2012

Yankee Fork Salmon River Chinook Salmon Run Report

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Shoshone-Bannock Tribes

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Annual Report

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United States Fish and Wildlife Service
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Cooperative Agreement F12AC00090
October 1, 2011 – September 30, 2012

December 31, 2012

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ABSTRACT

The Shoshone-Bannock Tribes initiated a Chinook salmon (*Oncorhynchus tshawytscha*) reintroduction project in Yankee Fork Salmon River, Idaho to assist in returning 2,000 adults to meet Tribal harvest and conservation objectives. Staff released 197,036 BY 10 Chinook salmon smolts in Yankee Fork on April 3 and 4, 2012. Survival to Lower Granite Dam was equaled 29.7% and was not significantly different between acclimated vs. direct stream released fish. The Tribes installed a temporary picket weir near Pole Flat Campground on June 26. Overall, 197 Chinook salmon were trapped in 2012, of which 82.2% were natural-origin and 17.8% hatchery-origin. Natural adults were released above the weir for natural spawning and 26 hatchery adults were outplanted above a secondary weir for natural spawning. Five Mile weir was installed on June 28 for hatchery adult outplanting activities and 15 fish were trapped. An additional 1,054 hatchery-origin fish were obtained from Sawtooth Fish Hatchery and outplanted into upper Yankee Fork. Tribal harvest accounted for the mortality of 242 fish, 43 natural-origin and 199 hatchery outplants. Intensive spawning ground surveys were completed from August 8 – October 15 and 235 redds were observed. Using mark-recapture techniques we estimate 283 (±34) fish passed Pole Flat weir for an overall trapping efficiency of 69.6%. We observed 16 redds below Pole Flat weir and expanding these counts by a fish/redd ratio of 3.54. An estimated 57 adults spawned below Pole Flat weir bringing the total adult escapement estimate to 340 adults, resulting in an in-river abundance estimate of 1,394 Chinook salmon. Pre-spawn mortality was estimated at 57 females leaving an estimated spawner abundance of 1,095 salmon, after harvest. In addition, the Tribes installed a rotary screw trap in the Yankee Fork in 2012 to estimate juvenile migrants. The Tribes estimate 143 (± 183) BY10 smolts, 1,423 (± 1,547) BY11 parr, and 12,101 (± 2,543) BY11 pre-smolts migrated past the screw trap from April 11 through November 13. Due to insufficient recaptures, an overall estimate of BY11 fry migrants could not be calculated. Our overall minimum estimate for the 2012 juvenile migration season is 13,525 Chinook salmon juveniles.

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ACKNOWLEDGEMENTS

The Shoshone-Bannock Tribes (Tribes) provided the administrative framework and support for this project to be successful. Program staff included Lytle Denny (Program Manager), David Evans (Biologist), William Youmans (Biologist), Carlos Lopez (Sr. Technician), Wyatt Petersen (Technician), Keno Coby, Rocco Chacon Jr., and Keith Moore (Seasonal Technicians).

We are especially thankful to Scott Marshall, Chris Starr, Steve Yundt and the Lower Snake River Compensation Plan (LSRCP) – Office for providing funding and ultimately supporting this project. We are also thankful to the Idaho Department of Fish and Game (IDFG) for working cooperatively to implement this project. Pete Hassemer and Sam Sharr from the Boise Headquarters office provided supportive planning and implementation oversight on behalf of IDFG. Brent Snider and the employees at Sawtooth Fish Hatchery (Sawtooth) were very helpful implementing the fish culture aspect of the program and providing adults for outplanting.

INTRODUCTION

Yankee Fork of the Salmon River (Yankee Fork) is an important spawning and rearing stream for Chinook salmon (*Oncorhynchus tshawytscha*). Historically, Yankee Fork supported a large run of Chinook salmon (Reiser and Ramey 1987) and traditional fishery for members of the Shoshone-Bannock Tribes Tribes. However in 1992, Chinook salmon native to Yankee Fork were listed as threatened under the Endangered Species Act (ESA) (57 FR14653). Chinook salmon native to Yankee Fork were identified as an independent population of Snake River spring/summer Chinook salmon (ICTRT 2007a) and the population is currently classified at high risk of extinction.

Tribal fishermen have witnessed a significant decline in the number of Chinook salmon returning to the Yankee Fork, resulting in a significant impact to cultural and subsistence-based linkages to the resource. One obvious candidate to explain this decline is the number of dams that Chinook salmon smolts (juvenile downstream migrants) and returning adults must pass to survive and complete their life cycle (Schaller et al. 1999; Deriso et al. 2001). In addition, habitat fragmentation and connectivity, and habitat quantity and quality are presently limiting factors within the Yankee Fork watershed affecting abundance, productivity, spatial structure, and genetic diversity (Lyon et al. 2011) of Chinook salmon. In response, the Tribes developed the Yankee Fork Chinook Salmon Program (YFCSP) to increase the number of Chinook salmon returning to Yankee Fork.

NOAA Fisheries, the Tribes, and IDFG agreed to initiate an artificial propagation program in Yankee Fork in 2004 after reviewing the ICTRT population viability assessment (ICTRT 2007b), historic and current abundance trends, the artificial propagation history, regional plans, and management objectives. When planning the YFCSP, the Tribes, NOAA Fisheries, and IDFG met on numerous occasions to ensure the artificial propagation strategy would meet each agencies goals and objectives (e.g., harvest, ESA recovery, ect). There was broad consensus to reintroduce a closely related stock in Yankee Fork, rather than try and propagate the extant stock which was believed to be non-local and from an out-of-basin source (i.e., Rapid River). This group determined the appropriate donor stock would be derived from Sawtooth Fish Hatchery, which is located within 20 miles of Yankee Fork. The group further agreed that the reintroduction effort would occur for several years and be based on outplanting hatchery smolts and pre-spawn adults, then the YFCSP would transition to collecting broodstock locally from Yankee Fork once abundance is increased.

The decision to use artificial propagation in Yankee Fork resulted from a number of factors including: (1) the importance of having a subsistence-based fishery; (2) regional support for a Tribal artificial propagation program; (3) the importance of having Chinook salmon spawning naturally throughout the watershed; (4) justification to reintroduce a local stock; and (5) the proximity of a donor stock (i.e., Sawtooth) that could support a reintroduction effort.

It is very important to the Tribes to harvest Chinook salmon in Yankee Fork and throughout the Salmon River basin. Prior to the 1970's, Tribal Chinook salmon fisheries occurred throughout the Salmon River basin under the authority of the Fort Bridger Treaty of July 3, 1868 (Treaty) and fisheries targeted naturally produced Chinook salmon. Yankee Fork was a popular Chinook salmon hunting area. During this period, Chinook salmon hunting opportunities were adequate, but by the end of the 1970's, most Chinook salmon runs, including fish returning to Yankee Fork were drastically decreasing.

By the 1980's, the majority of Chinook salmon runs were fully depressed and Tribal harvest opportunities were severely constrained. During this period of time, the Tribes identified sanctuary and fishery areas to help rebuild runs, but also to provide some level of harvest. In addition, the State of Idaho closed all of their recreational fisheries. Sanctuary areas included most, if not all of the natural production areas (e.g., Middle Fork), while fishery areas included Yankee Fork, the upper Salmon River, East Fork Salmon River, and South Fork Salmon River; basically where hatchery fish were relatively abundant. As a result, numerous Tribal members grew accustomed to only hunting Chinook salmon in the newly desingated fishery areas. Very few Chinook salmon were harvested in this time period, with the exception of the occasional "bathtub" fisheries in the Yankee Fork in the mid-1980's. The "bathtub" fisheries were nothing more than harvest of outplanted adult hatchery fish released in Yankee Fork and Panther Creek.

By the 1990's, Tribal fisherman use patterns fully transitioned to the productive hatchery influenced areas (e.g., South Fork Salmon River, upper Salmon River) and natural production fisheries were basically non-existent. Tribal fishing effort and harvest was essentially nonexistent in Yankee Fork. Policy directives focused on rebuilding habitat and restoring natural fish populations.

In the 2000's, Chinook salmon returns began to significantly increase, especially hatchery returns. This provided additional fishing opportunity, but the runs were inconsistent and for the most part began to decrease just as fast as they increased. During this period, Tribal members focused their efforts in the South Fork Salmon River, where abundant hatchery fish were located. Fisheries targeting natural-origin Chinook salmon again gained popularity because of the cultural aspect these fisheries provide. In this era, Tribal policy makers directed attention to implementing an artificial propagation program in Yankee Fork that would partially meet the harvest needs of the Tribes.

Project Background

The first juvenile smolt release associated with the YFCSP occurred in April 2006 and the first pre-spawn adult release occurred in July 2008. Weir operations were initiated in 2008 along with intensive spawning ground surveys and harvest monitoring. A rotary screw trap was installed to monitor juvenile production in 2009 and a PIT tag array was installed in lower Yankee Fork this spring. In 2008, the Tribes also began development of plans to construct the Crystal Springs Fish Hatchery to propagate spring Chinook salmon for the YFCSP.

From 2008 – 2011, a total of 422 Chinook salmon were trapped at Pole Flat weir (Table 1). Of these, approximately 159 fish were natural-origin and 263 fish were hatchery-origin. On average, natural-origin fish have comprised 58.2% of the return, with hatchery-origin fish comprising 41.8% of the return. Overall, an average of 40 natural-origin and 66 hatchery-origin adults are trapped each year. The largest number of fish trapped occurred in 2008, with 228 adults trapped, of which 43 were natural-origin and 185 were hatchery-origin. The fewest number of adults trapped occurred in 2010, with only 17 natural-origin adults trapped. Since initiating adult trapping, the natural-origin fish return has remained far below the ICTRT viability threshold of 500 spawners and harvest has still remained very low to non-existent.

Table 1. Number and percentage of natural and hatchery-origin Chinook salmon trapped at Pole Flat weir from 2008 – 2011.

Year	Natural		Hatchery		Total
	Natural	%	Hatchery	%	
2008	43	18.9%	185	81.1%	228
2009	29	59.2%	20	40.8%	49
2010	17	100.0%	0	0.0%	17
2011	70	54.7%	58	45.3%	128
Total	**159**		**263**		**422**
Average	**40**	**58.2%**	**66**	**41.8%**	**106**

Far fewer females tend to return to Yankee Fork than males. From 2008 – 2011, the average percentage of males returning to Yankee Fork is 66.5%, while the average return of females is 33.5% (Table 2). The overall sex ratio of males returning to Yankee Fork has ranged from a low of 51% in 2009 to a high of 86.7% in 2011. The overall female sex ratio has ranged from a low of 13.3% in 2011 to a high of 49% in 2009. The natural-origin fish sex ratio is 68.1% male to 31.9% female. The hatchery-origin fish sex ratio is 64.5% male to 35.5% female. It is likely the sex ratios are skewed towards males solely because Pole Flat weir is typically installed after the run is in progress and females tend to return earlier than males.

Table 2. Sex ratio of natural and hatchery-origin Chinook salmon trapped at Pole Flat weir from 2008 – 2011.

Year	Natural		Hatchery		Total	
	% Males	% Females	% Males	% Females	% Males	% Females
2008	65.1%	34.9%	48.6%	51.4%	51.8%	48.2%
2009	55.2%	44.8%	45.0%	55.0%	51.0%	49.0%
2010	76.5%	23.5%			76.5%	23.5%
2011	75.7%	24.3%	100.0%	0.0%	86.7%	13.3%
Average	**68.1%**	**31.9%**	**64.5%**	**35.5%**	**66.5%**	**33.5%**

In 2012, the Tribes planned to operate two portable picket weirs to enumerate returning adult Chinook salmon, operate a rotary screw trap to monitor and measure broodyear specific life-stage abundance and survival, conduct harvest monitoring to determine how

many fish are caught, conduct intensive spawning ground surveys to document spawning success, distribution, and effective spawners. This report covers the methods and results from YFCSP activities in 2012.

