal should deter managers from striving to achieve mitigation requirements of the LSRCP.

The Tribes determined, and IDFG and NOAA-Fisheries agreed, YF is an acceptable watershed to initiate a supplementation program in conjunction with SFH. Smolt production capacity for SFH is set at 1.3 million smolts based on the amount of pathogen free well water, preferred rearing densities, and incidence of whirling disease (Snider, IDFG; personal communication), however, achieved 1.6 million smolts with broodyear 2004 chinook salmon. The current release target for SFH is 1.0 million smolts, therefore, providing additional rearing space for 300,000 to 600,000 smolts.

Analyses of data reveals significantly fewer smolts released and adults returning compared to the initial production targets and adult return objectives. Over a nineteen year period (1987 – 2006) of smolts released into the Salmon River at SFH, average release was 698,177 (max of 2,092,595). Average adult return at SFH by broodyear for 1986-2000 was 591 adults (SAR = 0.26%) or approximately 5.2% of the goal (11,310).

During EFSR operation, average smolts released were 164,689 (max of 514,600) and average adult return was 55 (SAR = 0.034%) individuals or approximately 0.9% of the goal (6,090).

The YFCSS will facilitate improvements, modifications, efficiencies, and adaptive management at SFH. This may include increasing pathogen free well water, increasing rearing densities, reducing whirling disease, releasing non-adipose fin natural-origin broodstock, and development of a satellite facility in YF.

Program Goal

There are two primary goals for the YFCSS, both based on abundance of adult chinook salmon (Denny and Tardy 2007). The long-term goal of the YFCSS project is to provide natural spawning escapement of 500 adults annually, enough supplementation broodstock (approximately 102 pairs) to sustain the program, and harvestable surplus for a total escapement of 1,050 adults. The interim goal is to release hatchery-origin smolts and collect returning adults while planning, funding, and infrastructure is acquired.

The YFCSS program will improve spatial distribution of chinook salmon, increase abundance and contribute to genetic diversity through adaptive management. Monitoring and evaluation will determine the overall productivity of supplementation adults through genetic parentage analysis (Denny et al. 2006). Juvenile and adult survival will likely be controlled by out-of-basin effects, but the combined productivity of the hatchery and natural-origin components should increase by 85% according to the base-to-future survival multiplier developed by NOAA-Fisheries (NOAA-Fisheries 2007).

Study Area

Yankee Fork, located in the Salmon-Challis National Forest in Custer County, Idaho, is a major tributary of the upper Salmon River (Appendix A; Figure 9). The YF flows through narrow canyons and moderately wide valleys with forest of lodgepole pine (*Pinus contorta)* (Richards and Cernera 1989). The West Fork of the YF is the largest tributary. Other notable tributaries to the YF include Jordan, Lightning, Greylock, Cearly, and Eightmile Creeks (Appendix A; Figure 10). Most of the system is characterized by highly erosive sandy and clay-loam soils. YF is an important spawning and rearing stream for chinook salmon and steelhead. Utilization by chinook salmon and steelhead has declined since the mid-1960’s. Other fish species present in the YF system include bull trout (*Salvelinus confluentus*), cutthroat trout (*Oncorhynchus clarki*), mountain whitefish (*Prosopium williamsoni*), and short head sculpin (*Cottus confuses*).

The drainage is composed of 190 square miles of river. Elevations range from 8,204 feet at the northern boundary to 6,171 feet at the confluence with the Salmon River. Mean stream length varies annually and average precipitation is roughly 27 inches. Base flows in YF are approximately 40 cubic feet per second and mean flows (Qa) are 247 cubic feet per second.

Historic mining activities in the YF further aggravated the tenuous status of chinook stocks, resulting in further decline. Mining activities have resulted in the complete re-channeling of lower portions of the YF and the deposition of extensive unconsolidated dredge piles. Such activities have eliminated or degraded much of the rearing and spawning habitat in the lower YF. As a result, the YF drainage is grossly underutilized with respect to salmon and steelhead production (Reiser and Ramey 1987).

Chinook destined for the YF would enter the Columbia River during March-May, with spawning occurring in August and September (Bjornn 1960). The runs of upper Salmon River spring chinook, an exceptionally large fish, were found to be comprised of primarily 4-5 year old fish having fork lengths exceeding 32 inches (Bjornn et al. 1964). Egg incubation extended into December, with emergence occurring in February or March (Reiser and Ramey 1987). The juveniles would typically rear in freshwater until the spring (March-April) of their second year, generally at a length of 4-5 inches (Bjornn 1960).

Over six percent of the chinook redds found in the upper Salmon River have been located in the YF system (Reiser and Ramey 1987). Chinook redd counts taken in the upper YF have ranged from a high of 250 in 1967, to 0 in 1980, 1982, and 1983 (Pollard 1985). Within the entire drainage, the number of redds have ranged from over 600 in 1967 to less than 10 in the mid-1980's (Konopacky et al. 1986). Intensive multiple-ground redd counts conducted by the Tribes for the whole drainage from 1986-2005 have averaged 36.9 redds/year (Ray unpublished data).

The large runs of salmon not only afforded a sport fishery for the upper Salmon River but also provided a subsistence and ceremonial fishery for the Tribes. YF is an important treaty-guaranteed anadromous fishing area for the Tribes and one which has been used for many generations (Reiser and Ramey 1987). The Tribes have volunteered to help with the restoration of anadromous fish by temporarily curtailing salmon fishing in the YF, with the exception of bath tub fisheries provided from the Pahsimeroi Fish Hatchery management shift from spring chinook to summer chinook during 1985 and 1986.

METHODS

Adult Collection

The Tribes requested the South Fork Salmon River satellite facility picket weir from IDFG and LSCRP in 2007 to initiate adult trapping in the YF. The Tribes were unable to obtain the picket weir and, therefore, did not trap adult chinook salmon returning to the YF in 2007, even though a large proportion of hatchery-origin jack salmon were speculated to return.

Juvenile Release

The Tribes requested hatchery origin chinook salmon smolts from IDFG in February 2007 (Kiefer, 2007; memo). IDFG was unwilling to release any broodyear 2005 smolts in the YF, however, did release ~1,000,000 million smolts at SFH achieving their 2007 on-station smolt production target.

RESEARCH, MONITORING, AND EVALUATION

Tissue and Scale Sampling

Broodstock males and females sampled for genetic analysis and parental assignment. Male samples obtained through an operculum punch; samples from females taken from a caudal fin clip. Scale samples obtained for age and life history determination as a contingency to tissue samples. Proportion of natural origin juveniles are tissue sampled prior to out-migration to determine proportion of *w x w*, *w x h*, *h x h* produced offspring. Un-marked adults sampled at the YF weir will also be tissue sampled to determine origin. All samples stored in 95% ethanol for later analysis. A DNA parentage analysis will reveal relative productivity of wild and hatchery F1 and F2 juveniles and adults.

Abundance and Density

Determine stratified random sampling sites in YF to collect naturally spawned chinook salmon above the YF weir. Electroshocking used in accordance with NMFS ESA permits. Location, fork length, and mass of each individual recorded. Fin tissue and scale samples taken from juveniles to link adult parents and broodyear.

Harvest Monitoring

Conduct creel surveys and estimate total chinook catch. Obtain tissue sample, fork length, gender, CWT, or PIT information from harvested chinook. Provide Shoshone-Bannock tribal fisherman with scale envelops to preserve scales from harvested fish not surveyed and sampled. Total fish harvested, pressure, and CPUE estimated yearly.

Juvenile Out-migration and Adult Returns

A proportion (15%) of hatchery smolts released PIT tagged to monitor dispersal, emigration, and arrival at Lower Granite Dam by using the SURPH model. In addition, naturally produced smolts will be PIT tagged to detect survival differences between life stages for hatchery and naturally produced offspring. Adult returns are monitored through dam and weir counts, creel surveys, CWT information, redd surveys, spawning surveys, and carcass recoveries.

DISCUSSION

LSRCP hatcheries were constructed to mitigate for fish losses caused by construction and operation of the four lower Snake River federal hydroelectric dams. The goals of the YFCSS are to restore and promote a viable population with harvest potential, aid to spatial distribution, and contribute to diversity of the ESA listed species. The Tribes Fisheries Department has considered and implemented habitat restoration actions to achieve program goals. However, habitat in the YF is not the limiting factor for chinook salmon and steelhead trout. Natural origin chinook salmon survival from smolt-to-adult must reach 2-6% or a supplementation action must be initiated to prevent near-term extinction or avoid further losses of genetic variation. Therefore, a long-term chinook salmon supplementation program releasing smolts may be the only short-term option for increasing abundance, diversity, and distribution of chinook salmon in the YF.

The SBT Fisheries Department completed the HGMP for the YFCSS program in February 2007 and has submitted the plan to NOAA-Fisheries, LSRCP, and Idaho Department of Fish and Game. Parties are currently developing a coordination meeting for the review and approval of the HGMP and acknowledge the importance of accomplishing short-terms to install a weir and begin trapping chinook salmon in the Yankee Fork.

CITATIONS

Bjornn, T.C. 1960. The Salmon and Steelhead Stocks of Idaho. Idaho Department of Fish and Game.

Bjornn, T.C., D.W. Ortmann, D. Corley, and W. Platts. 1964. Salmon and Steelhead Investigations. Idaho Department of Fish and Game. Federal Aid in Fish Restoration, Annual Progress Report, Project F-49-2-2.

Denny, L. P., K. Witty, and S. Smith. 2006. A monitoring and evaluation plan for the Shoshone-Bannock Tribes: Hatchery supplementation activities Yankee Fork; Salmon River sub-basin. Draft Review Shoshone-Bannock Tribes, Department of Fisheries Resources Management.

Denny, L.P. and K.A. Tardy. 2007. Yankee Fork Chinook Salmon Supplementation Hatchery Genetics Management Plan. Prepared for NOAA-Fisheries. Fort Hall, Idaho.

Heiberg, E.R. 1975. Lower Snake River Fish and Wildlife Compensation Plan, Washington and Idaho: Special Report. Department of the Army.

Konopacky, R. C., P. J. Cernera, and E. C. Bowles. 1986. Salmon River Habitat Enhancement. Annual Report FY 1985, Part 1 or 4, Subproject III: Yankee Fork Salmon River. Shoshone-Bannock Tribes Report to Bonneville Power Administration.

NOAA Fisheries. 2007. Draft Federal Columbia River Power Systems Biological Opinion. Prepared for ESA Section 10 Permit and NWF v. NMFS, Civ. No. CV 01-640-RE (D. Oregon).

Pollard, H.A. 1985. Salmon and Spawning Ground Surveys. Federal Aid in Fish

Restoration, Job Performance Report. Idaho Department of Fish and Game, Project F-73-R-7.

Reiser, D. W. and M. P. Ramey. 1987. Feasibility plan for the enhancement of the Yankee Fork of the Salmon River, Idaho. Prepared for the Shoshone-Bannock Tribes, Fort Hall, Idaho. BPA contract No. 83-359.

Richards, C. and P. J. Cernera. 1989. Dispersal and abundance of hatchery-reared and naturally spawned juvenile chinook salmon in an Idaho stream. North American Journal of Fisheries Management 9: 345-351.

CHAPTER 2. DOLLAR CREEK CHINOOK SALMON SUPPLEMENTATION PROGRAM

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ABSTRACT

The Tribes initiated an in-stream chinook salmon supplementation program (DCCSS) in 1997 to utilize excess or surplus summer chinook salmon production from McCall Fish Hatchery (MFH) to help maintain, rehabilitate, and enhance summer chinook in tributary habitats of the South Fork Salmon River (SFSR). This report covers accomplishments resulting from broodyear 2006 and 2007 outplants.

In 2006, staff participated in spawning 98 pairs of chinook salmon at the South Fork Satellite Facility. There were a total of 334,580 eyed salmon eggs outplanted into 22 in-stream egg incubators in Dollar Creek, a tributary to the SFSR. Of the 22 total incubators, 14 successfully produced fry that volitionally emigrated into the stream. Due to limited funding, staff was unable to enumerate dead eggs to determine an approximate hatch success for 2006. However, the Tribes applied the 85% success historical average of the program to the 14 effective incubators and estimated that approximately 176,737 fry were seeded in Dollar Creek. This results in a hatch success of 52.82% for 2006.

Through monitor and evaluation activities, in-stream egg incubation was most effective in glide habitats with specified ranges for temperature, dissolved oxygen, conductivity, pH, flow, and sediment accumulation.

As a result of intensive forest fires during July through October, 2007, our staff requested IDFG to release pre-spawned adult summer chinook salmon in lieu of taking eggs for the incubation program.

On August 24 and 28, 2007, MFH personnel released 90 females and 70 males; and 100 females and 125 males, respectively, for a total release of 385 adult chinook salmon. The release site was located approximately 1.5 miles below the Dollar Creek confluence with the SFSR. This site was utilized due to the lack of ready access to Dollar Creek and the necessity to get in and out because of forest fires.

ACKNOWLEDGEMENTS

The Tribes thank Scott Marshall and staff at the LSRCP-Office for providing funding to further support this program. Special thanks to IDFG personnel including Sharon Kiefer, Sam Sharr, Tom Rogers, Donald McPherson, Joel Patterson, Steven Kammeyer, and Doug Munson for their support. We especially thank Mike DeLarm for providing technical expertise and commitment to this program.

The Tribes provided the administrative framework for this project to be successful. We would like to thank the Fish and Wildlife Department personnel Carlos Lopez, Rodney Burns, and Tyron Broncho for project operations and monitoring and evaluation. Thanks to Hal Hayball of the Shoshone-Bannock Tribes for furnishing maps.

INTRODUCTION

As part of the Tribes effort to maintain, rehabilitate, and enhance chinook salmon populations, an in-stream egg incubation (eggbox) supplementation program was initiated in the SFSR in 1997 to increase abundance of chinook salmon. Since there is already a successful hatchery program in the SFSR, the Tribes are focused on hatchery reform since natural origin chinook salmon are currently listed under the ESA and warrant further attention.

Prior to 1997, the Tribes position was to utilize hatchery fish to rebuild wild fish populations. The clear imbalance of excessive hatchery fish and depleted natural origin chinook in the SFSR led the Tribes to analyze alternatives for increasing abundance of natural origin fish, where the problem was exemplified. The MFH chinook salmon smolt program was previously capped by the addition of the Johnson Creek Artificial Propagation Enhancement (JCAPE) Program at 1.1 million smolts (AOP 2007), however, the Tribes identified additional egg incubation space at MFH and excess adult production.

The eggbox program is designed to utilize surplus hatchery production (i.e. adults and eggs) in an effort to increase abundance of natural origin fish under the assumption that hatchery fish can rebuild natural origin fish populations contingent that hatchery eggs are incubated in stream water and hatched fry enter the stream in a manner and time as fry produced naturally. Surprisingly, there is little research on the variation in adult reproductive success as a function of spawning date, and the relationship between fry emergence and survival. Therefore, gametes for this program are collected from the entire salmon run to maximize genetic diversity and adaptability to the natural environment and further identify factors that limit production.

Under Cooperative Agreement 141107J017, the Tribes monitored and evaluated in-stream eggboxes containing broodyear 2006 eyed summer run chinook salmon eggs and released chinook salmon fry into Dollar Creek to test the following hypotheses:

Hypothesis 1: The eggbox program produces F1 juvenile parr and smolt offspring.

Hypothesis 2: F1 eggbox individuals survive and successfully produce F2 progeny.

Hypothesis 3: Emergence timing of juvenile chinook salmon originating from eggboxes is the same as naturally spawned chinook.

Hypothesis 4: The size of emigrating parr and smolts originating from eggboxes is the same as those from naturally spawned adults.

Hypothesis 5: The relative productivity from eggboxes compared to naturally deposited eggs is the same at various program sizes and natural deposition rates.

Goal and Objectives

The goal of the DCCSS program is to investigate whether in-stream incubation can increase adult returns of summer chinook in the South Fork Salmon River.

The Tribes are seeking to accomplish three primary objectives with summer chinook in Dollar Creek (Denny et al. 2006):

1) Increase viability and production of the South Fork Salmon River chinook population.

2) Increase harvest of summer chinook for members of the Tribes.

3) Increase knowledge of fishery management techniques to accomplish the first two objectives in the timeliest, cost-effective and least instrusive manner.

Study Area

Dollar Creek, a tributary of the South Fork Salmon River, is located in the Boise National Forest (Appendix A; Figure 11). The dendritic flow drainage is a single 10,590 acre sixth field subwatershed approximately four miles north of Warm Lake, Idaho. Elevations range from 7,900 feet at the northern boundary to 4,900 feet at the confluence with the South Fork Salmon River. Mean stream length is 16.5 miles annually and average precipitation is roughly 33.2 inches. Base flows in Dollar Creek at the confluence with the South Fork Salmon River are approximately eight cubic feet per second and mean flows (Qa) are 28 cubic feet per second.

METHODS

Eyed eggs for the Tribes eggbox project are from chinook broodstock collected for normal program purposes at MFH (see MFH HGMP for a description of adult collection, holding, mating and incubation procedures). During spawning, caudal fin tissue samples and scale samples will be taken from parents of fertilized eggs destined for the Tribes eggbox project. All tissue samples will be stored in 95% ethanol. Scales will be secured in standard scale envelopes. Standard phenotypic information will be collected from each spawner and its origin, hatchery or wild, noted.

Tissue and scale samples from broodstock will be shipped to Mr. Bill Ardren at USFWS' Abernathy Fish Technology Center, 1440 Abernathy Creek Road, Longview, Washington 98632 for analysis. Tissue samples will be processed, DNA amplified using polymerase chain reaction (PCR), and microsatellite loci identified following standard laboratory procedures. Scales will be used if problems arise with any given tissue sample.

Eggs destined for the Tribes eggbox program will be incubated separately, but following regular hatchery procedures. Temperature units of incubating eggs will be recorded. Upon eyeing, eggs will be supplied to the Tribes for transport and planting. Eggboxes will be distributed throughout incubation areas. Eggboxes will be planted following standard Tribal protocols. At least one recording thermograph will be installed at the location of the middle eggbox site. Temperature information from the thermograph will be used to ascertain time of hatching and emigration from the eggboxes.

When fry are estimated to have vacated the eggboxes in substantial numbers, eggboxes will be examined and number of remaining dead eggs enumerated to estimate hatch success rate.

In late March or early April, after eggbox and natural fry emergence (check for timing), a field crew will sample for age-0^+ chinook fingerlings in the habitat immediately adjoining the location of the eggboxes. The sampling objective will be to collect ≥ 100 tissue samples from fingerlings arising from the Tribes eggbox program. Total tissue collection will depend on the estimated proportion of fry produced from the eggboxes compared to fry produced from the egg deposition of naturally spawning chinook the previous year.

In the first year of study, egg deposition from naturally spawning chinook should be estimated from detailed spawning ground surveys. Numbers and locations of redds relative to eggbox sites need to be recorded. Average fecundity of summer chinook from MFH broodstock will be used to estimate the naturally spawning population each year in Dollar Creek. In later years, when returning adults from the program are expected, natural egg deposition will also be estimated based on the number of adults passed through the established adult sampling station.

Based on 1997 – 2001 index redd surveys in SFSR, an average of 571 summer chinook redds have been estimated. For design purposes, the expected probability of a sampled fingerling being an SBT eggbox fish is about 15% (calculations below). However, this estimate should be made each year prior to fingerling sampling to determine total sample size needed to ensure a sample of approximately 100 fingerlings originating from the egg box program.

Calculations for summer chinook DNA study in Dollar Creek and the S.F. Salmon River:

Annually 300,000 summer chinook eggs for SBT eggbox program

ASSUMPTIONS	REFERENCE
SBT eyed-egg to fry = 85%	SBT reports
Wild green egg-to-fry = 60%	EDT benchmark
McCall Hatchery eyed egg-to-smolt = 94%	AOP
SF summer Chinook = 4,300 eggs/female	AOP
Johnson Cr Chinook = 4,300 eggs/female	AOP
McCall green egg-to-eyed egg = 86%	AOP
Johnson Cr green egg-to-eyed = 90%	AOP
McCall green egg-to eyed = 80+%	HGMP
McCall fry-to-smolt = 80+%	HGMP
’90-’98 spr/sum Chinook smolts/female = 243	HGMP

Range = 92-406
S.F. Salmon Chk index redds ('97-'01) = 571 HGMP
McCall Hatchery releases ~ 1.0 million (10% unclipped) HGMP

Assume that SBT egg box fry survive equal to naturally produced fry.
Assume that SBT egg box smolts survive equal to natural-origin smolts

571 redds x 4,300 eggs/female = 2,455,300 eggs
2,455,300 eggs x 60% natural hatch rate = 1,473,180 fry
300,000 SBT eggs x 0.85% hatch rate = 255,000 fry
255,000 SBT fry/ (1,473,180 natural fry + 255,000 SBT fry) = 14.8% SBT fry

255,000 fry x 38% (fry-smolt survival) = 96,900 eggbox smolts
1,473,180 natural fry x 38% (fry-smolt survival) = 559,808 natural smolts

96,900 SBT smolts / (559,808 natural smolt + 96,900 SBT smolts + 100,000 MFH unclipped smolt) = 12.8% SBT smolts

Conclusions:

1. Probability of a captured unmarked fry in lower SFSR being an SBT eggbox fish is about 14.8%.
2. Probability of a captured unmarked smolt and adult in lower SFSR being an SBT eggbox fish is about 12.8%.
3. These calculations are based on average numbers of natural and hatchery production. At the higher escapements of natural origin fish, an SBT juvenile or adult would be even more difficult to discern. At low escapement levels, eggs for the SBT program might not be available in the same quantity.

For design and budget purposes, tissue samples were needed from 676 fingerlings (= 100 / 0.148). This sample should consist of near equal subsamples from each of the habitat sites where the egg boxes were placed.

Tissue from each fingerling will be a caudal fin clip, preferably, or an anal fin clip if necessary. All tissue samples will be stored in 95% ethanol and shipped to William Ardren at USFWS' Abernathy Lab in Abernathy, Washington for analyses.

In late March or early April of the following year, a field crew will collect tissue samples from 781 (= 100 / 0.128) age-1^+ chinook pre-smolts. Procedures will follow those for fingerling tissue sampling. However, sampling will need to occur over a wider range of habitats in SFSR, particularly downstream. Beginning in year two of the study, sampling for age-1^+ chinook pre-smolts will occur simultaneously with collection of tissue samples from age-0^+ fingerling chinook. Scale samples will also be taken from age-1^+ chinook to ensure assignment to proper broodyear. Tissue and scale samples should be processed as above.

RESULTS

Parental Selection and Mating

In 2006, Tribal staff, in coordination with IDFG, randomly spawned 32 pairs, 42 pairs, and 24 pairs for a total of 98 pairs on 8/25/06, 8/29/06, and 9/1/06, respectively. During spawning, staff collected genetic tissue samples and fork lengths from all 196 individuals. After spawning, eggs were transferred to MFH and incubated following standard MFH protocols to the eyed stage, separately from general production gametes.

Egg Planting

Twenty-two incubation sites containing pools or glides were located and utilized in Dollar Creek (Appendix A; Figure 11). Outplanting occurred on three separate occasions: 9/27/06; 10/4/06; and, 10/5/06 with totals of 115,270, 119,200, and 100,110, respectively. Of the twenty-two boxes, eight contained approximately 14,408 eggs, another eight contained 14,900, and the remaining six reared 16,685 eggs. Overall, staff outplanted a total of 334,580 eggs into Dollar Creek.

For each outplanting date, eggs were initially randomized upon collection and loaded based on volumetric calculations (obtained at MFH) into Rubbermaid in-stream boxes standardized with 1/8 inch mesh sides for flow and 1/4 inch mesh tops for volitional emigration. In-stream boxes were anchored to the stream bed using a combination of rebar and tie wire.

IDFG and SBT staff attempted to rear approximately 20 fry per family at the McCall Fish Hatchery to confirm family profiles for future parentage exclusion analysis at Abernathy Fish Technology Center, but unfortunately all eggs and fry perished prior to collecting genetic samples.

Research, Monitoring, and Evaluation

In-stream incubators were monitored monthly on 11/16/06, 12/20/06, 1/19/07, 2/13/07, and 3/21/07. On each monitoring occasion, staff recorded temperature, dissolved oxygen, conductivity, pH, flow, sediment accumulation, and embryo stage as well as cleaned and removed debris from the in-stream boxes. Due to funding limitations, staff was unable to accurately determine hatch success, conduct juvenile sampling, or collect juvenile tissue samples for future parentage analysis with Abernathy Fish Technology Center.

Little results are available due to the constraints of funding allocated to the in-stream chinook salmon supplementation program. However, through monitor and evaluation, boxes located in glides objectively performed much higher than boxes placed in pools due to sediment accumulation. Sediment accumulation averaged greater than 63% in boxes within pool habitats compared to less than 21% accumulation in those boxes located in glides. In addition, areas of greater flow indices (i.e. glides) showed greater fry development due to the inability of sediment to readily drop-out of the water column. Temperature, dissolved oxygen, conductivity, and pH varied insignificantly within and between sites (Table 1).

From data collected, it is apparent that in-stream boxes placed in glide habitats are more efficient than those in pool habitats most likely due to increased flows and less sedimentation. Unfortunately, boxes 19 and 20 were lost one week after egg outplanting probably due to insufficient anchoring to the stream bed. Box seven, which had zero fry produced, was placed slightly downstream of a hot spring as an experimental trial to note the affects of elevated temperature, elevated pH, and decreased dissolved oxygen on egg incubation survival. Eggs from this box had perished within two weeks of outplanting, however, box eight, located within three meters downstream of box 7, had an average lower temperature, higher dissolved oxygen, but elevated pH, indicating that pH levels have less effect than temperature and dissolved oxygen on egg survival (Table 1).

Table 1. In-stream chinook salmon eggbox performance measures in Dollar Creek.

Box #	Habitat	Eggs Planted	Avg. ^{o}C	Avg. DO	Avg. mS/cm	Avg. pH	Avg. Flow	Sediment Avg. %	Estimated Production
1	Pool	14,408	0.7	9.84	0.024	7.82	0.03	10	12,247 fry
2	Pool	14,408	0.7	10.34	0.025	7.88	0.05	95	0 fry
3	Glide	14,408	0.7	9.82	0.024	7.87	0.10	8	12,247 fry
4	Glide	14,408	0.7	9.80	0.024	7.88	0.13	16	12,247 fry
5	Glide	14,408	0.8	10.16	0.026	7.94	0.13	26	12,247 fry
6	Glide	14,408	0.7	10.13	0.025	7.98	0.25	25	12,247 fry
7	Pool	14,408	4.0	7.99	0.050	9.20	Eddy	65	0 fry
8	Pool	14,408	2.0	9.41	0.037	8.68	0.06	55	0 fry
9	Glide	14,900	1.0	9.11	0.030	7.71	0.17	15	12,665 fry
10	Glide	14,900	1.0	9.02	0.030	7.71	0.10	29	12,665 fry
11	Glide	14,900	1.0	9.45	0.031	7.73	0.18	27	12,665 fry
12	Glide	14,900	1.1	9.45	0.030	7.72	0.13	32	12,665 fry
13	Glide	14,900	1.2	9.12	0.030	7.71	0.40	19	12,665 fry
14	Glide	14,900	1.2	9.05	0.030	7.73	0.32	22	12,665 fry
15	Glide	14,900	1.2	9.00	0.030	7.69	0.27	22	12,665 fry
16	Pool	14,900	1.2	9.23	0.030	7.77	0.05	44	12,665 fry
17	Glide	16,685	1.4	8.95	0.033	7.82	0.20	10	14,182 fry
18	Pool	16,685	1.2	9.48	0.032	7.77	0.16	77	0 fry
19	Pool	16,685	Box Missing						0 fry
20	Pool	16,685	Box Missing						0 fry
21	Pool	16,685	1.3	10.09	0.030	7.73	0.09	78	0 fry
22	Pool	16,685	1.3	10.08	0.030	7.67	0.08	85	0 fry
Totals/Average		**334,580**	**1.22**	**9.48**	**0.030**	**7.90**	**0.15**	**38**	**176,737 fry**

Since staff was unable to enumerate dead egg totals in 2007 to estimate hatch success, the historical average (85%) of the program was applied to each effective egg box to determine the approximate amount of fry seeded in Dollar Creek. From visual observations, there were a total of 14 boxes that effectively produced fry and eight that failed. There was an estimated 176,737 fry produced from outplanting 334,580 eggs in Dollar Creek, resulting in 52.82% hatch success in the spring of 2007.

DISCUSSION

In 2006, staff and IDFG spawned adult chinook salmon at the South Fork Salmon River and outplanted a total of 334,580 eyed eggs in Dollar Creek. However, as a result of intensive forest fires during July-October, 2007, Tribal staff requested IDFG to release pre-spawned adult summer chinook salmon in lieu of taking eggs for the egg-box program.

On August 24 and 28, 2007, McCall Fish Hatchery personnel released 90 females and 70 males; and 100 females and 125 males, respectively for a total release of 385 adult chinook salmon. The release site, Roaring Creek, was located approximately 1.5 miles below the Dollar Creek confluence with the South Fork Salmon River. This site was utilized due to the lack of readily available access to Dollar Creek and the necessity to get in and out because of forest fires.

As a result of limited funding in 2006, staff determined, by applying the historical average, a total of 176,737 fry were seeded in the Dollar Creek tributary. Therefore, hatch success was estimated at 52.82%, an important qualitative and quantitative value. On paper, 52.82% seems very low; however, given that these eggs were "surplus," any level of fry production is an accomplishment toward maintaining, rehabilitating, and enhancing salmon populations in the Salmon River basin and supplementing natural production in SFSR tributaries where limited numbers of naturally spawning chinook were known to occur.

Through monitor and evaluation activities, staff identified that in-stream boxes in glide habitats are more effective and productive than pool areas. Ideal in-stream chinook salmon egg incubation would occur in glide habitats with average temperature ranging between 0.5 – 1.5 ^{o}C, dissolved oxygen between 9.00 – 11.00 mg/l, conductivity between 0.020 – 0.030 mS/cm, pH between 7.5 – 8.0, flow above 0.10 m/s, and sediment accumulation below 30% of box volume.

Even though staff assumes fry were produced in Dollar Creek, the SBT acknowledges, in conjunction with scientific literature that suggests hatchery offspring experience lower survival to the adult stage, that life stages beyond that of fry may not be produced. However, juveniles from the eggbox program will experience natural selection and this natural process is thought to produce highly fit hatchery fish (Denny et al. 2006).

With additional funding, the SBT proposes that future evaluations will include pairing Dollar Creek with a control stream to document changes in fish densities resulting from in-stream egg incubation. However, the program will need to pair multiple treatment and control streams to detect significant relationships. Fish densities will be evaluated by baiting fry traps, electro-fishing, and/or snorkeling and data will be compared to control streams to determine significant differences. If fry densities indicate supplementation is increasing the population, this will warrant further cooperation between the parties to justify future investigations.

CITATIONS

Annual Operating Plan (AOP) Salmon River Basin. 2007. The annual operating plan for fish production programs in the Salmon River basin, 2005. Prepared by the Idaho Department of Fish and Game, U.S. Fish and Wildlife Service, Shoshone-Bannock Tribes, Idaho Power Company, and Nez Perce Tribe.

Denny, L. P., K. Witty, and S. Smith. 2006. A monitoring and evaluation plan for the Shoshone-Bannock Tribes: Hatchery supplementation activities Yankee Fork; Salmon River sub-basin. Draft Review Shoshone-Bannock Tribes, Department of Fisheries Resources Management.

CHAPTER 3. STEELHEAD SMOLT SUPPLEMENTATION PROGRAM

Annual Report

October 1, 2006 – September 30, 2007

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Cooperative Agreement 141107J017

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ABSRACT

To maintain, rehabilitate, and enhance steelhead populations, the Tribes, under Cooperative Agreement 141107J017, initiated a steelhead supplementation program in Yankee Fork (YF), Valley Creek, and Slate Creek.

The main objective of the program is to release 330,000 in Yankee Fork, 50,000 in Valley Creek, and 100,000 in Slate Creek for an approximate total release of 480,000 smolts. The goal is to return > 2,000 adults; a level to help rebuild the population, collect broodstock, and sustain harvest. In 2007, with the help of Idaho Fish and Game and US Fish and Wildlife, SBT staff released at total of 490,120 smolts (103% of overall objective) collectively in the three tributaries. Staff met or exceeded the release values for each tributary within the program.

Initial estimates of juvenile survival and migration timing through the hdrosystem will be conducted by monitoring PIT tag evaluations using the SURPH model and will be completed in the summer of 2008. The Tribes propose to install a weir, screw trap, and/or PIT tag reader in the YF to effectively estimate population size, collect genetic samples from returning adults, and determine the efficacy of the steelhead smolt supplementation program.

ACKNOWLEDGEMENTS

The Tribes thank Scott Marshall and staff at the LSRCP-Office for providing funding to further support this program. Special thanks to IDFG personnel including Sharon Kiefer, Sam Sharr, Tom Rogers, and Richard Lowell as well as USFWS personnel Bryan Kenworthy and Nathan Wiese. We especially thank Mike DeLarm for providing technical expertise and commitment to this program.

The Tribes provided the administrative framework for this project to be successful. We would like to thank the Fish and Wildlife Department personnel Carlos Lopez, Rodney Burns, and Tyron Broncho for project operations and monitoring and evaluation. Thanks to Hal Hayball of the Shoshone-Bannock Tribes for furnishing maps.

INTRODUCTION

The Tribes initiated a smolt supplementation program in YF, Valley Creek, and Slate Creek to increase the viability and production of the steelhead populations, increase harvest of steelhead for members of the Tribe, and increase knowledge of fishery management techniques to accomplish the first two goals in a timely, cost-effective, and least intrusive manner.

The objectives of the steelhead smolt supplementation program, under the agreement in *U.S. v Oregon*, are to release approximately 330,000 in YF, 50,000 in Valley Creek and 100,000 in Slate Creek for a total of 480,000 smolts with a goal of returning > 2,000 adults.

In cooperation with LSRCP, the current focus of monitor and evaluation for smolt supplementation research is structured in the YF. This focus allows the Tribes to evaluate the efficacy of multiple programs in one location, i.e. smolt supplementation compared to streamside incubation compared to natural production.

STUDY AREA

Salmon River Sub-basin

Physical and biological characteristics of the Salmon River sub-basin influence the potential to enhance anadromous salmonid populations. Generally, streams have high gradient that causes them to be dynamic environments for fish. In addition to natural factors limiting fish production, humans have taken water for irrigation, reduced riparian vegetation, mined, developed rural residential areas, built and maintained roads, grazed domestic livestock, and logged (Kutchins et al. 2001). However, the Salmon River sub-basin has potential to rear large numbers of salmon and steelhead.

The Salmon River sub-basin is located in central Idaho (Appendix A; Figure 9). The total drainage area of the Salmon River watershed is over 14,000 square miles (36,260 square kilometers). The Salmon River flows 410 miles (650 kilometers) in a large arch from northeast to northwest to join the Snake River at River Mile 188.2. The Salmon River is the second largest sub-basin in the Columbia River drainage with the Snake River drainage being the largest (Kutchins et al. 2001). Major tributaries of the Salmon River include the Little Salmon River, South Fork Salmon River, Middle Fork Salmon River, Panther Creek, Lemhi River, Pahsimeroi River, East Fork Salmon River, Valley Creek, and Yankee Fork Salmon River (Appendix A; Figure 9) (Kutchins et al. 2001).

Yankee Fork Salmon River

Yankee Fork, located in the Salmon-Challis National Forest in Custer County, Idaho, is a major tributary of the upper Salmon River (Appendix A; Figure 9). The YF flows through narrow canyons and moderately wide valleys with forest of lodgepole pine (*Pinus contorta)* (Richards and Cernera 1989). The West Fork of the Yankee Fork is the largest tributary. Other notable tributaries to the YF include Jordan, Lightning, Greylock, Cearly, and Eightmile Creeks (Appendix A; Figure 12). Most of the system is characterized by highly erosive sandy and clay-loam soils. YF is an important spawning and rearing stream for chinook salmon and steelhead. Utilization by chinook salmon and steelhead has declined since the mid-1960's. Other fish species present in the YF system include bull trout (*Salvelinus confluentus*), cutthroat trout (*Oncorhynchus clarki*), mountain whitefish (*Prosopium williamsoni*), and short head sculpin (*Cottus confuses*).

The drainage is composed of 190 square miles of river. Elevations range from 8,204 feet at the northern boundary to 6,171 feet at the confluence with the Salmon River. Mean stream length varies annually and average precipitation is roughly 27 inches. Base flows in YF are approximately 40 cubic feet per second and mean flows (Qa) are 247 cubic feet per second.

Historic mining activities in the YF further aggravated the tenuous status of natural stocks, resulting in further decline. Mining activities have resulted in the complete re-channeling of lower portions of the YF and the deposition of extensive unconsolidated dredge piles. Such activities have eliminated or degraded much of the rearing and spawning habitat in the lower YF. As a result, the YF drainage is grossly underutilized with respect to salmon and steelhead production (Reiser and Ramey 1987).

METHODS

Steelhead for this program are collected, spawned, and sampled by SBT and IDFG staff at the Sawtooth Fish Hatchery. Smolts destined for YF supplementation will be incubated and reared separately from all other hatchery production at the Magic Valley and Hagerman National Fish Hatcheries. Upon transport to YF, the 330,000 smolts will be scatter planted at several pre-determined habitat areas, with approximately 110,000 smolts at each location.

Upon return to YF, adult, F1 steelhead will be sampled in the SBT harvest. Tissue samples, scales, and phenotypic information will be collected. In the summer, following spawning, age-0^+ parr will be collected and sampled. DNA typing will be used to differentiate steelhead produced from the smolt supplementation program from all other steelhead produced either naturally or planted in egg incubators in the study watershed. Each steelhead (P1, parent) used in brood-stock mating to produce the supplementation smolts (F1) are genotyped, allowing for all progeny to later be identifiable when captured and sampled as F1 adults or later, as F2 parr or F2 adults.

A parental exclusion, pedigree analysis (Letcher and King 2001) will be performed to determine the relative reproductive success of hatchery origin steelhead compared to natural origin steelhead in producing F2 juveniles. The number of naturally spawning steelhead in YF will be determined by the number of unique genotypes that will be assessed in sampling of age-0^+ juvenile parr.

Monitor and evaluation activities will focus on recording juvenile smolt out-migration and estimating adult steelhead escapement resulting from smolt releases. Staff will estimate juvenile survival and timing through the hydrosystem using the SURPH model and searching for PIT tags. Implanted tags will be used in IDFG hatchery evaluations and data will be shared with staff for evaluation purposes. Information will be applied to estimate adult escapement by assuming similar survival of SFH general production steelhead.

RESULTS

Parental Selection and Mating

SBT staff, in coordination with Idaho Department of Fish and Game (IDFG) at the Sawtooth Fish Hatchery (SFH), randomly spawned 56 pairs, 24 pairs, and 16 pairs for a total of 96 pairs on 4/12/07, 4/19/07, and 4/26/2007, respectively. During spawning, staff collected genetic tissue samples and fork lengths from all 192 individuals. All other adults utilized for Valley Creek and Slate Creek smolt production were spawned by SFH personnel. After incubation at SFH, eggs were transferred to Magic Valley and Hagerman Hatcheries where YF, Valley Creek, and Slate Creek fish were reared separately from general production fish.

Smolt Release

Smolts were released into Pond Series 1 and 4 in YF (Appendix A; Figure 12), in Valley Creek at the Stanley Lake Creek confluence (Appendix A; Figure 13), and into an upper and lower site in Slate Creek (Appendix A; Figure 14).

With the help of IDFG and USFWS, staff was present to release 339,088 smolts into Pond Series 1 and 4 in YF (102% of our objective) and 100,392 smolts into Slate Creek (100% of our objective). Due to time constraints, staff was unable to be present for the release 54,640 smolts into Valley Creek (109% of our objective). Overall, IDFG, USFWS, and SBT staff released a total of 494,120 smolts in YF, Valley Creek, and Slate Creek (103% of our overall objective). Locations, dates, release numbers, collaborating hatchery, and mark values are presented below in Table 2.

Table 2. 2007 steelhead smolt releases in Yankee Fork, Valley Creek, and Slate Creek.

Date	Location	Hatchery	Ad-clipped	CWT	Pit-Tag	No-mark	Total
4/18/2007	Lower Slate Creek	Magic Valley	40,000	30,000	0	0	40,000
4/27/2007	Yankee Fork p/4	Magic Valley	30,332	30,451	298	30,153	91,234
4/30/2007	Valley Creek	Magic Valley	0	0	299	54,341	54,640
5/1/2007	Upper Slate Creek	Magic Valley	0	0	146	29,887	30,033
5/2/2007	Upper Slate Creek	Magic Valley	0	0	146	30,213	30,359
5/3/2007	Yankee Fork P/1	Hagerman	15,990	0	300	37,813	54,103
5/4/2007	Yankee Fork P/1	Hagerman	21,314	0	0	33,239	54,553
5/7/2007	Yankee Fork P/4	Hagerman	30,794	0	0	23,793	54,587
5/8/2007	Yankee Fork P/4	Hagerman	18,330	0	0	34,564	52,894
5/9/2007	Yankee Fork P/4	Hagerman	19,085	0	0	12,632	31,717
	Yankee Fork	MVH & HFH	135,845	30,451	598	172,194	339,088
	Valley Creek	Magic Valley	0	0	299	54,341	54,640
	Slate Creek	Magic Valley	40,000	30,000	292	60,100	100,392
	Total Release		**175,845**	**60,451**	**1,189**	**286,635**	**494,120**

Of the 494,120 smolts released, 246,854 were reared at the Magic Valley Fish Hatchery (49% of total) and 247,854 were reared at the Hagerman National Fish Hatchery (51% of total). In summary, there were 175,845 ad-clipped, 60,451 coded-wire tagged, 1,189 pit-tagged, and 286,635 smolts with no marks released in YF, Valley Creek, and Slate Creek, collectively.

Juvenile Survival

Staff conducted initial queries for PIT-tagged juveniles in PITAGIS and Fish Passage. Estimates of juvenile survival and migration through the hydrosystem will be conducted by continued monitoring and evaluation of PIT tags and utilizing the SURPH model. The staff will be collecting information on PIT tagged juvenile steelhead detected in the hydrosystem to complete this evaluation during summer 2008.

Furthermore, additional evaluations will be conducted, including trapping adults at a weir located in YF, sampling tissue for genetic analysis, and determining whether adults successfully reproduce.

DISCUSSION

Of the major objectives and tasks under the SBT steelhead smolt supplementation program, staff completed the spawning of 192 individuals and the release of 490,120 smolts in YF, Valley Creek, and Slate Creek, collectively. Furthermore, the final tasks, estimating juvenile survival and adult escapement, will be complete by summer of 2008.

Genetic samples taken from spawning all 192 individuals were transferred to Abernathy Fish Technology Center (AFTC) for future analysis. With additional funding, AFTC will conduct parentage exclusion analysis to estimate adult production and smolt-to-adult survival. Under this study design, staff will be able to determine the efficacy and cost-effectiveness of the steelhead smolt program compared to natural production and/or the steelhead streamside incubation program. To increase the efficiency of monitoring and evaluation, the SBT propose to install a weir in the YF to trap returning adults to collect additional genetic samples beyond just creel surveys for conclusive parentage analysis studies. In addition, the SBT propose to install a screw trap and/or PIT tag reader at the mouth of the YF to effectively determine population and relative breeding size of steelhead.

In the past, steelhead smolts have been released on an irregular schedule in the Lemhi River, YF, Valley Creek, or Slate Creek. To date, evaluation of this program has been limited to observation of adult steelhead and minimal redd counts. However, with the completion of a sound monitor and evaluation plan, the SBT can evaluate, using DNA, survival from the steelhead smolt release program in YF. The plan is also designed to estimate capacity of the natural environment to support additional hatchery steelhead, give early warning of adverse impacts caused by the projects, and track trends in environmental quality.

CITATIONS

Kutchins,K., C. Colter, and M. Haddix. 2001. Draft. Shoshone-Bannock Tribes Salmon River salmon-steelhead production master plan. Shoshone-Bannock Tribes, Fort Hall, Idaho.

Letcher, B.H. and T.L. King. 2001. Parentage and grandparentage assignment with known and unknown matings: Application to Connecticut River Atlantic Salmon restoration. Canadian Journal of Fisheries and Aquatic Science. 58, 1812-1821.

Reiser, D. W. and M. P. Ramey. 1987. Feasibility plan for the enhancement of the Yankee Fork of the Salmon River, Idaho. Prepared for the Shoshone-Bannock Tribes, Fort Hall, Idaho. BPA contract No. 83-359.

Richards, C. and P. J. Cernera. 1989. Dispersal and abundance of hatchery-reared and naturally spawned juvenile chinook salmon in an Idaho stream. North American Journal of Fisheries Management 9: 345-351.

CHAPTER 4. STEELHEAD STREAMSIDE INCUBATION (SSI) PROGRAM

Annual Report

October 1, 2006 – September 30, 2007

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ABSTRACT

The Tribes initiated a steelhead streamside supplementation program in 1995 to help maintain, rehabilitate, and enhance steelhead populations. The objective is to release approximately 1.0 million eggs into five Upper Salmon River tributaries to meet a return goal of > 2,000 adults.

Under Cooperative Agreement 141107J017 with the LSRCP, the focus of study evaluations is confined to the Yankee Fork Salmon River (YF). The YF, a major tributary to the upper Salmon River, is an important spawning and rearing system for anadromous salmonids, as well an important traditional use area for the Shoshone-Bannock Tribes. Based on the population delineations and viability criteria from the Interior Columbia Basin Technical Recovery Team, the YF is underutilized by anadromous species.

The Tribes operate the steelhead streamside incubation (SSI) program in the Yankee Fork Salmon River, Idaho. An objective is to determine if targets for hatchery contributions are being achieved and can be improved using DNA parentage analysis. Approximately 214,750 eyed eggs were outplanted in 2006 resulting in 155,908 fry seeded. In 2007, a total of 333,194 fry were seeded from outplanting 358,353 eyed eggs. We completed three-pass electrofishing in September 2006 and 2007 at 18 and 21 randomly stratified reaches for density, distribution, parentage analysis, genetic diversity/structure. Observed sample densities in 2006 and 2007 were 0.041 fish/m^2 and 0.059 fish/m^2, respectively. Tissue samples collected from BY06-0^+ (n=349) and BY06-1^+ (n=123) age *O. mykiss* resulted in 61 total parentage assignments. We estimated 17,850 (± 2207) total age-0^+ juveniles in 2006, of which an estimated 4,268 (± 1244) were hatchery-origin; 23.9% (95% C.I. = 19.3 – 27.5%). Survival of hatchery-origin fry to age-0^+ parr is estimated at 2.7%, however, fish maybe leaving the system before sampling or low sample size underestimates abundance. DNA analysis identified five hatchery-origin age-1^+ juveniles representing 4.1% of the population in 2007. There is no significant difference in mean condition factor between hatchery and natural origin juveniles in either year. Mismatches were most commonly due to weakly amplified samples, or point errors traced back to data transcription errors. The final error rate assigned to the data set was 1.0%. Production (juvenile survival) among outplanted families is not equally distributed. Nineteen known mated broodstock pairs did not produce progeny. We observed high allelic polymorphism across 14 loci. Among 8 groups of *O. mykiss* evaluated, we observed F_{st} values ranging from 0.002 to 0.014 across loci. The overall estimate of 0.009 indicates significant among-group variability (99% C.I. = 0.007 – 0.011). The high proportion of HWE deviations observed likely indicates the presence of multiple spawning populations (e.g. juveniles of resident, natural origin, and other hatchery origin).

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The Tribes thank Scott Marshall and staff at the LSRCP-Office for providing funding to further support this program. Special thanks to IDFG personnel including Sharon Kiefer, Bill Horton, Tom Rogers, Paul Kline, Brent Snider, Roger Elmore, Todd Garlie, Doug Engemann, Jocelyn Hatch, Danielle Dorsch, Phil Stone, Caleb Price, Lars Alsager, and Mel Hughes for their support. We especially thank Mike DeLarm, and William Ardren and Andrew Matala from Abernathy Fish Technology Center for providing technical expertise and commitment to this program.

The Tribes provided the administrative framework for this project to be successful. We would like to thank the Fish and Wildlife Department personnel Chad Colter, Claudeo Broncho, Carlos Lopez, Rodney Burns, Jeremy Broncho, Mike Haddix, Andy Kohler, and Tyron Broncho for project operations and monitoring and evaluation. Thanks to Hal Hayball of the Shoshone-Bannock Tribes for furnishing maps. We especially thank several volunteers including Jared Moss and Garret Galloway for their assistance in the field.

INTRODUCTION

The objectives of the SSI program, under the agreement in *U.S. v Oregon*, are to outplant 1.0 million eyed steelhead eggs into five Upper Salmon River tributaries; 375,000 in Yankee Fork, 250,000 in Panther Creek, 125,000 in Basin Creek, 125,000 in Morgan Creek, and 125,000 in Indian Creek.

Current monitor and evaluation focus for the SSI program is structured in the YF. The purpose of monitor and evaluation activities is designed to evaluate the efficacy of a steelhead eyed egg incubator program in the YF as compared to naturally spawning steelhead and/or the on-going smolt supplementation program. The Tribes primary purposes under the SSI program are to: 1) increase the viability and production of the YF steelhead population; 2) increase harvest of steelhead for members of the Shoshone-Bannock Tribes; and, 3) increase knowledge of fishery management techniques to accomplish the first two objectives in a timely, cost-effective and least intrusive manner.

The YF, a major tributary of the Salmon River, is a spawning and rearing system for steelhead trout (*Onchorhychus mykiss*) and chinook salmon (*O. tshawytscha*). Historically, there were large spawning populations of steelhead and chinook in YF which are a cultural, social and subsistence based resource of historical significance for the Tribes. Factors including hydroelectric dam construction, reduced riparian habitat, irrigation, river and ocean harvest, and fish passage have caused a decline in salmon and trout populations.

Reiser and Ramey (1987) determined YF could produce an estimated 740,064 chinook and 295,499 steelhead smolts. Based on information from the Interior Columbia Basin Technical Recovery Team (TRT 2005) and Reiser and Ramey (1987), YF is underutilized by anadromous fish.

The Tribes developed supplementation activities to enhance the viability of natural steelhead populations. Without changing downstream harvest and hydrosystem management, supplementation may be necessary to maintain elevated populations to support harvest and improve abundance, productivity, structure, and genetic diversity (Denny et al. 2006). Effective management of steelhead stocks can be determined by increases in abundance and distribution through a combination of electroshocking and DNA genotyping.

The tasks, as identified within monitor and evaluation objectives, were to: (1) collect genetic samples for parentage analysis, (2) document salmonid species, (3) estimate relative abundances for wild origin and SSI progeny, (4) determine condition of wild origin and SSI progeny, (5) determine if program objectives for rate of contribution by hatchery fish is being achieved or can be improved, (6) determine natural production increase resulting from supplementation of steelhead in YF and relate this information to possible limiting factors, (7) identify adaptive management to increase sampling resolution, and (8) communicate monitoring and evaluation findings to resource managers.

STUDY AREA

Salmon River Sub-basin

Physical and biological characteristics of the Salmon River sub-basin influence the potential to enhance anadromous salmonid populations. Generally, streams have high gradient that causes them to be dynamic environments for fish. In addition to natural factors limiting fish production, humans have taken water for irrigation, reduced riparian vegetation, mined, developed rural residential areas, built and maintained roads, grazed domestic livestock, and logged (Kutchins et al. 2001). However, the Salmon River sub-basin has potential to rear large numbers of salmon and steelhead.

The Salmon River sub-basin is located in central Idaho (Appendix A; Figure 9). The total drainage area of the Salmon River watershed is over 14,000 square miles (36,260 square kilometers). The Salmon River flows 410 miles (650 kilometers) in a large arch from northeast to northwest to join the Snake River at River Mile 188.2. The Salmon River is the second largest sub-basin in the Columbia River drainage with the Snake River drainage being the largest (Kutchins et al. 2001). Major tributaries of the Salmon River include the Little Salmon River, South Fork Salmon River, Middle Fork Salmon River, Panther Creek, Lemhi River, Pahsimeroi River, East Fork Salmon River, Valley Creek, and Yankee Fork Salmon River (Appendix A; Figure 9) (Kutchins et al. 2001).

Yankee Fork Salmon River

Yankee Fork, located in the Salmon-Challis National Forest in Custer County, Idaho, is a major tributary of the upper Salmon River (Appendix A; Figure 9). The YF flows through narrow canyons and moderately wide valleys with forest of lodgepole pine (*Pinus contorta)* (Richards and Cernera 1989). The West Fork of the Yankee Fork is the largest tributary. Other notable tributaries to the YF include Jordan, Lightning, Greylock, Cearly, and Eightmile Creeks (Appendix A; Figure 15). Most of the system is characterized by highly erosive sandy and clay-loam soils. YF is an important spawning and rearing stream for chinook salmon and steelhead. Utilization by chinook salmon and steelhead has declined since the mid-1960's. Other fish species present in the YF system include bull trout (*Salvelinus confluentus*), cutthroat trout (*Oncorhynchus clarki*), mountain whitefish (*Prosopium williamsoni*), and short head sculpin (*Cottus confuses*).

The drainage is composed of 190 square miles of river. Elevations range from 8,204 feet at the northern boundary to 6,171 feet at the confluence with the Salmon River. Mean stream length varies annually and average precipitation is roughly 27 inches. Base flows in YF are approximately 40 cubic feet per second and mean flows (Qa) are 247 cubic feet per second.

Historic mining activities in the YF further aggravated the tenuous status of natural stocks, resulting in further decline. Mining activities have resulted in the complete re-channeling of lower portions of the YF and the deposition of extensive unconsolidated dredge piles. Such activities have eliminated or degraded much of the rearing and spawning habitat in the lower YF. As a result, the YF drainage is grossly underutilized with respect to salmon and steelhead production (Reiser and Ramey 1987).

METHODS

Parental Selection and Mating

Spawning occurs at Sawtooth Fish Hatchery (SFH), where staff actively participates in spawning approximately 97 pairs of returning steelhead adults. Staff collects genetic samples, gametes, and fork length for each parent fish isolated for YF and Basin Creek. Mating is conducted as 1:1 female to male and eggs are incubated separately from general production gametes. All other adults utilized for Panther Creek, Morgan Creek, and Indian Creek are spawned and fork length recorded by IDFG personnel at the Pahsimeroi Fish Hatchery (PFH).

Egg Planting

Staff constructed two incubators located in Morgan Creek, two in Indian Creek, three in Panther Creek, two in Basin Creek, and five in Yankee Fork.

Incubators were standardized with 2-inch PVC pipe with a 3-inch head pipe to collect additional flow from the stream. Each head pipe was fitted with ¼ inch mesh screen to minimize sediment and debris collection. Each incubator consisted of a 50-gallon polyurethane cylinder with a sediment tray, gravel, saddles, six egg trays, and one cover tray to contain eggs until hatching occurred. Each catch tank was a 30-gallon Rubbermaid polyurethane tub with a custom fit cover.

Steelhead eyed eggs from PFH were collected and transferred to SSI incubators in Panther Creek (Appendix A; Figure 16), Morgan Creek (Appendix A; Figure 17), and Indian Creek (Appendix A; Figure 18). Eyed eggs from SFH, destined for YF, were initially randomized (to mix family units) prior to transport and then loaded proportionately into five incubators on two outplanting dates. Steelhead eggs for Basin Creek were only transported and outplanted, not randomized due to no further juvenile assessment.

Incubation and Hatching Success

Incubators were monitored twice weekly from 4/12/2007 through 7/20/2007. Staff recorded water condition, temperature, dissolved oxygen, conductivity, pH, and embryo stage as well as cleaned and removed debris from head pipe screens.

Upon full volitional emigration, hatch success was estimated from enumerating dead eggs in the incubator and dead fry in the catch tank. Fry seeded is estimated as the number of eggs planted minus the number of dead eggs enumerated.

Juvenile Assessment

Juvenile sampling was conducted on the Yankee Fork drainage during September 13 – 14, 19 – 21, and October 11 – 13, in 2006 and September 12 – 13, 18 – 19, and October 2 – 5, 10 – 12, in 2007.

Konopacky et al. (1985, 1986) divided the drainage into seven distinct strata (Appendix A; Figure 19); three reaches were selected within each stratum except for stratum five which contained four reaches in 2007. Sites were selected for a variety of habitats (pools, glides, riffles) and ease of accessibility for an upper, middle, and lower location within each stratum. Appendix A; Figure 19 shows the center position for all sampling locations throughout YF. Unlike 2006, staff was able to sample and collect data for the West Fork Yankee Fork (strata 6) in 2007. Sites were generally rectangular in shape, aligned with the shoreline, and divided into transects for habitat measurements.

Multiple-pass electrofishing requires closed populations to minimize emigration and immigration; hence the use of block nets. Sites were predominately 100 m in length, but did reach above 100 m due to habitat inclusion and accessibility for block net placement. Upstream and downstream ends of the sampling reach were blocked using 7-mm-mesh nets secured to the streambed with tri-pods and rebar, generally at habitat unit separations. Sites were electrofished in an upstream direction between 20 – 30 minutes with one crew member electroshocking (Smith-Root, Inc. Pulsed DC LR-24 Backpack Electrofisher) and two to three others utilizing dip nets to capture fish drifting downstream under electronarcosis. Voltage and frequency were adjusted and monitored to maximize capture, but limit fish injury (voltage: 350-450, frequency: 30-50 Hz, duty cycle: 10-12%). Fish were transferred immediately to a bucket and then to a holding tub for further analysis.

Fish were anesthetized in a 10 p.p.m. solution of clove oil. Prior to mixing solution, clove oil was first dissolved in 95% ethanol (1:10 ratio clove oil-ethanol) since clove oil is insoluble at water temperatures below 15 ^{o}C (Cho and Heath 2000). Trout and salmon were measured for fork length to the nearest 1 mm and weight to the nearest 0.01 g. Fin clips were taken from the ventral caudal lobe and scales were taken anterior of the caudal fin for parentage analysis and aging, respectively. Post-sampling, fish were transferred to a tub of fresh water to recover. A minimum of 20 minutes between passes was given to allow the return of normal fish activity and visual clarity. Fish were released after full recovery once sampling was finished.

Population estimates and probability of capture was calculated using model $M_{(b)}$ (Zippen removal population estimator, Zippen 1956) by the program CAPTURE. CAPTURE computes estimates of capture probability and population size for all electrofishing passes based on a stationary population, equal probability of capture for each animal, and constant probability of capture.

Habitat measurements included reach length, mean width (wetted), mean depth, maximum depth, start temperature, end temperature, woody debris, and dominant substrate. Mean width was obtained by taking width measurements on every twenty-meter transect along the stream section length. Mean depth was estimated from five equally spaced measurements on each width transect. Maximum depth was observed as the deepest point along each width transect. Temperature was recorded at the start and finish of each three-pass electrofishing.

Both woody debris and dominant substrate composition were visually graded on a scale. Woody debris was classified as absent (1), slight (2), dominant (3), or ubiquitous (4). Dominant substrate was coded as sand (1), gravel (2), cobble (3), or boulders (4). In sites with multiple habitat types, a visual estimate of stream section area (%) was recorded as well as each habitat was coded separately for woody debris and dominant substrate.

Total reach area sampled was determined as the product of stream section length and mean width. Width: depth ratio was calculated by dividing mean width by mean depth. Catch-per-unit-effort (CPUE) for each site, strata, and YF was calculated as fish per meter squared (fish/m^2).

A parental exclusion, pedigree analysis (Letcher and King 2001) was/will be performed to determine the relative reproductive success of hatchery origin steelhead compared to natural origin steelhead in producing F2 juveniles. The number of naturally spawning steelhead in YF will be determined by the number of unique genotypes that will be assessed in sampling of age-0^+ and 1^+ juvenile parr.

RESULTS

Egg Planting, Hatch Success, and Fry Seeded

Overall, staff gathered 597,070 and 584,545 green eggs at PFH and SFH, respectively, for a total of 1,181,615 green eggs. Green eggs were incubated on pathogen free well water for approximately 45 days at 43°C to achieve 573,188 (96% green egg to eyed egg survival) and 496,863 (85% green egg to eyed egg survival) eyed eggs, respectively, for a total of 1,070,051 eyed eggs received.

Upon full volitional emigration from incubators and catch tanks, hatch success and total fry seeded were estimated from enumerating dead eggs. Average hatch success for all fourteen incubators equaled 83.76% (0 – 99.91%) with a total of 896,278 fry seeded in the five Upper Salmon River tributaries (Table 3) from 1,070,051 outplanted eggs. Hatch success from the five incubators in YF averaged 92.98% (84.91 – 98.85%) with a total of 333,194 fry seeded from outplanting 358,353 eyed eggs (Table 3).

Table 3. SSI program tributary incubator characteristics.

Tributary Incubator	Stock	Date	Eggs Planted	Dead Eggs	Hatch %	Fry Produced
Panther Creek	**PFH**		**299,277**	**9,299**	**96.89**	**289,978**
Beaver Creek 1		*4/20 & 5/22*	*135,233*	*969*	*99.28*	*134,264*
Beaver Creek 2		*4/27*	*80,170*	*6,800*	*91.52*	*73,370*
Deep Creek		*4/27*	*83,874*	*1,530*	*98.18*	*82,344*
Morgan Creek	**PFH**		**149,888**	**76,038**	**49.27**	**73,850**
WF Morgan Creek		*4/11*	*75,338*	*75,338*	*0.00*	*0*
Lick Creek		*4/11*	*74,550*	*700*	*99.91*	*73,850*
Indian Creek	**PFH**		**124,023**	**1,776**	**98.57**	**122,247**
Indian Creek 1		*4/20*	*62,153*	*526*	*91.15*	*61,627*
Indian Creek 2		*4/20*	*61,870*	*1,250*	*97.98*	*60,620*
Basin Creek	**SFH**		**138,510**	**61,501**	**55.60**	**77,009**
East Basin Creek		*5/24 & 6/6*	*81,205*	*61,287*	*24.53*	*19,918*
Hay Creek		*5/31*	*57,305*	*214*	*99.63*	*57,091*
Yankee Fork	**SFH**		**358,353**	**25,159**	**92.98**	**333,194**
Cearly Creek		*6/6 & 6/8*	*73,179*	*3,346*	*95.43*	*69,833*
WF Yankee Fork		*6/6 & 6/8*	*71,636*	*1,149*	*98.40*	*70,487*
Jordan Creek		*6/6 & 6/8*	*71,177*	*817*	*98.85*	*70,360*
Greylock Creek		*6/6 & 6/8*	*71,180*	*10,738*	*84.91*	*60,442*
12 Mile Creek		*6/6 & 6/8*	*71,181*	*9,109*	*87.20*	*62,072*
		Total	**1,070,051**	**173,773**	**83.76**	**896,278**

Habitat Characterization

Mean habitat variables for all 22 study sites are presented below in Table 4. Average area sampled was 1115.5 m^2 with length, wetted width, and depth averaging 97.7 m, 11.2 m, and 0.27 m, respectively. Mean start temperature was 5.1 ^oC, but ranged from 0.5 ^oC to 12.5 ^oC. End of sampling temperature averaged 6.7 ^oC among all sites with a range of 3.5 ^oC to 16^oC.

Sampling area was dominated by glide and riffle, 44.9% and 50.0%, respectively, for all reaches sampled. Pool percentage accounted for only 5.1% of the reaches sampled. Cobble was the most common substrate and the categorical designation, absent to slight, was the most commonly used to describe abundance of woody debris.

Table 4. Habitat characteristics of 22 study sites in Yankee Fork, Idaho.

Variable	Mean	SD	Range
Site elevation (m)	2003	129.3	1833 - 2281
Site length (m)	97.7	10.7	50 - 100
Mean wetted width (m)	11.2	5.1	3.3 - 20.6
Mean depth (m)	0.27	0.09	0.14 - 0.51
Mean area (m^2)	1115.5	530	208.4 - 2060.0
Width:depth	42.9	21.9	19.5 - 117.2
Start Temperature (°C)	5.1	3.2	0.5 - 12.5
End Temperature (°C)	6.7	3.0	3.5 - 16.0
Pool area (%)	5.1	8.4	0 - 30
Glide area (%)	44.9	27.9	5 - 92
Riffle area (%)	50.0	27.4	6 - 88
Substrate			
Pool substrate (code)	0.5	0.7	0 - 3
Glide substrate (code)	3	0.7	2 - 4
Riffle substrate (code)	3.2	0.6	2 - 4
substrate: sand (1), gravel (2), cobble (3), boulder (4)			
Pool woody debris (code)	1.0	1.3	1 - 3
Glide woody debris (code)	1.7	0.6	1 - 3
Riffle woody debris (code)	1.7	0.6	1 - 3
woody debris: absent (1), slight (2), dominant (3), ubiquitous (4)			

Total Salmonid Density and Relative Abundance

Area sampled and abundance, density, and biomass for all captured species (per strata and total) are displayed below in Table 5. Total salmonid density was highest in stratum 7 (0.417 fish/m^2), and was 3.5x that of the next highest density, 0.122 fish/m^2, in stratum 3. Strata 4 and 5 had the lowest fish densities of all seven strata sampled. Biomass/m^2 was highest in stratum 3, due to the presence of large mountain whitefish, and lowest in strata 4, an area of limited natural production. Density for the entire sampling area (24,541.35 m^2) was 0.079 fish/m^2, well below the suggested carrying capacity of 1.0 fish/m^2, while overall biomass equaled 1.233 g/m^2 (Table 5).

Steelhead were the most ubiquitous species in Yankee Fork, equaling richness of 60% or more in six of the seven strata sampled (Figure 1). Upper Yankee Fork (stratum 5) was almost entirely bull trout with very few steelhead and cutthroat individuals. Chinook and cutthroat abundances were highest in stratum four and seven, respectively. Multiple species were present in each stratum; strata 1, 3, and 6 had the highest species richness containing all five salmonid species (steelhead, chinook, bull trout, cutthroat, and whitefish).

Table 5. Abundance, density, and biomass presented per strata and total for all captured species in Yankee Fork, Idaho 2007.

Strata	Area (m^2)	Abundance	95% CI	Density ($fish/m^2$)	95% CI	Biomass (g/m^2)
1	5047.5	219	109	0.043	0.049	0.803
2	4740	316	94	0.067	0.045	0.531
3	3747.5	457	127	0.122	0.125	4.454
4	3235	101	61	0.031	0.04	0.161
5	2723	99	48	0.036	0.084	0.404
6	4140	377	161	0.091	0.062	0.544
7	908.35	379	207	0.417	0.599	3.439
Total	**24541.35**	**1948**	**278**	**0.079**	**0.269**	**1.233**

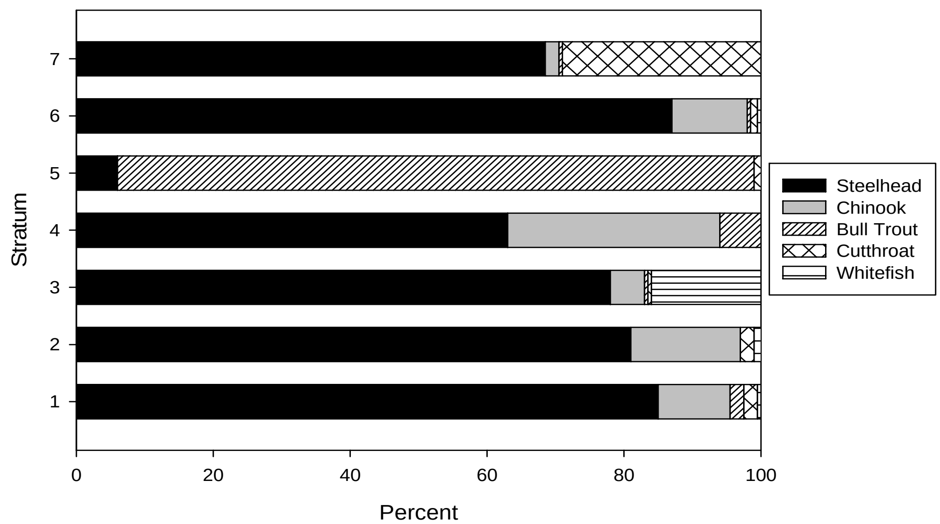

Figure 1. Relative abundance of fish species by strata, Yankee Fork, Idaho 2007.

Onchorhychus mykiss

Steelhead were present in all strata sampled in 2007. Total steelhead abundance was greatest in strata 3 (n = 355) and strata 6 (n = 321). However, these densities were significantly lower compared to Jordan Creek (0.287 fish/m^2) due to greater stream widths and, subsequently, larger coverage area (Figure 2). Biomass was highest in strata 7 (1.399 g/m^2) and lowest in strata 5 (0.009 g/m^2), although individuals in strata 1 were observably larger with average fish length and mass being 92 mm and 19.6 g. Total steelhead abundance (Figure 2), density (Figure 2), and biomass for the entire sampling area were 1,450 individuals, 0.059 fish/m^2, and 0.551 g/m^2, respectively.

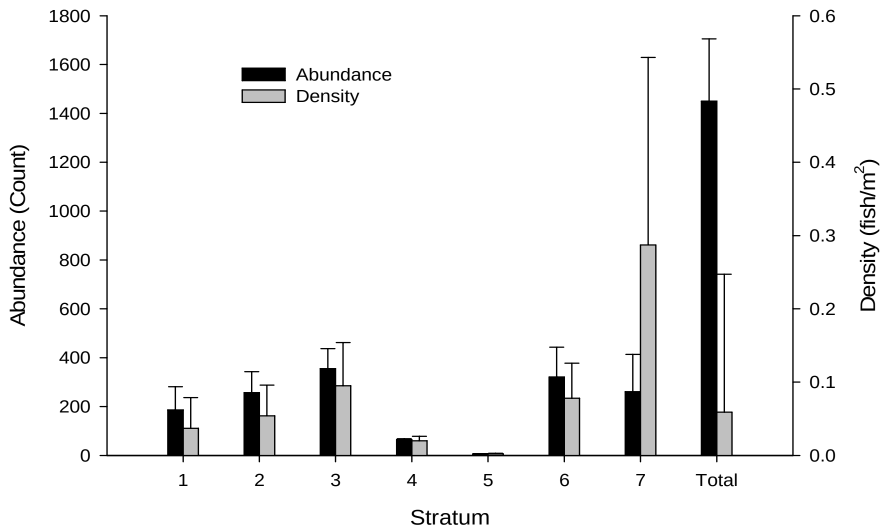

Figure 2. *O. mykiss* abundance and density by strata (n=3) and total for Yankee Fork, Idaho 2007. Error bars represent 95% confidence interval of mean.

From literature review, the Tribes classified age-0^+ individuals as ≤ 80 mm and age-1^+ or older as > 80 mm. Future scale analyses, collected during sampling, will indicate any variation in age at length and be applied to our genetic parentage analysis. Of the 1,450 individuals, 1,276 (88%) were classified as age-0^+ and 174 (12%) as age-1^+ (Figure 3). Highest age-0^+ abundance was found in strata 3 (n = 326) while age-1^+ was greatest in strata 1 (n = 55).

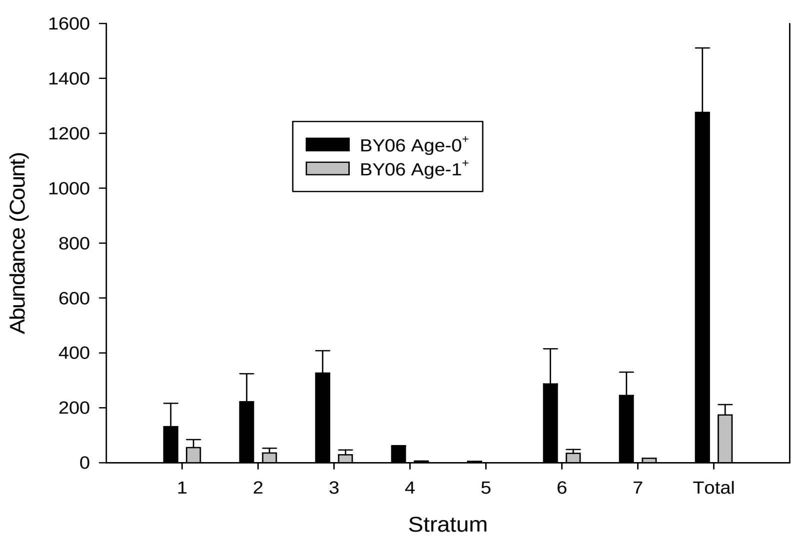

Figure 3. Age-0^+ and 1^+ *O. mykiss* abundance by strata (n=3) and total for Yankee Fork, Idaho 2007. Error bars represent 95% confidence interval of mean.

Due to greater stream widths and, subsequently, larger coverage area in the mainstem sampling reaches, both age-0^+ and age-1^+ densities (0.270; 0.018 fish/m^2, respectively) were the highest in stratum 7. Overall density for age-0^+ and 1^+ individuals for the entire sampling area was 0.052 and 0.007 fish/m^2, respectively (Figure 4).

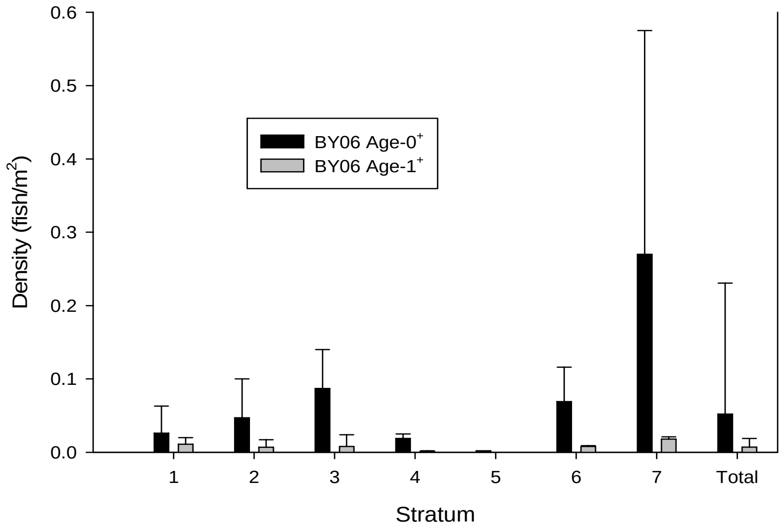

Figure 4. Age-0^+ and 1^+ *O. mykiss* density by strata (n=3) and total for Yankee Fork, Idaho 2007. Error bars represent 95% confidence interval of mean.

Mean steelhead length ranged from 59 mm in stratum 7 to 92 mm in stratum 1. Average length equaled 80 mm in lower YF (strata 1 – 3), 67 mm in West Fork Yankee Fork, and 59 mm in upper YF (strata 4 and 5) and Jordan Creek. Length frequency distribution consisted predominately of age-0^+ individuals with a median of 61 mm and mode 60 mm. Majority of the individuals (n = 424) were between 60 – 69 mm (Figure 5).