Program Phases, Goals, and Objectives

The number of adult Chinook salmon returning from program operations is the basis for determining whether management actions are successful. The long-term goal is to return 2,000 adult Chinook salmon to the Yankee Fork for broodstock, harvest, and natural production objectives. To accomplish this, the program has three implementation phases: (1) reintroduction; (2) propagation; and (3) conservation. Each phase has different goals and objectives and currently the YFCSP is implementing phase one reintroduction.

The first phase of this program is to reintroduce a closely adapted Chinook salmon stock in Yankee Fork. Numerous non-local stocks have been outplanted in Yankee Fork resulting in extremely poor productivity and severely low natural-origin adult abundance. The natural stock in Yankee Fork is believed to be functionally extirpated and Sawtooth (hatchery stock) was chosen as the source population for the reintroduction effort. Note, that Sawtooth obtained broodstock from mining the natural-origin Chinook salmon population returning to the upper Salmon River. Phase one reintroduction is accomplished by annually releasing hatchery fish (juveniles or adults) and allowing such fish to spawn naturally when they return to Yankee Fork, promoting local adaptation through natural processes. The goal of this phase is to return 1,000 adults (hatchery and natural) to Yankee Fork annually and will be accomplished by releasing 200,000 – 400,000 smolts (depending upon availability) and outplanting up to 1,500 pre-spawn adults. Phase one efforts will cease when the five year average adult abundance exceeds >1,000 natural and hatchery adults combined. In this phase, the Tribes may collect adults in Yankee Fork as a contingency plan for meeting the broodstock objective, when insufficient adults return to Sawtooth to meet both program needs.

In phase two, the program will terminate the outplanting of Sawtooth stock (juveniles and adults) and shift to collecting broodstock in the Yankee Fork from locally-adapted Chinook salmon returning from phase one efforts. The goal of this phase is to return 2,000 adults (hatchery and natural) annually and will be accomplished by releasing up to 600,000 smolts, contingent upon construction of the Crystal Springs Fish Hatchery and whether the facility is fully operational. A broodstock management sliding-scale schedule will be developed to determine the appropriate number of adults to release above the weirs for natural spawning, which meets the cultural objective of having fish spawn naturally.

Following a detailed monitoring and evaluation plan (in development), the Tribes will measure adult and juvenile abundance, survival, productivity, distribution, and diversity during each implementation phase. If productivity reaches a point where the harvest and cultural objectives can be met by natural production, then the Tribes will consider implementing a “true” conservation program.

Regardless of phase, the Tribes will continue to manage harvest according to the Tribal Resource Management Plan (TRMP) (Denny et al. 2010). The goal of the TRMP is to provide population specific harvest management of Chinook salmon in a manner that promotes recovery of the listed species while protecting, preserving, and enhancing rights reserved under the Treaty and any inherent rights. Harvest guidelines are developed for natural and hatchery-origin Chinook salmon following the harvest rate schedules in the TRMP. Harvest monitoring is conducted to determine overall catch and harvest impact rates.

Study Area

Yankee Fork is located in the Salmon–Challis National Forest near Stanley, Idaho (Figure 1). The Yankee Fork flows through narrow canyons and moderately wide valleys with forest of lodgepole pine (*Pinus contorta*) (Richards and Cernera 1989). The Yankee Fork flows 41.8 kilometers (km) from north to south and enters the upper Salmon River at rkm 590.6. The Yankee Fork headwaters originate at an elevation of 2,500 m and the watershed enters the upper Salmon River at an elevation of 1,880 m. The drainage is composed of 313.8 km^2 and includes Yankee Fork proper and West Fork Yankee Fork (largest tributary), followed by other notable tributaries including Ramey, Cearly, Lightning, Cabin, Jordan, Five Mile, Greylock, and Eight Mile creeks. Average annual precipitation is roughly 68.6 cm, base flows are approximately 1.13 cubic meters per second (m^3s^{-1}), and mean flows are 6.99 m^3s^{-1}. Most of the system is characterized by highly erosive sandy and clay-loam soils.

Gold was discovered in the area in the 1800s, 1930s, and 1950s which prompted human settlements and as such mining has become part of the rich history in Yankee Fork. Mining activities resulted in the complete re-channeling of lower portions of the Yankee Fork from Jordan Creek to Pole Flat Campground and the deposition of extensive unconsolidated dredge piles. The dredged portion of the Yankee Fork floodplain is sparsely vegetated with long sections containing riparian habitat only near the stream and bank interface.

Most of the Yankee Fork watershed remains in excellent condition for the production of fish. Within the entire drainage, the number of redds have ranged from over 600 in 1960's (Pollard 1985), to less than 10 in 1980's (Konopacky et al. 1986), to zero in 1984 and 1995.

Chinook salmon destined to the Yankee Fork enter the Columbia River during March through May, with spawning occurring in August and September (Bjornn 1960). Chinook salmon are exceptionally large fish, found to be comprised of primarily age^4 to age^5 adults having fork lengths exceeding 81 cm (Bjornn et al. 1964). Egg incubation extends into December, with emergence occurring in February or March (Reiser and Ramey 1987). Juveniles rear in freshwater until the spring (March-April) of their second year, prior to migrating to the ocean generally at a length of 100-130 mm (Bjornn 1960). The YFCSP has documented that the majority of juveniles leave Yankee Fork as fry, parr, and pre-smolt with a smaller percentage leaving as smolts (Tardy and Denny 2011).

Other fish species present in the Yankee Fork include bull trout (*Salvelinus confluentus*), westslope cutthroat trout (*O. clarki lewisii*), steelhead trout (*O. mykiss*), mountain whitefish (*Prosopium williamsoni*), shorthead sculpin (*Cottus confuses*), and mountain sucker (*Catostomus platyrhynchus*) (Richards and Cernera 1989).

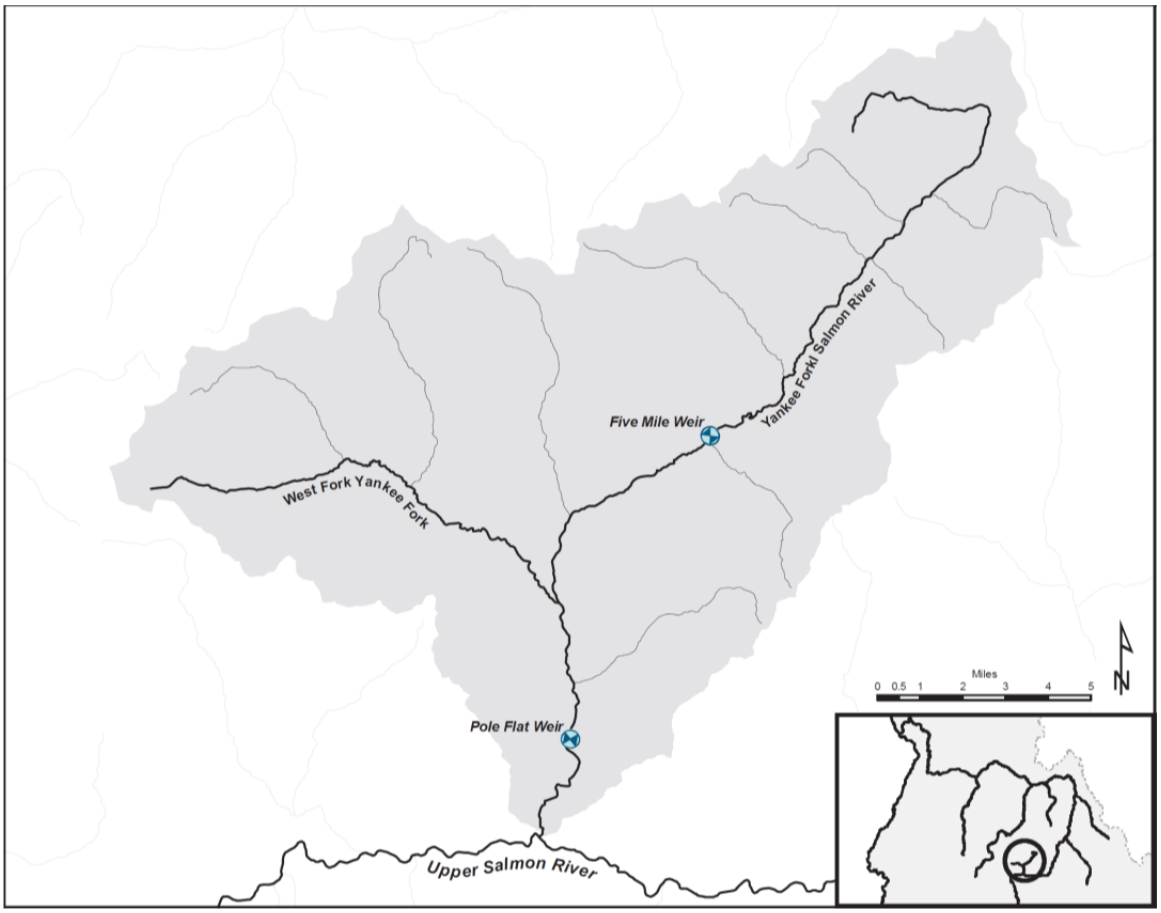


Figure 1. Map of Yankee Fork Salmon River, Idaho, displaying weir locations.

SMOLT RELEASE AND ACCLIMATION STUDY

This was the fourth year, third consecutive, that the YFCSP released Chinook salmon smolts in the Yankee Fork. The annual smolt release target for the YFCSP is based upon an agreed-to sliding-scale production table developed specifically to address smolt release targets for the YFCSP and Sawtooth. The 2012 smolt release objective was set at 200,000 juveniles.

Broodstock to accomplish this release was collected from hatchery-origin Chinook salmon adults returning to Sawtooth in 2010. Approximately 197,036 total juvenile Chinook salmon were propagated for the YFCSP at Sawtooth for phase one reintroduction efforts. Juveniles were reared to the smolt stage (April) and transferred to Yankee Fork in large tanker trucks. We coordinated with IDFG to continue the acclimation study and set-up infrastructure to accommodate the releases.

This was the third year of implementing the acclimation study in Yankee Fork. The goal of this study is to determine if there is a survival benefit for acclimating juveniles in Yankee Fork prior to releasing them to migrate to the Pacific Ocean versus just releasing them in the stream. To accomplish this, we planned to release juvenile Chinook salmon in Yankee Fork in equal numbers in a quasi-acclimation pond (treatment) and compare survival to individuals released directly into the stream (control). Treatment fish are acclimated for 48 hours prior to being released at nearly the same time as direct stream release juveniles. The study will be conducted for at least three years, but may continue for up to five years, in order to conclusively determine benefits and risks. A t-test will be used to compare survival of juveniles reaching Lower Granite Dam and adults returning to Yankee Fork. Differential marks, PIT tags, and DNA marks are used to enumerate returning adults.

In 2012, YFCSP personnel set-up aluminum pipes at the pre-determined release sites to accomplish the smolt release and acclimation study. A block net was installed at the outlet of Pond Series One (PS1) to control outmigration. Treatment fish were released into PSI on April 3 and control fish were released at Jordan Creek confluence on April 4. The block net on PS1 was removed the afternoon of April 4 after smolts were acclimated for 48 hours.

BY10 hatchery-origin Chinook salmon smolts were reared in one raceway (raceway 12) at Sawtooth and split into two groups on April 2. Raceway 12A contained 98,518 adipose intact smolts of which 1,696 were injected with PIT tags (Table 3). This group was established as the acclimation group, which was released into PS1 on April 3. Raceway 12B also contained 98,518 adipose intact smolts of which 1,692 were injected with PIT tags. This group was established as the direct stream release group, which was released directly into Yankee Fork near the confluence of Jordan Creek on April 4. All 197,036 smolts were injected with CWTs to allow determination of origin when they return as adults. YFCSP personnel were present at Sawtooth to assist with smolt set-up, crowding, loading, transporting, and clean-up (Figure 2).

Figure 2. Yankee Fork hatchery-origin Chinook salmon smolt release.

An unknown amount of juveniles from the treatment group escaped PS1 prior to full acclimation. This was the direct result of a small gap in the block net that was deployed

to retain the acclimation group released into PS1. The block net was repositioned and securely placed until acclimation was complete.