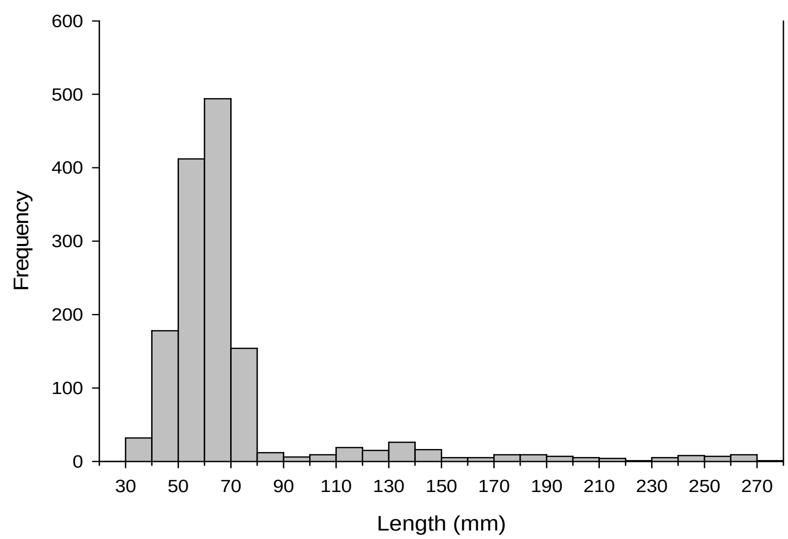

Figure 5. Frequency distribution of *O. mykiss* for all strata Yankee Fork, Idaho 2007.

Genetic Parentage Analysis

Staff collected 349 BY06 age-0^+ (2006) and 123 BY06 age-1^+ age (2007) juvenile genetic samples that were analyzed by Abernathy Fish Technology Center for parentage analyses. There were no functional upwellers in strata five, six, or seven in 2006 and therefore, as expected, no age-0^+ parental assignments in those locations (Matala et al. 2008; Appendix C). Juvenile age-1^+ matches in strata five (n = 1) and seven (n = 1) indicate that more developed juveniles exhibit migration throughout the system. Primary age-0^+ juvenile migration, as seen by increased densities below upweller sites, is restricted downstream due to poorly developed functional morphology. Stratum four, site two, located below the Greylock Creek upweller, showed 100% genetic assignment (n = 38). Total percent assignment equaled 13.14% (62 of 472). There were a total of 57 age-0^+ (16.3%) and 5 age-1^+ (4.1%) assignments from broodyear 2006 outplants (Figure 6) (Matala et al. 2008; Appendix C).

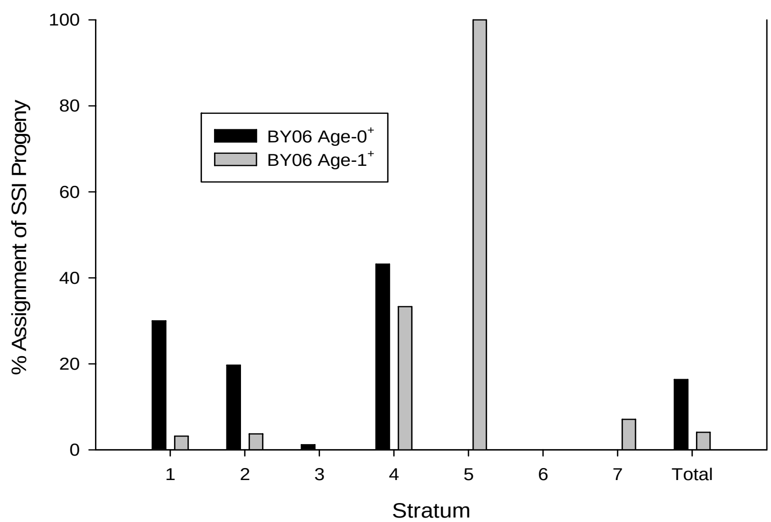

Figure 6. Parental assignment percentages per stratum and total.

There was no significant difference in mean condition factor or mean fork length between SSI progeny (genetically identified) and wild steelhead (unidentified) sampled in the YF (Figure 7). Slightly shorter streamside progeny length may be the result of earlier emigration as compared to natural steelhead.

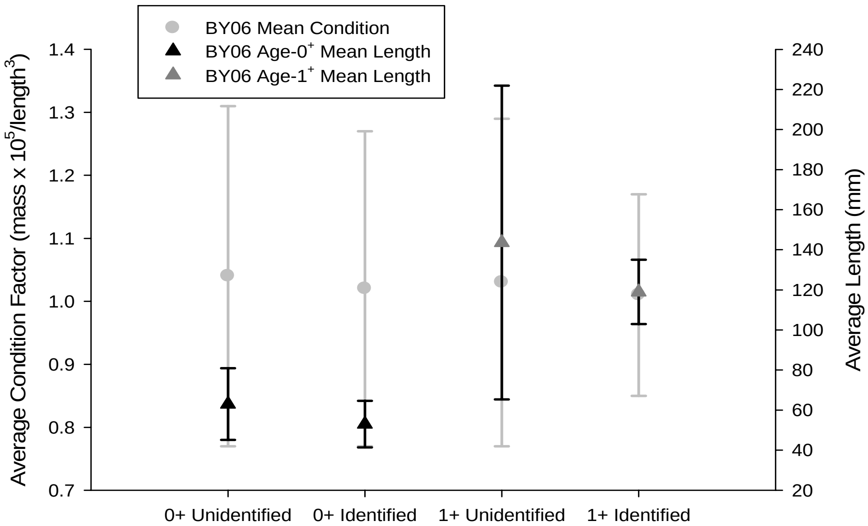

Figure 7. Average condition and fork length of SSI (identified through parentage) vs. wild (unidentified) progeny.

Staff calculated the area by strata and for the entire YF from length and width data collected by Konopakcy et al. (1986) and Ray et al. (SBT unpublished). Using densities collected during 2006 sampling, the Tribes estimated total abundance by strata and for the overall drainage. Percent parental assignment by strata was applied to the estimated abundance of *O. mykiss* to determine the percent of SSI progeny. Overall estimated age-0^{+} *O. mykiss* equaled 17,850 juveniles in 2006 with 4,268 individuals being from streamside origin (Figure 8). Therefore, we estimate that 23.9% of the YF steelhead population originates from streamside incubator supplementation. Stratum four shows the highest abundance of incubator progeny at 50% of the sample.

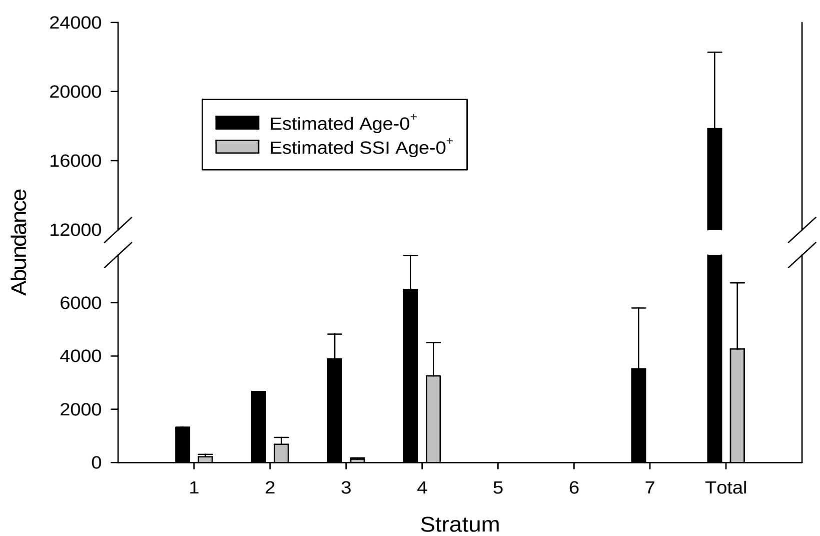

Figure 8. Age-0^{+} abundance estimates for SSI progeny and total *O. mykiss* in 2006.

DISCUSSION

During the eleven days of sampling, staff collected a total of 866 random fin samplings from different size steelhead. After age classification, there were 123 BY06 age-1^+ and 743 BY07 age-0^+ samples sent to Abernathy Fish Technology Center for parentage analyses. Age-1^+ juveniles, as well as BY06 age-0^+, were assigned in January 2008, however, BY07 age-0^+ samples will not be analyzed until the summer of 2008. There were forty-five total mortalities or 2% of all fish handled. In addition, scale samples were randomly taken from a total of 72 steelhead individuals for analysis of age. Fifteen samples were acquired from steelhead $\leq$ 80 mm in fork length and 57 from individuals > 80 mm.

Salmonid species observed in YF included steelhead, chinook salmon, bull trout, cutthroat trout, and mountain whitefish. Steelhead were the most ubiquous species in YF, although, bull trout was found dominating upper YF (strata 5). On average, strata 5 water temperature was cooler than other strata and may restrict the presence of other salmonid species. Highest percentage of cutthroat trout was found in strata 7, an area characterized as a large resident population. Chinook salmon densities remain low, although greater than observed densities in 2006. Overall density was extremely low (0.079 fish/m^2), not nearly close to a predicted carrying capacity of 1.0 fish/m^2. Densities of stream salmonids may be lower in the fall due to lower temperature and emigration. Peery and Bjornn (2000) reported seeing lower fall salmonid densities at or below 10 ^oC. At low temperatures, salmonids may seek cover in the bottom substrate and be less susceptible to electrofishing. In addition, emigration to locate over wintering habitat may have also contributed to low salmonid densities (Peery and Bjornn 2000).

The use of DNA, especially the parental exclusion method, has improved the ability to discriminate stocks and progeny of parental crosses without harming fish in the collection process. The success of the upweller program and contributions to overall abundance of steelhead in the YF has been difficult to evaluate beyond documenting changes in overall density. Survival of hatchery origin progeny has not been well documented, however, parentage assignments observed from the 2007 analysis provides evidence that upweller origin juveniles successfully emerge and survive in-stream through the first year of life (Matala et al.; Appendix C). Future evaluations will determine the fate of juveniles (i.e. mortality vs. outmigration) after the first year of life as only five age-1^+ were identified.

Migration time and age at migration is unknown; however, parentage analysis provides an initial foundation for understanding movement of juvenile steelhead in the YF. Migratory behavior of age-0^+ juveniles appears to be limited and individuals remain in areas directly adjacent to and below incubators as no age-0^+ progeny were found in strata five or seven (Matala et al.; Appendix C). Likewise, Richards and Cernera (1989), Close and Anderson (1992), and Peery and Bjornn (2000) determined upstream steelhead fry densities were insignificant and movement was exclusively downstream from release sites. Greater movement is observed with age-1^+ juveniles as two SSI progeny were identified in strata five and seven, areas with no incubator influence. However, staff collected few fish above 80 mm (predominate age class was 50 – 80 mm) indicating age-1^+ juveniles may be migrating from the YF before sampling in the second fall.

Acknowledging there is combination of SSI and natural progeny in the YF, differences in length and condition factor should be observable. Irvine and Bailey (1992) and Perry and Bjornn (2000) determined hatchery-origin fish are typically larger in length and mass. Irvine and Bailey (1992) have also reported higher mean condition factors for hatchery-origin fish than wild fry in supplemented regions. After genetic analysis, staff was able to compare fork length and condition factor of identified SSI progeny and wild juveniles and found no statistical difference. Countering the above studies, through hatchery domestication, progeny from outplanted eggs may migrate earlier and, therefore, be slightly smaller in size (i.e. length and condition) compared to the natural origin counterpart (Matala et al.; Appendix C)

Estimated overall productivity in the YF is extremely low. Staff estimated 17,850 ($\pm$ 2,207) *O. mykiss* age-0^+ juveniles for the YF in 2006. Of the 17,850, 4,268 ($\pm$ 1,244) or 23.9% of the population were estimated as SSI progeny. Understanding this is probably an underestimate; the Tribes will implement a mark-recapture study, increase sampling efforts for better resolution between sites, and increase supplementation in vacant habitat. All juveniles sampled in the upper YF were from SSI progeny. Stratum four, especially site two and above, and stratum five are areas with relatively lower natural spawning productivity and are potentially excellent sites to bolster supplementation activities (Matala et al.; Appendix C).

Continued genetic evaluation is critical to determine the long-term efficacy of steelhead streamside supplementation activities. Limited information on numbers of returning adults, redd counts, size of the natural origin population, and migration timing restricts our ability to fully estimate the relative productivity of upweller supplementation. The Tribes propose that the addition of a weir and/or screw trap would greatly increase the ability to document the natural spawning population and estimate the efficacy of streamside supplementation to increase population abundance in Yankee Fork.

CITATIONS

Cho, G. K. and D. D. Heath. 2000. Comparison or tricaine methanesulphonate (MS222) and clove oil anaesthesia effects on the physiology of juvenile chinook salmon *Oncorhynchus tshawytscha* (Walbaum). Aquaculture Research 31: 537-546.

Close, T. L. and C. S. Anderson. 1992. Dispersal, density-dependent growth, and survival stocked steelhead fry in Lake Superior tributaries. North American Journal of Fisheries Management 12: 728-735.

Denny, L. P., K. Witty, and S. Smith. 2006. A monitoring and evaluation plan for the Shoshone-Bannock Tribes: Hatchery supplementation activities Yankee Fork; Salmon River sub-basin. Draft Review Shoshone-Bannock Tribes, Department of Fisheries Resources Management.

Interior Columbia Basin Technical Recovery Team. 2005. Draft. ICBTRT: Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs.

Irvine, J. R. and R. E. Bailey. 1992. Some effects of stocking coho salmon fry and supplemental in stream feeding on wild and hatchery-origin salmon. North American Journal of Fisheries Management 12: 125-130.

Konopacky, R. C., E. C. Bowles, and P. Cernera. 1985. Salmon River Habitat Enhancement. Annual Report FY 1984, Part I, Subproject III, Yankee Fork of the Salmon River Inventory and Problem Identification. Shoshone-Bannock Tribes Report to Bonneville Power Administration.

Konopacky, R. C., P. J. Cernera, and E. C. Bowles. 1986. Salmon River Habitat Enhancement. Annual Report FY 1985, Part 1 or 4, Subproject III: Yankee Fork Salmon River. Shoshone-Bannock Tribes Report to Bonneville Power Administration.

Kutchins, K., C. Colter, and M. Haddix. 2001. Draft. Shoshone-Bannock Tribes Salmon River salmon-steelhead production master plan. Shoshone-Bannock Tribes, Fort Hall, Idaho.

Letcher, B.H. and T.L. King. 2001. Parentage and grandparentage assignment with known and unknown matings: Application to Connecticut River Atlantic Salmon restoration. Canadian Journal of Fisheries and Aquatic Science. 58, 1812-1821.

Matala, A.P., W. Ardren, L. Denny, and K. Tardy. 2008. FY2007 Project Report. Pedigree analysis reveals relative survival and abundance of juvenile hatchery steelhead outplanted as eyed eggs in the Yankee Fork, Salmon River, Idaho.

Peery, C. A. and T. C. Bjornn. 2000. Dispersal of hatchery-reared chinook salmon parr following release into four Idaho streams. North American Journal of Fisheries Management 20: 19-27.

Reiser, D. W. and M. P. Ramey. 1987. Feasibility plan for the enhancement of the Yankee Fork of the Salmon River, Idaho. Prepared for the Shoshone-Bannock Tribes, Fort Hall, Idaho. BPA contract No. 83-359.

Richards, C. and P. J. Cernera. 1989. Dispersal and abundance of hatchery-reared and naturally spawned juvenile chinook salmon in an Idaho stream. North American Journal of Fisheries Management 9: 345-351.

APPENDIX A. MAPS

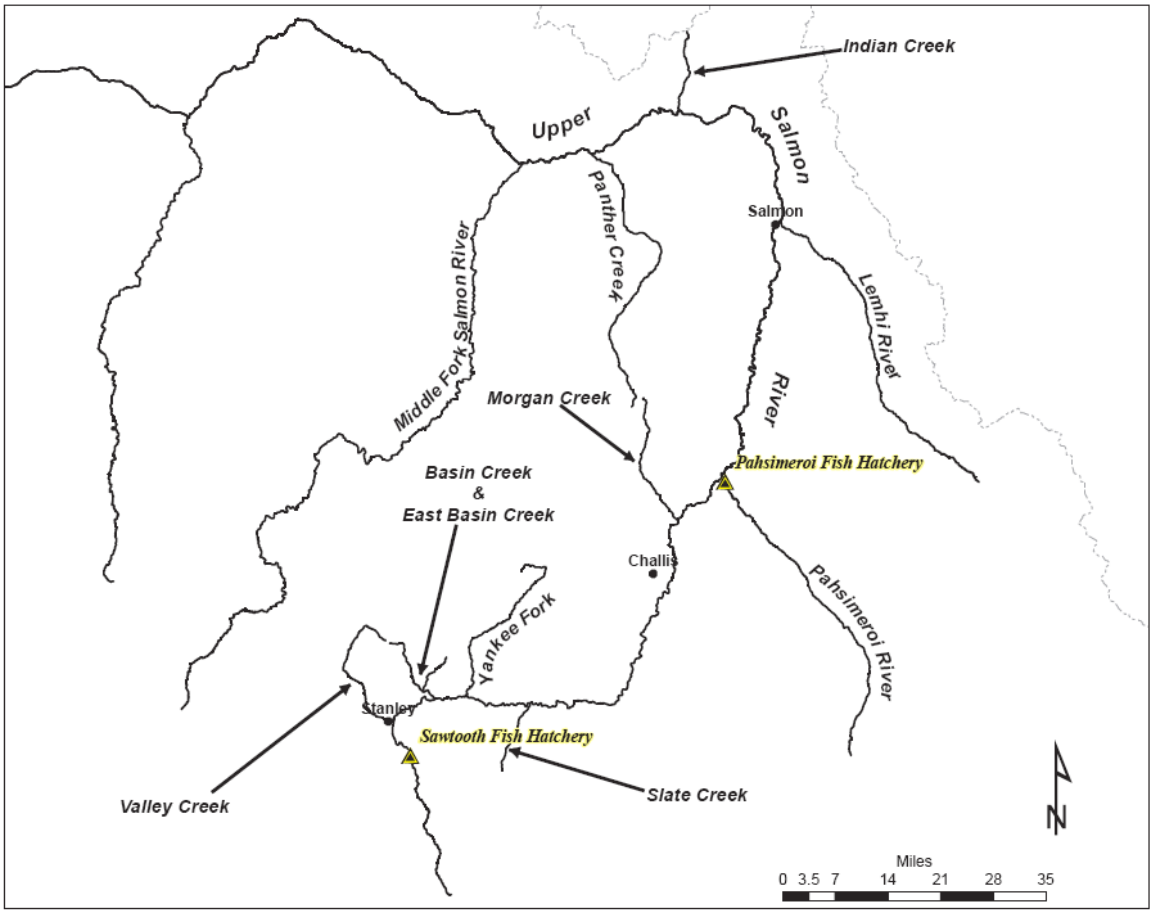

Figure 9. Upper Salmon River Basin.

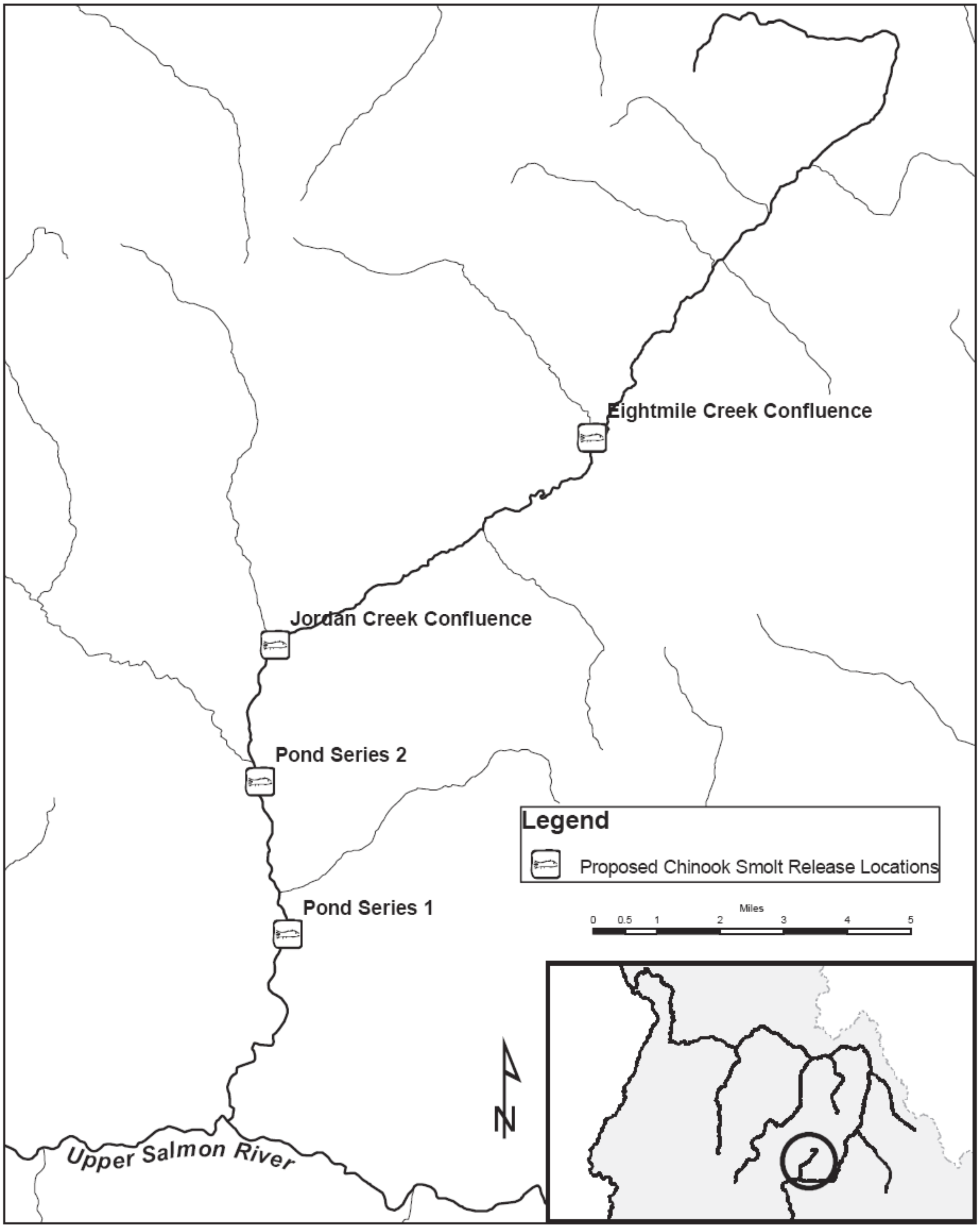

Figure 10. Yankee Fork Salmon River with respect to proposed chinook smolt release locations identified in the YFCSS HGMP.

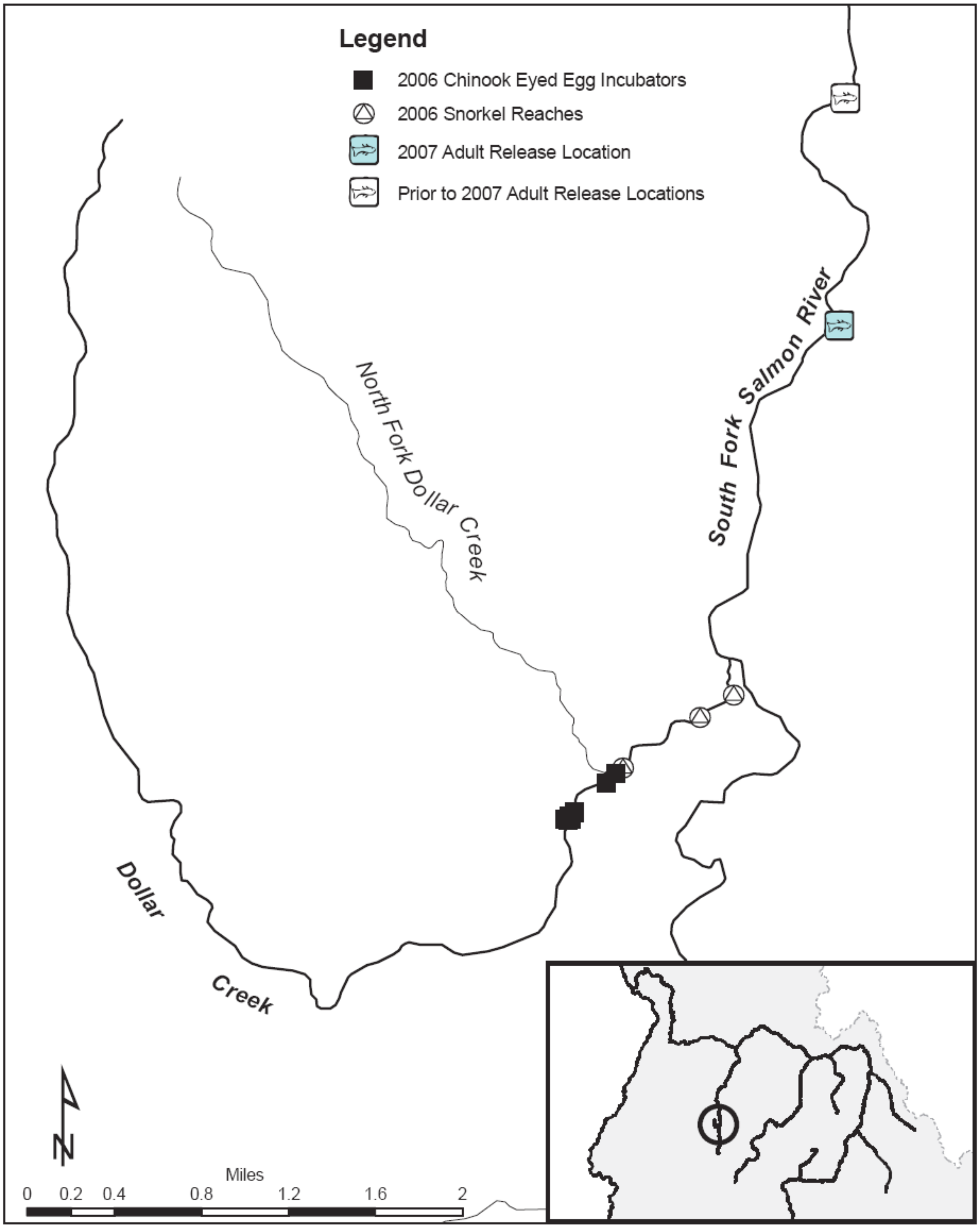

Figure 11. South Fork Salmon River with respect to Dollar Creek incubators and adult releases.

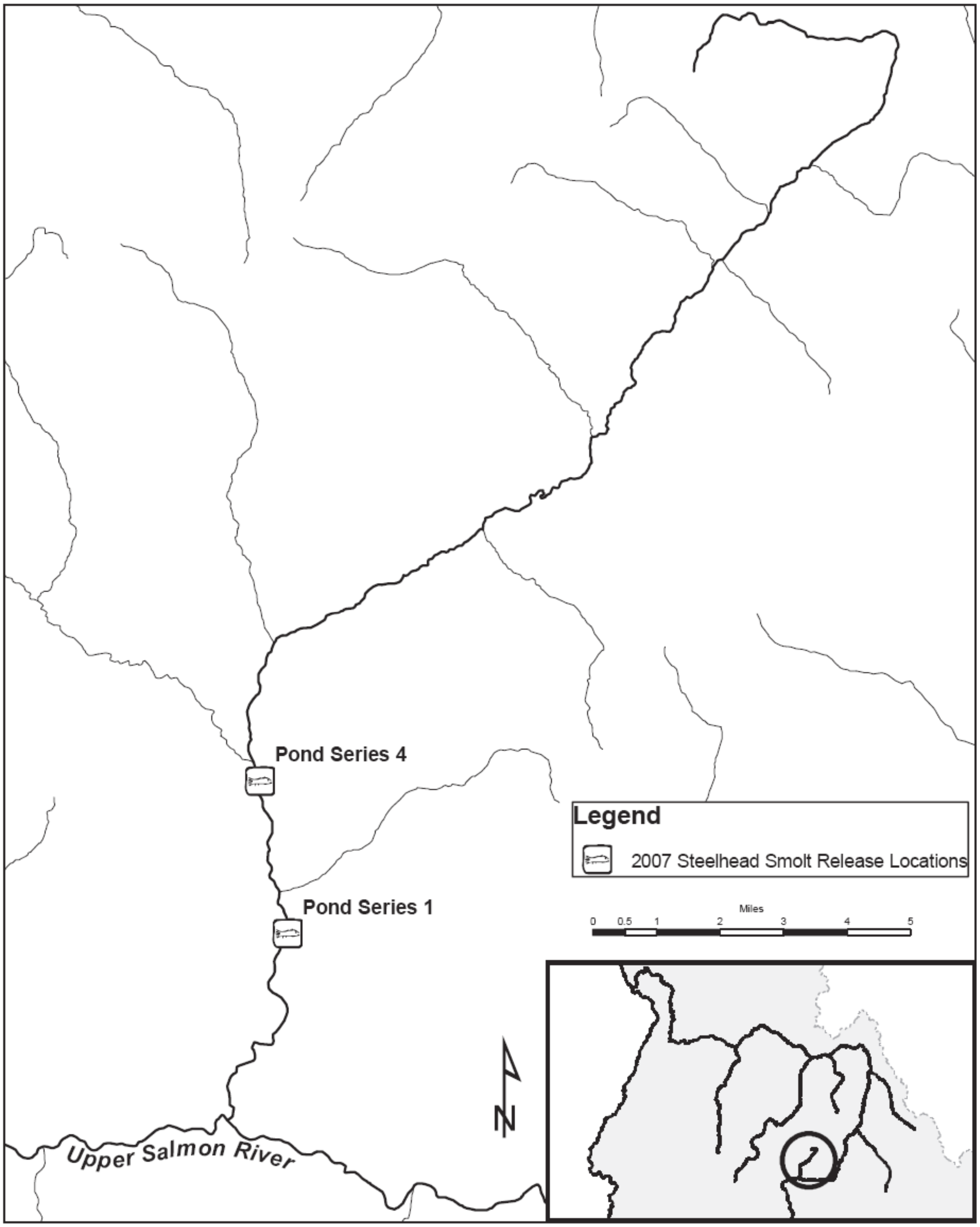

Figure 12. Yankee Fork Salmon River with smolt release locations.

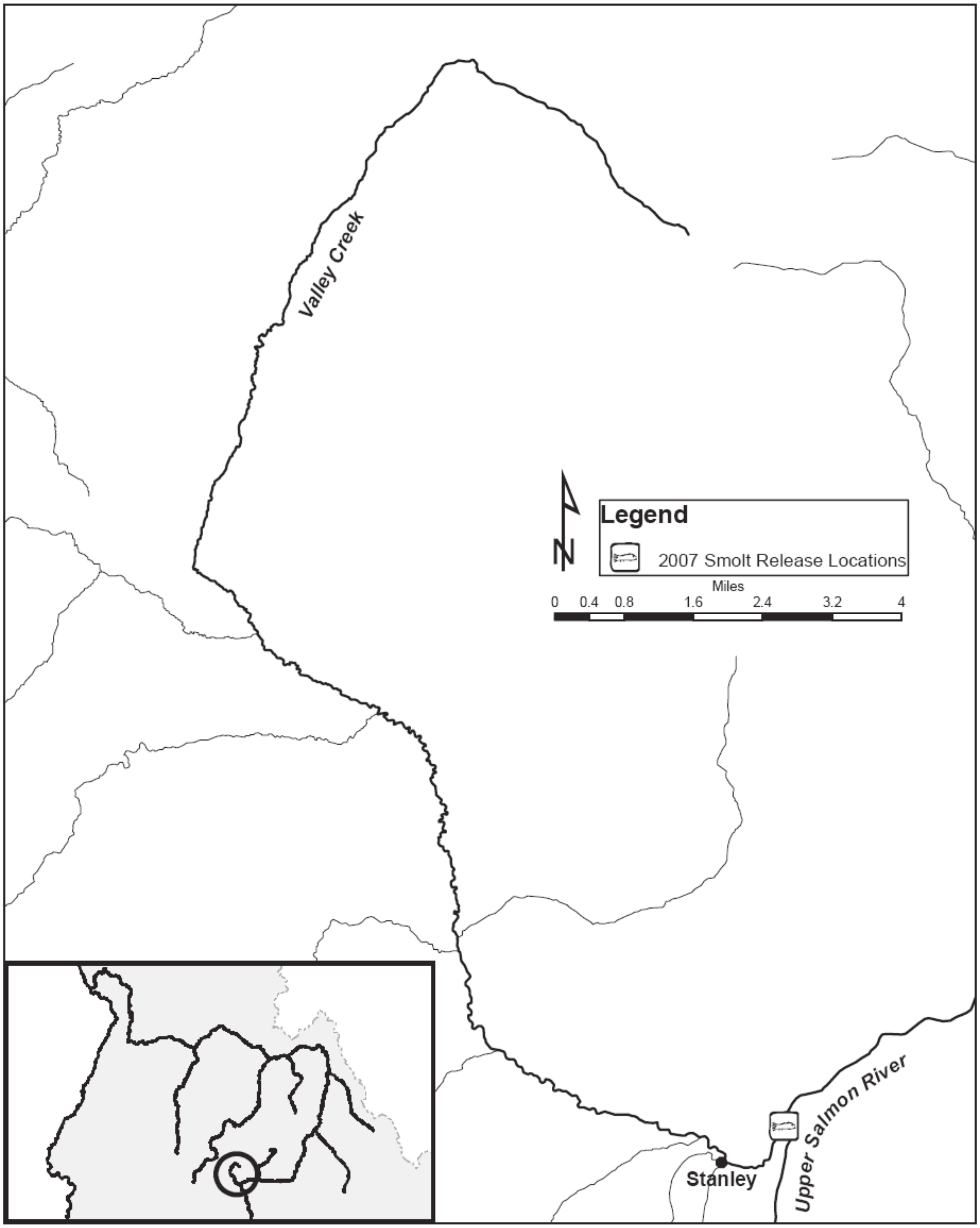

Figure 13. Valley Creek with smolt release locations.

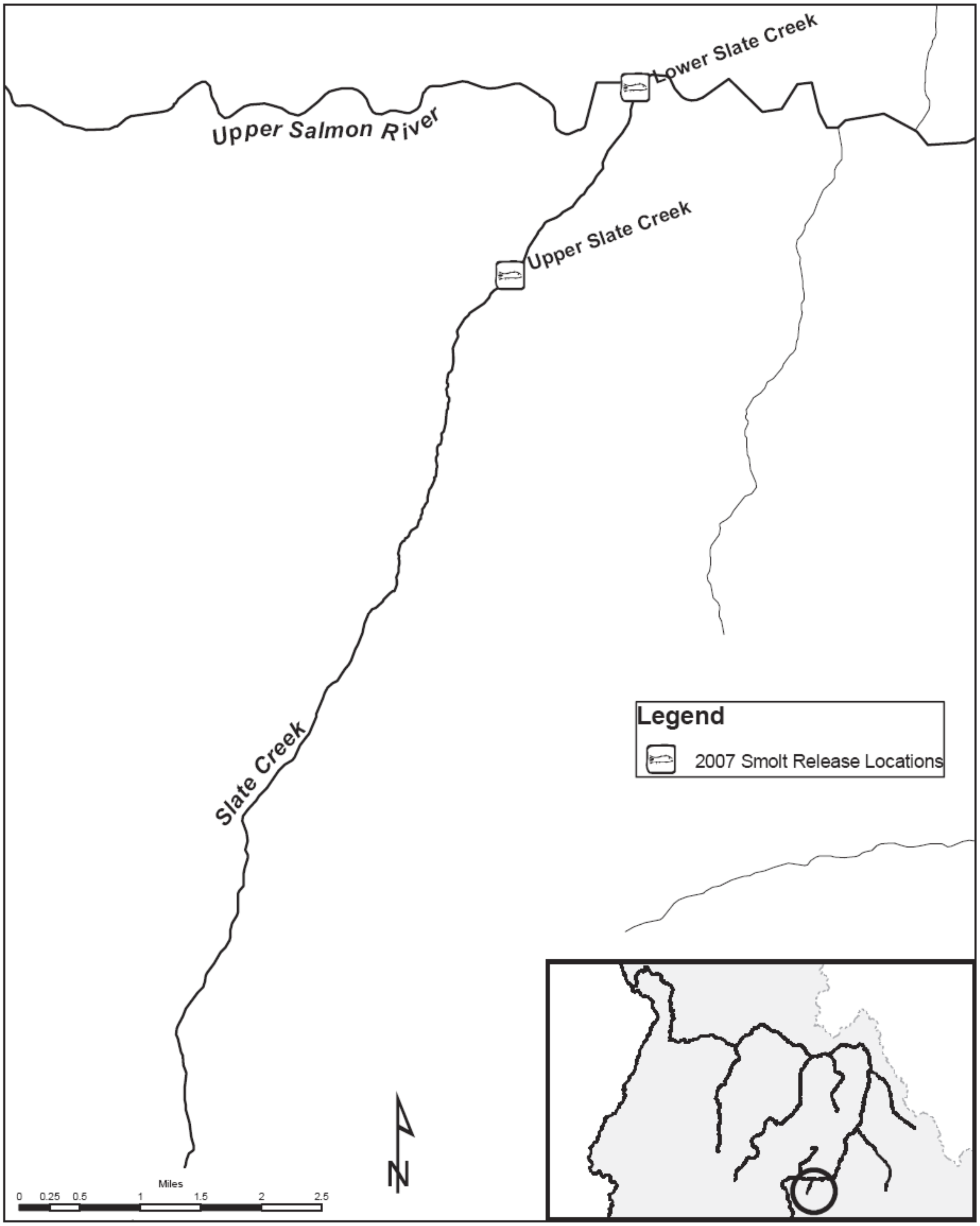

Figure 14. Slate Creek with smolt release locations.