Overall, a total of 197,036 smolts were released into Yankee Fork in 2012 (Table 3). All of these fish had intact adipose fins and 100% were marked with CWTs. As indicated above, two groups of fish were released to compare differences in survival and travel time to Lower Granite Dam.

Table 3. Broodyear 2010 Chinook salmon smolt release in Yankee Fork.

Mark	Initial # Smolts (PITs)	Release Date	Location	Final Releases (PITs)	Release Strategy
Adipose Fin-Intact/CWT	98,518 (1,692)	4/4	Mainstem	98,518 (1,692)	Direct Stream
Adipose Fin-Intact/CWT	98,518 (1,696)	4/4[1]	PS1	95,518 (1,696)	Acclimated
Total	197,036 (3,338)			**197,036 (3,338)**	

[1/] Juveniles were released into PS1 on April 3rd and acclimated for 48 hours.

The Cormack/Jolly-Seber survival estimate for all hatchery-origin Chinook salmon smolts released in Yankee Fork in 2012 equaled 0.297 to Lower Granite Dam, which was 7% lower survival as compared to the smolts released in 2011. Surprisingly, the acclimated juveniles (29.6%) exhibited no difference in survival rate than the direct stream release juveniles (29.6%), which was inconsistent with past results. In 2011, the acclimated (treatment) group survived at a rate of 0.374, as compared to the direct stream (control) group rate of 0.266 (Tardy 2011). The Tribes recognize that the differences in survival rates between 2012 and 2011 may be attributed to the escapement of significant numbers of individuals from the acclimation ponds.

Of the 197,036 total smolts released into Yankee Fork in 2012, approximately 29,161 acclimated smolts and 26,206 direct stream smolts survived to Lower Granite Dam. In 2011, we estimate 74,496 acclimated and 52,838 direct stream smolt survived to Lower Granite Dam.

Based on PIT tag detections, arrival timing at Lower Granite Dam averaged 31.9 days for the acclimated group and 30.1 days for the direct stream group, respectively. The 50% passage date occurred on April 3 for the acclimated group, and April 2 for the direct stream group. The 80% arrival window was April 25 – May 18 for both groups.

Juvenile Trapping

The Tribes installed a rotary screw trap (screw trap) in Yankee Fork in 2012 to monitor and evaluate juvenile Chinook salmon abundance and survival by life-history type (e.g., fry). The screw trap was installed on April 11 and removed on November 13. During spring run-off and while hatchery smolts were being released, the screw trap was temporarily removed. The screw trap was located approximately 5.0 rkm upstream from the confluence with the Salmon River (Figure 3).

The screw trap is a fish monitoring device consisting of two floating pontoons, a rotating cylindrical corkscrew cone (1.5 m diameter), a live-well, and a clean-out drum (Figure 3). The screw trap was attached to a cable suspension system consisting of 5 cm braided

steel cable spanning approximately 20 m across the river and connected to a large conifer stump on the west bank of the river and a live conifer on the east bank (road side). The screw trap was attached to a main cable system using a large cinch block pulley connected to two additional 5 cm cables, which were attached to each pontoon islet. The cinch block pulley allows the trap to be adjusted laterally across the stream thalweg.

From April 21 through May 9, the screw trap was not fishing due to high flows that prevented our team from safely boarding the screw trap and adjusting the east/west orientation (Figure 3). On May 9, flows receded to a level at which we were able to attempt adjusting the trap for higher trapping efficiency and return the trap to fishing status. An additional pulley was placed on the main cable approximately 5 m from the west bank, and a 10 mm Cordura© rope ran through the pulley and back to the east bank conifer, to anchor the trap in the thalweg, and to assist lateral movement of the screw trap. The trap was adjusted into a position that allowed our crew to safely board and monitor trapping efforts daily. However, the screw trap continued to fish poorly in the high flows and trapping efficiency was not increased. High flows continued through May and into the third week of June. From the period of April 11 through June, only 15 juvenile Chinook salmon were trapped. On June 25, we recorded the first recapture event of the 2012 juvenile trapping season.

During the month of July, flows receded quickly and trapping efficiency improved. However, nearly all fish trapped were juvenile steelhead trout or Chinook salmon ≤ 65 mm fork length. Flows receded to a point where staff had to raise the cone 6" on July 22 to keep the cone from grounding on the stream substrate. We also position the screw trap 3 m closer to the east bank and the cone up another 6" on August 1. After raising the cone another 2" on August 9, and minimal improvement in trapping efficiency, the Tribes were forced to consider a new strategy to improve screw trap efficiency. On August 10, a river rock fyke was built from the west bank to the left edge of screw trap, and a 2' x 4' steel panel placed from the east bank to the right edge of the trap, thus channeling the majority of flow directly into the cone of the screw trap. Additionally, our crew dug out substrate underneath the cone and pontoons of the trap to allow the cone to be lowered into its full fishing potential.

The adjustments on August 10 produced immediate improvements to trapping efficiency, but for the remainder of August and most of September, trapping continued to produce mainly juvenile steelhead trout and Chinook salmon ≤ 65 mm. On September 26, our crew again dug out substrate below the trap in an attempt to increase the number of cone revolutions per minute. Trapping efficiency improved dramatically and we were able to meet trapping protocols accordingly. For the remainder of the 2012 trapping season, all juvenile Chinook ≥ 65 mm fork length were PIT tagged and released 1 rkm above the screw trap at Maternity Hole.

Figure 3. Yankee Fork rotary screw trap, May 17, 2012.

Our initial trapping protocol was established to PIT tag at least 20 Chinook salmon (fish ≥ 65 mm) each day of operation. Young of the year or fish ≤ 65 mm were to be stained in Bismark Brown (1.8 L to 18.2 L water) for a minimum of 20 minutes and maximum of 40 minutes on Mondays, Wednesdays, and Fridays. However, low trapping efficiency prevented us from capturing high enough numbers of fish to accomplish these quotas for most of the season. Our staff made multiple attempts to increase trapping efficiency by adjusting the east/west positioning of the trap; however, high flows often impeded our ability to move the trap without compromising the safety of our crew.

The screw trap was checked on a daily basis between 07:00 – 11:00 hours. Evident non-target species were enumerated, recorded, and released directly downstream of the trap with minimal handling. Juvenile Chinook salmon were processed following standard program protocol.

Fish collected in the screw trap were transported to a 7’ x 16’ enclosed utility trailer (tagging trailer) equipped with plug in outlets and two overhead florescent lights powered by a 3300 cc Honda generator (Figure 4). The trailer is outfitted with two storage cabinets set above a countertop fitted with a 15” x 15” sink and drain. Two storage cabinets reside below the countertop for additional storage. A laptop computer was plugged into the power outlet and connected to a Destron© loop-style PIT tag detector and reader. The sink was utilized as a basin for anesthetizing fish. Approximately 6.3 L of water was placed into the sink basin and treated with 0.5 ml of a 50:50 eugenol and water solution. Water containing anesthetic was drained into an 18.9 L bucket placed below the sink drain. During periods of inclement weather, the trailer was heated by a 18.7 L propane cylinder fitted with a heating element.

Figure 4. Yankee Fork screw trap tagging trailer.

The daily catch of juvenile Chinook salmon were loaded into several 18.9 L buckets filled with fresh river water. Each bucket was fitted with Frabil© bucket aerators and transported to the tagging trailer. Temperature and staff gauge measurements were also recorded. All juvenile Chinook salmon were enumerated, morphometric measurements taken, a scanned for PIT tags.

On Mondays, Wednesdays, and Fridays, any young of the year (e.g., fry) juveniles ≤ 65 mm fork length were enumerated and biological data taken. On Tuesdays, Thursdays, Saturdays, and Sundays, juveniles ≤ 65 mm fork length were just enumerated and released 0.2 rkm downstream of the screw trap near Pole Camp Creek.

Biological data (species, length, weight, and genetic sample) were acquired from all target individuals used in the mark-recapture study that were ≥ 65 mm fork length. All fish used in the mark-recapture trials were measured to the nearest 1.0 mm, weighed to the nearest 0.01 g, and tissue sampled. PIT tagged juveniles were released 1 rkm upstream of the trap at Maternity Hole for mark-recapture analysis of trap efficiency. Recaptured PIT tagged fish were transported to the downstream release site at Pole Camp Creek. During fish handling, mortalities were recorded as either the result of trapping or handling. If the mortality was a PIT tagged individual, the tag was recollected prior to disposing of the mortality downstream of the trap.

In 2012, there were 1,587 juvenile Chinook salmon captured in screw trap operations with six (0.39%) mortalities recorded. Captures were slightly down from 1,625 juvenile Chinook salmon in 2011, and down significantly from the 34,706 juvenile Chinook salmon captured in 2010. A total of 627 juveniles were PIT tagged and tissue sampled for mark-recapture purposes and/or parental-based tagging, respectively. Of the 627 juveniles PIT tagged, 72 were recaptured, for an overall trap efficiency of 0.114 ± 0.014.

This was an improvement to trap efficiency achieved in 2011 (0.06 ± 0.021) and mainly the results of screw trap modifications later in the season. However, the majority of recaptured fish were from the pre-smolt life history type.

The Tribes used the Peterson estimator (Chapman 1951) to estimate the number of juvenile Chinook moving past the screw trap by life stage (e.g., fry), where broodyear specific life-stage survival (S_t) is equal to the total number of juvenile Chinook salmon marked (M) times the total number of fish captured (C), divided by the total number of marked fish recaptured (R), as

$$S_t = \left[\frac{(M+1)(C+1)}{(R+1)}\right] - 1$$

Where M is equal to the sum of the number of fish marked daily (M_d) and released above the screw trap, as

$$M = \sum M_d$$

Where C is equal to the sum of the total number of fish captured daily (C_d), as

$$C = \sum C_d$$

Where R is equal to the sum of the number of marked fish recaptured daily (R_d), as

$$R = \sum R_d$$

The Tribes estimate 143 (± 183) BY10 smolts, 1,423 (± 1,547) BY11 parr, and 12,101 (± 2,543) BY11 pre-smolts migrated past the screw trap from April 11 through November 13. Due to insufficient recaptures, an overall estimate of BY11 fry migrants could not be calculated. Our overall minimum estimate for the 2012 juvenile migration season is 13,525 Chinook salmon juveniles.

Of the 1,587 juvenile Chinook salmon captured, 11 were BY 10 smolt (0.7%), two were BY 11 fry (0.1%), 88 were BY 11 parr (5.5%), and 1,486 were BY 11 pre-smolt (93.6%) (Figure 5). All 11 BY 10 smolts were PIT tagged, but none of these fish were recaptured. We did not mark the two BY 11 fry. Of the 88 BY 11 parr captured, approximately 31 were PIT tagged and one was recaptured. Of the 1,486 BY 11 pre-smolts captured, approximately 585 were PIT tagged and 71 recaptured.

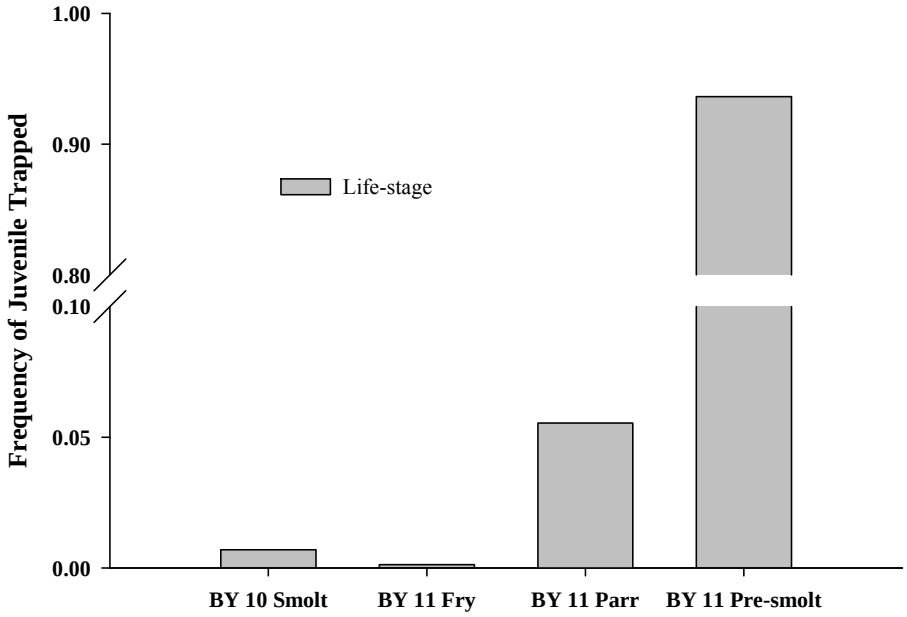


Figure 5. Frequency of life-stage specific juvenile Chinook salmon observed at the screw trap.

The overall movement of juvenile fish was highly skewed towards the pre-smolt life stage (Figure 6). As indicated above, we had difficulty operating the trap during high spring flows and this likely influenced our perception of fish movement by life-stage. However, our data suggests the 10th, 50th, and 90th percentile of fish movement was observed on September 28, October 17, and October 26, respectively.

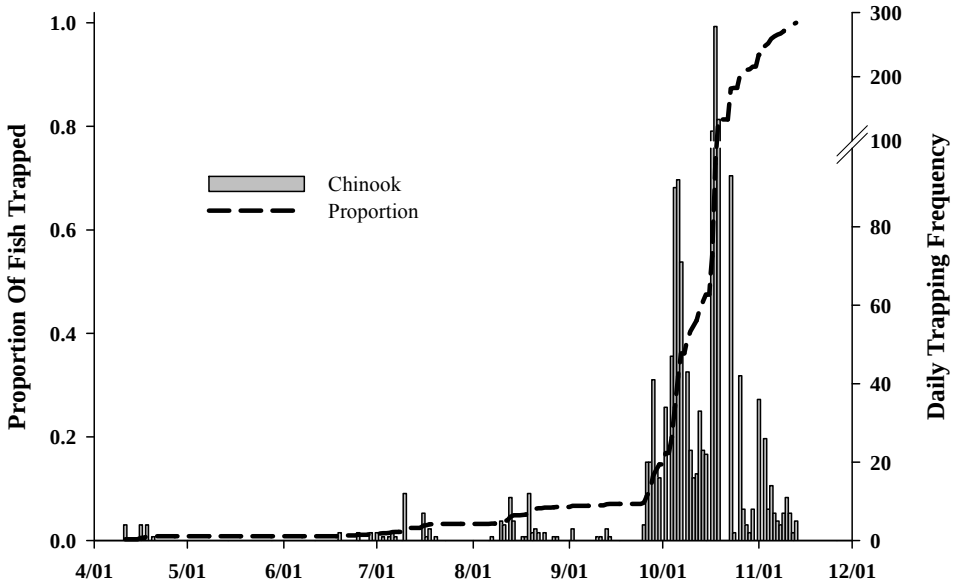


Figure 6. Daily trapping frequency and proportion of juvenile Chinook salmon observed at the screw trap.

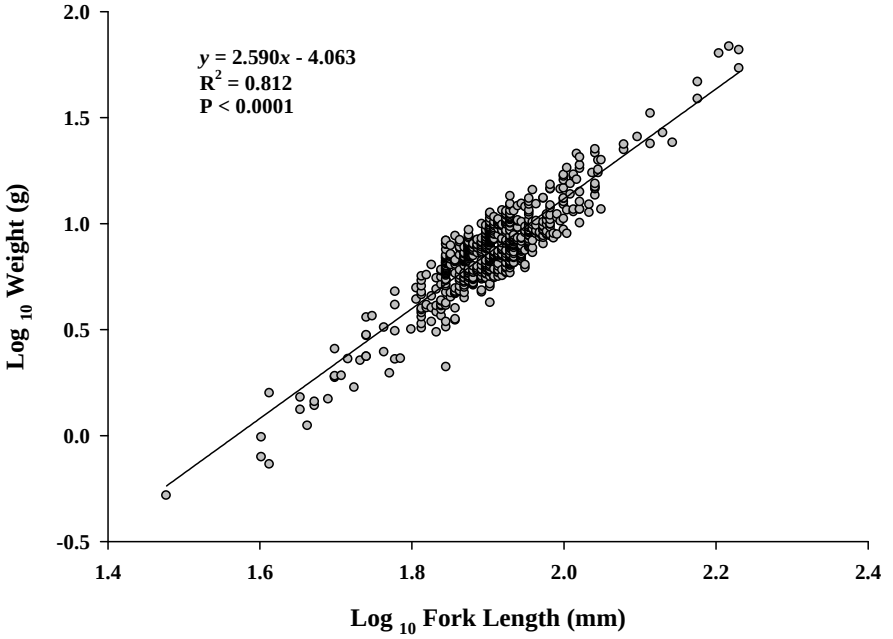
Length weight relationships were derived for all juveniles migrating in 2012. The relationships were derived using the fish growth formula (Murphy et al. 1991).

$$W = aL^b$$

Where W is weight, L is length, and a and b are parameters (i.e., a is the regression intercept and b is the regression slope). The parameters a and b were estimated by a linear regression of logarithmically transformed weight - length data. When weight and length data are transformed, the curvilinear relation between weight and length becomes "straightened", which allows for estimation of a and b by means of linear regression procedures. We used the formula $y = mx + b$ to find the slope of the linear regression to solve for m, which is equated to the slope b in the equation $W = aL^b$.

In general, b less than 3.0 represents fish that become less rotund as length increases and b greater than 3.0 represents fish that become more rotund as length increases. These are both examples of allometric growth. For most species and populations, b is greater than 3.0. If b equals 3.0, fish growth may be isometric, meaning that the shape does not change as the fish grows.

The length-weight relationship for all life stages of migrating juvenile Chinook in 2012 was significant (Figure 7). The b value of 2.59 indicates negative allometric growth, meaning that Yankee Fork juvenile Chinook salmon are becoming progressively thinner with increasing length; however, this does not necessarily indicate the low slope is the result of prey size or abundance deficiencies (Halseth et al., 1990). Although a low b factor indicates a fish has less cross sectional area per unit length than a high b value fish, in salmonids, the b factor represents a streamlining body type, important for swimming function in higher velocity current (Jones et al. 1999). Ultimately, juvenile Chinook salmon in Yankee Fork exhibited exponential growth and this relationship was significant.



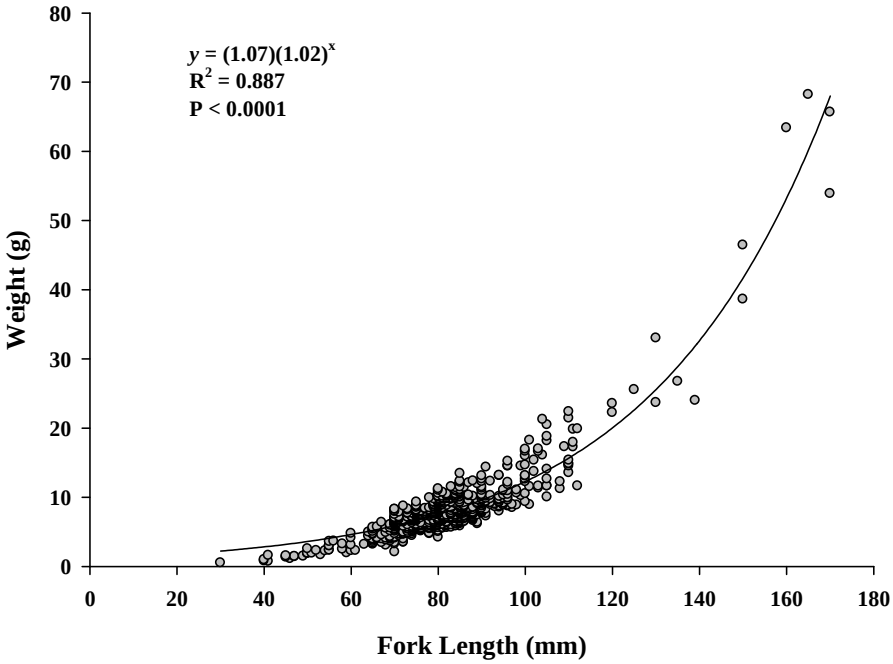


Figure 7. Length-weight relationship of juvenile Chinook salmon observed at the screw trap.

The length frequency of juvenile Chinook salmon ranged from 30 to 170 mm fork length and averaged 81.6 mm. (Figure 8). The majority of juveniles captured ranged from 76 – 80 cm fork length. A total of 10 juveniles were greater than 126 cm fork length. Due to trapping protocols, the length frequency data is likely biased for fish ≤ 65 cm fork length, since the majority of these fish were not handled.

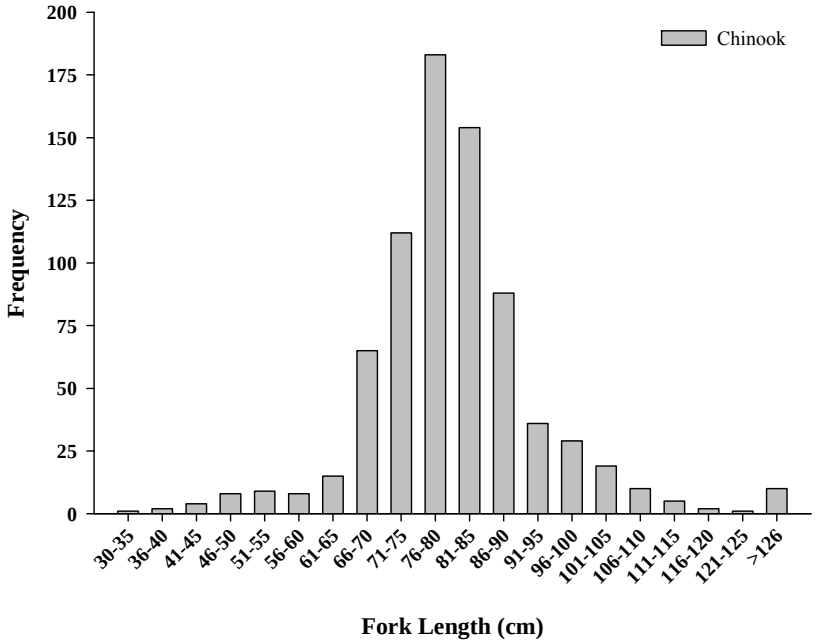


Figure 8. Length frequency of juvenile Chinook salmon.

We examined the fork length, weight, and condition factor of brood-year specific juvenile Chinook salmon emigrants (Figure 9). The overall fork length of each migrant group was not significantly different. Although BY 10 smolts exhibited slightly higher fork lengths, they were not significantly different than BY 11 parr or pre-smolt. However, BY 11 smolts exhibit less variability in fork length than did BY 11 parr. BY 11 parr exhibited a wide range of fork lengths indicating they are putting on significant growth during this period of time (i.e., June 1 – August 31). BY 11 pre-smolts exhibited less variable fork lengths, similar to BY 10 smolts, indicating that growth during this period of time is also minimal (i.e., September 1 – end of trapping). Each migrant group appeared to emigrate after reaching a weight of 8 grams (Figure 9). Consistent with our length data, we did not see a significant difference in weight between groups. BY 10 smolts and BY 11 pre-smolts are nearly the exact same weight at time of emigration, even though BY 10 smolts are slightly longer. This indicates that additional length is acquired during the overwinter stage, but no additional weight is gained. We looked at condition factor (*C*) of each migrant group. There was no significant difference in condition factor between migrant type. However, the mean condition factor for BY 10 smolts was lower than all other migrant types. The BY 11 pre-smolt migrant type exhibited the highest condition factor, although this relationship was not significant.