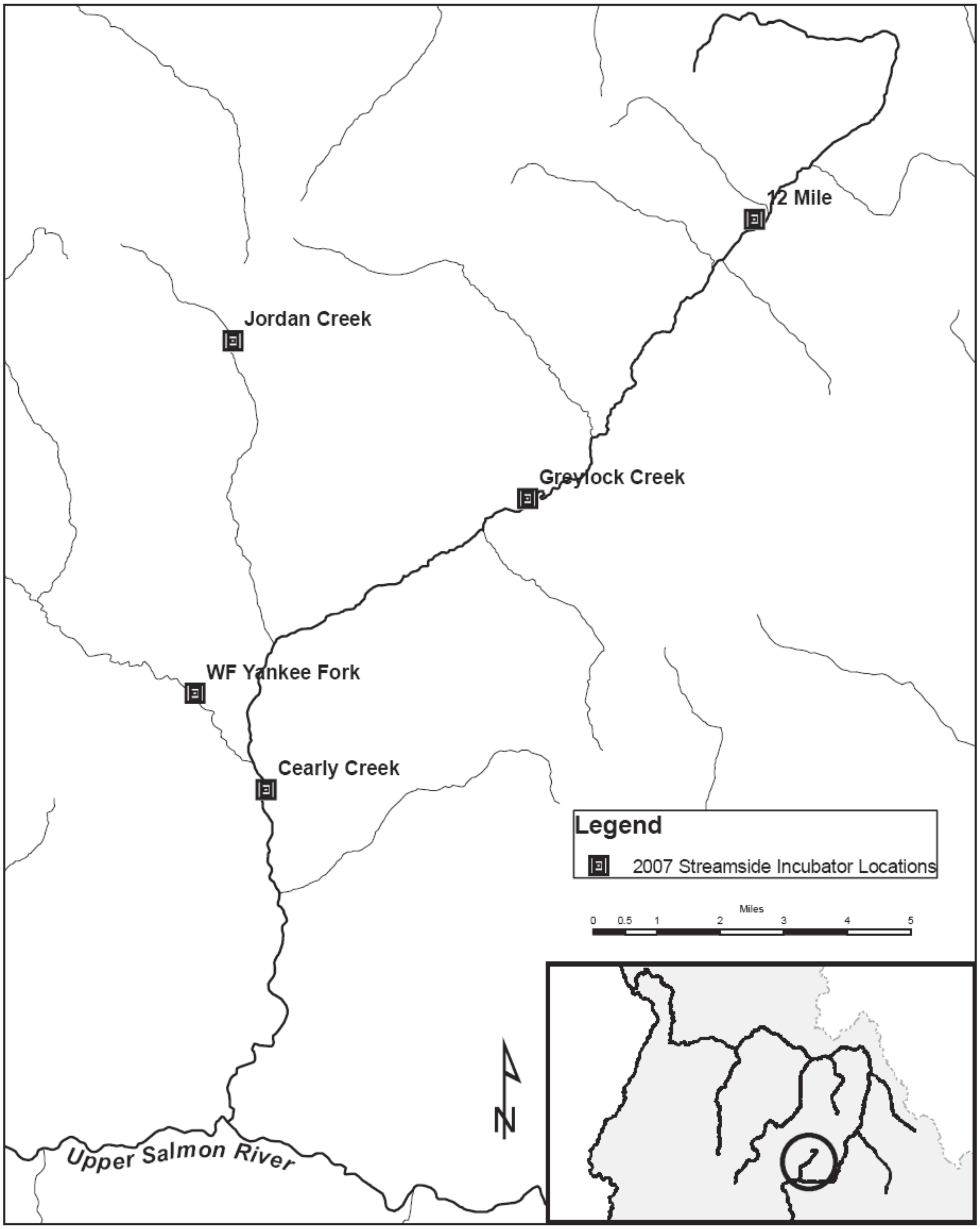

Figure 15. Yankee Fork Salmon River with egg incubation locations.

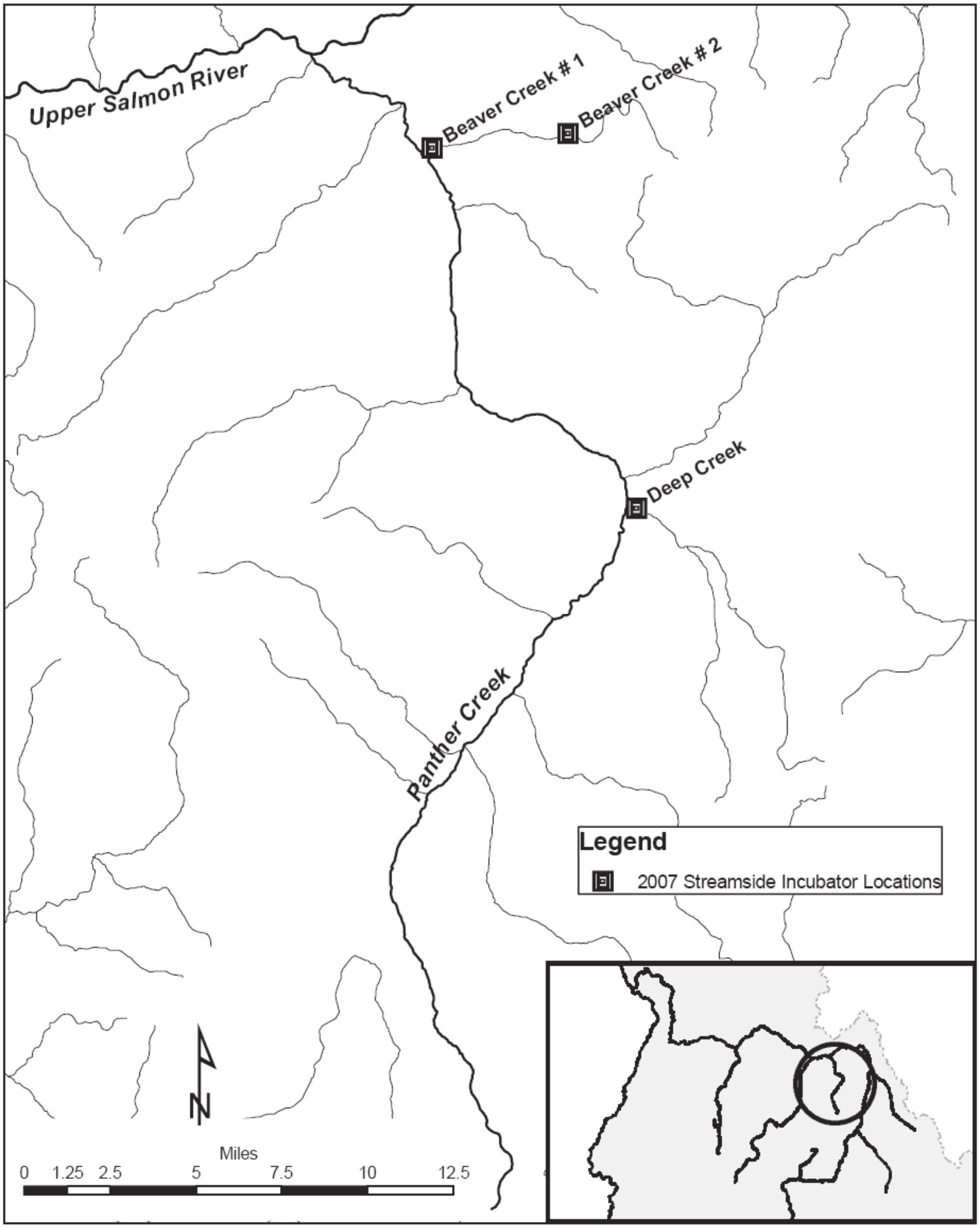

Figure 16. Panther Creek with egg incubation locations.

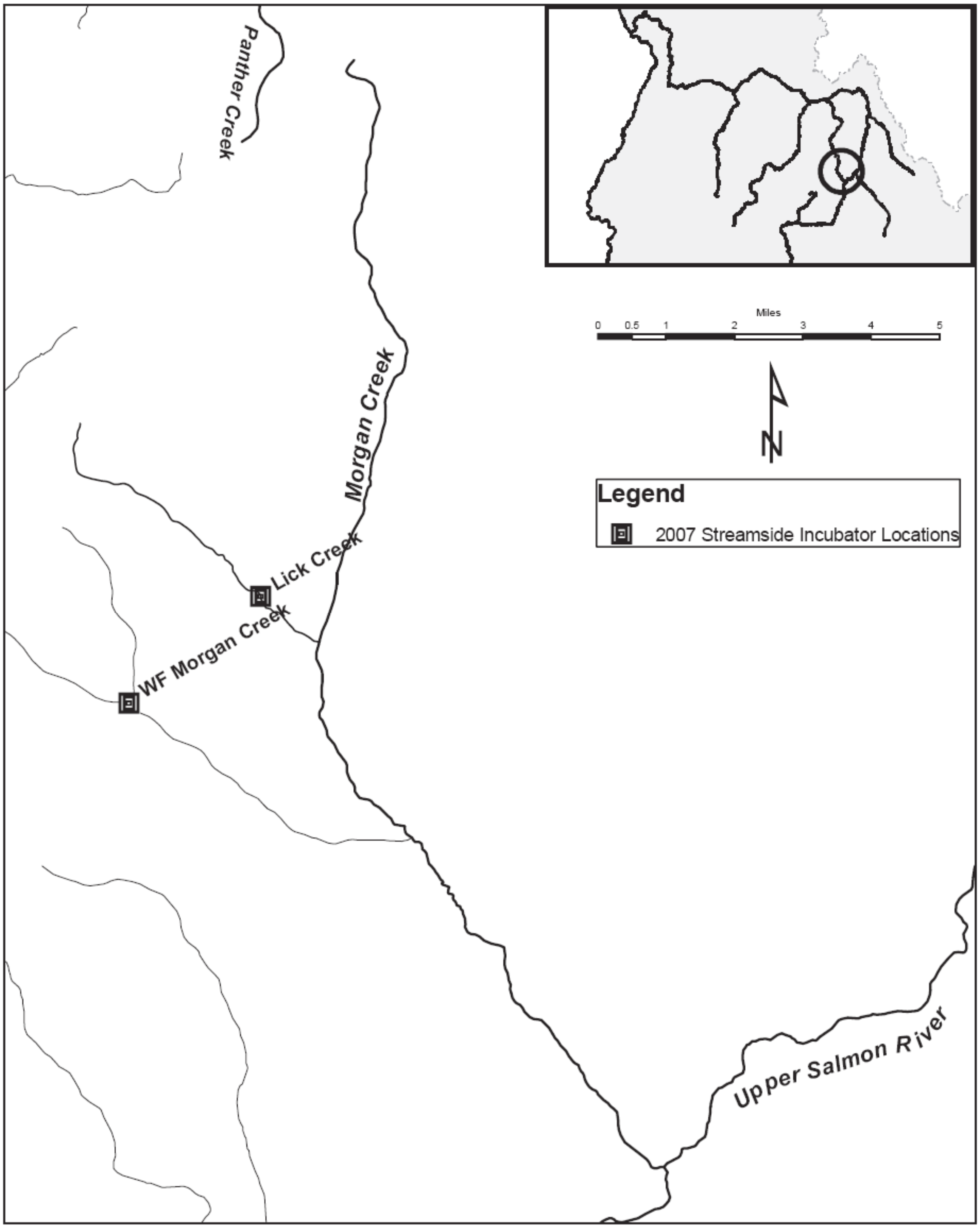

Figure 17. Morgan Creek with egg incubation locations.

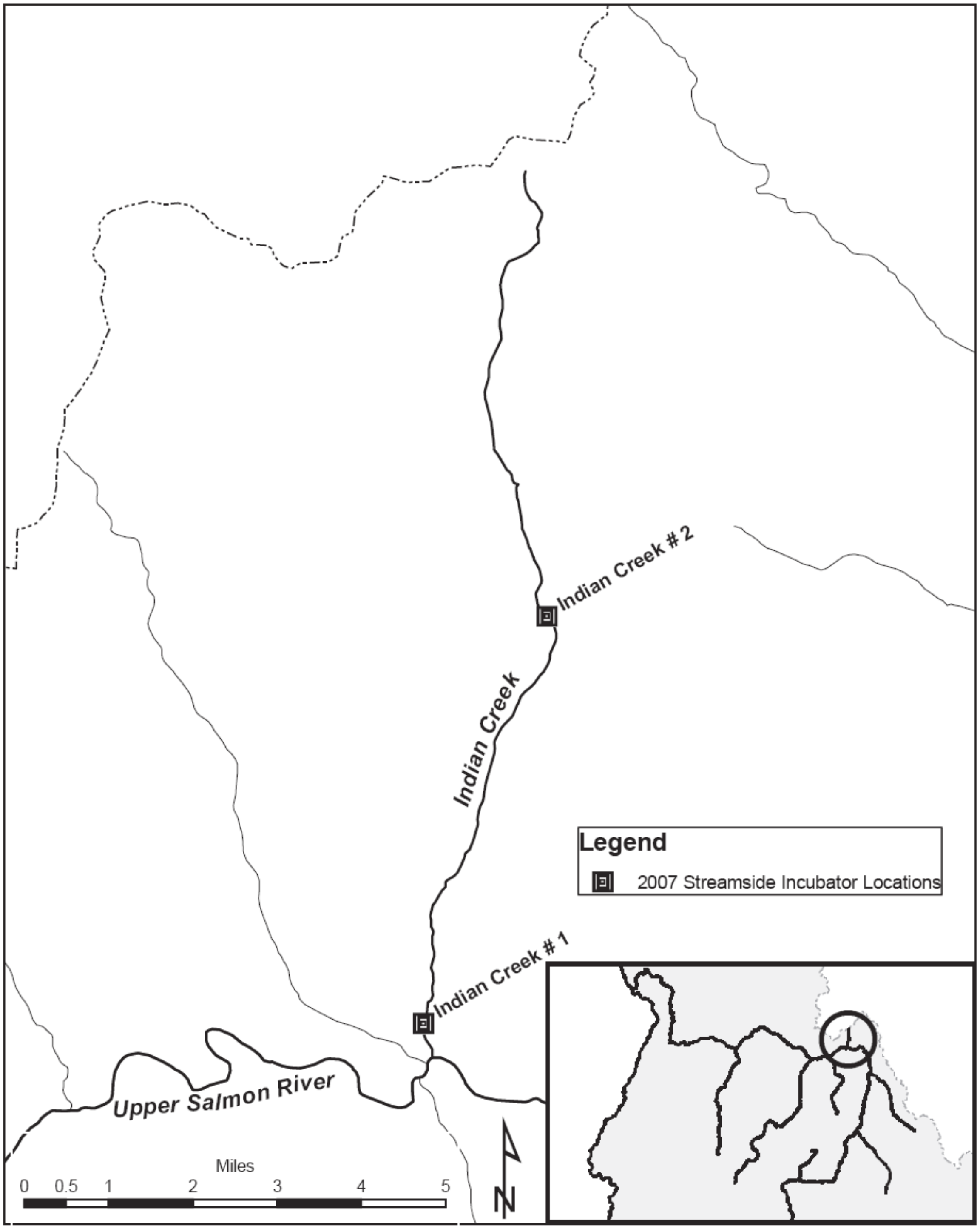

Figure 18. Indian Creek with egg incubation locations.

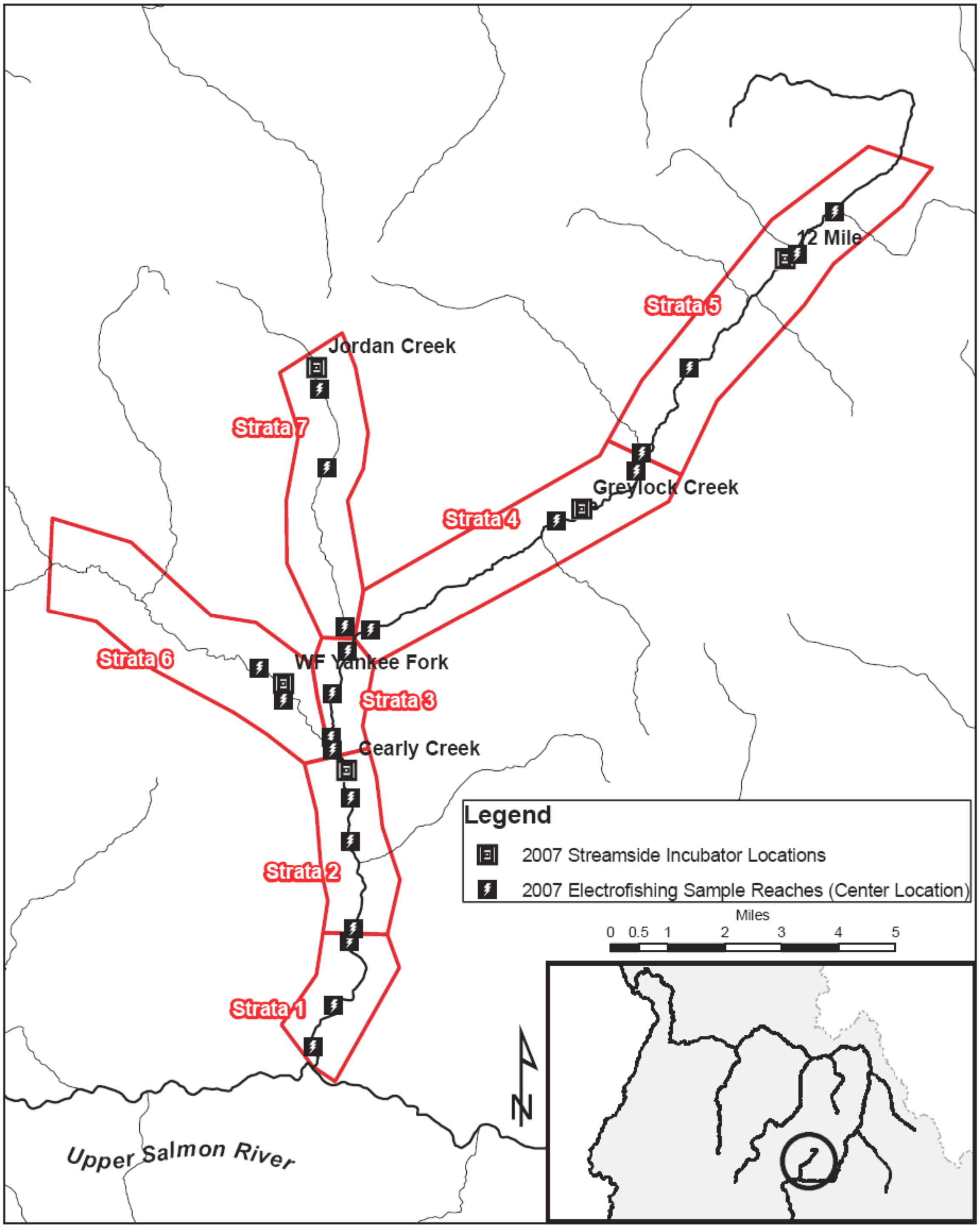

Figure 19. Yankee Fork stratified by Konopacky et al. (1985, 1986) displaying 2007 sampling locations.

APPENDIX B. YFCSS HATCHERY AND GENETICS MANAGEMENT PLAN

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Yankee Fork Chinook Salmon Supplementation (YFCSS) Project
Species or Hatchery Stock:	Chinook Salmon *Oncorhynchus tshawytscha.*
Agency/Operator:	Shoshone-Bannock Tribes
Watershed and Region:	Columbia River, Snake basin, Salmon River Subbasin, Yankee Fork, Idaho.
Date Submitted:	
Date Last Updated:	16 February 2007

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Hatchery: Sawtooth Fish Hatchery (Egg Incubation & Juvenile Rearing)
Yankee Fork Salmon River Satellite Facility (juvenile acclimation, adult trapping & spawning)

Program: Yankee Fork Chinook Salmon Supplementation Project

1.2) Species and population (or stock) under propagation, and ESA status.

Yankee Fork and Upper Salmon Mainstem Spring/Summer Chinook Salmon (*Oncorhynchus tshawytscha*) listed threatened 22 in April 1992. The listed Snake River Spring/Summer Chinook Salmon ESU includes the Upper Salmon River Major Population Group (MPG). The Upper Salmon River MPG includes the Yankee Fork and the Upper Salmon mainstem Distinct Population Segments (DPS).

1.3) Responsible organization and individuals

Lead Contact
Name (and title): Lytle P. Denny, Anadromous Fish Manager.
Agency or Tribe: Shoshone-Bannock Tribes.
Address: 3rd and B Avenue, P.O. Box 306, Fort Hall, ID 83203.
Telephone: (208) 239-4560 or cell 221-9058.
Fax: (208) 478-3986.
Email: ldenny@shoshonebannocktribes.com

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

U.S. Fish and Wildlife Service – Lower Snake River Compensation Plan Office: Administers the Lower Snake River Compensation Plan as authorized by the Water Resources Development Act of 1976. Owner of Sawtooth Fish Hatchery (SFH).

Idaho Department of Fish and Game – co-manager in SFH facility.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

The Shoshone-Bannock Tribes (Tribes) is the lead fisheries management agency for the Yankee Fork Chinook Salmon Supplementation (YFCSS) project. The Tribes seek funding with the Lower Snake River Compensation Plan (LSRCP), Bonneville Power Administration (BPA), and Pacific Coastal Salmon Recovery

Fund (PCSRF) to implement this project. Until long-term facilities are completed, specific funding levels for annual operating costs will not be finalized.

1.5) Location(s) of hatchery and associated facilities.

Sawtooth Fish Hatchery – The SFH is located on the upper Salmon River approximately 8.0 kilometers south of Stanley, Idaho. The river kilometer code for the facility is 503.303.617. The hydrologic unit code for the facility is 17060201. SFH will provide both interim and long-term egg incubation and juvenile rearing facilities for the YFCSS project. In addition, the East Fork Salmon River Satellite Facility and/or the SFH may be used in the interim to hold Yankee Fork adult broodstock, until an adult facility is constructed on Yankee Fork.

Yankee Fork Salmon River Satellite – The Yankee Fork Salmon River Satellite Facility will provide long-term juvenile acclimation, adult trapping, holding, and spawning. The exact location has yet to be determined, but will most likely be located within lower Yankee Fork.

1.6) Type of program.

<u>Integrated Artificial Propagation Program</u>

General production SFH (hatchery x hatchery) crosses will provide broodstock released as smolts in the Yankee Fork Salmon River for several generations until three cohorts (1-ocean, 2-ocean, and 3-ocean) return within the same spawn year. At which time broodstock collection will transition to supplementation crosses (wild x hatchery). Initially, artificial production will occur from hatchery crosses and transition to supplementation or wild crosses depending upon adult returns.

1.7) Purpose (Goal) of program.

<u>Recovery/Harvest Mitigation</u>

There are two primary goals for the YFCSS, both based on abundance of adult chinook salmon. The long-term goal of the YFCSS project is to provide natural spawning escapement of 500 adults annually, enough supplementation broodstock (approximately 102 pairs) to sustain the program, and 346 fish for harvest for total escapement of 1,050 adults. The short-term goal, while YFCSS is dependent on the SFH for adult broodstock, smolt production and release, is to annually achieve a 0.003 smolt-to-adult survival rate.

A secondary goal is to improve spatial distribution into the entire usable Yankee Fork habitat and contribute to diversity by developing a Yankee Fork stock. Juvenile and adult survival will be controlled by out-of-basin effects, but the combined productivity of the hatchery and natural components will exceed 1.0 parent replacement.

1.8) Justification for the program.

The Lower Snake River Compensation Program has operated since 1983 to provide mitigation for lost salmon and steelhead production caused by the construction and operation of the four lower Snake River dams. The SFH was constructed in 1985 to contribute to this end with a goal to return approximately 19,445 adult spring chinook salmon. The adult return goal is based on a return of 11,310 to the SFH, 6,090 to the East Fork Salmon River, and 2,045 to Valley Creek (all based on a smolt-to-adult return rate of 0.87%).

Initial facility plans identified a production target of 2.3 million smolts: 1.3 million smolts released in the Salmon River at SFH, 700,000 smolts released in the East Fork Salmon River, and 300,000 smolts released in Valley Creek, a tributary to the Salmon River. The Valley Creek component of the program has never been implemented and the East Fork Salmon River component was terminated in 1998. The Tribes, IDFG, and NOAA-Fisheries determined Yankee Fork as an acceptable watershed to initiate a supplementation program in conjunction with SFH.

Presently, production targets and adult return goals have yet to be met at SFH. Smolt production capacity for SFH is set at 1.3 million smolts based on the amount of pathogen free well water, preferred rearing densities, and incidence of whirling disease (Snider, IDFG; personal communication), however is listed at 1.6 million depending upon egg take in the current United States vs. Oregon 2005-2007 Interim Management Agreement for Upriver Chinook, Sockeye, Steelhead, Coho and White Sturgeon. The current release goal for SFH is set at 1.0 million smolts, therefore, providing additional rearing space for up to 300,000 to 600,000 smolts.

Analysis of data supplied by the IDFG reveals significantly lower amounts of smolts released and adults returning compared to the initial production target and adult goal. During East Fork operation, average smolts released were 164,689 (max of 514,600). Average adult return was 55 (SAR = 0.034%) individuals or approximately 0.9% of the goal (6,090). Over a nineteen year period (1987 – 2006) of smolts released into the Salmon River from SFH, average release was 698,177 (max of 2,092,595). Average adult return by broodyear for 1986-2000 was 591 adults (SAR = 0.26%) or approximately 5.2% of the goal (11,310) (Table 4).

In order to achieve the original adult return goal for SFH, facility improvements, additions, and modifications will be necessary. This may include increasing pathogen free well water, increasing rearing densities, reducing whirling disease, releasing non-adipose fin-clipped juveniles, and expanding production options similar to the YFCSS.

The YFCSS will release 350,000 smolts to obtain 1,050 returning adults for broodstock collection, harvest mitigation, and recovery in the Yankee Fork. In order to achieve the adult return goal, survival from smolt-to-adult should be 0.26% to 0.3%. If broodstock are adipose fin-clipped we expect SAR survival to be closer to 0.26% and 400,000 smolts should be released. In order to determine origin at the Yankee Fork weir, all juveniles released under the YFCSS will be marked by CWT.

1.9) List of program "Performance Standards."

3.1 Legal Mandates.
3.2 Harvest.
3.3 Conservation of natural spawning populations.
3.4 Life History Characteristics.
3.5 Genetic Characteristics.
3.6 Research Activities.
3.7 Operation of Artificial Production Facilities.
3.8 Socio-Economic Effectiveness.

1.10) List of program "Performance Indicators," designated by "benefits" and "risks."

Note: Performance Standards and Indicators used to develop Sections 1.10.1 and 1.10.2 were taken from the final January 17, 2001 version of Performance Standards and Indicators for the Use of Artificial Production for Anadromous and Resident Fish Populations in the Pacific Northwest. Numbers referenced below correspond to numbers used in the above document.

1.10.1) "Performance Indicators" addressing benefits.

3.1.1 Standard: Program contributes to fulfilling tribal trust responsibility mandates and treaty rights, as described in the applicable agreements such as under *U.S. v. Oregon* and *U.S. v. Washington*.

Indicator 1: Total number of fish harvested in tribal fisheries targeting this program.
Indicator 2: Total fisher days or proportion of harvestable return taken in tribal resident fisheries, by fishery.
Indicator 3: Tribal acknowledgement regarding fulfillment of tribal treaty rights.

The Shoshone-Bannock Tribe under the YFCSS program and the monitor and evaluation (M&E) plan conduct annual creel surveys, mail surveys, and harvest monitoring to determine number of fish harvested, fishing pressure, catch-per-unit effort (CPUE), and proportion of naturally produced fish harvested compared to hatchery-produced. Data will be archived and reports written annually. Harvest levels, procedures, guidelines, and treaty rights governed by the Shoshone-Bannock Tribal Resources Management Plan (TRMP).

3.1.2 Standard: Program contributes to mitigation requirements.

Indicator 1: Number of fish returning to mitigation requirements estimated.

The YFCSS will adhere to the recommendations of the Interior Columbia Basin Technical Recovery Team (TRT). The goal is to provide natural spawning escapement of 500 adults annually, 102 pairs for broodstock to sustain the program, and approximately 346 fish for harvest for a total escapement of 1,050 adults. The TRT (2005) determined that Yankee Fork needs 500 spawning adults and a total escapement of 1,000 individuals to once again be a viable population.

3.1.3 Standard: Program addresses ESA responsibilities.

Indicator 1: ESA consultation(s) under Section 7 have been completed, Section 10 permits have been issued, or HGMP has been determined sufficient under Section 4(d), as applicable.

HGMP completed.

3.2.1 Standard: Fish produced for harvest are produced and released in a manner enabling effective harvest, as described in all applicable fisheries management plans, while avoiding over-harvest of non-target species.

Indicator 1: Recreational angler days, by fishery.
Indicator 2: Annual escapements of natural populations that are affected by fisheries targeting program fish.
Indicator 3: Catch-per-unit effort, by fishery.

The Shoshone-Bannock Tribe under the YFCSS program and monitor and evaluation (M&E) plan conduct annual creel surveys, mail surveys, and harvest monitoring to determine number of fish harvested, fishing pressure, catch-per-unit effort (CPUE), and proportion of naturally produced fish harvested compared to hatchery-produced. Data will be archived and reports written annually. Harvest levels, procedures, guidelines, and treaty rights governed by the Shoshone-Bannock Tribal Resources Management Plan (TRMP).

3.2.2 Standard: Release groups sufficiently marked in a manner consistent with information needs and protocols to enable determination of impacts to natural- and hatchery-origin fish in fisheries.

Indicator 1: Marking rate by type in each release group documented.

Adults (P1) used for broodstock will be tissue sampled; tissue will be stored in 95% ethanol for DNA genotyping with (F1 & F2) progeny as juveniles and adults. Approximately 15% of juveniles will be PIT tagged yearly to monitor survival and migration timing at Lower Granite Dam using the SURPH model and provide adult return estimates from interrogations at Bonneville and other dams. All smolts (100%) will be coded-wire tagged.

3.3.1 Standard: Artificial propagation program contributes to an increasing number of spawners returning to natural spawning areas.

Indicator 1: Annual number of spawners on spawning grounds estimated in specific locations.
Indicator 2: Spawner-recruit ratios estimated is specific locations.
Indicator 3: Number of redds in natural production index areas documented in specific locations.

Document age, length, sex, and number of spawners collected at the Yankee Fork weir and released above for natural spawning. All adults release above weir will be tissue sampled; tissue will be stored in 95% ethanol for DNA genotyping. Determine estimates for smolt-to-adult return rates for hatchery-produced and supplemental fish. Conduct annual ground redd counts and initiate telemetry study to determine use of available spawning habitat.

3.3.2 Standard: Releases are sufficiently marked to allow statistically significant evaluation of program contribution.

Indicator 1: Marking rates and type of mark documented.
Indicator 2: Number of marks identified in juvenile and adult groups documented.

Record tagging information (sex, length, release date and location) for marked individuals. Summarize marking and tagging information and document identified marks or interrogations at traps, dams, and other collection facilities.

1.10.2) "Performance Indicators" addressing risks.

3.4.1 Standard: Fish collected for broodstock are taken throughout the return in proportions approximating the timing and age structure of the population.

Indicator 1: Temporal distribution of broodstock collection managed.
Indicator 2: Age composition of broodstock collection managed.

Broodstock randomly collected throughout the entire run period. Age 4, 5, and 6 year spring chinook salmon collected for broodstock.

3.4.2 Standard: Broodstock collection does not significantly reduce potential juvenile production in natural areas.

Indicator 1: Number of natural-origin spawners removed for broodstock determined annually and documented.
Indicator 2: Natural origin spawners released to migrate to natural spawning areas documented.
Indicator 3: Number of adults, eggs or juveniles placed in natural rearing areas managed.

Generate an adult weir trapping database; record total number of natural-origin (NOR) and hatchery-origin (HOR) adult chinook trapped, collected, and released. Also incorporate phenotypic information, gender, fork length, weight, tissue, scale, age, PIT, CWT, other marks and disposition. Use information to manage Yankee Fork weir in accordance with HGMP. Record ancillary species encountered at Yankee Fork weir.

3.4.3 Standard: Life history characteristics of the natural population do not change as a result of this program.

Indicator 1: Life history characteristics of natural and hatchery-produced populations are measured (e.g., juvenile dispersal timing, juvenile size at outmigration, juvenile sex ratio at outmigration, adult return timing, adult age and sex ratio, spawn timing, hatch and swim-up timing, rearing densities, growth, diet, physical characteristics, fecundity, egg size).

Document, report, and archive all information to record differences in life history characteristics and survival for juvenile (migration timing, population size, size at release or capture, gender, age, origin) and adult (run-timing, population size, length, weight, age, gender, tissue, scale, PIT, CWT) NOR and HOR chinook salmon.

3.4.4 Standard: Annual release numbers do not exceed estimated basin-wide and local habitat capacity.

Indicator 1: Annual release numbers, life-stage, size at release, length of acclimation documented.

Indicator 2: Location of releases documented.
Indicator 3: Timing of hatchery releases documented.

Record data for smolt release location, duration, time, numbers, and size of fish. Three model average (Reiser and Ramey Spawning Habitat; Reiser and Ramey Rearing Habitat; SPG and MEG Presence/Absence) for smolt capacity is 417,135. The YFCSS program will release 350,000-400,000 (depending upon SAR) smolts annually to achieve a return of 1,050 adults.

3.5.1 Standard: Patterns of genetic variation within and among natural populations do not change significantly as a result of artificial production.

Indicator 1: Genetic profiles of naturally produced and hatchery-produced adults developed.

Juvenile NOR chinook salmon tissue samples are currently being collected for baseline information. Tissue samples will also be taken to generate a parental assignment database. A parentage assignment study will determine the proportion and survival of NOR, HOR, or NOR/HOR juveniles produced naturally in Yankee Fork.

3.5.2 Standard: Collection of broodstock does not adversely impact the genetic diversity of the naturally spawning population.

Indicator 1: Total number of natural spawners reaching collection facilities documented.
Indicator 2: Total number of natural spawners estimated passing collection facilities documented.
Indicator 3: Timing of collection compared to overall run timing.

Timing and numbers of natural spawners collected and/or released at weir recorded. All remaining fish will be released above the weir for natural spawning. The Tribes developed Table 2 to guide harvest, broodstock collection, and spawning escapement in accordance with NOAA-Fisheries.

3.5.3 Standard: Artificially produced adults in natural production areas do not exceed appropriate proportion.

Indicator 1: Ratio of natural to hatchery-produced adults monitored.
Indicator 2: Observed and estimated total numbers of natural and hatchery-produced adults passing counting stations.

Number and disposition of naturally produced and hatchery-produced adult chinook salmon will be recorded at the Yankee Fork weir. The

Tribes will annually generate proportions of NOR to HOR adult chinook salmon released above weir, collected for broodstock, or harvested by Tribal members (Table 2).

3.5.4 Standard: Juveniles are released in natural acclimation areas to maximize homing ability to intended return locations.

Indicator 1: Location of juvenile releases documented.
Indicator 2: Length of acclimation period documented.
Indicator 3: Release type (e.g., volitional or forced) documented.
Indicator 4: Adult straying documented.

Fry will be reared in pathogen free well water prior to transfer to river water at SFH. Smolts will be transferred from SFH raceways (reared in upper Salmon river water) to large tanker trucks and transported to Yankee Fork.

The interannual variation in smolt timing in response to environmental conditions is really the fine-tuning of a fundamental internal sequence of changes in morphology, physiology, and behavior needed for transition to saltwater (Quinn 2005). The best predictor for seasonal processes is day length, and this strongly influences parr-smolt transformation. However changes in temperature, fish body shape and color will also be monitored.

Timing of release will be crucial in allowing smolts to acclimate and imprint to Yankee Fork. Date, time, location, as well as water temperature and discharge will be monitored annually to determine optimum conditions for releasing smolts in Yankee Fork. YFCSS will coordinate and communicate trapping information and determine annual adult straying.

3.5.5 Standard: Juveniles are released at fully smolted stage of development.

Indicator 1: Level of smoltification at release documented.
Indicator 1: Release type (e.g., forced or volitional) documented.

The size of juvenile chinook salmon largely determines whether the individual will migrate or stay in freshwater. All smolts released into the Yankee Fork will be 1+ and meet specific size criteria. In addition, YFCSS and SFH personnel will monitor physiological changes, water temperature, day length, and discharge to determine optimum release time.

3.5.6 Standard: The number of adults returning to the hatchery that exceeds broodstock needs is declining.

Indicator 1: The number of adults in excess of broodstock needs documented in relation to mitigation goals of the program.

Excess broodstock identified, documented, and released above weir for natural spawning and harvest.

3.6.1 Standard: The artificial production program uses standard scientific procedures to evaluate various aspects of artificial production.

Indicator 1: Scientifically based experimental design with measurable objectives and hypotheses.

YFCSS conducts experiments and research based on the Scientific Method. The SBT has developed the Yankee Fork Spring Chinook Supplementation Monitor and Evaluation Plan. The plan focuses on documenting survival of several broodyears of juveniles and adults through the F2 adult generation (Denny et. al. 2006). See Appendix A.

3.6.2. Standard: The artificial production program is monitored and evaluated on an appropriate schedule and scale to address progress toward achieving the experimental objectives.

Indicator 1: Monitoring and evaluation framework including detailed time line.
Indicator 2: Annual and final reports.

See Appendix A.

3.7.1 Standard: Artificial production facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols.

Indicator 1: Annual reports indicating level of compliance with applicable standards and criteria.

The YFCSS and SFH program operates under regional guidelines. Reports will be provided to cooperating agencies documenting compliance standards and criteria.

3.7.3 Standard: Water withdrawals and in stream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning, or impact juveniles.

Indicator 1: Water withdrawals documented – no impacts to listed species.
Indicator 2: NMFS screening criteria adhered to.

Water will be supplied through gravity flow from underground piping and maintained at no less than one cubic feet per second for biological oxygen demand. Flow, temperature, and water quality will be recorded. Screening criteria is consistent with NMFS regional guidelines. Specific criteria will be developed and implemented at the YFCSS satellite facility.

3.7.4 Standard: Releases do not introduce pathogens not already existing in the local populations and do not significantly increase the levels of existing pathogens.

Indicator 1: Certification of juvenile fish health documented prior to release.