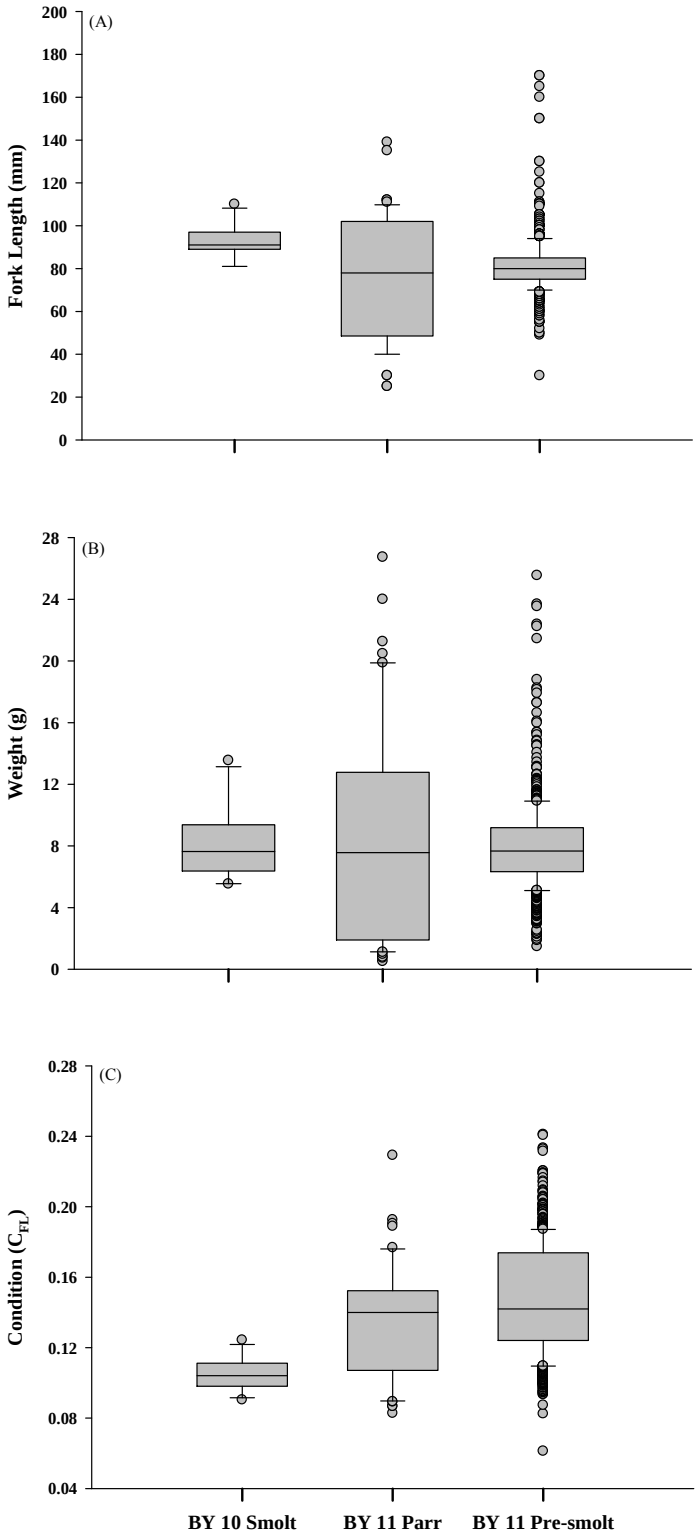


Figure 9. Fork length (mm) (a), weight (g) (b), and condition (C) of juvenile Chinook salmon. Box plots show the 10th, 25th, 50th, 75th, and 90th percentiles, and individual data points outside the 10th and 90th percentiles.

ADULT TRAPPING

The Tribes installed two portable picket weirs in Yankee Fork to manage the adult Chinook salmon return. Pole Flat weir was installed to enumerate all adults (natural and hatchery-origin). Because there is an active supplementation study (i.e., Idaho Supplementation Study) in progress in the West Fork, resource managers wanted to exclude hatchery-origin fish from returning and spawning in this system. Hatchery-origin fish trapped at Pole Flat weir were removed and transported above a secondary weir and released for natural spawning. Natural-origin fish trapped at Pole Flat weir were directly released above the weir after biological data was collected. Five Mile weir was installed to serve as a blocking weir to prevent outplanted hatchery-origin adults from moving downstream and spawning in the West Fork. Five Mile weir was also operated to enumerate the return of Chinook salmon to the upper Yankee Fork.

Pole Flat Weir

In previous years, personnel have waited for stream flows to recede to around 500 cubic feet per second (cfs) before installing Pole Flat weir. The weir was installed as soon as discharge was determined to allow safe installation on June 26, when discharge reached 548 cfs. Pole Flat weir is located approximately 5.22 rkm upstream from the confluence with the Salmon River (Figure 10). Several modifications were made to Pole Flat weir in 2012 to improve trapping operations, therefore, an updated description of the weir design is provided below.

Pole Flat weir is a temporary structure consisting of a v-shaped picket weir attached to a fish trap and work station (Figure 10). The v-shaped picket weir is used to funnel upstream migrating adult Chinook salmon to the inlet of the fish trap. The left weir face consists of four aluminum tripods counterweighted with four 56.8 L steel buckets. Each tripod/counterweight structure is attached to one end of a 3.0 m (length) × 0.6 m (width) rectangular aluminum panel, which is connected to the next panel to increase durability. Each panel contains sixty pre-drilled holes on the top and bottom panel for embracing pickets. The left weir face was positioned to a 45° angle to the streambank and 55° angle to the streambed. A total of 120 aluminum pickets were inserted into the aluminum panels to impede fish migration. A custom built cat-walk was attached to the left weir face to promote quick, dry access to and from the fish trap and work station. The weir face was sealed by attaching a black plastic mesh to the pickets to prevent jumping adult Chinook salmon from being able to split the pickets and bypass the system. In addition, small rocks were stacked between the weir and streambed interface to prevent adults from being able to split the pickets.

The right weir face consists of eleven tripods counterweighted with eleven buckets, supporting six panels, and 360 pickets (Figure 10). The right weir face was also positioned to a 45° angle to the streambank and 55° angle to the streambed. We stacked 40 sandbags unilaterally on the right weir and streambed interface to prevent adults from being able to split the pickets and to redirect flow towards the fish trap.

The fish trap, consisting of the trap itself, a dry workstation, and two in-stream recovery live-wells was attached to the left and right weir wings and positioned in the stream thalweg for optimum trapping configurations (Figure 10). Both weir wings were attached to the fish trap via two custom built harps. The fish trap was developed from four interlocking steel panels and contained 250 steel pickets, which sealed the inside of the trapping structure. All large rocks were removed from the inside of the fish trap and distributed downstream to improve our ability to net fish. The downstream panel of the fish trap protruded in the center to attract fish to the opening of a tapered proboscis. The opening of the tapered proboscis was 15.2 cm (length) x 15.2 cm (width).

A workstation was installed on top of the fish trap to improve fish handling and minimize stress to fish (Figure 10). The workstation consisted of an anchored 2.4 m (length) x 1.2 m (width) sheet of 0.38 cm floorboard mounted on top of the fish trap panels. The floorboard was covered with blue turf to improve traction and promote safe operations. The workstation was housed with a jobox, cooler, table, measuring board, and buckets. The locked jobox contained a hand-held PIT tag reader, CWT wand, DNA vials, balance, extra batteries, eugenol, multiple O_2 diffusers, clipboard, data sheets, and hole punch.

Two in-stream recovery live-wells were developed to resuscitate and temporarily hold adult fish (Figure 10). The in-stream recovery live-wells were developed by attaching one main panel and three smaller separating panels to the fish trap. Each in-stream live-well (1.5 m (length) × 1.2 m (width) × 0.9 m (height)) was covered by a sheet of 0.38 cm floorboard. The upstream live-well was used to recuperate natural-origin adults. The live-well wass accessed through a circular hole that fit an 18.9 L bottomless bucket. Natural-origin adults were gently placed into the live-well, through the bottomless bucket, and allowed to volitionally leave through an upstream or lateral 12.7 cm passage way. The downstream live-well was used to hold hatchery-origin adults until we were ready to transport them above the Five Mile weir. The picket and streambed interface of this live-well was completely sealed with sandbags and/or rocks to prevent adults from escaping. This live-well was covered with a split floorboard and hinge system, which allowed us to put fish in and net fish out.

Figure 10. Pole Flat weir, catwalk, fish trap, live-wells, and work station.

Pole Flat weir was checked on a daily basis, typically between 08:00 – 12:00 hours, for newly trapped Chinook salmon and non-target species. All fish were individually netted and transferred to a 136.4 L insulated cooler holding 75.7 L of fresh river water. Fish were anesthetized in the cooler for a period of one to two minutes using a 50:50 solution of eugenol and water. Approximately 4 ml of solution was used to anesthetize fish.

Chinook salmon and non-target species were visually examined for phenotypic characteristics and to collect morphometric data. Each fish was visually examined to determine gender, measured to the nearest 0.5 cm, weighed to the nearest 0.1 lb, inspected for fin-clips, pre-existing marks, and injuries, scanned for external and internal tags, and sampled for tissue. The tissue sample was taken from the right operculum with a paper punch. The operculum punch also served as a mark, indicating the fish was trapped at Pole Flat weir and part of a mark-recapture evaluation for estimating total escapement above the weir.

All natural-origin Chinook salmon were volitionally or directly released by hand above Pole Flat weir for natural spawning. Hatchery-origin Chinook salmon were held in a recovery tub or placed in the live-well (depending upon quantity) and ultimately transported above Five Mile weir and released for natural spawning. Hatchery-origin fish were individually loaded into a fish tank mounted on a ¾ ton pick-up truck. The fish tank contained one 1363.8 L compartment, a circulating pump, and was supplied with pure oxygen through a stone diffuser to increase oxygenation. The fish tank was filled with fresh river water directly pumped from Yankee Fork with a two horsepower water

pump. IHOT guidelines were followed for transporting adult fish, which is approximately 0.45 kg of fish per 4.5 L of water.

Once all fish were enumerated, the weir structures were cleaned and checked to ensure proper function. Staff snorkeled and/or walked the upstream and downstream periphery of the weirs to ensure the structures were sealed and functioning properly and to collect carcasses that had washed up on the weir face. All carcasses were visually examined for phenotypic characteristics and to collect morphometric data. All carcasses had their caudal fin removed after being processed to prevent duplicate counting, used in the mark-recapture evaluation, and distributed below the weir for nutrient enrichment.

Adult Trapping

The first Chinook salmon was trapped at Pole Flat weir on June 28, two days after installation. Overall, a total of 197 Chinook salmon were trapped at Pole Flat weir. We were unable to operate the weir from August 15 through 16 due to the Halstead Fire and mandatory evacuation. Seven pickets inside the trap box were pulled during this period of time to allow fish to move through the system. The last Chinook salmon was trapped on September 10 and the weir was removed on September 20.

Of the 197 Chinook salmon trapped, approximately 30 were hatchery-origin, 133 were natural-origin, and 34 were of unknown-origin (Table 4). The majority of unknown-origin fish were trapped on several days in mid-August during the peak of spawning run when the CWT wand was not available to trap tenders. Of the 30 hatchery-origin fish trapped, approximately 24 were ad-intact/CWT fish, while the remaining six were ad-clipped fish. The 133 ad-intact fish were unmarked adults indicating they were naturally produced. Of the 34 unknown-origin adults, all had intact adipose fins intact, but again we were unable to scan these fish for the presence of a CWT tag to determine their true origin.

Table 4. Chinook salmon trapping summary observed at Pole Flat weir.

Gender	Hatchery		Ad-Intact (Natural)	Ad-Intact (Unknown)	Total
	Ad-Intact/CWT	Ad-Clipped			
Males	9	5	79	24	117
Females	15	1	54	10	80
Total	24	6	133	34	197

By summing the two known groups of fish that had intact adipose fins (Ad-Intact/CWT + Ad-Intact), approximately 15.3% contained CWTs and 84.7% were truly unmarked fish (Table 5). We applied this rate to the unknown group of fish (n = 34) and estimate that five of these fish were hatchery-origin and the remaining 29 fish were natural-origin. These calculations result in an adjusted total of 29 ad-intact/CWT hatchery-origin fish and 162 ad-intact or natural-origin fish.

Table 5. Weighted estimates of unknown-origin fish trapped at Pole Flat weir.

Group	Count	Percent	Unknown Origin Fish	Estimated Origin of Unknown Fish	Summary
Ad-Intact/CWT (Hatchery)	24	15.3%	34	5	29
Ad-Intact (Natural)	133	84.7%		29	162
Total	157			34	191

The breakdown of unknown-origin fish into hatchery and natural fish results in an adjusted estimate of 35 hatchery-origin fish and 162 natural-origin fish (Table 6) for an overall proportion of hatchery-origin fish encountered at Pole Flat weir of 17.8% and 82.2% natural-origin.

Table 6. Adjusted hatchery and natural-origin Chinook salmon trapping estimates and overall proportion of hatchery and natural-origin fish observed at Pole Flat weir.

Group	Count	Total	Proportion
Ad-Intact CWT (Hatchery)	29	35	17.8%
Ad-Clipped (Hatchery)	6		
Ad-Intact (Natural)	162	162	82.2%
Total	197	197	

Gender was determined on all fish trapped at Pole Flat weir (Table 7). Our direct observations indicate 117 (59.4%) fish were male and 80 (40.6%) were female. This reveals that the overall male:female sex ratio was skewed towards males. The sex ratio of hatchery-origin fish was 46.7% male and 53.3% female. The sex ratio of natural-origin fish was 59.4% male and 40.6% female. The sex ratio of unknown-origin fish was 70.6% male and 29.4% female.

Table 7. Sex ratio of all fish, hatchery-origin fish, natural-origin fish, and unknown-origin fish observed at Pole Flat weir.

Gender	Overall		Hatchery		Natural		Unknown	
	Count	Sex Ratio	Count	Sex Ratio	Count	Sex Ratio	Count	Sex Ratio
Males	117	59.4%	14	46.7%	79	59.4%	24	70.6%
Females	80	40.6%	16	53.3%	54	40.6%	10	29.4%
Total	197		30		133		34	

Chinook salmon migration occurred over a 75 day period from June 28 – September 10 (Figure 11). Returning Chinook salmon exhibited bi-modal run-timing distribution. The first peak occurred on July 6 (n = 11), shortly after weir installation. The second peaked occurred on August 20 (n = 13), following the onset of spawning. From June 28 – July 10, Pole Flat weir was not trapping very well. Personnel documented this by setting lanterns out during the night and observing Chinook salmon approaching the weir structure. The numbers of fish trapped during this period of time was far lower than the number of fish observed during nighttime surveys indicating the fish trap and weir was not working properly. On July 11, personnel adjusted the right weir wing to increase the

angle to the entrance of the fish trap. Numerous rocks were stacked below the weir and boards installed on the weir face and trap to redirect flow through the fish trap. Once this was accomplished, our daily trapping frequency was more consistent (Figure 11).

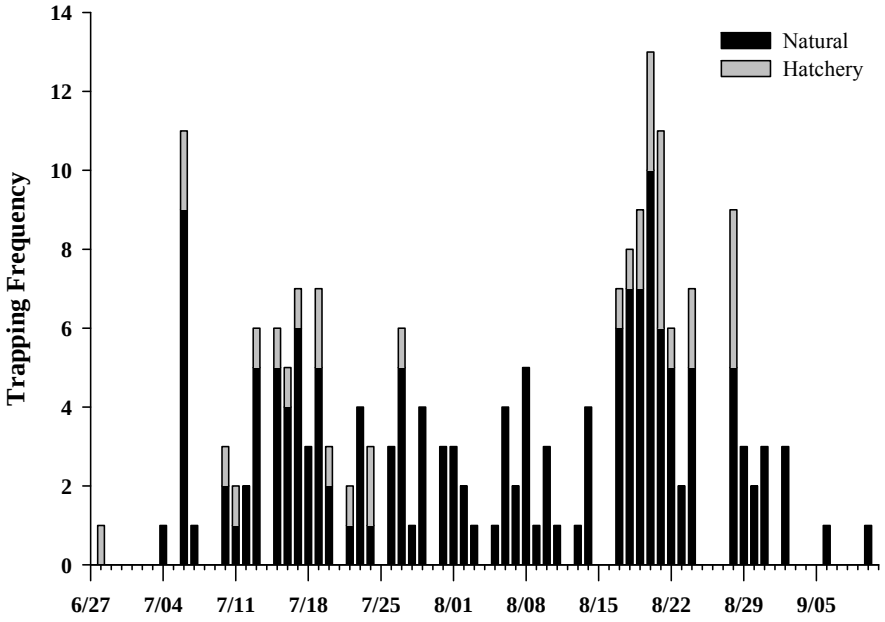
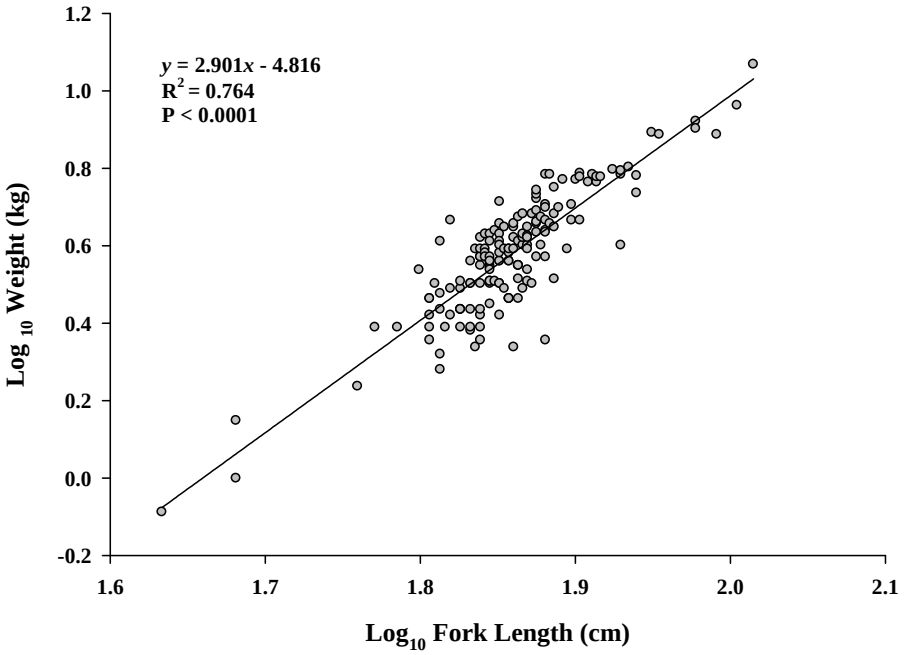


Figure 11. Trapping frequency of natural and hatchery-origin Chinook salmon at Pole Flat weir.

Out of the 197 fish trapped, approximately 195 were marked with a right operculum punch. Two fish were accidentally marked with left operculum punches. We also collected approximately 194 tissue samples that will be used in future parent-based tagging studies.

Of the 197 fish trapped, approximately 167 (84.8%) were weighed the nearest 0.01 kg. Fish weighed an average of 4.05 kg and ranged from 0.82 kg to 11.70 kg. The length-weight relationship for all adult Chinook salmon was significant (Figure 12). The *b* value of 2.90 indicates negative allometric growth, meaning that Yankee Fork adult Chinook salmon are becoming progressively thinner with increasing length. Ultimately, adult Chinook salmon in Yankee Fork exhibited exponential growth and this relationship was significant.



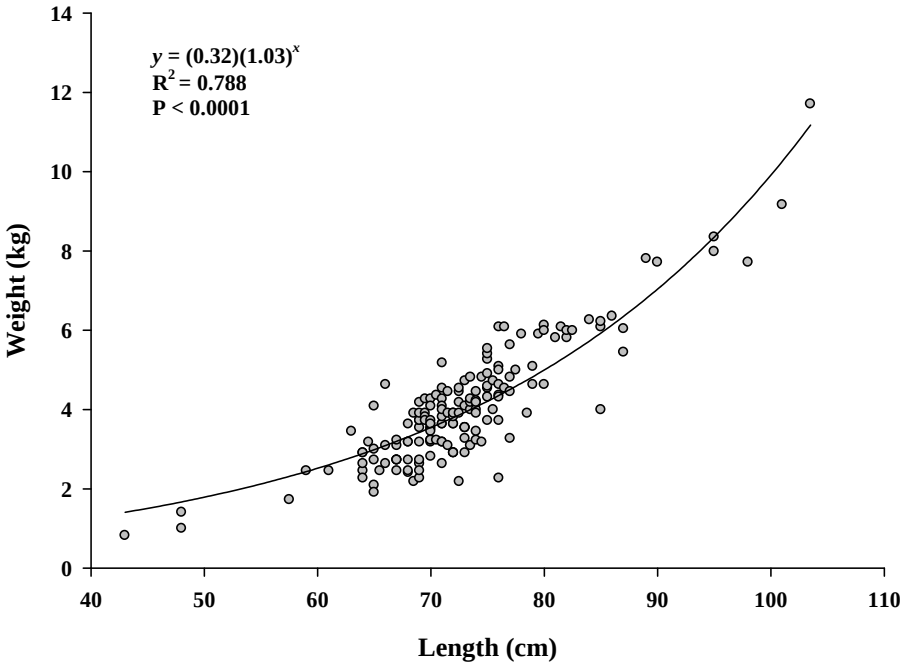


Figure 12. Length-weight relationship of adult Chinook salmon.

Run-Timing

The first hatchery-origin Chinook salmon was trapped on June 28 and the last hatchery-origin fish was trapped on August 28 for an overall migration period of 62 days. The

10th, 50th, and 90th percentile passage dates for hatchery-origin fish occurred on July 10, August 18, and August 24 (Figure 13). The first natural-origin Chinook salmon was trapped on July 4 and the last fish was trapped on September 10 for an overall migration period of 69 days. The 10th, 50th, and 90th percentile passage dates for natural-origin fish occurred on July 13, August 7, and August 28 (Figure 13). Overall, natural and hatchery-origin fish exhibited similar migration timing.

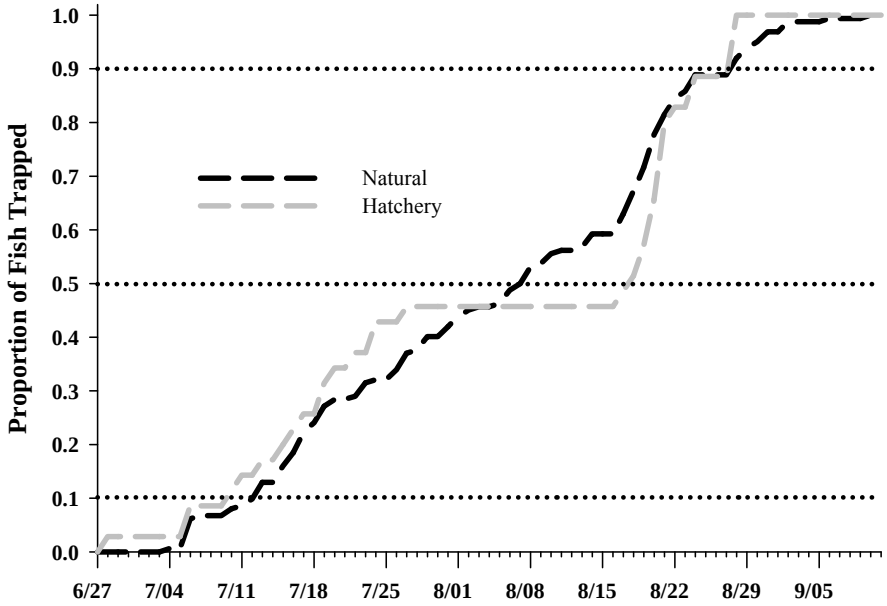


Figure 13. Run-timing of natural and hatchery-origin Chinook salmon at Pole Flat weir.