Health certification received prior to smolt release from the IDFG Eagle Fish Health Laboratory.

3.7.5 Standard: Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines.

Indicator 1: Number and location(s) of carcasses distributed to habitat documented.

Numbers and locations documented for carcass redistribution into the natural spawning habitat.

3.7.6 Standard: Adult broodstock collection operation does not significantly alter spatial and temporal distribution of natural population.

Indicator 1: Spatial and temporal spawning distribution of natural population above and below trapping facilities monitored.

Redd counts recorded above and below facilities for natural and supplemental populations. Numbers and fish type recorded prior to release above the weir for natural spawning. In addition, telemetry may be used to document use of available spawning habitat.

3.7.7 Standard: Weir/trap operations do not result in significant stress, injury, or mortality in natural populations.

Indicator 1: Mortality rates in trap documented.
Indicator 2: Prespawning mortality rates of trapped fish in hatchery or after release documented.

Mortalities in holding facilities and trap are recorded. Mortality data will include date, time, fish collection number, cause of death (if known), body condition, and sex. Biological samples taken for analysis.

3.7.8 Standard: Predation by artificially produced fish on naturally produced fish does not significantly reduce numbers of natural fish.

Indicator 1: *Size and time of release of juvenile fish documented and compared to size and timing of natural fish.*

Release time will coincide with natural emigration. Predation will be incidental for two reasons: chinook salmon are not piscivorous and emigration occurs almost immediately.

3.8.3 Standard: Non-monetary societal benefits for which the program is designed are achieved.

Indicator 1: Number of adult fish available for tribal ceremonial use.
Indicator 2: Recreational fishery angler days, length of season, and number of licenses purchased.

Annual forecast and harvest will be developed using the Tribal Resource Management Plan yearly to adjust harvestable numbers of fish and length of season according to estimated return run size. Catch levels, hours fished, and CPUE compared to historical data to report non-monetary societal benefits.

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

Approximately 102 pairs of chinook salmon broodstock annually are necessary to sustain the YFCSS program. The objective is to release 350,000 chinook smolts annually into Yankee Fork. If juveniles are adipose fin-clipped then the smolt release objective will increase to 400,000 and approximately 116 pairs would be needed.

Sliding Scale for SFH Production Allocation

A sliding scale (Table 1) was developed for smolt release for the YFCSS. At full production, the YFCSS will receive 26.9%, or 350,000 smolts. As production decreases, percent allotted for the YFCSS proportionately decreases by 6.7%. Production below 325,000 smolts becomes subject to annual review by the LSRCP, IDFG, and YFCSS. Currently, the YFCSS is requesting a minimum of 20,000 smolts.

Table 6. Sliding scale for SFH production and proportion released into Yankee Fork.

SFH PRODUCTION	% FOR YFCSS	YFCSS RELEASE
≥ 1.3 million	26.9	350,000 or more if excess
975,000 – 1.3 million	20.2	196,950 – 350,000
650,000 – 975,000	13.5	87,750 – 196,950
325,000 – 650,000	6.8	22,100 – 87,750
< 325,000	Subject to annual review	20,000 minimum

Sliding Scale for Broodstock Collection

A broodstock sliding scale for the YFCSS is presented below (Table 2). Viability was determined by the number of natural spawners needed according to the ICTRT and broodstock needs for YFCSS (500 escapement + 204 broodstock = 704). Broodstock collection is influenced by the percent return of the viability abundance goal and harvest rate. Collection rate is determined by dividing the number of remaining adults (less harvest) by the viability abundance goal of 704. The number of NOR fish collected for broodstock is calculated by multiplying the collection rate by the maximum number of broodstock (204).

When expected returns exceed 761 NOR adults, 100% NOR fish will be used for broodstock. Broodstock will be supplemented with HOR adults when NOR returns are less than 761 individuals.

Table 7. Broodstock collection, harvest, and estimated spawning escapement for YFCSS.

Location	Viability Abundance Goal	Expected Return (% of goal)	Total Escape-ment	Harvest Rate (%)	# of Fish for Harvest	Remaining Adults	Broodstock Collection Rate	NOR Fish Collected	Spawning Escapement
Yankee Fork	704	< 10%	70.4		1	69	0 - 9%	0 - 6	0 - 63
NOR		10.1 - 30%	71 - 211		2 - 3	69 - 208	10 - 29%	20 - 59	49 - 149
		30.1 - 50%	212 - 352	3%	6 - 11	206 - 341	30 - 49%	61 - 100	144 - 241
		50.1 - 75%	353 - 528	5%	18 - 26	335 - 502	50 - 69%	102 - 141	233 - 361
		75.1 - 108%	529 - 760	8%	42 - 61	486 - 699	70 - 99%	143 - 202	344 - 498
		> 108.1%	**> 761**	**35%**	**> 61**	**704**	**100%**	**204**	**> 500**

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Adult chinook will return to their release site and search for available spawning habitat. Therefore, the release locations were determined by both the location of excellent spawning habitat, juvenile chinook density, and ability to transfer smolts to the site. Bechtel (1987) reported excellent spawning habitat in the mainstem Yankee Fork from Ninemile Creek to directly below Fivemile Creek and highest fish densities from Jordan Creek to Eightmile Creek and West Fork Yankee Fork.

Releasing smolts at Eightmile Creek confluence would likely result in beneficial use of excellent spawning and rearing habitat in the upper Yankee Fork (Table 3). However, access would be limited to smaller trucks and be dependent upon snowpack. In 2006, smolts were released at Jordan Creek confluence without difficulty, however it is unknown if adults will utilize the upper Yankee Fork and this may be a concern. Pond Series 1 and/or 4 have been used for steelhead smolts releases since 2001. Both sites are accessible to large tanker trucks and will provide temporary acclimation.

Table 8. Release locations for YFCSS project.

Life Stage	Release Location	Elevation (ft)	Annual Release
Yearling	Eightmile Creek Confluence 11T 689401 E – 4921950 N	6,817	TBD
Yearling	Jordan Creek Confluence 11T 681560 E – 4916396 N	6,375	350,000
Yearling	Pond Series 1 and/or 4 P1: 11T 682150 E – 4909094 N P4: 11T 681309 E – 4912923 N	6,161 6,269	TBD TBD

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels.

Since the YFCSS is currently not a fully functioning program, performance, production, and survival rates from chinook salmon releases into the upper Salmon River at the SFH are presented as production guidelines for the YFCSS. East Fork Salmon River smolt releases were terminated in 1995 and Valley Creek supplementation was never implemented and, consequently, no information is provided.

Information for juvenile chinook salmon released into the upper Salmon River at the Sawtooth Fish Hatchery from 1987 to 2006 is presented in the Table 4.

Table 9. Performance of chinook salmon released into the upper Salmon River at SFH from 1987-2006. Data taken from SFH Brood Year and Run Year reports.

			Return Age From BY				
Brood Year	Number Released	Year Released	1-ocean	2-ocean	3-ocean	Total	SAR (%)
1986	1,705,500	1987 - 88	428	1,410	326	2,164	0.127
1987	2,092,595	1988 - 89	112	199	109	420	0.020
1988	1,895,600	1989 - 90	41	246	475	762	0.035

1989	650,600	1991	15	77	26	118	0.018
1990	1,263,864	1992	29	63	6	98	0.008
1991	774,583	1993	5	7	7	19	0.002
1992	213,830	1994	8	24	25	57	0.026
1993	334,313	1994 - 95	20	74	23	117	0.035
1994	25,006	1996	0	3	4	7	0.028
1995	4,650	1997	0	12	37	49	1.010
1996	43,161	1998	60	135	32	227	0.526
1997	217,336	1999	279	1,219	327	1,825	0.840
1998	123,425	2000	176	531	131	838	0.679
1999	57,134	2001	65	98	27	190	0.033
2000	385,761	2002	522	1,281	175	1,978	0.500
2001	1,105,169	2003	654	1182	(2006)	-	-
2002	821,415	2004	204	(2006)	(2007)	-	-
2003	134,812	2005	(2006)	(2007)	(2008)	-	-
2004	1,416,610	2006	(2007)	(2008)	(2009)	-	-

Once the YFCSS is a functional program, annual broodstock collection levels can be obtained from returning adults. Below are the performance measures for the YFCSS based on the performance of SFH for annual broodstock collection (Table 5).

Table 10. Expected performance measures used to develop broodstock needs for YFCSS.

Total Number of Females Taken	102	Calculations	Results
Pre-spawning Mortality[1]	8%	102 x .92	94 females spawned
Fecundity[2]	4,800	4,800 x 94	451,200 green eggs
Green Egg to Fry Survival[3]	85%	451,200 x .85	383,520 fry
Fry to Smolt Survival[4]	91%	383,520 x .91	349,003 smolt
Smolt to Adult Return[5]	0.3%	349,003 x .003	1,047 adults

[1]The ten-year average (brood year 1992-2001) of adult mortality for SFH is 4%. YFCSS expects 8% mortality for additional trap and weir mortality as well as handling and transportation stress.
[2]Ten year fecundity at SFH is 4,800 eggs per female.
[3]SFH average of green egg to fry survival is 85% from BY 1992 to 2001.
[4]Ten year fry to smolt survival at SFH is 91%.
[5]SFH average SAR from BY 1986 to 2000 is 0.26%. We anticipate a 0.3% SAR to achieve a return of approximately 1,050 adults.

With the exception of the above table, 350,000 smolts will be reported as the basic target number of the hatchery program in the remainder of this HGMP. This is a round, clean number that is easily presented and communicated to the scientific community. Mathematically, the difference between 349,003 and 350,000 smolts with a 0.003 smolt-to-adult return rate is only an additional three adults (350,000 x 0.003 = 1,050 compared to the 1,047 reported in the above table).

1.13) Date program started (years in operation), or is expected to start.

The first operation was initiated in 2006 with the release of 135,934 smolts into the Yankee Fork Salmon River at Jordan Creek confluence.

1.14) Expected duration of program.

This program is expected to continue indefinitely to provide mitigation under the Lower Snake River Compensation Plan.

1.15) Watersheds targeted by program.

Listed by hydrologic unit code –Yankee Fork Salmon River: 17060201

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

LSRCP hatcheries were constructed to mitigate for fish losses caused by construction and operation of the four lower Snake River federal hydroelectric dams. The goal of the YFCSS is to restore a viable population with harvest potential, aid to spatial distribution, and contribute to diversity. The Tribes Fisheries Department has considered and implemented habitat restoration actions to achieve program goals. Habitat in the Yankee Fork is not the limiting factor for chinook salmon and steelhead trout. NOR chinook salmon survival from smolt-to-adult must reach 2-6% or a supplementation action must be initiated to prevent near-term extinction or avoid further losses of genetic variation.

Recently, two IDFG projects, "Chinook Salmon Captive Adult Propagation Program and Idaho Supplementation Studies," have not recovered Yankee Fork Salmon River distinct population segment of chinook salmon. Both projects are considered non-aggressive supplementation projects.

A long-term chinook salmon supplementation project releasing smolts may be the only short-term options for increasing abundance of chinook salmon in the Yankee Fork.

SECTION 2. PROGRAM EFFECTS ON NMFS ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

No current ESA permits have been issued for the YFCSS program.

2.2) Provide descriptions, status, and projected take actions and levels for NMFS ESA-listed natural populations in the target area.

2.2.1) **Description of NMFS ESA-listed salmonid population(s) affected by the program.**

The following excerpts describing the current ESA-listed Salmon River spring/summer chinook salmon population were taken from the Draft Salmon Subbasin Summary prepared for the Northwest Power Planning Council (NPPC 2001).

Salmon Subbasin

The Salmon Sub-basin lies within the northern Rocky Mountains of central Idaho and encompasses 10 major watersheds. The Salmon River flows 410 miles north and west through central Idaho to join the Snake River in lower Hells Canyon. The Salmon is one of the largest sub-basins in the Columbia River Basin and encompasses some of the most pristine terrestrial and aquatic temperate ecosystems.

The Salmon Sub-basin covers approximately 14 thousand square miles, 16.7 percent of the land area of Idaho. Ten major hydrologic units (watersheds) occur within the sub-basin: the Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, South Fork Salmon, Lower Salmon, and Little Salmon watersheds.

Idaho’s stream-type chinook salmon are truly unique. Smolts leaving their natal rearing areas migrate 700 to 950 miles downstream every spring to reach the Pacific Ocean. Mature adults migrate the same distance upstream, after entering freshwater, to reach their place of birth and spawn. The life history characteristics of spring/summer chinook are well documented by IDFG et al. 1990; Healey 1991; NMFS: 57 FR 14653 and 58FR68543). Kiefer’s (1987) An Annotated Bibliography on Recent Information Concerning Chinook salmon in Idaho, prepared for the Idaho Chapter of the American Fisheries Society provides a reference of information available through the mid-1980s on life history, limiting factors, mitigation efforts, harvest, agency planning, and legal issues. Snake River Spring/Summer Chinook salmon, of which spawning populations in the Salmon Sub-basin is a part, were listed as Threatened under the Endangered Species Act in 1992 (57 FR 14653); critical habitat was designated in 1993 (58 FR 68543).

Recent and ongoing research has provided managers with more specific knowledge of the Salmon Sub-basin stocks. Intensive monitoring of summer parr and juvenile emigrants from nursery streams has provided insights into freshwater rearing and migration behavior (Walters et al. 2001; Achord et al. 2000; Hansen and Lockhart 2001; Nelson and Vogel 2001). Recovered tags and marks on returning adults at hatchery weirs and on spawning grounds have indirectly provided stock specific measures of recruitment and fidelity (Walters et al. 2001; Berggren and Basham 2000). Since 1992, hatchery produced chinook has been marked to distinguish them from naturally produced fish.

Age-length frequency and age composition of individual stocks are currently being refined for specific stocks (Kiefer et al. 2001). Distribution and abundance of spawning is being monitored with intensity in specific watersheds (Walters et al. 2001; Nelson and Vogel 2001). Ongoing since the mid-1980s, annual standard surveys continue to provide trends in abundance and distribution of summer parr (Hall-Griswold and Petrosky 1997, 2001 in progress). Resultant data show an erratic trend toward lower abundance of juvenile chinook salmon in their preferred habitat (Rosgen C type channels), both in hatchery influenced streams and in areas serving as wild fish sanctuaries.

Analysis of recent stock-recruitment data (Kiefer et al. 2001) indicates that much of the freshwater spawning/rearing habitat of Snake River Spring/Summer Chinook salmon is still productive. The average production for brood years 1990-1998 was 243 smolts/female. Stock-recruitment data show modestly density-dependent survival for the escapement levels observed in recent years and have been used to estimate smolt-to-adult survival necessary to maintain or rebuild the chinook populations. A survival rate of 4.0% (this is less than historic levels) would result in an escapement at Lower Granite Dam of approximately 40,000 wild adult spring/summer chinook salmon.

In the mid-1900s, the Salmon Sub-basin produced an estimated 39% of the spring and 45% of the summer chinook salmon that returned as adults to the mouth of the Columbia River. Natural escapements approached 100,000 spring and summer chinook from 1955 to 1960; with total escapements declining to an average of about 49,300 (annual average of 29,300 spring chinook salmon and 20,000 summer chinook salmon) during the 1960s. Smolt production within the Salmon Subbasin is estimated to have ranged from about 1.5 million to 3.4 million fish between 1964 and 1970 (IDFG 1985).

Populations of stream-type (spring and summer) chinook in the sub-basin have declined drastically and steadily since about 1960. This holds true *despite substantial capacities of watersheds within the sub-basin to produce natural smolts and significant hatchery augmentation of many populations*. For example, counts of spring and summer chinook redds in IDFG standard survey areas within the sub-basin declined markedly from 1957 to 1999. The total number of spring and summer chinook redds counted in these areas surveys ranged from 11,704 in 1957 to 166 in 1995 (Elms-Cockrum in press). Stream-type chinook redds counted in all of the sub-basins monitored spawning areas have averaged only 1,044 since 1980, compared to an average 6,524 before 1970. Land management activities have affected habitat quality for the species in many areas of the sub-basin, but spawner abundance declines have been common to populations in both high-quality and degraded spawning and rearing habitats (IDFG 1998).

Kucera and Blenden (1999) have reported that all five "index populations" (spawning aggregations) of stream-type chinook in the Salmon Sub-basin, fish that spawn in specific areas of the Middle Fork and South Fork Salmon watersheds, exhibited highly significant ($p<0.01$) declines in abundance during the period 1957-95. NMFS (2000) estimated that the population growth rates (lambda) for these populations during the 1990s were all substantially less than needed for the fish to replace themselves: Poverty Flats (lambda = 0.757), Johnson Creek (0.815), Bear Valley/Elk Creek (0.812), Marsh Creek (0.675), and Sulphur Creek (0.681). Many wild populations of stream-type chinook in the sub-basin are now at a remnant status and it is likely that there will be complete losses of some spawning populations. Annual redd counts for the index populations have dropped to zero three times in Sulphur Creek and twice in Marsh Creek, and zero counts have been observed in spawning areas elsewhere within the Salmon Sub-basin. All of these chinook populations are in significant decline, are at low levels of abundance, and at high risk of localized extinction (Oosterhout and Mundy 2001).

Large reductions in historic fisheries on chinook from the Salmon Sub-basin occurred as populations declined. Historic tribal and recent non-tribal sport fisheries targeted naturally produced salmon. Current fisheries are focused on the harvest of mitigation hatchery-produced fish while attempting to minimize impacts to fish produced in the wild. Sport harvest is now limited to only hatchery produced salmon with an acceptable incidental harvest of naturally produced salmon. Tribal fisheries are still focused in natural-origin origin populations; however harvest is minimal at best.

Yankee Fork Salmon River

The Yankee Fork Salmon River historically supported large runs of anadromous salmonids. The decline of anadromous fish in the Yankee Fork can be linked to the combined effects of downstream hydroelectric developments and local mining activities. The construction of Lower Monumental (1969), Ice Harbor (1962), Little Goose (1970), and Lower Granite (1974) dams on the Snake River, and Bonneville, Dalles, McNary, and John Day dams on the Columbia River, all served to reduce the number of adults returning to the Yankee Fork and the number of smolts successfully migrating to the ocean. The historic mining activities in the Yankee Fork have further aggravated the tenuous status of chinook stocks, resulting in further decline.

Yankee Fork Salmon River, located in Custer County, Idaho, constitutes one of the major tributaries of the upper Salmon River. The Yankee Fork drainage historically supported large runs of anadromous salmonids, primarily spring chinook salmon and steelhead trout. These runs have been dramatically reduced in the last 20-25 years due to localized mining activities and the effects of downstream hydroelectric developments (Reiser and Ramey 1987). The mining activities have resulted in the complete re-channeling of lower portions of the Yankee Fork and the deposition of extensive unconsolidated dredge piles. Such activities have eliminated or degraded much of the rearing and spawning habitat in the lower Yankee Fork. As a result, the Yankee Fork drainage is grossly underutilized with respect to salmon and steelhead production (Reiser and Ramey 1987).

Chinook destined for the Yankee Fork would enter the Columbia River during March-May, with spawning occurring in August and September (Bjornn 1960). The runs of upper Salmon River spring chinook, an exceptionally large fish, were found to be comprised of primarily 4-5 year old fish having fork lengths exceeding 32 inches (Bjornn et al 1964). Egg incubation extended into December, with emergence occurring in February or March (Reiser and Ramey 1987). The juveniles would typically rear in freshwater until the spring (March-April) of their second year, generally at a length of 4-5 inches (Bjornn 1960).

Over six percent of the chinook redds found in the upper Salmon River have been located in the Yankee Fork system (Reiser and Ramey 1987). Chinook redd counts taken in the upper Yankee Fork have ranged from a high of 250 in 1967, to 0 in 1980, 1982, and 1983 (Pollard 1985). For the whole drainage, the number of redds have ranged from over 600 in 1967 to less than 10 in the mid-1980's (Konopacky et al. 1986). Intensive multiple-ground redd counts conducted by the Tribes for the whole drainage from 1986-2005 have averaged 36.9 redds/year (Ray unpublished data).

The large runs of salmon not only afforded a sport fishery for the upper Salmon River but also provided a subsistence and ceremonial fishery for the SBT. The Yankee Fork system in particular is an important and treaty-guaranteed anadromous fishing area for the Tribes and one which has been used for many generations (Reiser and Ramey 1987). The Tribes have volunteered to help with the restoration of anadromous fish by temporarily curtailing salmon fishing in the Yankee Fork, with the exception of bath tub fisheries provided during Pahsimeroi Fish Hatchery management shifting from spring Chinook to summer Chinook during 1985 and 1986.

Identify the NMFS ESA-listed population(s) that will be <u>directly</u> affected by the program

The Yankee Fork Salmon River and Upper Salmon River Mainstem Spring/Summer Chinook Salmon distinct population segments will be the two stocks directly affected by the YFCSS. Direct impacts include collection of broodstock and fish handling at the Yankee Fork and SFH weirs. Juvenile and adult sampling for monitoring and evaluation will include non-lethal fin clips and scale samples.

Identify the NMFS ESA-listed population(s) that may be <u>incidentally</u> affected by the program.

Bull trout (*Salvelinus confluentus*) and steelhead (*Oncorhynchus mykiss*) are present in Yankee Fork and Upper Salmon Mainstem. Bull trout and steelhead may be encountered while conducting M & E studies or while trapping adult Chinook salmon at the Yankee Fork weir. We anticipate some level of straying from other NOR and HOR chinook salmon populations, but this is not a result of YFCSS or SFH management actions.

2.2.2) <u>Status of NMFS ESA-listed salmonid population(s) affected by the program.</u>

Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds.

The Tribes utilized the technical expertise of the NOAA-Fisheries staff and used the latest viability criteria for application to the Snake River Spring/Summer Chinook ESU, found in "Viable Criteria for Application to Interior Columbia Basin Salmonid ESUs" (ICTRT, July 2005). The viability guidelines are organized around four major considerations: abundance, productivity, spatial structure and diversity.

Diversity is expressed through 22 different NOR populations and four separate HOR populations. The analysis of likely intrinsic potential of stream segments throughout historically accessible areas leads to population delineation closer approximating historic ESU structure rather than precise designations of geographic boundaries (McClure and Cooney, May 11, 2005). The foundation work is described in "Independent Populations of Chinook, Steelhead, and Sockeye for Listed Evolutionarily Significant Units Within the Interior Columbia River Domain" (ICTRT, July 2003). Genetic (allozyme data (28 loci) for 35 sampling locations collected from 1991 to 1996), dispersal/distance (distance between spawning areas and generalized dispersal distance analysis), phenotypic (length-at-age, age structure, adult run-timing, and juvenile outmigration-timing characteristics), habitat (EPA-defined eco-regions), and demographic correlation (index redds per mile), spawner counts or run reconstruction for 33 spawning areas were used to delineate populations.

Spatial structure and complexity is determined by assigning each population to one of four general structural categories (A=simple linear; B=Dendritic; C=Trellis pattern; D=core drainage plus adjacent but separate small tributaries). This is combined with major spawning aggregations (MSAs) (supporting at least 500 spawners) and minor spawning areas (mSAs) (supporting between 50 and 500 spawners).

Abundance and productivity estimates are driven by estimates of stream width, gradient, and valley width (median weighted area) with intrinsic productivity ratings (spawners per KM – weighted) to index the areas by spawning/rearing area. These result in Minimum Abundance Thresholds for four different size categories – basic, intermediate, large and very large. The ICTRT does not consider any population with fewer than 500 individuals to be viable, regardless of intrinsic productivity; thus, viability curves for populations in the Basic size category are truncated at a minimum spawning level of 500 fish. Incrementally higher spawning thresholds were established for the remaining three population size categories. Increased thresholds for larger populations promote achieving the full range of abundance objectives including utilization of multiple spawning, avoiding problems associated with low population densities (e.g., Allele effects) and maintaining populations at levels where compensatory processes are functional.

Combined, these factors result in the minimum abundance thresholds that are shown in Table 6 (Basic = 500, Intermediate = 750, large = 1,000 and very large = 2,000). The Tribes did not develop a critical population level, but are contemplating that 30% of the viable population threshold (e.g., 150 fish for a basic population, 225 for the intermediate, 300 for a large and 600 for a very large population) represents a conservative critical population size. Incrementally higher abundances for critical population levels as the intrinsic population threshold increase is consistent with size, dispersion, and spatial complexity increases associated with the larger intrinsic populations. Table 6 lists the natural and hatchery fish populations, viable and critical population thresholds, and associated hatchery stocks included in this HGMP.

Table 11. List of the natural fish populations, Viable and Critical Salmonid Population Thresholds, and associated hatchery stocks included in the HGMP.

Natural Populations (or Fishery Management Area)	Name	Critical Population Threshold	Viable Population Threshold	Associated hatchery stock(s)	Hatchery stock surplus to recovery? (Y or N)
SRLSR	Lsalmon	225	750	Rapid River Hatchery	Not Listed
SRLSR-A	LSalmonHOR	720	2,400	Rapid River Hatchery	Not Listed
SFMAI	South Fk	300	1,000	McCall Hatchery	Y
SFMAI-A	South FkHOR	420	1,400	McCall Hatchery	Y
SFSEC	Secesh	225	750		
SFEFS	E.FkS.Fk	225	750	JCAPE	N
SRCHA	Chamberlain	225	750		
MFLMA	L.Middle Fk	150	500		
MFBIG	Big Cr.	300	1,000		
MFCAM	Camas Cr.	150	500		
MFLOO	Loon Cr.	150	500		
MFUMA	U.Middle Fk	225	750		
MFSUL	Sulphur Cr.	150	500		
MFBEA	BearValley	225	750		

MFMAR	Marsh Cr.	150	500		
SRPAN	Panther Cr.	225	750	McCall Hatchery	Y
SRNFS	North Fk.	150	500		
SRLEM	Lemhi R.	600	2,000		N
SRLMA	LmainSalmon	300	1,000		
SRPAH	Pahsimeroi	300	1,000	Pahsimeroi Hatchery	N
SRPAH-A	Pahsim.HOR	162	540	Pahsimeroi Hatchery	N
SREFS	East Fk.	225	750	Captive Rearing	N
SRYFS	**Yankee Fk.**	**150**	**500**	**Captive Rearing**	**N**
SRVAL	Valley Cr.	150	500		
SRUMA	UMainSR	225	750	Sawtooth Hatchery	N
SRUMA-A	UMainSRHO R	180	600	Sawtooth Hatchery	N

Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage or other measures of productivity for the listed population. Indicate the source of these data.

Little information regarding progeny-to-parent ratios and life-stage survival data is available for the Yankee Fork Salmon River. Redd count information will be presented below for annual spawning abundance estimates. In 2003, the TRT (2003) found no evidence of hatchery introgression or natural spawning of HOR fish in Yankee Fork. Besides 2006 smolt plants, there have been no outplants of additional Chinook salmon in Yankee Fork in the past ten years. The TRT classified the Yankee Fork chinook population as basic, needing 500 spawning individuals to be a viable population (TRT 2005).

Age class totals and sex ratios for all trapped Chinook salmon at the SFH weir from 1989 to 2003 is presented below (Table 7).

Table 12. Age composition from trapped chinook salmon from 1989 to 2003 at the Sawtooth Fish Hatchery weir.

Year	Sample Size (n)	Age 3 Returns	Age 4 Returns	Age 5 Returns
1989	888	387	251	250
1990	1,488	83	1,049	356
1991	1,166	60	780	326
1992	387	23	205	159
1993	587	29	78	480
1994	96	6	63	27
1995	37	16	15	6
1996	156	24	104	28

1997	215	10	148	57
1998	153	4	33	116
1999	196	79	78	39
2000	986	376	500	110
2001	2,103	227	1,664	212
2002	1,786	98	958	730
2003	1,236	522	193	521
Totals	11,480	1,944	6,119	3,417
Percent	——	16.93%	53.30%	29.77%

Table 13. Sex ratio and age class for male and female chinook salmon trapped at the Sawtooth Fish Hatchery weir from 1989 to 2003.

Age	# Return Males	% Males	# Return Females	% Females
3 (≤ 64 cm)	1,935	99.54%	9	0.46%
4 (64 – 82 cm)	3,906	63.83%	2,213	36.17%
5 (≥ 82 cm)	1,468	42.96%	1,949	57.04%
Combined	7,309	63.67%	4,171	36.33%

Provide the most recent 12-year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

Table 14. Yankee Fork abundance trends 1986-2005.

Year	REDDS[1]				Estimated Adult Escapement[5]	Estimated Smolt Production[6]
	Upper[2]	Lower[3]	WFYF[4]	Total		
1986	NC	35	NC	35	87.5	8,505
1987	5	4	17	26	65	6,318
1988	2	4	31	37	92.5	8,991
1989	0	16	6	22	55	5,346
1990	5	2	20	27	67.5	6,561
1991	9	3	8	20	50	4,860
1992	10	9	6	25	62.5	6,075
1993	4	11	13	28	70	6,804
1994	0	0	9	9	22.5	2,187
1995	0	0	0	0	0	0
1996	0	1	7	8	20	1,944
1997	5	7	7	19	47.5	4,617
1998	1	14	12	27	67.5	6,561
1999	2	0	0	2	5	486
2000	10	1	4	15	37.5	3,645
2001	32	50	36[7]	118	295	28,674

2002	21	56	53[8]	130	325	31,590
2003	9	77	24	110	275	26,730
2004	15	13	15[9]	43	107.5	10,449
2005	17	6	14[10]	37	92.5	8,991
TOTAL	**147**	**309**	**282**	**738**	**1845**	**179,334**
AVG	***7.4***	***15.5***	***14.1***	***36.9***	***92.3***	***8,966.7***

[1]Redd counts from Ray and Kohler (unpublished), Shoshone-Bannock Tribes.
[2]Upper Yankee Fork is Strata 4, 5, and 7.
[3]Lower Yankee Fork is Strata 1, 2, and 3.
[4]West Fork Yankee Fork
[5]Adult estimates obtained by assuming 2.5 spawners/redd (Matthews and Wapels 1991).
[6]Estimated smolt production determined from Kiefer et al. (2001); Average of 243 smolts per redd (assume one redd = one female) over nine year period (BY 1990-1998).
[7] 18 wild/natural and 18 captive rearing from IDFG observations.
[8] 20 wild/natural and 33 captive rearing from IDFG observations.
[9] 4 wild/natural and 11 captive rearing from IDFG observations.
[10] 4wild/natural and 8 captive rearing from IDFG observations.

Reiser and Ramey (1987) determined chinook smolt capacity of 86,512 based on rearing area and 740,064 for spawning habitat. The System Planning Group (SPG) and Monitoring and Evaluation Group (MEG) of the Northwest Power Planning Council estimated chinook smolt carrying capacity in Yankee Fork, including all tributaries, to be 424,829 smolts. After combining all three models, the average capacity for Yankee Fork is 417,135 chinook smolts. From the above table, neither one year nor the sum of all years remotely reached carrying capacity suggesting adult returns to Yankee Fork have been insufficient to utilize available habitat.

Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

The IDFG has made repeated plants of fry, smolt, pre-smolt, and adults for chinook salmon and steelhead trout in the Yankee Fork with-out long-term goals (Table 10). In addition, in 1986 the IDFG released over 2,000 adult Chinook into the upper Yankee Fork above Fivemile Creek. These adults not only provided the SBT with a ceremonial spear fishery, but many spawned successfully and contributed to juvenile production. In 2006, 135,934 Chinook salmon smolts of SFH origin where released into Yankee Fork. Prior to 2006, Yankee Fork was supplemented with several stocks including Rapid River, Salmon River, and Pahsimeroi from 1977 to 1994. Information from the Salmon Subbasin Plan (1990), Fish Passage Center (2005), and Sawtooth Fish Hatchery Annual Report (1992) is summarized in the table below.

Table 15. Yankee Fork chinook salmon artificial propagation history 1977-2006.

BY	RY	Number	Location	Stock	Size	fish/lb	Hatchery
	1977	56,700	WFYK	Rapid River	fry-fingerling		Mackay
	1978	75,036	Yankee Fork	Rapid River	fry-fingerling		Mackay

	1985	61	Yankee Fork	Sawtooth	adult		Sawtooth
	1985	659	Yankee Fork	Rapid River	adult		Pahsimeroi
	1986	61	Yankee Fork	Sawtooth	adult		Sawtooth
	1986	1,505	Yankee Fork	Rapid River	adult		Pahsimeroi
	1986	386,348	Yankee Fork	Rapid River	fry-fingerling		Pahsimeroi
	1987	157,877	Yankee Fork	Rapid River	fry-fingerling		Sawtooth
	1987	600	Yankee Fork	Rapid River	adult		Pahsimeroi
1986	1987	158,000	Yankee Fork Ponds	Salmon R.	pre-smolt	250	Sawtooth
1986	1988	725,500	Yankee Fork Ponds	Pahsimeroi	smolt	20	Sawtooth
1987	1988	50,100	Yankee Fork Ponds	Rapid River	fry-fingerling	120	Sawtooth
1987	1989	198,200	Yankee Fork Ponds	Salmon R.	smolt	24	Sawtooth
1988	1989	125,000	Yankee Fork Ponds	Salmon R.	fry-fingerling	100	Sawtooth
1988	1990	200,800	Yankee Fork Ponds	Salmon R.	smolt	21	Sawtooth
1989	1990	50,000	Yankee Fork Ponds	Rapid River	fry-fingerling	100	Yakima
1989	1990	491,300	Yankee Fork	Salmon R.	smolt	45	Sawtooth
1989	1990	50,000	Yankee Fork Ponds	Salmon R.	fry-fingerling	111	Sawtooth
1990	1991	50,000	Yankee Fork Ponds	Rapid River	fry-fingerling	120	Sawtooth
	1994	25,025	WFYF	Sawtooth	smolt		Sawtooth
2004	2006	135,934	Yankee Fork	Sawtooth	smolt	21.3	Sawtooth

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of NMFS listed fish in the target area, and provide estimated annual levels of take.</u>

See below.

Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the take may occur, the risk potential for their occurrence, and the likely effects of the take.

Broodstock collection will result in the direct take of ESA-listed Snake River Spring/Summer Chinook salmon. There is the possibility that steelhead or bull trout may be incidentally captured at the Yankee Fork weir. Non-target captured individuals will be immediately released either upstream or downstream of the weir with minimal handling.

The Shoshone-Bannock Tribes developed a monitoring and evaluation (M&E) plan to assess the success of hatchery supplementation activities in the Yankee Fork Salmon River. Monitoring and evaluation of chinook salmon will occur by fin clips for genetic analysis, a non-lethal method of data collection. DNA typing will be used to differentiate chinook salmon of hatchery-origin or natural-origin. Additional M&E activities will include creel surveys, redd counts, and carcass recoveries.

Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Presently, there have been no prior take by the YFCSS.

Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

See Table 17.

Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

If adult collection exceeds broodstock take levels, those individuals not required for the YFCSS will be released upstream of the Yankee Fork weir for natural spawning.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

The SFH and YFCSS program conforms to the plans and policies of the Lower Snake River Compensation Program administered by the U.S. Fish and Wildlife Service to mitigate for the loss of chinook salmon production caused by the construction and operation of the four dams on the lower Snake River. In addition, the Tribes have developed the YFCSS to assist with the recovery the

Upper Salmon Major Population Group as described by the Interior-Columbia Technical Recovery Team.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

- Shoshone-Bannock Tribes
- United States Fish and Wildlife Service - Lower Snake River Compensation Plan
- Idaho Department of Fish and Game
- National Marine Fisheries Services National Oceanic and Atmospheric Administration-Fisheries

Description of cooperating agencies and programs:

Shoshone-Bannock Tribes

Lower Snake River Compensation Plan (LSRCP)

The LSCRP was authorized by Congress in 1976. It's purpose is to mitigate for losses of adult chinook salmon and steelhead, along with angling days for resident species due to the construction and operation of four dams on the lower Snake River.

The goals of the LSRCP are to return 55,100 adult steelhead and 58,700 adult spring and summer chinook salmon above Lower Granite Dam, along with returning 18,300 adult fall Chinook salmon above Ice Harbor Dam. To mitigate lost angler days for resident species, the LSRCP program stocks 86,000 pounds of trout into inland lakes and ponds close to the project area. Many LSRCP programs emphasize conservation of salmon and steelhead.

The SFH is a LSRCP program initiated to mitigate for spring chinook losses caused by the four federal dams constructed on the lower Snake River. The goal of the SFH is to return approximately 19,445 adult spring chinook salmon above Lower Granite. Under the LSRCP, the SFH was constructed in 1985 with production targets of 1.3 million smolts for release in the Salmon River, 700,000 into the East Fork Salmon River, and 300,000 smolts for release into Valley Creek.

Idaho Department of Fish and Game (IDFG)

IDFG is a co-manager with the YFCSS in the SFH operation. SFH will provide egg incubation and juvenile rearing facilities for the YFCSS as well as may be used to hold adult broodstock until an adult holding facility is constructed on Yankee Fork.

Pacific Coastal Salmon Recovery Fund (PCSRF)

The PCSRF was congressional established in 2000 to aid in the restoration and conservation of Pacific salmon populations and their habitat. Funds are provided to the National Marine Fisheries Services (NMFS) for allocation to Washington, Oregon, California, Idaho, Alaska, and the Pacific Coast and Columbia River tribes. PCSRF funds are used to protect and restore salmon habitat, address limiting factors, conduct supplementation activities, monitor and evaluate recovery actions, and conduct research on salmon populations.

Proposed Recovery Plan for Snake River Salmon

In March 1995, NMFS developed and issued a Proposed Recovery Plan for Snake River Salmon. The goal of the plan is to restore the health of the Columbia and Snake River ecosystem and to recover listed Snake River salmon stocks. Two major actions include improving environmental factors associated with reduced stocks and rebuilding populations to an evident level of production. In order to rectify the latter, an improvement in smolt emigration and adult immigration into Yankee Fork is necessary.

Snake River Sub-Basin Plan

Under the Northwest Power Planning Council (NPPC), a sub-basin plan was developed for the Salmon River. This plan documents current and potential salmon and steelhead production, summarizes goals and objectives, and provides proper management strategies. The NPPC created the System Planning Group (SPG) and the Monitor and Evaluation Group (MEG) to document habitat quality and potential smolt capacity for regions within the sub-basin.

Columbia River Fish Management Plan (CRFMP)

The Columbia River Fish Management Plan (CRFMP) is a court approved settlement between the parties in U.S. v Oregon, a case addressing treaty fishing rights in the Columbia River basin. The signatories to the settlement are the United States of America acting through the Department of the Interior and the Department of Commerce; the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian reservation; the Confederated Tribes of the Warm Springs Reservation of Oregon; the Confederated Tribes and bands of the Yakama Nation; the Shoshone-Bannock Tribes and the states of Oregon, Washington, and Idaho. The plan is a framework for these parties to protect, rebuild, and enhance Columbia River Fish runs while providing fish for both treaty Indian and non-Indian fisheries. The agreement establishes procedures to facilitate communication and resolve disputes through a Policy Committee composed of the parties. Two technical committees guide management decisions of the Policy Committee. The Production Advisory Committee (PAC) responds to hatchery production issues; the Technical Advisory Committee (TAC) responds to harvest issues.

Since the escapement goals for salmon to the Snake River basin are viewed as hard constraints on harvest by the regulators within the Columbia River basin, the nature of these goals is critical to the sustainable management of all salmon and steelhead. Although the Yankee Fork spring chinook is part of an aggregate escapement goal for areas above Lower Granite Dam, the CRFMP has no explicit escapement goal for Yankee Fork.

The Shoshone-Bannock as co-managers and CRFMP signatories, would be responsible for consultation with the other parties to CRFMP to ensure that hatchery management and operations are in compliance with the CRFMP with regard to production issues, harvest in the ocean and mainstem Columbia River and harvest in the Salmon River in Idaho.

3.3) Relationship to harvest objectives.

The goal of the YFCSS is to recover a viable chinook salmon population as well as to provide harvest opportunities for tribal members.

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

Harvest opportunities in Yankee Fork will be available to tribal members and will be governed by the Shoshone-Bannock Tribes' Tribal Resource Management Plan. Hatchery-produced adults will be subjected to potential commercial ocean and in-river fisheries with a sport fishing season. Since the inception of the LSRCP, chinook salmon sport fishing seasons have not occurred in the upper Salmon River.

3.4) Relationship to habitat protection and recovery strategies.

The decline of anadromous fish in the Yankee Fork can be linked to hydropower developments and mining activities. Mining has resulted in complete re-channeling of lower Yankee Fork and deposition of extensive dredge piles and, thus, has eliminated or destroyed significant amounts of excellent rearing and spawning habitat (Reiser and Ramey 1987). Without habitat enhancement, production of salmon and steelhead will remain below historic levels. In addition to habitat enhancement, significant changes in hydropower operation must be adopted to increase survival of Yankee Fork chinook salmon.

Currently, the NOAA-Fisheries is developing a recovery plan specific to the Snake River Spring/Summer Chinook salmon of which Yankee Fork is a distinct population segment. YFCSS will incorporate guidance from the proposed recovery plan for Snake River Salmon.

3.5) Ecological interactions.

Possible negative effects on listed salmon from the release of hatchery-produced spring chinook smolts may occur through predation, competition, or disease transmission.

Predation
It may be probable, although highly unlikely, that hatchery-origin juveniles from the YFCSS may prey on natural-origin spring chinook. Although it is possible for HOR individuals to ingest NOR fry based on size (39.8 mm; Peery and Bjornn 1992), emigration from release sites is expected to occur almost immediately alleviating any pressure to NOR fish. In addition, no studies suggest juvenile chinook salmon are piscivorous as well as it is unlikely HOR individuals will convert to a natural diet immediately upon release (USFWS 1992, 1993).

Competition
Initial competition in Yankee Fork should be minimal due to the limited population size of natural chinook salmon and steelhead trout in the system. Competition for food and space should also be minimal because of the location of selected release sites, rapid emigration from those, and the initial non-natural diet of hatchery-produced juveniles. Space and habitat selection should be controlled by the size difference between HOR and NOR juveniles (Everest 1962). Generally, hatchery-produced juveniles are larger and, therefore, more adapted to occupy deeper water and faster velocities compared to smaller, natural juveniles (Hampton 1988).

Disease
There is history of chronic bacterial disease (BKD) in spring chinook salmon from SFH. SFH has installed adult antibiotic injections, egg disinfection, egg culling based on BKD ELISA values, egg segregation incubation, juvenile segregation rearing, and juvenile antibiotic feedings as disease control measures (SFH HGMP 2002). SFH, IDFG, and the YFCSS will monitor the health status of hatchery-produced spring chinook salmon and follow protocols established by the PNFHPC and AFS Health Section.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Rearing Facilities (taken from SFH HGMP 2003**)**

Sawtooth Fish Hatchery
The Sawtooth Fish Hatchery receives water from the Salmon River and from four wells. River water enters an intake structure located approximately 0.8 km upstream of the hatchery facility. River water intake screens comply with NMFS criteria. River water flows from the collection site to a control box located in the hatchery building where it is screened to remove fine debris. River water can be distributed to indoor vats, outside raceways, or adult holding raceways. The hatchery water right for river water use is approximately 60 cfs. Incubation and early rearing water needs are met by two primary wells. A third well provides tempering water to control the build up of ice on the river water intake during winter months. The fourth well provides domestic water for the facility. The hatchery water right for well water is approximately 9 cfs. River water temperatures range from 0.0ºC in the winter to 20.0ºC in the summer. Well water temperatures range from 3.9ºC in the winter to 11.1ºC in the summer.

Adult Holding Facility
Presently, construction of adult holding facilities for the YFCSS has yet to begin. YFCSS water will be supplied from an underground pipeline 1,000 feet upstream, capable of supplying 3.5 cubic feet per second (cfs) of water (3-16°C) through gravity flow. Flow will be regulated to supply a minimum of one cfs necessary for biological oxygen demand. Screening requirements will be installed in accordance with NMFS.

Release Facility
Acclimation periods and locations have currently not been finalized. IDFG and SBT concluded that smolt acclimation was considered negligible. Pond series 1 and 4 in lower Yankee Fork will be used as acclimation sites for the release site initiated in lower Yankee Fork. Acclimation sites will be supplied with ambient stream water and monitored 24 hours a day by SBT personnel while in operation.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Intake screens at all facilities will comply with NMFS criteria by the Corps of Engineers design. IDFG monitors and maintains SFH 24 hours a day and is responsible for emergency actions. The YFCSS will be monitored and occupied 24 hours a day and will be equipped with similar emergency systems.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

YFCSS broodstock collection will consist of either naturally spawned or hatchery-produced adults, dependent on run size, captured at the Yankee Fork weir. The Yankee Fork portable picket weir is scheduled to be installed in the summer of 2008 and, thereafter, when flow drops to a level for safe installation. Weir site selection will be dependent on ease of access, installation, operation, and protection from vandalism.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Smolt

Three possible methods are available for smolt transfer: two-ton trucks, helicopters, or tanker trucks. Two-ton trucks would require numerous truck loads; helicopter releases are not viable for large releases, but may be useful for low production broodyears at SFH. Tanker trucks are considered the favorable approach for smolt transfer to Yankee Fork.

Transportation of smolt will be conducted using a 5,000 gallon capacity tanker truck. Five tanks of 1,000 gallons with 6°C water and fish size of 20 FPP can safely hold 26,112 smolts per tank for a total of 130,560 smolts per load. Three trips would safely stock approximately 391,680 smolts.

Distance from SFH to the stocking site is approximately 26 miles. Safe travel time would be one hour, dependent on road conditions. Smolt loading cannot occur at SFH until 10:00 a.m. during winter weather conditions, therefore, estimating completion of one stocking trip (SFH to SFH) by 12:00 p.m.

Adult

Prior to developing the YFCSS satellite facility, adults will be transported using a 2,100 gallon capacity two-ton truck to either SFH and/or East Fork satellite facility for holding and spawning. The truck has three tanks of 700 gallon capacity with 6^{o}C water and is insulated to minimize environmental effects on water temperature. Each tank contains a rear release gate allowing adult fish to be released directly into the holding ponds. Normal hauling guidelines for adult fish are approximately one pound of fish per gallon of water.

Eggs

Eggs will be placed in individual containers to maintain separation from other female eggs. Containers will be placed in 80 quart sealed, insulated coolers for transportation. Ice is added to each cooler to keep eggs chilled during transport.

5.3) Broodstock holding and spawning facilities.

Sawtooth Fish Hatchery

Fish volitionally migrate into the trap at the SFH where they are manually sorted into proper holding raceways. Each raceway is 167 ft. long x 16 ft. wide x 5 ft. deep and capable of holding 1,300 adults. Spawning is conducted in an enclosed building.

YFCSS
Adult spring chinook are collected at the YFCSS weir. The facility will consist of a removable weir, fish trap, two adult holding ponds (10 ft x 90 ft x 5 ft), and covered spawning area. The holding capacity for the facility is approximately 1,000 adult salmon. Adults are collected and spawned at this facility. Fertilized eggs are transported to the SFH for incubation, hatch, and rearing through release.

5.4) Incubation facilities.

Incubation will occur at SFH, which is owned by the USFWS-LSRCP and operated by the Idaho Department of Fish and Game. Egg incubation will occur in forty-two 8-tray stack, vertical flow incubators in SFH. Incubation facilities at SFH consist of 100 stacks of incubator frames containing 800 incubation trays.

5.5) Rearing facilities.

Rearing of YFCSS progeny will occur at the SFH.

Inside Rearing – Ten tanks of 17 cubic feet and a capacity of 15,000 swim up fry. Six additional tanks with a capacity for 30,000 fry each. There are also thirteen, 391 cubic feet rearing vats capable of holding 100,000 fry.

Outside Rearing – Twelve fry raceways of 750 cubic feet and 28 production raceways capable of raising 100,000 chinook fry to smolts.

5.6) Acclimation/release facilities.

Acclimation of smolts for release into Yankee Fork is considered negligible. Presently, acclimation facilities for the YFCSS have not been constructed. However, Pond Series 1 and 4 will be used as acclimation site facilities for the lower Yankee Fork release site.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

SFH broodyear 1992 spring chinook salmon developed an epizootic condition of apparent mycotic nature. These individuals were released earlier and resulted in smolt release survival of 50.4%.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

Sawtooth Fish Hatchery

SFH is continually staffed and equipped with an all-purpose alarm system. Generators are in place for emergency and water supply can be switched to gravity flow when necessary. Appropriate protocols are in place for emergency situations and methods for disinfection.

YFCSS

Once the YFCSS is fully operational, facilities and operations will be monitored full time by SBT personnel. Adult holding and smolt acclimation facilities will be equipped with back-up pumps in case of low water events.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

Initially, YFCSS will be dependent upon SFH broodstock for smolt release into Yankee Fork. Once the YFCSS weir has been installed, broodstock collection will be derived from both naturally spawned and hatchery-produced returning adults to meet broodstock collection goals. At all levels of adult returns, a proportion will be released upstream of the weir to spawn naturally.

6.2) Supporting information.

6.2.1) History.

Yankee Fork Salmon River is located within the boundaries of the Salmon-Challis National Forest in Custer County, Idaho. Yankee Fork is a fourth field HUC watershed and a major tributary of the Salmon River.

Historically, the Yankee Fork drainage was a main supply source of anadromous fish, composed primarily of chinook salmon and steelhead trout. Runs of these species have been drastically reduced due to a combination of downstream hydroelectric developments and localized mining activities (Reiser and Ramey 1987). Mining has resulted in stream re-channeling, deposition of extensive amounts of dredge piles, and degraded rearing and spawning habitat in lower Yankee Fork.

Generally, spring chinook would historically enter the Columbia River during March – May and spawn in the Yankee Fork in August and September (Bjornn 1960). Currently, the diminished run of chinook salmon in the upper Salmon River and Yankee Fork has dramatically reduced an important subsistence and ceremonial fishery for the Shoshone-Bannock Tribes.

Redd counts have consistently declined from a high of 600 for the whole drainage in 1967 (Konopacky et al. 1986). In the mid-1980's, redd counts were zero for upper Yankee Fork (Pollard 1985) and 10 for the entire region (Konopacky et al. 1986). From 2000 – 2004, redd counts averaged 80 per year (Ray unpublished data) resulting in only 200 estimated adults (2.5 spawners/redd) and 48,600 estimated smolts (243 smolts/redd). Average smolt capacity from three models (Reiser and Ramey 1986; NPPC 1988) indicates Yankee Fork is capable of supporting 417,135 smolts.

The Yankee Fork system is an important subsistence, ceremonial treaty-guaranteed anadromous fishing area for the SBT. Presently, this is in jeopardy. The TRT (2005) has classified the Yankee Fork spring chinook salmon population at high risk, needing 500 spawning individuals and 1,000 escaping adults to once again become a viable population.

6.2.2) Annual size.

YFCSS broodstock collection goals will range from 2 – 200 adults (assuming equal sex ratio), depending on return size. A proportion of adults will be allowed to spawn naturally above the weir independent of run size (sliding scale); Table 2.

6.2.3) Past and proposed level of natural fish in broodstock.

There has been no broodstock collected for the YFCSS program to date. Future broodstock collection will favor naturally spawned adults to limit hatchery artificial selection. However, due to limited return numbers of adult chinook, broodstock goals will be met with both hatchery and naturally produced adults.

6.2.4) Genetic or ecological differences.

Annual hatchery-produced populations and source populations are genetically similar. (May be different with new TRT information) Since YFCSS broodstock will be obtained at the Yankee Fork weir, there should not be any genetic or ecological differences in populations.

6.2.5) Reasons for choosing.

The upper Salmon River endemic spring chinook stock was selected for the YFCSS program. This population is available and poses the least amount of risk to other upper Salmon River stocks. The SBT goal is to restore the Yankee Fork spring/summer Chinook salmon population and once again provide subsistence and ceremonial fisheries to the tribes.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Artificial selection is difficult to avoid while restoring a diminished natural population. Due to run size, goals are in place to maximize the number of natural-origin adults allowed to spawn above the weir. When selection of naturally spawned adults is necessary, broodstock collection will conform to the federal ESA guidelines and permits. The YFCSS program will attempt to additionally limit the effects of artificial selection by randomly selecting broodstock.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults
General production adults (hatchery x hatchery) will be collected at SFH for smolt production to be released in Yankee Fork. Once sufficient adults return to Yankee Fork, adult crosses (wild x hatchery) will be spawned to create supplementation smolts released into the Yankee Fork Salmon River.

7.2) Collection or sampling design.

Adults captured at the weir will be sampled and information will be recorded: time, date, location, and length. Broodstock will be randomly collected throughout the entire run to alleviate artificial selection. Guidelines for sampling are as follows:

1.) Weir installed yearly at earliest possible safe flow levels.

2.) Adequate personnel will be present at all times for proper weir and trap operation.

3.) Broodstock collected over entire run.

4.) 102 pairs collected dependent upon SAR average.

5.) Natural fish take priority to spawn upstream.

6.) NOR individuals take first priority for broodstock.

7.) HOR individuals comprise remaining broodstock levels.

8.) Surplus H x W adults released to spawn naturally.

9.) Adults sampled for DNA typing and parentage analysis.

7.3) Identity.

Only one spring chinook salmon aggregate is recognized in Yankee Fork. Hatchery produced adults will be identified by PIT tags, coded-wire tag, or tissue sampling. Adults without marks will be deemed NOR.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

Approximately 102 female and 102 male spring chinook salmon are needed annually to achieve a release objective of 350,000 smolts and 1,050 returning adults.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

No broodstock has been collected under the YFCSS program. SFH broodstock was used to produce 135,934 smolts in 2006 for release into Yankee Fork.

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Surplus hatchery-origin fish will be released above the Yankee Fork weir for natural spawning. There will be no limits placed on the number of hatchery-reared adults allowed to spawn naturally within Yankee Fork. All collected fish in excess of the number required for broodstock purposes will be immediately released above the Yankee Fork weir for natural spawning.

7.6) Fish transportation and holding methods.

In the interim, the YFCSS project will depend on transporting adult spring chinook salmon from Yankee Fork weir to 1) East Fork Salmon River satellite facility or 2) SFH adult holding facility. Long-term adult holding and spawning facilities will be designed for location in Yankee Fork.

Smolt transfer from SFH to Yankee Fork will occur by tanker truck transportation. If the YFCSS facilities are not complete by the summer of 2008, adults will be transferred by two-ton trucks to East Fork or SFH holding facilities. Fish transportation and holding facilities are described in section 5.2 and 5.3.

7.7) Describe fish health maintenance and sanitation procedures applied.

YFCSS fish health maintenance, monitoring, disease control, and sanitation will conform to the protocols and procedures of the Sawtooth Fish Hatchery under the Idaho Department of Fish and Game.

Adults

Adults will initially be inspected for any external fungi, which is a possible sign of ectoparasitic infestation. Samples for viral, bacterial, and parasitic disease agents will be taken at spawning. Viral assays are conducted on ovarian fluid and kidney samples from a number of spawned females characteristic of the broodstock are analyzed in bacterial assays. Whirling disease will be tested for by obtaining head wedges from a proportion of the spawning broodstock.

Eggs
After fertilization and before being placed in incubation trays, eggs are rinsed in pathogen free water and cleansed with a 100 parts per million (ppm) buffered iodophor solution for one hour.

Pre-spawn Mortalities
Necropsies are conducted based on the guidelines by the Idaho Department of Fish and Game.

7.8) Disposition of carcasses.

Adult holdings will be checked once an hour on a daily basis by trap tenders. Mortalities will be removed and data will be collected on date, time, sex, cause of death (if known), and body condition. Biological samples will be collected and placed in proper containers for later analysis. Mortalities will then be spread across the spawning habitat to help replenish depleted marine nutrients in the system.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

Broodstock collection for the YFCSS program will comply with an issued ESA section 10 permit, IDFG, and mitigation and supplementation guidelines and goals. Natural spawning production and escapement will take priority over hatchery broodstock retention. For any returning run size, there will be a minimum number of adults released above the weir for natural spawning. Disease transfer will be controlled by a systematic health monitoring and evaluation program for all age classes used in the YFCSS.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Three groups of chinook salmon will be collected at the YFCSS weir: NOR, NOR/HOR, and HOR. Naturally spawned adults will not be marked. Supplementation adults (NOR/HOR) will be PIT tagged and/or coded-wire tagged. General production fish will also be PIT tagged and/or coded-wire tagged. Fish will be classified into one of the groups and numbered based on capture order. Broodstock will be collected in pairs to maintain a 1:1 spawning ratio of males to females. Coded-wire tag identification or genetic sampling can determine individual relatedness to limit artificial selection and maximize genetic variability by mating unrelated fish.

8.2) Males.

Males will only be spawned once. In cases of unequal broodstock collection, male holding mortality exceeds female, or late male maturation, males may be spawned twice.

8.3) Fertilization.

Spawning will occur by means of three mating schedules depending on the number of adult returns.

Single pair mating (1:1 male to female spawning) will be utilized when there are 10 or more returning adult pairs (≥ 20 adults). Maturing fish will be randomly paired with an unrelated individual of the opposite sex.

When adult returns are below 10 pairs (< 20 adults), diallel or systematic mating will be used. This mating will distribute diversity among progeny by mating each female with every male. Eggs from each female will be split into separate sub-groups and fertilized with the milt of each male. In both methods, backup males will be retained to ensure fertilization. Excess males will be held over for the next spawning date or be segregated for gamete cyropreservation.

8.4) Cryopreserved gametes.

The Tribes strive to ensure availability of a representative genetic sample of original male population by establishing and maintaining a germplasm repository. Gamete cryopreservation permits the creation of a genetic repository, but is not a cure for decreasing fish stock problems. Gamete samples will be collected and shipped to storage facilities for genetic processing within 24 hours.

Milt will be cryopreserved from transported broodstock NOR males for future spawning. Also, milt will be cryopreserved from adults captured during the second peak (assuming there is a bi-modal distribution) of migration when spawning is occurring.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

Single pair mating will limit apparent artificial selection by randomly selecting a male to fertilize a “ripe” female. Diversity is distributed among progeny through diallel or systematic mating by fertilizing female egg sub-groups with every male. Random backup males will be present to ensure fertilization and also increase genetic diversity through use of multiple males. Disease control mechanisms are in place to limit the incidence of BKD and fungus related mortality. In addition, cryopreserved milt will be used to maximize NOR genetic diversity in YFCSS program.

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. “egg to smolt survival”) that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

YFCSS is currently not functioning and, consequently, survival rates between life stages have yet to be determined. The YFCSS program anticipates survival rates to be similar to those at SFH. SFH green-egg to eyed-egg survival for broodyears 1986 – 2003 is reported below in Table 11 (SFH Reports 1986-03).

Table 16. Sawtooth Fish Hatchery gamete survival for broodyears 1986-2003 (SFH Reports 1986-2003).

Broodyear	Green Eggs Taken	Eyed-eggs	Survival to Eyed Stage (%)
1986	2,035,535	1,870,306	91.9
1987	2,721,399	2,533,640	93.1
1988	3,120,669	2,846,235	93.1
1989	733,365	668,373	91.1
1990	1,431,360	1,346,350	94.1
1991	922,000	794,800	86.2
1992	468,300	423,600	90.5
1993	369,340	341,641	92.5
1994	29,933	26,232	87.6
1995	7,377	4,977	68.0
1996	51,743	45,128	87.0
1997	260,480	231,827	89.0
1998	139,469	129,593	93.0
1999	63,642	59,373	93.3
2000	454,355	420,733	92.6
2001	1,529,051	1,371,733	89.7
2002	1,037,558	920,651	88.7
2003	174,575	145,744	83.5

9.1.2) Cause for, and disposition of surplus egg takes.

The YFCSS does not consider excess amounts of eggs, parr, or smolts as useless/expendable “surplus.” Excess eggs, parr, or smolts will be out planted in Yankee Fork if survival rates are exceeded between life stages or fecundity is elevated.

9.1.3) Loading densities applied during incubation.

Eight trays will be used per stack of vertical incubation units. Flows to each eight tray stack will be between five to six gallons per minute (gpm). Trays will be loaded with eggs (3,000 – 5,000) from only one female.

9.1.4) Incubation conditions.

Incubation for the YFCSS will occur at the Sawtooth Fish Hatchery. During all incubation periods and processes, pathogen-free well water is used. Catch basins are in place to eliminate the accumulation of silt and sand within the trays. After 48 hours, formalin treatments (1667 ppm) are issued three times per week to control fungal contamination and are discontinued when eggs reach eye-up. Eyed egg stage is generally reached at 560 FTUs at which eggs are then shocked to locate and remove dead or unfertilized eggs.

9.1.5) Ponding.

Ponding occurs once majority of fish reach swim-up stage at approximately 1,650 FTUs.

9.1.6) Fish health maintenance and monitoring.

Eggs will be treated with a formalin solution (1667 ppm) three times per week to control fungal growth. Formalin treatments will be administered until the eggs reach the eyed-up stage. Shocking will be conducted around 560 FTUs. Dead and undeveloped eggs will be removed by an automatic egg picking machine. Good eggs will be electronically counted and returned to the same tray and stack location. Additional egg picks are conducted to remove any uncollected dead eggs. Tray lids and screens will be cleaned during each egg picking event.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

No adverse genetic or ecological effects to listed fish are expected. Density dependent mortality and disease transmission will be countered by placing female eggs in separate trays. Eggs are treated with formalin (1667 ppm) and water hardened in a 100 ppm Iodophor solution for 30 minutes following fertilization. Alarms and sensors are in place for low pressure and water levels.

9.2) Rearing:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.

YFCSS program rearing will occur at the SFH. The YFCSS program expects rearing survival data to be similar to those of SFH. Rearing conditions for the YFCSS will be equivalent to natural conditions so there is no advantage for either wild or hatchery-produced juveniles. Survival data is presented below in Table 12 (SFH Reports 1986 – 03).

Table 17. Sawtooth Fish Hatchery gamete rearing efficiency for 1986-2003.

BY	Eyed-Eggs	Ponded Fry	% Survival from Eye	Smolts Released	% Survival from Eyed to Release
1986	1,870,306	1,821,872	97.4	1,705,500	91.2
1987	2,533,640	2,487,500	98.2	2,338,244	92.3
1988	2,846,235	2,818,312	99.0	2,541,500	89.3
1989	668,373	667,900	99.9	652,600	97.6
1990	1,346,350	1,316,048	97.7	1,273,400	94.6
1991	794,800	793,908	99.9	774,583	97.5
1992	423,600	441,812	NA	213,830	50.5
1993	341,641	341,252	99.9	334,313	97.9
1994	26,232	25,632	97.7	25,006	95.3
1995	4,997	4,914	98.3	4,756	95.2
1996	45,128	44,600	98.8	43,161	95.6
1997	231,827	228,997	98.8	223,240	96.3
1998	129,593	127,064	98.0	123,425	95.2
1999	59,373	59,111	99.6	57,134	96.2
2000	420,733	402,777	95.7	385,761	91.7
2001	1,371,133	1,213,215	88.5	1,105,169	80.6
2002	920,651	879,040	95.5	821,415	89.2
2003	145,744	136,830	93.9	134,769	92.5

9.2.2) Density and loading criteria (goals and actual levels).

Following the conclusions of Piper et al. (1982) and operations at Sawtooth Fish Hatchery, density and flow indices are monitored to never exceed 0.30 and 1.5, respectively.

9.2.3) Fish rearing conditions

Swim-up fry are transferred to vats around 1,650 FTUs. Flows range between 20 and 110 gpm, increasing as fish grow. Water temperature ranges from 4.4 to 7.8°C and is supplied from pathogen-free wells. Outside raceways are supplied with river water ranging from 1.1 to 16.0°C. Spring chinook are relocated outside at approximately 7.6 mm. Flows and raceway size sections are proportionately increased as fish grow.

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

Average length, mass, fish/pound, and condition factor for chinook salmon at ponding, vat to raceway, and release is presented in Table 13. Length, mass, and condition factor are calculated from the fish per pound value.

Table 18. Average size by period for chinook salmon reared at SFH.

Time Period	Length (mm)	Mass (g)	Fish/lb	Condition Factor
Ponding	35	1.27	1,200	3.00
Vat to Raceway	76	14.27	130	3.25
Release	140	96.04	15	3.50

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

See Section 9.2.4 above.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

All fry are started on BioProducts Bio-Diet starter feed # 2 and #3. Fish are initially fed by hand. Once a response is seen, feeding commences with an automatic belt feeder. Feed amounts and sizes will vary depending on the manufacturer recommendations as fish grow (Table 14). BioProducts grower feed is administered once fish are transferred to outside raceways.

Table 19. Fish/pound, % body weight fed, feed size and term in culture information.

Fish/pound	% Body weight fed/day	Feed Size	Term in culture
Swim-up to 800 fpp	3.5	#2/#3 starter	Nov. – Jan.
800 – 500	3.3	#3 starter	Jan. – Feb.
500 – 400	2.5	1.0 mm	Feb. – March
400 – 350	2.5	1.0/1.3 mm	March – April
350 – 300	2.3	1.3 mm	April

300 – 250	2.2	1.3 mm (med)[1]	May – June
250 – 150	2.4	1.5 mm	June
150 – 110	2.4	1.5 mm	June – July
110 – 90	2.5	1.5 mm	July – August
90 – 50	2.2	2.5 mm	August – Sept.
50 – 17	2.0	2.5 mm	Sept – Oct.
17 to release	maintenance	3.0 mm (med)[1]	Oct. – release

[1]Medicated feed

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Hatcheries could potentially introduce diseases into the natural environment. Disposal of wastes or pathogen-contaminated water elevates the risk for fish to contract diseases. The IDFG fish health staff will conduct scheduled inspections and random ones if necessary. Individuals may be given injections of Erythromycin-200, oxytetracycline, or other prophylactic treatments to counter specific diseases, however consideration to Tribal fisheries will dictate treatments. During rearing, juveniles will be fed two meals of medicated feed. Disinfection protocols for foot baths, equipment, trucks, vats, raceways, and nets are in place for sanitation purposes.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

Not Applicable

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

Rearing conditions of YFCSS hatchery juveniles will be as consistent with natural conditions as possible. In theory, rearing raceways containing natural substrate, structure, feeding mechanisms, temperature, flow velocities, light, and densities will produce fish with characteristics similar to wild counterparts. Currently, the LSRCP is conducting ongoing Hatchery Evaluation Studies on this subject.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

Proper disinfection procedures, antibiotic treatments, and egg culling criteria will be used to limit the spread of disease. Fish observation and raceway cleaning will be conducted on a regular basis. Artificial selection should be limited by rearing juveniles consistent with natural conditions.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Table 20. Proposed release number and size for the YFCSS.

Age Class	Maximum Number	Size (fpp)	Release Date	Location	Rearing Hatchery
Eggs					
Unfed Fry					
Fry					
Fingerling					
Yearling	350,000	20 FPP	4/1 – 4/30 Annually	Yankee Fork	Sawtooth

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Yankee Fork
Release point: Eightmile or Jordan Creek Confluence & Pond Series 1 and/or 4
Major watershed: Yankee Fork Drainage of the Salmon River
Basin or Region: Salmon River Basin

10.3) Actual numbers and sizes of fish released by age class through the program.

In 2006, 135,934 smolts were released in Yankee Fork. Prior releases by the IDFG are also included in the Table 10.

10.4) Actual dates of release and description of release protocols.

Yankee Fork has a long history of artificial production (Table 10). With no long-term monitoring and evaluation little information exists on the effects of NOR population as a result of artificial production. Further information is presented below in Table 16 on release year, hatchery, life stage, and date of release for Yankee Fork.

YFCSS salmon will be released in the month of April coinciding with changes in length of day, discharge, temperature and noticeable physiologically and morphological changes of smolt. Generally, in the third week of April there is a noticeable physiological change in the fish. Fish will be allowed to volitionally emigrate. Those fish that choose not to leave will be forced from the truck.

Table 21. Yankee Fork Chinook salmon artificial propagation history 1987-2006.

Release Year	Rearing Hatchery	Life Stage	Date Released
1987	Sawtooth	pre-smolt	6/1987
1988	Sawtooth	smolt	3/14 – 3/18/1988
1989	Sawtooth	smolt	3/21/1989
1990	Sawtooth	smolt	3/20/1990
1990	Yakima	fry-fingerling	7/20/1990;10/10/1990
1991	Sawtooth	fry-fingerling	9/1991
1994	Sawtooth	smolt	10/1994
2006	Sawtooth	smolt	4/3 – 4/21/2006

10.5) Fish transportation procedures, if applicable.

See section 5.2

10.6) Acclimation procedures (*methods applied and length of time*).

All spring chinook salmon juveniles at SFH are reared on river water and the Idaho Fish and Game and Shoshone-Bannock Tribes agreed that acclimation is negligible. Smolts released into Pond Series 1 and/or 4 will be allowed to volitionally emigrate into the main stem. Smolts released at Jordan Creek or Eightmile confluence will be direct stream releases.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

The YFCSS does not support adipose fin clipping or any other fin removal for monitor and evaluation purposes. The goal of the YFCSS is to return fish for population recovery and harvest. Generally, fish intended for harvest interception are marked with an adipose fin clip. Adipose fin clipping Yankee Fork juveniles could, and probably will, further decrease smolt to adult return rates due to sport fisheries in other regions.

Passive integrated transponders (PIT tags) will be injected into 15% of juveniles prior to release to monitor survival and dispersal to Lower Granite Dam by using the SURPH model. PIT tags will also provide ability to predict annual returns and allow the YFCSS to develop annual spawning and harvest plans. Approximately 85% juveniles (all non-PIT tagged) will receive a coded-wire tag (CWT). Tissue samples will be collected from parent broodstock to generate a genetic parental assignment database.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Excess smolt production above the program goal will additionally be released into the Yankee Fork. If hatchery operations are negatively affected due to increased densities, a randomly selected proportion of eggs or parr will be released into Yankee Fork.

10.9) Fish health certification procedures applied pre-release.
Testing for bacterial kidney disease, whirling disease, and viral replicating agents will be conducted under the Idaho Fish and Game Eagle Fish Health Laboratory between 45 and 30 days prior to release to obtain fish health certification.

10.10) Emergency release procedures in response to flooding or water system failure.

The YFCSS will follow the emergency release procedures and protocols developed for the SFH.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

YFCSS actions taken to minimize adverse effects on listed fish include:

1.) Follow the health practices, procedures, and guidelines in place at the Sawtooth Fish Hatchery.

2.) Select proper release sites to utilize excellent spawning and rearing habitat.

3.) Program smolt releases with noticeable physiological changes in fish and natural rising water levels.

4.) Maintain rearing condition as equivalent as possible to those in the natural environment.

5.) Annual collection of broodstock with characteristics similar to historically evolved populations.

6.) Help Idaho Fish and Game and Sawtooth Fish Hatchery conduct continuing Hatchery Evaluation Studies.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

See section 1.10.1 and 1.10.2

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

The Shoshone-Bannock Tribes monitor and evaluation program will need to be fully funded and appropriately staffed to achieve the goals and objectives of the YFCSS.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

The YFCSS weir will be constantly monitored to limit the holding period and minimize adverse impacts to ESA-listed spring Chinook salmon and other listed species. Handling and tagging activities will be conducted to minimize injuries, stress, and mortality. Monitor and evaluation procedures include redd counts, creel surveys, carcass recoveries, tissue sampling, and density and abundance analyses to determine effects to listed fish.

SECTION 12. RESEARCH

12.1) Objective or purpose.

See Appendix A

12.2) Cooperating and funding agencies.

U.S. Fish and Wildlife Service – Lower Snake River Compensation Plan Office
IDFG

12.3) Principle investigator or project supervisor and staff.

Name (and title): Lytle P. Denny, Anadromous Fish Manager.
Agency or Tribe: Shoshone-Bannock Tribes.
Address: 3rd and B Avenue, P.O. Box 306, Fort Hall, ID 83203.
Telephone: (208) 239-4560 or cell 221-9058.
Fax: (208) 478-3986.
Email: ldenny@shoshonebannocktribes.com

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

Not Applicable.

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.

Research techniques for the monitor and evaluation of the YFCSS include: hatchery operations, tissue and scale sampling, abundance and density, harvest monitoring, and juvenile out-migration and adult returns.

Hatchery Operations
IDFG, LSRCP, and SFH staff monitors hatchery conditions (diet, ration, vat or raceway environmental conditions, growth, survival rates, mortalities, disease) and evaluate hatchery-related research.

Tissue and Scale Sampling
Broodstock males and females sampled for genetic analysis and parental assignment. Male samples obtained through a operculum punch; samples from females taken from a caudal fin clip. Scale samples obtained for age and life history determination as a contingency to tissue samples. Proportion of natural-origin juveniles are tissue sampled prior to out-migration to determine proportion of w x w, w x h, h x h produced offspring. Un-marked adults sampled at the Yankee Fork weir will also be tissue sampled to determine origin. All samples stored in 95% ethanol for later analysis. A DNA parentage analysis will reveal relative productivity of wild and hatchery F1 and F2 juveniles and adults.

Abundance and Density
Determine stratified random sampling sites in Yankee Fork to collect naturally spawned chinook salmon above the Yankee Fork weir. Electroshocking used in accordance with NMFS ESA permits. Location, fork length, and mass of each individual recorded. Fin tissue and scale samples taken from juveniles to link to adult parents and broodyear.

Harvest Monitoring
Conduct creel surveys and estimate total chinook catch. Obtain tissue sample, fork length, gender, CWT, or PIT information from harvested chinook. Provide Shoshone-Bannock tribal fisherman with scale envelops to preserve scales from harvested fish not surveyed and sampled. Total fish harvested, pressure, and CPUE estimated yearly.

Juvenile Out-migration and Adult Returns
A proportion (15%) of hatchery smolts released are PIT tagged to monitor dispersal, emigration, and arrival at Lower Granite Dam by using the SURPH model. In addition, natural produced smolts will be PIT tagged to detect survival differences between life stages for hatchery and naturally produced offspring. Adult returns are monitored through dam and weir counts, creel surveys, CWT information, redd surveys, spawning surveys, and carcass recoveries.

12.6) Dates or time period in which research activity occurs.

Hatchery conditions and research are monitored daily and throughout the year by IDFG, LSRCP, and SFH staff and personnel.

Tissue and scale sampling is conducted yearly for broodstock, smolt release, harvest monitoring, and electrosampling. Random sampling for abundance and density above the Yankee Fork weir completed yearly, generally during late spring and summer.

Harvest information through creel surveys is collected during the time of tribal fisheries. Mail surveys sent out after closure of season and compared to harvest information collected during fishing period.

Adult escapement is monitored at dams, traps, and through surveys throughout most of the year. Smolt emigration monitored from March through December. PIT tag and coded-wire tag queried from informational systems throughout the year.

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.

See section 9.

12.8) Expected type and effects of take and potential for injury or mortality.

See Table 17. Generally, take for research activities are defined as: "observe/harass", "capture/handle/release" and "capture, handle, mark, tissue sample, release."

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table."

See Table 17.

12.10) Alternative methods to achieve project objectives.

No alternative methods to achieve research objectives were/have been developed or initiated.

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

Not Applicable.

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

See Section 11.2.

SECTION 13. ATTACHMENTS AND CITATIONS

Literature Cited:

Achord, S.A., M.B. Eppard, E.E. Hockersmith, B.P. Sanford, G.A. Axel, and G.M. Mathews. 2000. Monitoring the migrations of wild Snake River spring/summer chinook salmon smolts, 1998. Prepared for the Bonneville Power Administration. Project 9102800, Contract DE-AI79-91BP18800. Portland, OR.

Berggren, T.J. and L.R. Basham. 2000. Comparative survival rate study (CSS) of hatchery PIT tagged chinook. Status Report for migration years 1996 – 1998 mark/recapture activities. Prepared for the Bonneville Power Administration. Contract No. 8712702. Portland, OR.