Age Structure

Age structure of Chinook salmon returning to Yankee Fork is determined by a length at age relationship developed by IDFG for use at Sawtooth (Table 8). These fork length categories are used to age all fish trapped at Pole Flat weir, since fish returning are either direct or indirect progeny of Sawtooth stock. Using the methodology listed above 18 fish were age3, 160 fish were age4, and 19 fish were age5 (Table 8). A total of 81.2% of the return was age4 fish.

Table 8. Age class totals for all Chinook salmon trapped at Pole Flat weir.

Fork Length (cm)	Year Class	Number	Percent
≤ 64	age3	18	9.1%
65-82	age4	160	81.2%
≥ 83	age5	19	9.6%

Of the 197 fish trapped at Pole Flat weir, the average fork length was 72.3 cm and ranged from 43 cm to 103.5 cm (Figure 14). We categorized length frequency into 5 cm bins to

describe the overall length distribution. The largest length bin frequency was the range of 71-75 cm fork length at 33.5% of the run (n = 66). Very few age^3 and age^5 fish were trapped in 2012, with the majority of fish being greater than 64 cm and less than 83 cm.

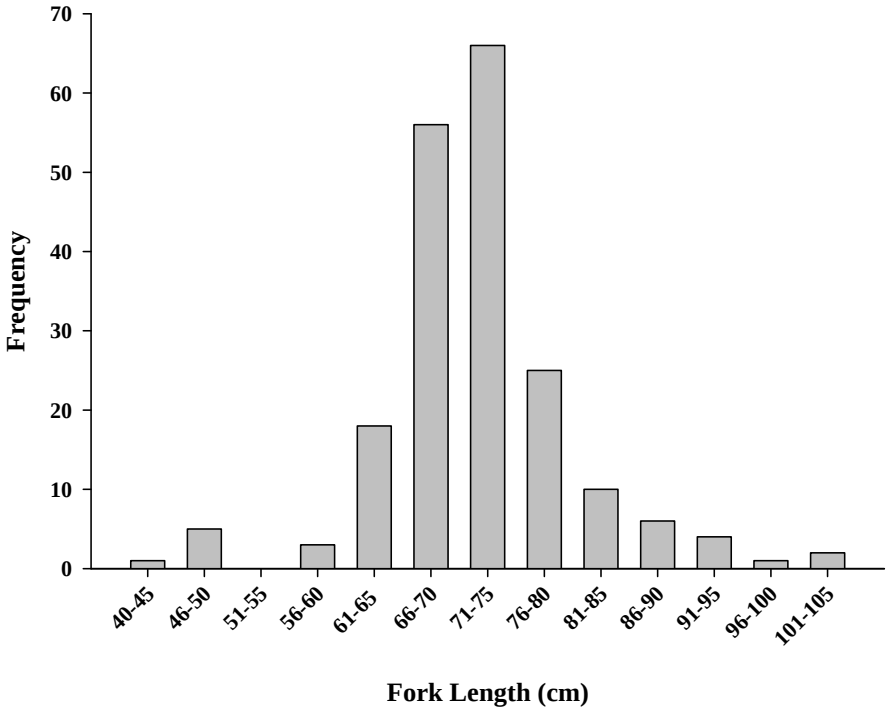


Figure 14. Length frequency of Chinook salmon trapped at Pole Flat weir.

In 2012, we anticipated the return of age^3 and age^4 hatchery-origin Chinook salmon from BY 08 and 09 smolt releases and a large return of age^4 natural-origin adults due to adult hatchery adult outplant activities in 2008. We obtained an age for hatchery and natural-origin Chinook salmon males and females trapped at Pole Flat weir (Figure 15). As anticipated, we did not have any age^5 hatchery-origin Chinook salmon return, since we didn't release any BY 07 juveniles. Of age^3 hatchery-origin returns, approximately 6.7% were males and 10.0% were females. The females were likely misclassified males and future gender calls on fish ≤ 64 cm fork length will be closely examined. Of age^4 hatchery-origin returns, approximately 40.0% were males and 43.3% were females. As expected the natural-origin adult return was comprised primarily of age^4 adults. We found that 6.8% of the natural-origin fish returning were comprised of age^3 males, which is a good indication for the 2013 adult return. Of the age^4 natural-origin returns, approximately 45.1% were males and 34.6% were females. Of age^5 natural-origin returns, approximately 7.5% were males and 6.0% were females.

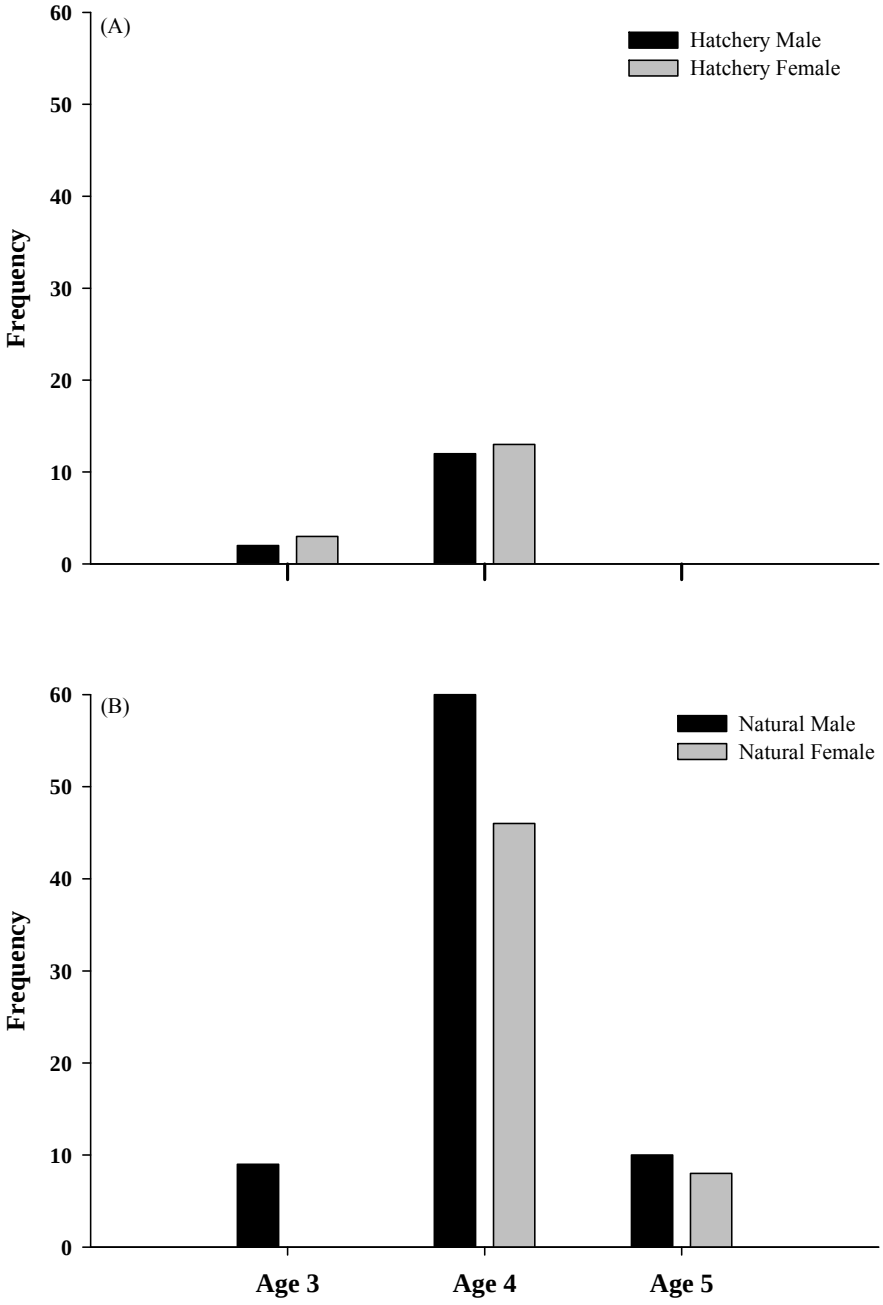


Figure 15. Age proportion of hatchery (A) and natural (B) Chinook salmon trapped at Pole Flat weir.

Lastly, a total of 194 tissue samples were collected from adult fish trapped at Pole Flat weir. These tissue samples will be used to determine the relative reproductive success of fish spawning naturally in Yankee Fork. All tissue samples were stored in 95% ethanol and archived at the Fish and Wildlife Department.

Five Mile Weir

The secondary weir, referred to as Five Mile weir, was installed to serve primarily as a blocking weir that would prevent outplanted hatchery-origin fish from moving back downstream and spawning in the West Fork. Five Mile weir was installed on June 28 just upstream of the confluence with Five Mile Creek at rkm 21.59 and removed on September 21 (Figure 16).

Five Mile weir is also temporary structure consisting of a v-shaped picket weir attached to a fish trap and work station (Figure 16). This weir was designed and built by program staff entirely from steel to accommodate trapping Chinook salmon in upper Yankee Fork. This weir was also used to funnel upstream migrating adult Chinook salmon to the inlet of the fish trap, where they enter and become trapped through a tapered proboscis.

The left weir face consists of six tripods and five counterweights supporting three panels and 180 steel pickets (Figure 16). The right weir face consists of four tripods and four counterweights supporting two panels and 120 steel pickets. The fish trap consisted of two harps, four panels, a workstation, and two in-stream live-wells, similar to Pole Flat weir. Five Mile weir was not sandbagged, nor black mesh attached to the weir face.

Figure 16. Photo of Five Mile weir, fish trap, live-wells, and workstation.

A total of 15 adult Chinook salmon were trapped at Five Mile weir. The first fish was trapped on July 12 and the last fish was trapped on August 26. Of these fish, approximately 13 (86.7%) fish were previously trapped at Pole Flat weir and two of these fish escaped detection at Pole Flat weir. Approximately 11 fish (73.3%) were males and

4 fish (26.7%) were females. The average fork length of fish trapped at Five Mile weir was 73.8 cm and ranged from 65 – 91 cm. All of these fish were released above Five Mile weir for natural spawning. It became apparent that fish were able to escape the Five Mile weir and modifications were made to the pickets, but it was too late in the season to see any dramatic results.

HATCHERY ADULT OUTPLANTS

Pole Flat Weir Hatchery Outplants

As mentioned above, hatchery-origin Chinook salmon trapped at Pole Flat weir were removed and outplanted above Five Mile weir for natural spawning. This strategy was in place to prevent hatchery-origin fish from spawning in the West Fork.

Hatchery-origin fish trapped at Pole Flat weir were outplanted in the upper Yankee Fork at one of five locations (Table 9). Our records indicate 26 hatchery-origin fish out of the 30 (identified hatchery fish) trapped at Pole Flat weir were transported upstream. The other four fish were incidentally released above Pole Flat weir or escaped the live-well system. The majority of fish (57.7%) were released at Five Mile Bridge, followed by Five Mile weir itself (15.4%). Of the 26 fish outplanted above Five Mile weir, 42.3% (n = 11) were male and 57.7% (n = 15) were female. Approximately 25 fish were marked with a right operculum punch and one was accidentally marked with a left operculum punch.

Table 9. Number, location, and percentages of hatchery-origin male and female Chinook salmon trapped at Pole Flat weir and outplanted in upper Yankee Fork.

Outplant Location	Male	Female	Number	%
Five Mile Bridge	9	6	15	57.7%
Five Mile Weir	2	2	4	15.4%
Eightmile Creek	0	2	2	7.7%
Tenmile Bridge	0	2	2	7.7%
Unknown	0	3	3	11.5%
Total	**11**	**15**	**26**	
Percent	**42.3%**	**57.7%**		

Sawtooth Hatchery Outplants

The Tribes and IDFG reached agreement to outplant excess hatchery-origin adults trapped at Sawtooth Fish Hatchery in upper Yankee Fork, when fish are in excess of harvest and/or broodstock needs. The Tribes and IDFG agreed to an outplant quota of up to 1,500 hatchery adults in upper Yankee Fork, when available. In 2012, the Tribes worked cooperatively with IDFG to outplant excess hatchery-origin fish trapped at Sawtooth to bolster natural production within Yankee Fork.