Bjornn, T.C. 1960. The Salmon and Steelhead Stocks of Idaho. Idaho Department of Fish and Game.

Bjornn, T.C., D.W. Ortmann, D. Corley, and W. Platts. 1964. Salmon and Steelhead Investigations. Idaho Department of Fish and Game. Federal Aid in Fish Restoration, Annual Progress Report, Project F-49-2-2.

Denny, L. P., K. Witty, and S. Smith. 2006. A monitoring and evaluation plan for the Shoshone-Bannock Tribes: Hatchery supplementation activities Yankee Fork; Salmon River sub-basin. Draft Review Shoshone-Bannock Tribes, Department of Fisheries Resources Management.

Everest, F.E. 1969. Habitat selection and spatial interaction of juvenile chinook salmon and steelhead trout in two Idaho streams. Ph.D. Dissertation. University of Idaho, Moscow, ID.

Hall-Griswold, J.A. and C.E. Petrosky. 1997. Idaho habitat/natural production monitoring, part 1. Annual Report 1996. Prepared for the Bonneville Power Administration. Project No. 91-73, Contract DE-BI79-91BP21182. Idaho Department of Fish and Game. Boise, ID.

Hampton, M. 1988. Development of habitat preference criteria for anadromous salmonids of the Trinity River. U.S. Fish and Wildlife Service. Sacramento, CA.

Hansen, J.M. and J. Lockhart. 2001. Salmon supplementation studies in Idaho rivers. Annual Report 1997 (brood years 1995 and 1996). Prepared for the Bonneville Power Administration. Project 8909802. Portland, OR.

Healey, M.C. 1991. Life history of chinook salmon. Pages 311-393 In Croot, C. and L. Margolis, ed: Pacific Salmon Life Histories. University of British Columbia Press, Vancouver, B.C. Canada.

Heiberg, E.R. 1975. Lower Snake River Fish and Wildlife Compensation Plan, Washington and Idaho: Special Report. Department of the Army.

Interior Columbia Basin Technical Recovery Team. 2003. Draft. ICBTRT: Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs.

Interior Columbia Basin Technical Recovery Team. 2005. Draft. ICBTRT: Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs.

Idaho Department of Fish and Game (IDFG), Nez Perce Tribe, Shoshone-Bannock Tribes. 1990. Salmon River Subbasin salmon and steelhead production plan. Columbia Basin System Planning.

Kiefer, S.W. 1987. An annotated bibliography on recent information concerning chinook salmon in Idaho. The Idaho Chapter of the American Fisheries Society.

Kiefer, R.B., J. Johnson, and D. Anderson. 2001. Natural production monitoring and evaluation: monitoring age composition of wild adult spring and summer chinook salmon returning to the Snake River Basin. Prepared for the Bonneville Power Administration. Project No. 91-73, Contract No. BP-94402-5. Idaho Department of Fish and Game. Boise, ID.

Konopacky, R. C., P. J. Cernera, and E. C. Bowles. 1986. Salmon River Habitat Enhancement. Annual Report FY 1985, Part 1 or 4, Subproject III: Yankee Fork Salmon River. Shoshone-Bannock Tribes Report to Bonneville Power Administration.

Kucera, P.A. and M.L. Blenden. 1999. Chinook salmon spawning ground survey in Big Creek, and tributary streams of the South Fork Salmon River, Idaho 1992-1995. Assessment of the status of salmon spawning aggregates in the Middle Fork Salmon River and South Fork Salmon river. Technical Report 99-7. Nez Perce Tribe Department of Fisheries Resources Management. Lapwai, ID.

Matthews, G.M. and R.S. Waples. 1991. Status review for Snake River spring and summer chinook salmon. NOAA tech. Memo. NMFS F/NWC-200, 75p. National Marine Fisheries Service, Northwest Fisheries Science Center, Montlake, WA.

National Marine Fisheries Service (NMFS). 2000. Endangered Species Act Section 7 Consultation. Biological Opinion. Reinitiation of consultation on the operation of the federal Columbia River power system, including the juvenile fish transportation program, and 19 Bureau of Reclamation projects in the Columbia Basin.

Nelson, D.D. and J.L. Vogel. 2001. Monitoring and evaluation activities of juvenile and adult fishes in Johnson Creek. Annual Progress Report. Period Covered: January 1, 1998 to December 31, 1998. Nez Perce Tribe Department of Fisheries Resource Management. Lapwai, ID.

Northwest Power Planning Council (NPPC). 1988. Anadromous Species Presence/Absence Database.

Northwest Power Planning Council (NPPC). 2001. Draft Subbasin Summary for the Salmon Subbasin of the Mountain Snake Province.

Oosterhout, G.R. and P.R. Mundy. 2001. The doomsday clock 2001: an update on the status and projected time to extinction for Snake River wild spring/summer chinook stocks. Prepared for Trout Unlimited. Portland, OR.

Peery, C.A. and T.C. Bjornn. 1992. Examination of the extent and factors affecting downstream emigration of chinook salmon fry from spawning grounds in the upper Salmon River. Unpublished report, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, ID.

Performance Standards and Indicators for the Use of Artificial Production for Anadromous and Resident Fish Populations in the Pacific Northwest. January 17, 2001.

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.

Pollard, H.A. 1985. Salmon and Spawning Ground Surveys. Federal Aid in Fish Restoration, Job Performance Report. Idaho Department of Fish and Game, Project F-73-R-7.

Reiser, D. W. and M. P. Ramey. 1987. Feasibility plan for the enhancement of the Yankee Fork of the Salmon River, Idaho. Prepared for the Shoshone-Bannock Tribes, Fort Hall, Idaho. BPA contract No. 83-359.

Sawtooth Fish Hatchery

Alsager, R.D. 1993. 1988 Spring chinook salmon brood year report. Idaho Department of Fish and Game: 13-01.

Alsager, R.D. 1993. 1989 Spring chinook salmon brood year report. Idaho Department of Fish and Game: 13-02.

Chapman, J. and P. Coonts. 1993. 1990 chinook brood year report. Idaho Department of Fish and Game: 13-03.

Chapman, J. and P. Coonts. 1994. 1991 Spring chinook brood year report. Idaho Department of Fish and Game: 94-25.

Rogers, T. L. 1969. 1986 Spring chinook brood year report. Idaho Department of Fish and Game.

Rogers, T.L. 1990. 1987 Spring chinook salmon brood year report. Idaho Department of Fish and Game.

Snider, B.R. and P. Coonts. 1998. 1992 Spring chinook brood year report. Idaho Department of Fish and Game: 98-4.

Snider, B.R. and K. Schilling. 1998. 1993 Spring chinook brood year report. Idaho Department of Fish and Game: 98-18.

Snider, B.R. and K. Schilling. 1998. 1994 Spring chinook brood year report. Idaho Department of Fish and Game: 98-21.

Snider, B.R. and K. Schilling. 1998. 1995 Spring chinook brood year report. Idaho Department of Fish and Game: 98-22.

Snider, B.R. and K. Schilling. 1999. 1996 Spring chinook brood year report. Idaho Department of Fish and Game: 99-15.

Snider, B.R., K. Schilling, and S. Macy. 1999. 1997 Spring chinook brood year report. Idaho Department of Fish and Game: 99-31.

Snider, B.R., K. Schilling, and C. Rohrbacher. 2000. 1998 Spring chinook brood year report. Idaho Department of Fish and Game: 00-43.

Snider, B.R. and K. Schilling. 2001. 1999 Spring chinook brood year report. Idaho Department of Fish and Game: 01-30.

Snider, B.R. and J.A. Heindel. 2003. 2000 Spring chinook brood year report. Idaho Department of Fish and Game: 03-02.

Snider, B.R., J. Heindel, M. Hughes, J.D. Seggerman, and D. Munson. 2003. 2001 Spring chinook brood year report. Idaho Department of Fish and Game: 03-45.

Snider, B.R., R. Elmore, M. Hughes, H. Lehman, and D. Munson. 2004. 2002 Spring chinook brood year report. Idaho Department of Fish and Game: 04-34.

Snider, B.R., R. Elmore, M. Hughes, H. Smith, and D. Munson. 2005. 2003 Spring chinook brood year report. Idaho Department of Fish and Game: 05-53.

U.S. Fish and Wildlife Service (USFWS). 1992. Biological assessment of proposed 1992 LSRCP steelhead and rainbow trout releases. Unpublished report, Lower Snake River Compensation Plan Office. Boise, ID.

U.S. Fish and Wildlife Service (USFWS). 1993. Programmatic biological assessment of the proposed 1993 LSRCP program. Unpublished report, Lower Snake River Compensation Plan Office. Boise, ID.

Walters, J., J. Hansen, J. Lockhart, C. Reighn, R. Keith, and J. Olson. 2001. Idaho supplementation studies five year report 1992 – 1996. Project Report, Idaho Department of Fish and Game. Prepared for the Bonneville Power Administration. Report No. 99-14, Contract DE-BI19-89BP01466. Portland, OR.

SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the information provided is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____________________________ Date:_____________

Table 22. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Spring/Summer Chinook Salmon ESU/Population: Yankee Fork/Upper Salmon Mainstem Activity: YFCSS				
Location of hatchery activity: Yankee Fork and Sawtooth Fish Hatchery Dates of activity: Annually Hatchery program operator: Shoshone-Bannock Tribes				
	Annual Take of Listed Fish By Life Stage (*Number of Fish*)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)			1,050	
Collect for transport b)		350,000[4]	204[1]	
Capture, handle, and release c)			100%[2]	
Capture, handle, tag/mark/tissue sample, and release d)		15%[5]; 85%[6]		
Removal (e.g. broodstock) e)			2 – 200	
Intentional lethal take f)			204[3]	
Unintentional lethal take g)	67,680[7]	34,517[8]	Pre-spawn mortality varies and may be as high as 8%.	
Other Take (specify) h) Carcass sampling				

1. Maximum number of adults retained for broodstock.
2. All adults handled at weir.
3. Maximum take numbers annually, dependent on total adult return
4. Smolts transported from SFH to Yankee Fork for release.
5. 15% smolts PIT tagged prior to release.
6. 85% smolts CWT prior to release.
7. 15% mortality from egg to fry stage.
8. 9% mortality from juvenile to smolt release stage.

APPENDIX C. ABERNATHY FISH TECHNOLOGY CENTER FY2007 STREAMSIDE INCBATOR PROJECT REPORT

Pedigree analysis reveals relative survival and abundance of juvenile hatchery steelhead outplanted as eyed eggs in the Yankee Fork Salmon River, Idaho.

FY2007 Project Report

April 2008

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Table of Contents

List of Figures

List of Tables

Summary

The Shoshone-Bannock Tribes (Tribes) are currently conducting monitoring and evaluation (M&E) of steelhead trout (*Oncorhynchus mykiss*) supplementation activities in the Yankee Fork Salmon River (Yankee Fork), which includes the use of streamside incubators for rearing hatchery-origin (HAT) fish. Juvenile fish that hatch from eggs transplanted to streamside incubators have no physical HAT mark, and cannot be distinguished from natural-origin (NOR) fish. As a consequence, the success of the supplementation program and contributions to overall abundance of steelhead in the Yankee Fork has been difficult to evaluate. Information contributed through parentage analysis conducted in 2007 will begin to address the efficacy of supplementation and current limitations. Full parental genotypes (FPG) were generated from all Sawtooth Fish Hatchery (SFH) broodstock that was used to produce eggs outplanted into streamside incubators at three locations within the Yankee Fork Salmon River in 2006 (Figure 1). Multilocus genotypes were also compiled for age-0^+ juveniles (n=349), and age-1^+ juveniles (n=123) sampled from throughout the Yankee Fork in 2006 and 2007, respectively. Parentage analysis was used to determine the proportion of HAT progeny originating from streamside incubators among unknown sampled juveniles; fish with no identified parental match can be either NOR, resident, or smolt supplementation offspring. We identified 57 known age-0^+ HAT juveniles and five known age-1^+ HAT juveniles with an overall relative proportion of 0.131 HAT among all juveniles sampled through 2006 – 2007 (n=472). Relative abundance estimates for NOR (including resident fish) and additional HAT supplementation activities (i.e. smolt release) are necessary before the results of these genetic analyses can be interpreted to evaluate streamside incubator supplementation. We recommend continued genetic monitoring that includes temporally stratified sampling, rotary screw trap sampling, spawner abundance estimates (i.e. adult weir), and genetic sampling of HAT smolt releases.

Introduction

Historically, the Yankee Fork supported large spawning populations of steelhead trout that are a significant cultural, social and subsistence based resource for the Tribes. Many Snake River steelhead trout populations (and chinook salmon) have experienced significant declines coincident with construction of hydroelectric dams on the lower Snake and Columbia Rivers (Raymond 1988; Williams 1989). Smolt-to-adult return rates (SARs) among these populations fell from greater than 4% in the mid to late 1960's, when only four dams were in place, to fewer than 2% on average during the 1970's after the number of dams doubled. Loss of available rearing habitat is an additional limiting factor identified in the Yankee Fork and other tributaries of the Salmon River. Habitat restoration efforts have been implemented in Yankee Fork that include installation of dredge ponds and connecting channels (Richards et. al. 1992) that may prove beneficial to rearing of both NOR steelhead and supplemented HAT steelhead.

An intensive M&E plan was developed and implemented by the Tribes (Denny *et al.* 2006) to determine the success of steelhead trout supplementation in the Yankee Fork (e.g. adult-to-adult survival and recruitment), and initially the adaptive ability and survival of HAT juveniles will be critical toward this end. Supplementation activities employed by the Tribes include the use of streamside incubators that allow natural rearing and volitional release of HAT juvenile fry and a traditional HAT smolt release. Although high egg-to-fry survival in streamside incubators has been demonstrated (Solazzi *et al.* 1999; Denny and Tardy 2008), the adaptive processes affecting survival of juveniles (fry and parr) after release are unknown, and utilization of winter concealment and shelter habitat may favor better adapted NOR juveniles (Nickelson *et al*. 1992; Orpwood *et al*. 2004). As a consequence of modified selection within captive breeding programs, the genetic and phenotypic differences between HAT and NOR fish may result in decreased survival of HAT in the natural environment (Kostow 2003; Kostow 2004; Miller *et al*. 2004), or a fitness deficit among HAT relative to NOR steelhead (Araki *et al.* 2007; Chilcote *et al.* 1986; Chilcote 2003; Matala *et al.* 2005). The relative survival and recruitment of HAT juveniles originating from streamside incubators (reared in the natural environment) is not well documented.

In this report we provide results from the first year of a long-term genetic evaluation of steelhead trout supplementation in the Yankee Fork. During the first four years of our genetic evaluation, we will use genetic parentage analysis to determine HAT juvenile survival post-release and the efficacy of streamside incubators as a supplementation tool. The application of genetic parentage analysis involves the matching of multilocus genotypes (nuclear microsatellite DNA) between parental reproductive pairs and their progeny (Jones and Ardren 2003). The likelihood of correctly matching offspring to parents increases with the number of loci used and degree of polymorphism of those loci (Bernatchez and Duchesne 2000). Parentage is a powerful method valuable for making inferences about mating systems (Seamons *et al.* 2004), fitness related factors and relative productivity among HAT and NOR stocks (Blouin and Araki 2004), dispersal and migration (Paetkua *et al.* 2004), and grandparentage (Letcher and King 2001).

Methods

Broodstock Collection and Adult Spawning

Adult steelhead trout were trapped at the SFH during the spring of 2006 for general production purposes and the Yankee Fork supplementation programs including the streamside incubator program and steelhead smolt program. Adult steelhead were spawned following a one-to-one protocol and eggs were water hardened after 15-25 seconds upon fertilization. Gametes from two adult females were incubated in health trays on pathogen free well water at 43°C for approximately 45 days. Fin clips (~3mm^2) were collected from 52 mated pairs that produced gametes for Yankee Fork streamside incubators. Each tissue sample was stored in a separate vial containing 95% non-denatured pure ethanol, and labeled with an individual identification number.

Egg Planting

Streamside incubator earmarked gametes were incubated separately from general production fish. After approximately 45 days, eyed eggs were shocked and dead eggs or unfertilized eggs were removed. Eyed eggs were then transferred to streamside incubators for further incubation. Prior to loading and transfer to Yankee Fork, each lot (group of fish spawned on a given day) was enumerated and randomized. Eyed eggs were transferred on three separate occasions to streamside incubators; numbers ranging from 44,953 to 56,599 per streamside incubator. One streamside incubator was maintained at Jordan Creek and Greylock Creek, and two at Cearly Creek in the Yankee Fork watershed in 2006 (Figure 1; Table 1).

Juvenile Sampling

Juvenile sampling was conducted in the Yankee Fork drainage during September 13 – 14, 19 – 21, and October 11 – 13, in 2006 and September 12 – 13, 18 – 19, and October 2 – 5, 10 – 12, in 2007. The Tribes utilized Konopacky et al. (1985, 1986) to divide the drainage into seven distinct strata (Figure 1 & 2); three reaches were selected within each stratum except for stratum five which contained four reaches in 2007. Sites were randomly selected within for a variety of habitats (pools, glides, riffles) and ease of accessibility for an upper, middle, and lower location within each stratum, but did not include any dredge pond habitat. Field crews did not sample the West Fork Yankee Fork (stratum$^{\#}$6) in 2006, nor were eyed eggs outplanted in this major tributary. Sites were generally rectangular in shape, aligned with the shoreline, and divided into transects for habitat measurements. Sites were electrofished in an upstream direction between 20 – 30 minutes with one crew member electroshocking (Smith-Root, Inc. Pulsed DC LR-24 Backpack Electrofisher) and two to five others utilizing dip nets to capture fish drifting downstream under electronarcosis. Upstream and downstream ends of the sampling reach were blocked using 7-mm-mesh nets secured to the streambed with tri-pods and rebar, generally at habitat unit separations. Fin clips (~3mm^2) for genetic analysis were taken from a total of 349 age-0$^+$ juveniles and 123 age-1$^+$ juveniles sampled randomly from the Yankee Fork. Each tissue sample was stored in a separate vial containing 95% non-denatured pure ethanol, and labeled with an individual identification number.

Microsatellite Amplification

DNA was extracted from all samples following the methods described by Miller and Kapuscinski (1996). DNA samples were polymerase chain reaction (PCR) amplified and genotyped following the methods of Ardren *et al.* (1999), using the following 14 microsatellite locus primers: *μOmy1011UW* (Spies *et al.* 2005), *μSsa407* and *μSsa408* (Cairney *et al.* 2000), *μOcl1* (Condrey & Bentzen 1998), *μOgo4* and *μOgo3* (Olsen *et al.* 1998), *μOts4, μOts100, μOts3 and μOts1* (Banks *et al.* 1999), *μOki23* (Smith *et al.* 1998), *μOmy7iNRA* (K. Gharbi, and R. Guyomard, Unpublished), *μOmy77* (Morris *et al.* 1996), and *μSsa289* (McConnell *et al.* 1995).

QA/QC: data quality assurance and quality control

Laboratory error rate was determined through random re-sampling and duplicate genotypic analyses. Individual samples were chosen at random (every 10th sample) from among all broodstock and juvenile samples, DNA was re-extracted from tissue, and re-amplified and genotyped at 14 loci. We then aligned the original data (genotypic scores) with the scores generated from the duplicate analysis and calculated an error rate from the number of mismatches. Original data collection and collection of QA/QC data were conducted independently by different laboratory personnel.

Parentage Analysis

We first screened all samples for duplicate genotypes, which indicate temporal replicate sampling or low exclusion power of the test. We calculated the non-exclusion rate for our suite of markers using the computer program CERVUS version 3.0 (Marshall *et al.* 1998; Kalinowski *et al.* 2006). Assignments among broodstock and potential progeny were evaluated using the program WHICHPARENTS version 1.0 (Banks and Eichert 1999). The stringency level for analysis was set to allow for one mismatch between parent/progeny genotypes (i.e. 13/14 matching alleles from each parent). Because all parental pairs were known, all mismatches and single parent assignments were evaluated by direct genotypic comparisons between putative parents and progeny.

Descriptive Statistics

Eight sample groups were evaluated in population structure analyses: broodstock (n=104), assigned HAT progeny (n=62), stratum#1 (n=41), stratum#2 (n=98), stratum#3 (n=187), strata #4&5 (n=92), stratum#6 (n=31) and stratum#7 (n=23) (Figure 1 & 2). Small sample sizes among juvenile age classes precluded their separation for meaningful analyses. Allele frequencies were generated using the program CONVERT (Glaubitz 2004), and numbers of alleles, private alleles, observed and expected heterozygosities, and index of inbreeding (F_{is}; indicating heterozygote deficiency) were generated using GDA (Lewis and Zaykin 2001). Hardy-Weinberg Equilibrium (HWE) probability tests were conducted using GENEPOP (Raymond and Rousset 1995). Statistical significance (α) was adjusted for the number of simultaneous tests k (α/k for $\alpha = 0.05$) by the sequential Bonferroni correction (Rice 1989). The program FSTAT v2.9.3.2 (Goudet 1995) was used to calculate number of private alleles and allelic richness between the HAT and putative NOR groups; a private allele is one that is observed in only a single group, and allelic richness is a weighted estimate of the number of alleles per group, scaled to the smallest sample size.

Population differentiation

Significance testing of population pairwise F_{st} comparisons (θ; Weir and Cockerham 1984) was conducted using ARLEQUIN version 3.1 (Excoffier et al. 2005). The F_{st} statistic indicates the proportion of total variation attributed to differences among groups. A pairwise genetic distance matrix of Cavalli-Sforza and Edwards (1967) chord distances (CSE) was generated using the software program PHYLIP version 3.5C (Felsenstein 1992). The NEIGHBOR application in PHYLIP was used to generate an unrooted neighbor joining (NJ) phylogram of genetic distance, and the program MEGA2 was used for graphical display. We estimated the consistency or confidence of the phylogram topology using bootstrap resampling of the data to evaluate 1000 replicate topologies.

Results

Evaluating data error rate

We conducted QA/QC tests following complete data collection that included evaluation of 56 total random samples screened across 14 loci, with a total of 1598 allelic comparisons (minus zero scores) evaluated. We observed a total of 16 single-locus scoring discrepancies (mismatches) between the original and QA/QC data sets. Mismatches were most commonly due to weakly amplified samples, or point errors traced back to data transcription errors. The final error rate assigned to the data set was 1.0%. Error rates <1% are typically considered acceptable for parentage analyses. For the Yankee Fork data set the parental mated pairs were known a priori. Therefore, we used a stringency level of 1 mismatch per parent in parentage tests, which allowed mismatches due to genotyping error or inheritance of null alleles to be identified among all parentage assignments.

Parentage Analysis

The non-exclusion rate for our data set was 0.0001 for the first parent, and 0.000001 for the second parent when the first is known, or a 1 in 1,000,000 chance of randomly assigning an unrelated individual. Evaluation of 22 single parent matches resulted in inclusion of 17 parentage assignments (observed parental crosses). Mismatches were primarily the result of null allele inheritance.

We observed a total of 62 parentage assignments among all age age-0^+ and age-1^+ juveniles. Parentage assignments among the nine sites in strata$^\#$1-3 ranged from 0-50% (Table 2; Figure 1 & 2). No parental assignments were identified among the age-0^+ juveniles (n=50) captured in stratum$^\#$4, site 1, while 100% of age-0^+ juveniles (n=38), and 1 of 2 age-1^+ juveniles captured in stratum$^\#$4, site 2 were assigned parentage by streamside incubator broodstock (Table 2; Figure 1). In 2006, there were no streamside incubators stationed in stratum$^\#$6 (West Fork Yankee Fork). The upweller in stratum$^\#$7 lost water intake after egg outplant, resulting in 100% egg mortality (Jordan Creek upweller; Figure 1). Consequently no assignments of age-0^+ juveniles were observed within that stratum. A single age-1^+ juvenile that was captured in stratum$^\#$7 in 2007 was a genotypic match for a female parent; the male genotype of the known mated pair was a match at 12/14 loci. The overall assignment proportion across strata and sites, indicating streamside incubator origin was 16.3% and 4.1% among age-0^+ and age-1^+ juveniles, respectively. Production (juvenile survival) among outplant families does not appear to be equally distributed. Nineteen known mated broodstock pairs did not produce progeny sampled in the 2007 parentage analysis (Table 3).

Descriptive Statistics

We observed high allelic variability or polymorphism across 14 loci evaluated in the 2007 analysis (Table 4). Numbers of alleles ranged from 3 at *µSsa289* within the stratum$^\#$7 juvenile group, to 18 at *µSsa407* in the broodstock and stratum$^\#$3 juvenile groups (mean = 10 over loci and groups). Observed heterozygosity ranged from 0.400 at *µSsa289* within the strata$^\#$4&5 juvenile group, to 1.00 at *µSsa408* in the stratum$^\#$7 juvenile group (mean = 0.758 over loci and groups). There were 16 departures from expected genotypic proportions among 112 total HWE tests. Suspected null alleles were responsible for five departures at locus *µOts1*, and four departures at *µOmy77* across sample groups. Heterozygote deficits were detected at five loci within the stratum$^\#$3 juvenile group, and six total HWE departures were detected in the strata$^\#$4&5 juvenile group. The number of private alleles among groups ranged from 0 (stratum$^\#$6 and stratum$^\#$7 juvenile groups) to 11 in the stratum$^\#$3 juvenile group (Table 4). Mean allelic richness ranged from 7.5 in the stratum$^\#$7 juvenile group to 8.7 in both the stratum$^\#$1 and stratum#7 groups. There was no significant difference in allelic richness between HAT (broodstock and assigned progeny) groups and NOR (strata 1-7) juvenile groups (P = 0.65).

Population Genetic Structure Analysis

Among the 8 groups of *O. mykiss* evaluated, we observed F_{st} values ranging from 0.002 to 0.014 across loci. The overall estimate of 0.009 indicates significant among-group variability (99% C.I. = 0.007-0.011). All but 4 pairwise F_{st} comparisons (group pairs) were highly significant (Table 5). The least amount of among-group variation was observed between broodstock and assigned HAT progeny, and between stratum#1 and stratum#2 juveniles. The genetic distance relationship among the 8 sample groups is demonstrated in the topology of an unrooted NJ phylogram (Figure 3). The confidence or concordance (>50%) of the topology is indicated with bootstrap values at the nodes, and reveals greatest similarity among the HAT broodstock parent group and assigned HAT progeny group. The putative NOR juvenile groups that are most genetically distant (overall) from the HAT groups are found in strata#4-7 (Figure 3).   A closer examination of NOR groups distinguished by age class reveals the largest genetic distance between age-0^+ juveniles from stratum#1 (n=11) and HAT fish (Figure 4). Juveniles collected from stratum#2, age-0^+ juveniles from stratum#3, and age-1^+ juveniles from stratum#1 cluster close to the HAT groups in the NJ topology.

Discussion

Parentage: Streamside Incubator productivity

Juvenile steelhead in Yankee Fork that are produced from HAT eggs outplanted in streamside incubators, have no identifiable hatchery marks and are indistinguishable from NOR fish. Survival of HAT streamside incubator progeny post-release (volitional) is not well documented, and the net supplementation benefit realized in the natural spawning population is unknown. Parentage assignments observed in the 2007 Yankee Fork parentage analysis provide evidence that HAT streamside incubator juveniles successfully emerge and survive in-stream through the first year of life. Our point estimate of abundance of age-0^+ *O. mykiss* in Yankee Fork for 2006 was 17,850 (± 2207) juveniles, with an estimated 4,268 (± 1244) individuals originating from streamside incubators; that is, streamside incubator supplementation contributed a 23.9% demographic boost to the Yankee Fork steelhead juvenile population (Denny and Tardy 2008). A small number of age-1^+ juveniles (n=5) sampled in 2007 were also matched to broodstock parents used to seed streamside incubators in 2006. Although this number of observations is small, the lack of data describing migratory behavior of juvenile steelhead in the Yankee Fork watershed precludes us from speculating about the fate of HAT streamside incubator fish beyond the first year of life.

Parentage: Progeny distribution and movement

Although no prior information is available to describe the migration behavior of juvenile *O. mykiss* throughout most of the Yankee Fork watershed, the results of parentage analysis provide a foundation for beginning to understand movement of young fish. It is reasonable to assume that migration or movement of juvenile steelhead during the first year of life will be relatively small, and in a predominately downstream direction (Richards and Cernera 1989; Close and Anderson 1992; Perry and Bjornn 2000). Because the streamside incubator in stratum#7 (located in the upper reach of Jordan Creek) was lost in 2006 it is not surprising that none of the age-0^+ juveniles (n=9) captured among the three sampling sites in Jordan Creek were identified as HAT progeny. Likewise, no age-0^+ HAT juveniles were captured among the sampling sites in the West Fork Yankee Fork, where no streamside incubators were maintained in 2006.

Sampling and juvenile capture in the mainstem Yankee Fork above the confluence with Jordon Creek (strata 4 & 5) resulted in capture of only four age-1^+ juveniles, including two HAT progeny above stratum#4, site 1 (Figure 1). Every age-0^+ juvenile sampled in stratum#4, site 2 (n=38), which is located approximately 1 mile downstream of the Greylock Creek streamside incubator, was matched to broodstock parents in parentage analysis. We suggest that strata 4&5 represent areas of relatively low natural spawning productivity that are available for supplementation (given suitable forage and over-wintering habitat) with potentially minimal NOR competition. Conversely, none of the age-0^+ juveniles captured at stratum#4, site 1 (n=50) were identified as HAT progeny from parentage analysis. However, this site on the mainstem Yankee Fork is located adjacent to the Jordan Creek confluence, far downstream of the Greylock Creek streamside incubator, and a significant distance upstream of the Cearly Creek streamside incubator. It is likely that those juveniles originated either from a lower mainstem spawning population or from Jordon Creek. Similarly, sampling of age-0^+ juveniles among stratum#3 (n=172) resulted in identification of two (1.2%) fish that were of HAT origin. The sites in stratum#3 are located downstream of stratum#4, site 1, and upstream of the Cearly Creek streamside incubator.

If in-stream movement of juvenile fish is limited within the first year of life, and fish are seeking shelter and foraging habitat, we would not expect to encounter a significant number of age-0^+ juveniles produced from the streamside incubators among the sampling sites in stratum#1. This section is located a substantial distance downstream from the nearest incubator (Cearly Creek), and is within a few miles of the Salmon River confluence with Yankee Fork. Juvenile fish encountered in this stratum may represent natural *O. mykiss* production in the lower mainstem of Yankee Fork. With the exception of stratum#4, site 2, we observed the largest relative abundance of HAT progeny (19.7%) in stratum#2 among sample sites within three downstream miles of the Cearly Creek incubator. Stratum# 3, sites 2&3 are located adjacent to off-channel dredge ponds with inlet from Cearly Creek and outlet to the mainstem Yankee Fork. Although all sample sites were located in the mainstem, their proximity to protective habitat in the dredge ponds may explain the higher relative abundance of HAT juveniles throughout this stratum. In fact, survival of streamside incubator juveniles (both age-0^+ and 1^+) may have been underestimated in these preliminary analyses if there is significant utilization of available protective habitat in dredge ponds that went unsampled in 2006 – 2007.

Among age-1^+ juveniles sampled in 2007 (n=123), a total of five (4.1%) were identified as HAT progeny of streamside incubator origin. The majority of age-1^+ juvenile (n=74) captures occurred in strata# 1-3, and only three were identified as HAT progeny. Interpretation of these results and inferences about relative survival of HAT progeny requires a cautious approach. Smolts are typically released from the SFH as age-1^+ smolt. Behaviors perpetuated and inherited through a history of domestication selection in the hatchery may be conveyed to progeny produced from outplanted HAT eggs, and early migration tendencies may be stronger among HAT progeny than is apparent in their NOR counterpart.

Sampling of the West Fork Yankee Fork (stratum#6) resulted in capture of 31 age-1^+ juveniles in 2007, of which no HAT progeny were identified. There were no streamside incubators operational in 2006, but the West Fork Yankee Fork contains known steelhead spawning habitat and is believed to support a stable NOR population. Similar results were observed in Jordan Creek (stratum#7) which supports known resident *O. mykiss* and cutthroat trout (*O. clarkii)* populations.

Genetic structure in Yankee Fork

Deviations from HWE expectations often indicate population mixtures. The high proportion of deviations observed in strata# 3&4 likely indicates the presence of multiple spawning populations among samples collected from these areas (e.g. juveniles of resident, NOR, and HAT origin). Significant group differences between putative NOR (strata# 4-7) and HAT (streamside incubator broodstock and progeny) are evident from pairwise F_{st} comparisons and genetic distances between groups. The observed genetic structure substantiates the presence of recognized resident (stratum#7) and anadromous (stratum#6) populations, and appears to corroborate the results of parentage analysis. However, supplementation in Yankee Fork also includes the release of SFH smolts which may contribute to natural production as returning adult spawners. Therefore, the genetic similarity of juveniles captured in strata# 1-2 (that did not match broodstock parents in parentage analysis) may indicate a HAT influence from a source other than streamside incubator origin.

Future direction: addressing goals and limitations

Continued genetic evaluation on a temporal scale will be critical to determining the long-term efficacy of supplementation activities that involve egg outplanting and streamside incubator rearing of HAT progeny. In this first year study, the eggs from broodstock mated pairs were randomized and mixed prior to seeding of incubators. As a consequence vital migration and movement information associated with streamside incubator volitional release was unattainable. In subsequent years, gametes from each mated broodstock pair should be outplanted randomly but exclusively to a single incubator. This practice will allow migration between outplant site and capture site to be documented for all HAT progeny, and in addition may provide clues to habitat preference and successful incubator site selection.

The paucity of *O. mykiss* demographic information in Yankee Fork (e.g. numbers of returning adults, redd counts, relative abundance of resident fish, etc.) restricts the interpretation of results from parentage analysis that may otherwise be used to reliably estimate relative productivity from supplementation activities. In the evaluations that follow, it will be vital for the Tribes to have means for enumerating adult returns (i.e. weir) and monitoring juvenile outmigration (i.e. rotary trap). Moreover, in order to better gauge survival of HAT juveniles through the first year of life (and production in general), sampling locations should better reflect habitat usage. Sample sites in 2006 – 2007 were randomly selected from within the mainstem Yankee Fork and tributaries but did not include known areas of high juvenile density such as dredge ponds, particularly near Cearly Creek.

Since it is likely that resident rainbow trout and HAT smolt outplants within the watershed contribute to overall annual *O. mykiss* production, subsequent efforts should include sampling (n=50) and genotypic analysis of each group that may help differentiate between units or areas of HAT and NOR productivity. It is also recommended that juvenile samples be screened for F1 hybridization between rainbow trout and cutthroat trout where they co-occur in the watershed.

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References

Araki, H. and Ardren, W. R., E. Olsen, B. Cooper and M. S. Blouin. 2007. Reproductive success of captive-bred steelhead trout in the wild: evaluation of three hatchery programs in the Hood River. *Conservation Biology* 21:181-190.

Ardren, W.R., S. Borer, F. Thrower, J. E. Joyce, and A.R. Kapuscinski. 1999. Inheritance of 12 microsatellite loci in *Oncorhynchus mykiss*. *Journal of Heredity* 90: 529-536.

Banks, M. A., M. S. Blouin, B. A. Baldwin, V. K. Rashbrook, H. A. Fitzgerald, S. M. Blankenship and D. Hedgecock. 1999. Isolation and inheritance of novel microsatellites in Chinook salmon *(Oncorhynchus tshawytscha*). *Journal of Heredity* 90: 281-288.

Banks, M.A., and W. Eichert. 1999. WHICHRUN (version 3.2) a computer program for population assignment of individuals based on multilocus genotype data. *Journal of Heredity* 91:87-89.

Bernatchez, l. and P. Duchesne. 2000. Individual-based genotype analysis in studies of parentage and population assignment: how many loci, how many alleles? *Canadian Journal of Fisheries and Aquatic Sciences* 57:1-12

Blouin, Michael, Hitoshi Araki, "Reproductive Success – Steelhead in the Hood River", 2003-2004 Annual Report, Project No. 200305400, 12 electronic pages, (BPA Report DOE/BP-00015883-1)

Cairney, M., J. B. Taggart and B. Høyheim. 2000. Characterization of microsatellite and minisatellite loci in Atlantic salmon *(Salmo salar* L.) and cross-species amplification in other salmonids. *Molecular Ecology* 9:2175–2178.

Cavalli-Sforza, L.L., and A. W. F. Edwards. 1967. Phylogenetic analysis: models and estimation procedures. *Evolution* 32: 550-570.

Chilcote, M. W., S. A. Leider, and J. J. Loch. 1986. Differential reproductive success of hatchery and wild summer-run steelhead under natural conditions. *Transactions of the American Fisheries Society* 115:726-735.

Chilcote, M. W. 2003. Relationship between natural productivity and the frequency of wild fish in mixed spawning populations of wild and hatchery steelhead (*Oncorhynchus mykiss*). *Canadian Journal of Fisheries and Aquatic Science*. 60:1057-1067.

Close, T. L. and C. S. Anderson. 1992. Dispersal, density-dependent growth, and survival of stocked steelhead fry in Lake Superior tributaries. North American Journal of Fisheries Management 12: 728-735.

Condrey, M. J. and P. Bentzen. 1998. Characterization of coastal cutthroat trout *(Oncorhynchus clarki clark*i) microsatellites and their conservation in other salmonids. *Molecular Ecology* 7:787-789.

Denny, L. P., K. Witty., and S. Smith. In Draft. A monitoring and evaluation plan for the Shoshone-Bannock Tribes: Hatchery supplementation activities Yankee Fork; Salmon River sub-basin. Draft Review Shoshone-Bannock Tribes, Department of Fisheries Resources Management.

Denny, L. P. and K. Tardy. 2008. Supplementation, Monitoring, and Evaluation Program Annual Report (Chapter 4). Prepared for USFWS Lower Snake River Compensation Plan. Cooperative Agreement 141107J017.

Excoffier, L. G. Laval, and S. Schneider (2005) Arlequin ver. 3.0: An integrated software package for population genetics data analysis. Evolutionary Bioinformatics Online **1**:47-50.

Felsenstein, J. 1992. PHYLIP (Phylogeny Inference Package) Version 3.5C. Department of Genetics. SK-50, University of Washington, Seattle, 98195, USA.

Glaubitz, J. C. 2004. CONVERT: A user-friendly program to reformat diploid genotypic data for commonly used population genetic software packages. *Molecular Ecology Notes* 4 (2), 309–310.

Goudet, J. 1995. FSTAT (v1.2): a computer program to calculate F-statistics. *Journal of Heredity* 86: 485-486.

Jones, A.G., and W.R. Ardren. 2003. Methods of parentage analysis in natural populations. *Molecular Ecology* 12, 2511-2523.

Kalinowski, ST, Taper, ML & Marshall, TC (2006) Revising how the computer program

CERVUS accommodates genotyping error increases success in paternity assignment. *Molecular Ecology* 16:1099-1106.

Konopacky, R. C., E. C. Bowles, and P. Cernera. 1985. Salmon River Habitat Enhancement. Annual Report FY 1984, Part I, Subproject III, Yankee Fork of the Salmon River Inventory and Problem Identification. Shoshone-Bannock Tribes Report to Bonneville Power Administration.

Konopacky, R. C., P. J. Cernera, and E. C. Bowles. 1986. Salmon River Habitat Enhancement. Annual Report FY 1985, Part 1 or 4, Subproject III: Yankee Fork Salmon River. Shoshone-Bannock Tribes Report to Bonneville Power Administration.

Kostow K. E., A. R. Marshall and S. R. Phelps. 2003. Naturally spawning hatchery steelhead contribute to smolt production but experience low reproductive success. *Transactions of the American Fisheries Society* 132:780-790.

Kostow K. E. 2004. Differences in juvenile phenotypes and survival between hatchery stocks and a natural population provide evidence for modified selection due to captive breeding. *Canadian Journal of Fisheries and Aquatic Sciences* 61:577-589.

Letcher, B. H., and T. L. King. 2001. Parentage and grandparentage assignment with known and unknown matings: application to Connecticut River Atlantic salmon restoration. *Canadian Journal of Fisheries and Aquatic Sciences* 58:1812-1821.

Lewis, P. O., and Zaykin, D. 2001. Genetic Data Analysis: Computer program for the analysis of allelic data. Version 1.0 (d16c). Free program distributed by the authors over the internet from http://lewis.eeb.uconn.edu/lewishome/software.html.

McConnell, S. K., P. O'Reilly, L. Hamilton, J. M. Wright, and P. Bentzen. 1995. Polymorphic micro-satellite loci from Atlantic salmon (*Salmo sala*r): genetic differentiation of North American and European populations. *Canadian Journal of Fisheries and Aquatic* 52:1863–1872.

Miller LM and Kapuscinski AR (1996) Microsatellite DNA markers reveal new levels of variation in northern pike. *Transactions of the American Fisheries Society* **125**, 971-997.

Morris, D. B., K. Richard and J. Wright. 1996. Microsatellites from rainbow trout (*Oncorhynchus mykis*s) and their use for genetic study of salmonids. *Canadian Journal of Fisheries and Aquatic Sciences* 53:120-126.

Nei, M. 1978. Estimation of average heterozygosity and genetic distance from a small number of individuals. *Genetics* 89:583–590.

Marshall, TC, Slate, J, Kruuk, LEB & Pemberton, JM (1998) Statistical confidence for likelihood-based paternity inference in natural populations. *Molecular Ecology* 7: 639-655.

Matala, A. P., D. Olson, T. Hoffman, M. Kavanagh, B. Brignon and W. R. Ardren. 2005. Population assignment tests and genetic structure analysis reveal relative productivity between hatchery origin and natural origin steelhead trout within Eagle Creek, OR. USFWS-FONS# 13210-2005-011.

Miller, L., T. Close and A. R. Kapuscinski. 2004. Lower fitness of hatchery and hybrid rainbow trout compared to naturalized populations in Lake Superior tributaries. *Molecular Ecology* 13:3379-3388.

Nickelson, T.E., J.D. Rodgers, S.L. Johnson, and M.F. Solazzi. 1992. Seasonal changes in habitat use by juvenile coho salmon Oncorhynchus kisutch in Oregon coastal streams. *Canadian Journal of Fisheries and Aquatic Science*. 49:783-789.

Olsen, J. B., P. Bentzen and J. E. Seeb. 1998 Characterization of seven microsatellite loci derived from pink salmon. *Molecular Ecology* 7 (8):1087-1089.

Orpwood, J. E., S. W. Griffiths, and J. D. Armstrong. 2004. Effect of density on competition between wild and hatchery-reared Atlantic salmon for shelter in winter. *Journal of Fish Biology* 65:201-209.

Paetkua, D., R. Slade, M. Burden, and A. Estoup. 2004. genetic assignment methods for the direct, real-time estimation of migration rate: a simulation-based exploration of accuracy and power. *Molecular Ecology* 13:55-65.

Raymond, H. L. 1988. Effects of hydroelectric development and fisheries enhancement on spring and summer Chinook salmon and steelhead in the Columbia River basin. *North American Journal of Fisheries Management* 8:1-24.

Raymond, M. and F. Rousset. 1995. Genepop: population genetics software for exact tests and Ecumenicism. *Journal of Heredity* 83:248-249.

Rice, W. R. 1989. Analyzing tables of statistical tests. *Evolution* 43:223-225.

Richards, C. and P. J. Cernera. 1989. Dispersal and abundance of hatchery-reared and naturally spawned juvenile chinook salmon in an Idaho stream. North American Journal of Fisheries Management 9: 345-351.

Richards, C., P. J. Cernera, M. P. Ramey, and D. W. Reiser. 1992 Development of off-channel habitats for use by juvenile Chinook salmon. *North American Journal of Fisheries Management* 12: 721-727.

Seamons, T. R., P. Bentzen and T. P. Quinn. 2004 The mating system of steelhead, *Oncorhynchus mykiss*, inferred by molecular analysis of parents and progeny. *Environmental Biology of Fishes* 69:333-344.

Smith, C. T., B. F. Koop. and R. J. Nelson. 1998. Isolation and characterization of coho salmon (*Oncorhynchus kisutch*) microsatellites and their use in other salmonids. *Molecular Ecology* 7 (11):1614-1616.

Solazzi, M.F., T.E. Nickelson, S.L. Johnson, and J.D. Rodgers. 1999. Development and evaluate techniques to rehabilitate Oregon's wild salmonids. Project No. F-125-R-13. Funded by the Sport Fish and Wildlife Restoration Program, USFWS. Report available at ODFW, Portland, Oregon.

Spies, I.B., Brasier, D.J., O'Reilly, P.T.L., Seamons, T.R., and Bentzen, P. 2005. Development and characterization of novel tetra-, tri-, and dinucleotide microsatellite markers in rainbow trout (*Oncorhynchus mykiss*). *Molecular Ecology Notes* doi 10.1111/j.14718286.2005.00900.x.

Weir, B.S., and C.C. Cockerham. 1984. Estimating F-statistics for the analysis of population structure. *Evolution* 38:1358-1370.

Williams, J. G. 1989. Snake River spring and summer Chinook salmon: can they be saved? Regulated Rivers: Research and Management 4: 17-26.

Figure 1. Streamside incubators locations and age-0^{+} *O. mykiss* sampling sites in the Yankee Fork, Idaho during 2006.

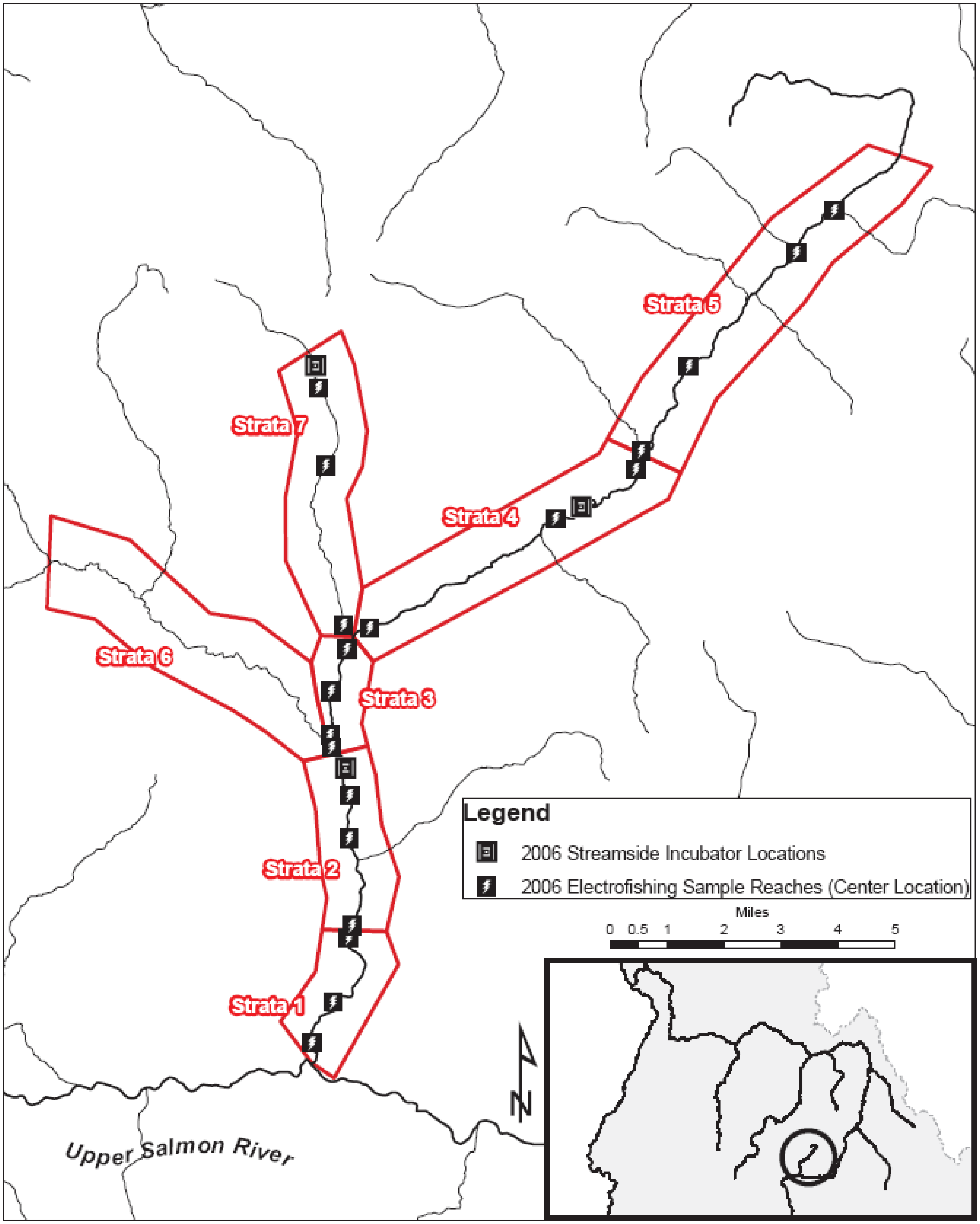

Figure 2. Streamside incubators locations (2006) and age-1+ *O. mykiss* sampling sites in the Yankee Fork, Idaho during 2007.

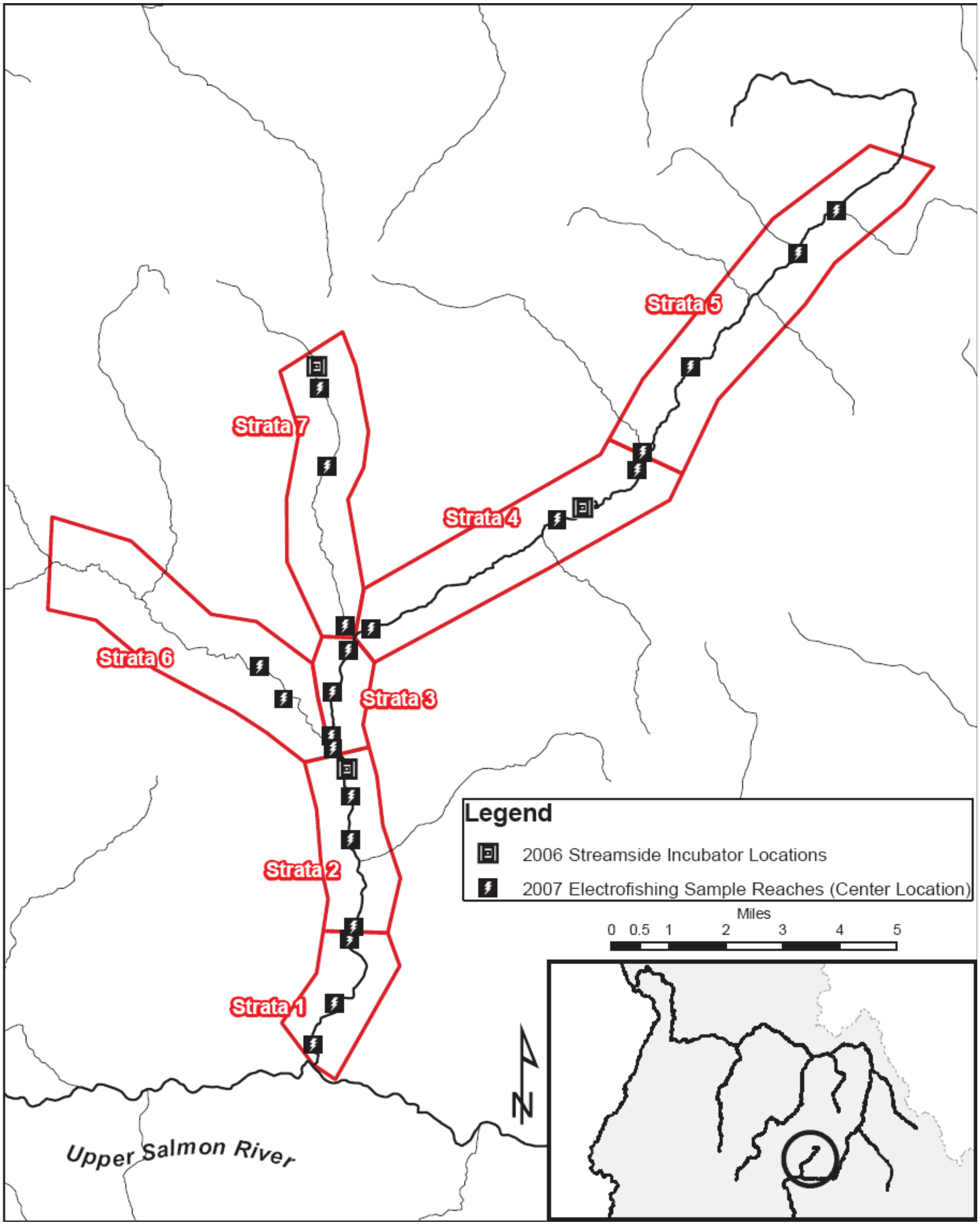

Figure 3. Neighbor-Joining phylogram topology and genetic distance relationship between 8 analysis groups. Values at nodes indicate bootstrap support among 1000 replicate data sets.

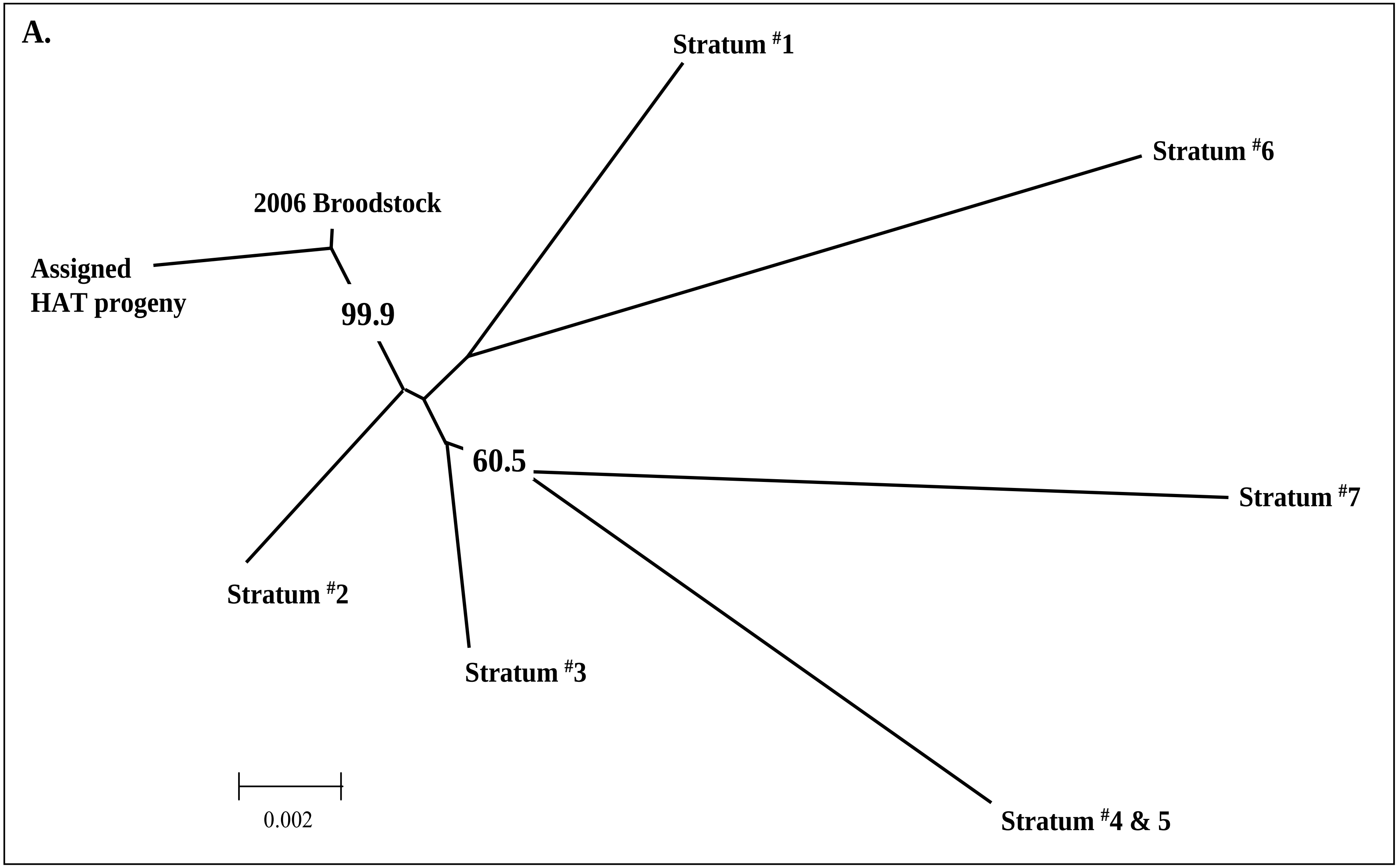

Figure 4. **The neighbor-Joining phylogram topology and genetic distance relationship between 8 analysis groups, and age class differences within groups.**

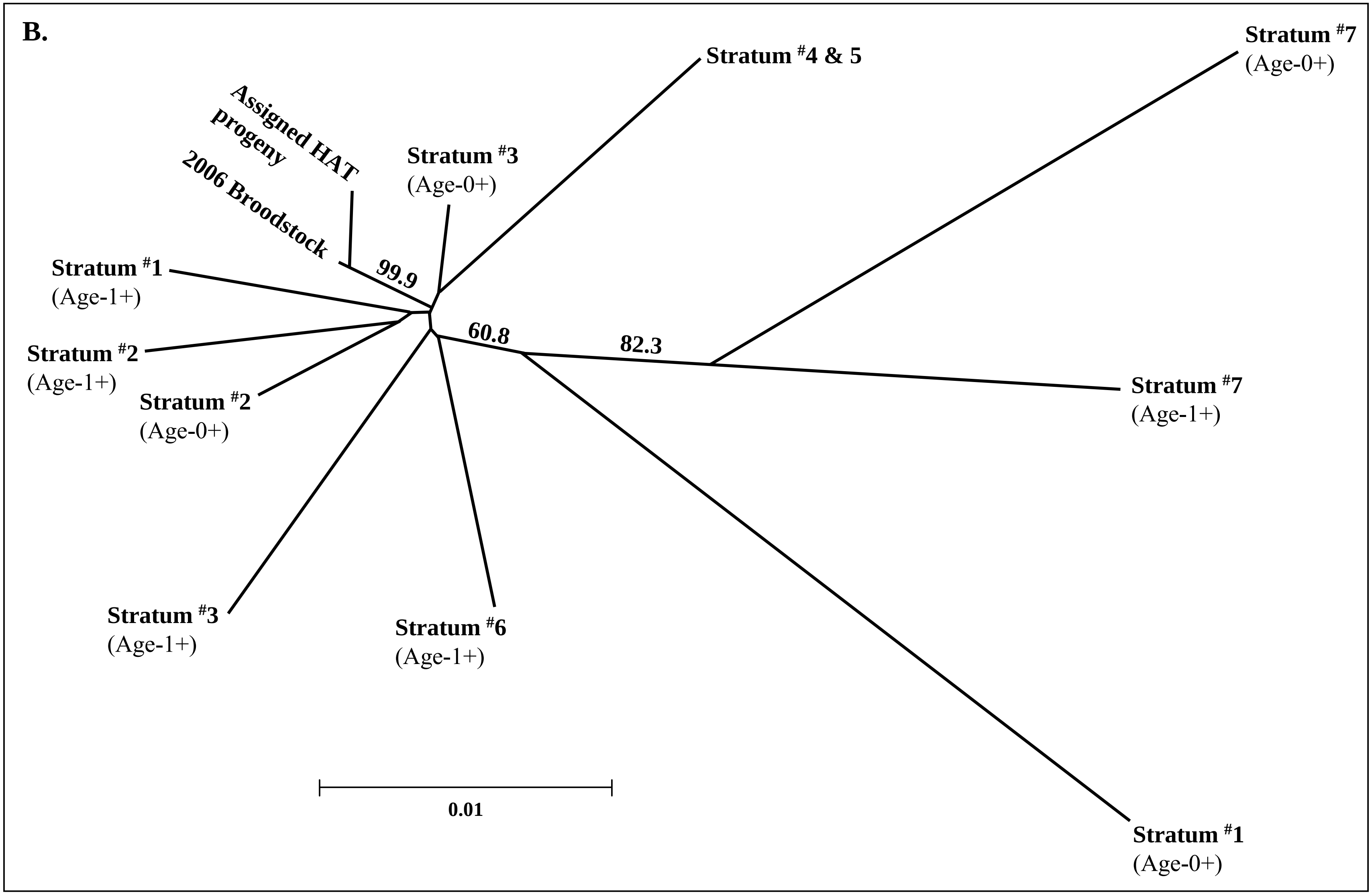

Table 1. Streamside incubator statistics for broodyear 2006 outplants in Yankee Fork, Idaho.

Yankee Fork	Jordan Creek	Cearly Creek Upper	Cearly Creek Lower	Greylock Creek	Total	Average
Eggs Planted	56,599	56,599	56,599	44,953	214,750	53,688
Average Temperature °F	48	45	45	46		46
Dead Eggs Counted	56,599	817	876	550	58,842	14,711
Hatch success %	0.0%	98.6%	98.5%	98.8%	72.6%	73.9%
Estimated Fry Produced	0	55,782	55,723	44,403	155,908	38,977

Table 2. Parentage assignment results from the progeny perspective. The numbers of Parent-Progeny matches are reported for each juvenile collection location (i.e. stratum and site).

Location		Age-0$^+$ juveniles			Age-1$^+$ juveniles		
		n (sampled)	# assigned	% assigned	n (sampled)	# assigned	% assigned
Stratum 1	Site 1	0	0	0	4	0	0
	Site 2	4	3	50.0	16	0	0
	Site 3	6	0	0	11	1	9.1
Stratum 2	Site 1	25	5	20.0	1	0	0
	Site 2	5	2	40.0	12	0	0
	Site 3	41	7	17.1	14	1	7.1
Stratum 3	Site 1	13	1	7.7	1	0	0
	Site 2	90	0	0	5	0	0
	Site 3	68	1	1.5	10	0	0
Stratum 4	Site 1	50	0	0	1	0	0
	Site 2	38	38	100.0	2	1	50.0
	Site 3	0	---	---	0	---	---
Stratum 5	Site 1	0	---	---	0	---	---
	Site 2	0	---	---	1	1	100.0
	Site 3	0	---	---	0	---	---
Stratum 6	Site 1	0	---	---	6	0	0
	Site 2	0	---	---	7	0	0
	Site 3	0	---	---	18	0	0
Stratum 7	Site 1	9	0	0	12	0	0
	Site 2	0	---	---	1	1	100.0
	Site 3	0	---	---	1	0	0
Overall		349	57	16.3	123	5	4.1

Table 3. Parentage assignment results reported from the parent perspective. The parental baseline was comprised of all Sawtooth Hatchery broodstock pairs used to outplant eggs in Yankee Fork upwellers in 2006. Among juvenile fish sampled in 2006 (0+) and 2007 (1+) we observed the following production from known mated parental pairs: zero progeny – 19 pairs, one progeny – 16 pairs, two progeny - 11 pairs, three progeny - 4 pairs, and four progeny - 2 pairs.

		Assigned Progeny					
Broodstock Father	Broodstock Mother	ID	Stratum	Site	Age	Length (mm)	Mass (g)
645-026_M	645-098_F	001-054	2	1	0+	57	1.71
		001-088	2	3	0+	57	1.79
		710-001	2	2	0+	56	2.04
		710-005	2	2	0+	56	1.89
645-054_M	645-096_F	001-025	1	2	0+	55	1.58
		649-092	4	2	0+	40	0.70
		649-096	4	2	0+	45	0.84
		712-052	4	2	0+	52	1.21
643-032_M	643-067_F	001-079	2	3	0+	64	2.39
		649-094	4	2	0+	53	2.13
		712-015	4	2	0+	54	1.83
643-005_M	643-072_F	712-027	4	2	0+	55	1.67
		987-020	7	2	1+	120	17.09
		712-055	4	2	0+	51	1.28
643-016_M	643-071_F	712-036	4	2	0+	50	1.10
		649-098	4	2	0+	45	0.95
		712-020	4	2	0+	54	1.41
645-035_M	645-087_F	002-081	3	3	0+	63	2.20
		649-093	4	2	0+	50	1.24
		712-054	4	2	0+	47	1.13
643-012_M	643-086_F	001-064	2	1	0+	61	2.17
		649-089	4	2	0+	57	2.20
		712-072	4	2	0+	54	1.84
643-003_M	643-081_F	712-063	4	2	0+	58	2.16

		712-011	4	2	0+	49	1.22
643-009_M	643-080_F	712-019	4	2	0+	50	1.29
		649-095	4	2	0+	55	1.73
643-020_M	643-059_F	712-053	4	2	0+	53	1.68
		001-059	2	1	0+	58	1.89
645-021_M	645-072_F	712-066	4	2	0+	52	1.81
		001-096	2	3	0+	40	0.64
645-022_M	645-073_F	001-042	1	2	0+	55	1.54
		712-014	4	2	0+	46	0.92
645-027_M	646-007_F	649-090	4	2	0+	42	0.75
		1070-057	1	3	1+	108	14.29
645-030_M	646-002_F	001-065	2	1	0+	59	1.95
		986-001	5	2	1+	122	18.20
645-033_M	645-094_F	001-016	1	2	0+	59	2.38
		649-100	4	2	0+	49	0.87
645-039_M	645-071_F	001-090	2	3	0+	53	1.58
		991-044	4	2	1+	115	15.77
645-043_M	645-099_F	712-029	4	2	0+	50	1.31
		712-056	4	2	0+	51	1.22
645-061_M	645-086_F	001-072	2	3	0+	58	1.83
		712-071	4	2	0+	59	2.12
645-023_M	645-078_F	712-039	4	2	0+	55	1.50
		712-046	4	2	0+	44	0.98
645-064_M	645-069_F	001-062	2	1	0+	62	2.01
643-006_M	643-061_F	002-019	3	1	0+	64	3.02
645-050_M	646-012_F	649-097	4	2	0+	43	0.75

645-049_M	645-080_F	712-033	4	2	0+	58	1.93
645-040_M	645-067_F	712-042	4	2	0+	53	1.81
645-019_M	645-088_F	712-048	4	2	0+	47	1.14
643-021_M	643-074_F	994-026	2	3	1+	130	19.91
645-036_M	645-100_F	712-017	4	2	0+	47	0.93
645-059_M	645-075_F	001-089	2	3	0+	55	1.63
645-044_M	645-074_F	001-092	2	3	0+	57	1.80
643-018_M	645-016_F	649-099	4	2	0+	55	1.96
645-025_M	646-005_F	712-012	4	2	0+	50	1.21
643-008_M	643-085_F	712-031	4	2	0+	57	2.08
643-024_M	643-064_F	712-070	4	2	0+	57	2.36
645-048_M	645-066_F	712-044	4	2	0+	42	0.65

Table 4. **Descriptive statistics for 8 genetic sample collections. Column headings are defined as follows:** n **is the number of individuals,** A **is the number of alleles,** AP **is the number of private alleles,** AR **is the allelic richness,** H_E **is Nei's (1978) unbiased estimate of expected heterozygosity,** H_O **is the observed heterozygosity, and** F_{is} **is the index of inbreeding. HWE significance is indicated by: *****P***<0.01, ******P***<0.001.**

	Sawtooth Hatchery Broodstock (n=104)							Assigned HAT Progeny (n=61)						
Locus	n	A	AP	AR	H_E	H_O	F_{is}	n	A	AP	AR	H_E	H_O	F_{is}
µOcl1	104	13	0	9	0.874	0.885	-0.012	59	12	0	9	0.861	0.898	-0.043
µOgo4	104	9	0	8	0.841	0.856	-0.018	59	9	0	8	0.823	0.847	-0.030
µOmy7i	104	11	0	9	0.818	0.769	0.060	58	11	0	9	0.794	0.759	0.045
µOts1	102	14	1	11	0.851	0.706	***0.171	59	11	0	10	0.836	0.847	-0.013
µOts100	104	13	0	10	0.835	0.827	0.009	59	12	0	10	0.791	0.797	-0.008
µOts3	104	7	0	5	0.693	0.683	0.015	59	7	1	5	0.666	0.712	-0.070
µOts4	104	5	0	5	0.761	0.769	-0.011	59	5	0	5	0.768	0.847	-0.105
µOgo3	104	6	0	4	0.670	0.692	-0.034	59	5	0	4	0.649	0.746	-0.150
µOki23	104	12	0	8	0.806	0.808	-0.003	59	11	0	8	0.798	0.847	-0.063
µOmy1011	104	13	0	10	0.875	0.923	-0.055	59	13	0	10	0.873	0.898	-0.029
µOmy77	104	13	0	10	0.873	0.740	0.153	57	12	0	10	0.868	0.772	0.112
µSsa289	104	7	0	4	0.487	0.442	0.092	59	5	0	4	0.511	0.559	-0.096
µSsa407	104	18	1	11	0.867	0.731	0.158	59	14	0	11	0.885	0.932	-0.054
µSsa408	104	17	0	13	0.904	0.875	0.032	59	15	0	13	0.908	0.915	-0.008

	Stratum #1 – Juveniles (n=42)							Stratum #2 – Juveniles (n=98)						
Locus	n	A	AP	AR	H_E	H_O	F_{is}	n	A	AP	AR	H_E	H_O	F_{is}
µOcl1	38	11	0	9	0.871	0.868	0.003	82	10	0	9	0.857	0.890	-0.039
µOgo4	38	8	0	7	0.818	0.842	-0.030	83	10	0	8	0.829	0.795	0.041
µOmy7i	38	11	1	9	0.839	0.842	-0.003	83	12	0	10	0.841	0.783	0.069
µOts1	37	11	0	10	0.875	0.568	***0.355	82	14	0	11	0.888	0.646	***0.273

μOts100	38	8	0	8	0.776	0.658	0.154	83	12	0	9	0.810	0.807	0.003
μOts3	38	6	0	5	0.750	0.658	0.124	83	6	0	5	0.689	0.590	0.143
μOts4	38	7	1	6	0.756	0.711	0.061	83	6	0	6	0.749	0.747	0.003
μOgo3	38	5	0	5	0.702	0.553	0.215	83	6	0	4	0.653	0.590	0.096
μOki23	38	12	0	11	0.869	0.842	0.031	83	12	0	9	0.824	0.855	-0.039
μOmy1011	38	12	0	9	0.827	0.789	0.046	82	13	0	11	0.875	0.915	-0.046
μOmy77	38	13	0	11	0.885	0.605	**0.319	82	17	1	13	0.889	0.732	***0.178
μSsa289	37	6	0	5	0.512	0.541	-0.057	83	5	0	4	0.489	0.530	-0.084
μSsa407	38	16	0	13	0.887	0.921	-0.039	83	17	1	12	0.872	0.916	-0.051
μSsa408	38	16	0	14	0.902	0.947	-0.051	83	16	0	12	0.904	0.880	0.027

	Stratum #3 – Juveniles (n=187)							Stratum #4&5 – Juveniles (n=92)						
Locus	n	A	AP	AR	H_E	H_O	F_{is}	n	A	AP	AR	H_E	H_O	F_{is}
μOcl1	183	12	0	9	0.859	0.847	0.014	55	8	1	7	0.834	0.982	**-0.180
μOgo4	183	10	0	9	0.844	0.831	0.016	55	10	0	9	0.844	0.818	0.030
μOmy7i	184	12	1	9	0.802	0.804	-0.003	55	9	0	8	0.741	0.782	-0.055
μOts1	178	14	0	10	0.849	0.601	***0.293	55	12	1	9	0.865	0.509	***0.413
μOts100	183	12	0	9	0.831	0.809	***0.027	55	10	1	8	0.831	0.818	**0.015
μOts3	183	10	3	6	0.761	0.705	**0.074	54	5	0	4	0.691	0.685	0.009
μOts4	181	6	1	5	0.739	0.724	**0.020	55	6	1	5	0.774	0.764	0.014
μOgo3	183	6	0	5	0.693	0.716	-0.032	55	6	1	5	0.763	0.582	0.239
μOki23	184	16	2	9	0.819	0.793	0.031	55	12	0	10	0.862	0.873	**-0.012
μOmy1011	184	17	2	11	0.869	0.826	0.050	55	11	0	8	0.805	0.836	-0.040
μOmy77	181	18	1	12	0.898	0.674	***0.250	55	14	0	11	0.876	0.618	***0.296
μSsa289	183	7	1	4	0.577	0.596	-0.033	55	4	0	4	0.460	0.400	0.131
μSsa407	184	18	0	11	0.855	0.875	-0.023	55	13	0	10	0.848	0.891	-0.051
μSsa408	183	17	0	13	0.898	0.863	0.039	55	14	0	12	0.892	0.909	***-0.019

	Stratum #6 – Juveniles (n=31)							Stratum #7 – Juveniles (n=23)						
Locus	n	A	AP	AR	H_E	H_O	F_{is}	n	A	AP	AR	H_E	H_O	F_{is}
μOcl1	31	10	0	9	0.795	0.871	-0.098	22	8	0	8	0.869	0.909	-0.047
μOgo4	31	7	0	7	0.831	0.871	-0.049	22	8	0	8	0.836	0.955	-0.145
μOmy7i	31	8	0	8	0.772	0.806	-0.045	21	10	0	10	0.756	0.762	-0.008
μOts1	31	9	0	8	0.749	0.645	0.141	20	7	0	7	0.768	0.500	0.355
μOts100	31	9	0	7	0.776	0.645	0.171	21	6	0	6	0.640	0.571	0.109
μOts3	31	4	0	4	0.709	0.548	0.230	22	6	0	6	0.686	0.500	0.276
μOts4	31	5	0	5	0.659	0.645	0.022	22	5	0	5	0.737	0.636	0.139
μOgo3	31	4	0	4	0.656	0.548	0.167	22	5	0	5	0.709	0.500	0.300
μOki23	31	10	0	9	0.865	0.871	-0.007	22	11	0	11	0.766	0.727	0.052
μOmy1011	31	10	0	9	0.838	0.871	-0.040	22	9	0	9	0.877	0.864	0.016
μOmy77	31	13	0	12	0.897	0.871	0.029	22	9	0	9	0.868	0.727	0.165
μSsa289	31	5	0	5	0.572	0.677	-0.189	22	3	0	3	0.449	0.500	-0.116
μSsa407	31	11	0	10	0.821	0.774	0.058	22	9	0	9	0.862	0.909	-0.057
μSsa408	31	13	0	12	0.910	0.935	-0.029	22	10	0	10	0.906	1.000	-0.107

Table 5. **Pairwise comparisons of among-group variation. The observed F_{st}-values are recorded in the top half-matrix; adjusted significance is given in the lower half-matrix (Rice 1989).**

F_{st}	Broodstock	Stratum#1	Stratum#2	Stratum#3	Strata#4&5	Stratum#6	Stratum#7
Stratum#1	0.0040						
Stratum#2	0.0023	0.0011					
Stratum#3	0.0052	0.0045	0.0061				
Strata#4&5	0.0147	0.0143	0.0204	0.0164			
Stratum#6	0.0123	0.0105	0.0152	0.0149	0.0274		
Stratum#7	0.0106	0.0131	0.0143	0.0099	0.0181	0.0208	
Assigned HAT	-0.0014	0.0073	0.0072	0.0086	0.0159	0.0141	0.0116

P-value							
Stratum#1	*0.0195*						
Stratum#2	*0.0254*	*0.2568*					
Stratum#3	***	**	***				
Strata#4&5	***	***	***	***			
Stratum#6	***	***	***	***	***		
Stratum#7	***	**	***	**	***	***	
Assigned HAT	*0.8916*	**	***	***	***	***	**