Sawtooth hatchery-origin adults were transported in tanks mounted on three ¾ ton pick-up trucks and/or a large tanker truck provided by IDFG. On outplanting days, hatchery

fish were crowded in the west pond at Sawtooth following normal protocols and individually netted out. The following biological data was collected from each outplant: fish identification #, gender, length (cm), genetic sample (0.5 cm^2), and vial #. Each fish was individually loaded into one of the truck tanks listed above and transported directly to Yankee Fork. Adult fish were either released using nets or funnel tubes (for large tanker truck).

The Tribes and IDFG outplanted approximately 1,054 hatchery-origin Chinook salmon adults trapped at Sawtooth in upper Yankee Fork (Table 10). YFCSP personnel assisted IDFG personnel with loading, sorting, crowding, and transporting fish from Sawtooth to upper Yankee Fork on July 12, 17, 19, 26, and September 6 and 7. Overall a total of 608 males (57.7%) and 446 females (42.3%) were outplanted. Eightmile Creek received the most adults (n = 398), followed by Tenmile Bridge (n = 347). A very late group of fish became available in September and these fish were scatter planted a various locations above Five Mile weir, with the exception of an estimated 40 fish outplanted between Jordan Creek and Five Mile weir. The first three outplants were skewed towards females at 66.5%, 54.5%, and 51.2%. The last two major outplants on July 26 and September 6 were heavily skewed towards males at 100% and 70.6%, respectively.

Table 10. Number, location, and percentage of hatchery-origin male and female Chinook salmon trapped at Sawtooth and outplanted in upper Yankee Fork.

Date	Males	Females	Total	% males	% females	Outplant Location
7/12/2012	67	133	200	33.5%	66.5%	Eightmile Creek
7/17/2012	90	108	198	45.5%	54.5%	Eightmile Creek
7/19/2012	102	107	209	48.8%	51.2%	Temmile Bridge
7/26/2012	138	0	138	100.0%	0.0%	Temmile Bridge
9/6/2012	211	88	299	70.6%	29.4%	Various Locations
9/7/2012	0	10	10	0.0%	100.0%	Various Locations
Total	**608**	**446**	**1054**	**57.7%**	**42.3%**	

Of the 1,054 fish obtained from Sawtooth Fish Hatchery, the average fork length was 69.5 cm and ranged from 39 to 86 cm (Figure 17). We categorized length frequency into 5 cm bins to describe the overall length distribution. The largest length bin frequency was the range of 71-75 cm fork length at 23.8% of the outplants (n = 357). Approximately 15.6% of the outplants were age^3, followed by 83.6% age^4, and 0.9% age^5 (Figure 18). There were more males than females in all age classes.

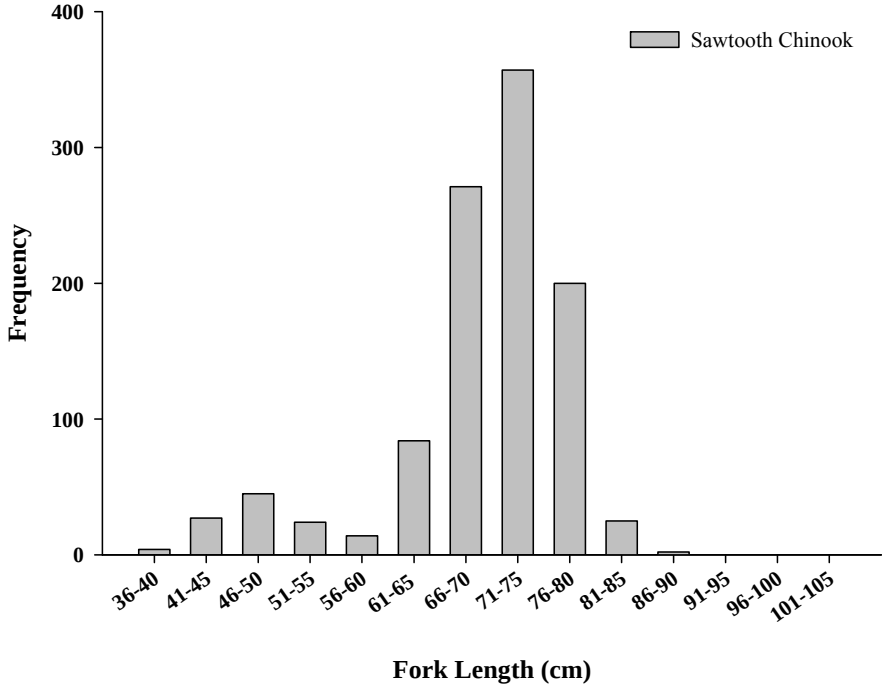


Figure 17. Length frequency of hatchery-origin Chinook salmon obtained from Sawtooth and outplanted into upper Yankee Fork.

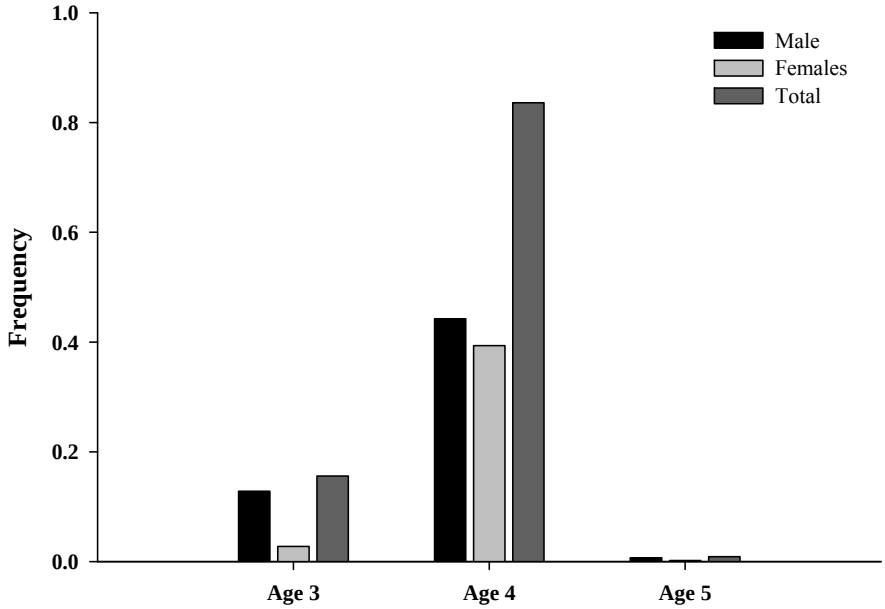


Figure 18. Age distribution of hatchery-origin Chinook salmon obtained from Sawtooth and outplanted into upper Yankee Fork.

HARVEST MONITORING

Harvest guidelines for Yankee Fork were developed according to the TRMP (Denny et al. 2010) and included the number of natural and hatchery-origin Chinook salmon available for harvest. Chinook salmon fisheries were managed to achieve escapement and broodstock goals as the first priority. The harvest framework for natural-origin populations incorporates the Viable Population Thresholds (VPT) defined by the ICTRT for basic, intermediate, and large populations. Using the in-season forecast, the Tribes developed a harvest guideline in 2012 for Yankee Fork based upon population specific abundance estimates developed by co-managers in Idaho. The Tribes harvest guidelines were considered maximum harvest rates for Snake River spring/summer Chinook salmon returning to Yankee Fork. The harvest rate was determined based on the anticipated forecast of 500 hatchery and 441 natural-origin fish returning to Yankee Fork. This resulted in a harvest guideline of 196 hatchery and 66 natural-origin Chinook salmon.

The goal of harvest monitoring is to provide accurate and precise estimates of Chinook salmon harvest in all areas open to Chinook salmon fishing. This is accomplished by obtaining catch per unit effort (CPUE) data. Fishery monitors covered Yankee Fork on nearly a daily basis from June 28 to August 12, gathering data in the field from fisherman on the amount of time fished, number of fish caught, released, type of gear used (spear, snag, hook and line), origin, mark, and length from fish harvested. Where applicable, fishery personnel collected tissue samples from harvested Chinook salmon for later verification of genetic identity.

Tribal staff conducted harvest monitoring while performing YFCSP activities to interview fishermen and obtain a catch per unit effort (CPUE). Log book data indicates staff completed 57 passes in Yankee Fork, observed 56 total fisherman for a total of 60 fishing days. Overall, a total of 242 fish were harvested of which 43 were natural-origin and 199 were hatchery-origin (Table 11). From 2008 – 2011, only three fish were harvested, indicating an extremely successful fishery took place in 2012.

Table 11. Yankee Fork harvest 2008 – 2012.

Year	Natural Adult Harvest	Hatchery Adult Harvest	Total Harvest
2008	1	0	1
2009	1	0	1
2010	1	0	1
2011	0	0	0
2012	43	199	242
Total	**46**	**199**	**245**

SPAWNING GROUND SURVEYS

Redd Counts

Intensive spawning ground surveys were conducted in Yankee Fork and its major tributary, West Fork, to determine spawn timing, redd enumeration and distribution, abundance of live fish, and to collect carcasses for biological information. Spawning ground survey procedures were developed specifically for the YFCSP for hatchery

effectiveness monitoring and coordinated with the various programs and/or agencies conducting field work in the Yankee Fork.

Yankee Fork was sub-divided into seven distinct strata (Konapacky et al. 1986) and one additional strata (Eightmile Creek) was added in 2009 (Tardy and Denny 2010). However, the seven strata are based on distinct habitat units and do not always translate into realistic spawner survey reaches, with some strata being too long to reasonably survey in a given day. Therefore, survey reaches were divided into walkable stream sections with easy to locate start and stop points (Table 12). Yankee Fork was divided into eleven survey reaches and walked weekly during mid-day marking Chinook salmon redds and recovering carcasses. In the past, West Fork was dived into two survey reaches (upper West Fork from Cabin Creek to Lightning Creek and lower West Fork from Lightning Creek to the confluence with Yankee Fork), however in 2012, upper West Fork was not surveyed all the way to Cabin Creek due to active forest fires.

Survey crews conducted four passes in reaches 1, 3, and 6, five passes in reaches 2 and 7, and six passes in reaches 4 and 5. Upper West Fork from approximately 1.75 km below Cabin Creek to approximately 1.36 km above West Fork canyon was surveyed once. Additional surveys on this reach were not possible due to the fire or warranted due to the very low redd numbers, the absence of live fish, carcasses, recent spawning activity, and low water levels. Lower West Fork from Lightning Creek to the confluence with Yankee Fork was surveyed twice. Short sections of Jordan Creek and Eightmile Creek were surveyed once in 2012. Further surveys were not conducted due to low observed water levels, no live fish, carcasses, redds, or any indication of spawning activity.

Table 12. Yankee Fork Spawning Ground Survey Reaches.

Survey	*Description*		*GPS Coordinates*		*Length*
Reach	*Start Description*	*End Description*	*Start Waypoint*	*End Waypont*	*(km)*
1	Mouth	Pole Flat Weir	N 44.269743°, W 114.734579°	N 44.303237°, W 114.720407°	5.23
2	Pole Flat Weir	WFYF confluence	N 44.303237°, W 114.720407°	N 44.349041°, W 114.726469°	5.83
3	WFYF confluence	Custer Pullout	N 44.349041°, W 114.726469°	N 44.385486°, W 114.701587°	5.6
4	Custer Pullout	Five Mile Weir	N 44.385486°, W 114.701587°	N 44.406184°, W 114.654159°	5.05
5	Five Mile Weir	Eight Mile Creek	N 44.406184°, W 114.654159°	N 44.426312°, W 114.620585°	4.87
6	Eightmile Creek	Ten Mile Bridge	N 44.426312°, W 114.620585°	N 44.458197°, W 114.589461°	5.53
7	Ten Mile Bridge	Twelve Mile Bridge	N 44.458197°, W 114.589461°	N 44.483150°, W 114.561433°	4.01
8	WFYF Confluence	Above WFYF Canyon	N 44.349041°, W 114.726469°	N 44.375450°, W 114.773000°	6.18
9	Above WFYF Canyon	1.75 km below Cabin Cr.	N 44.375450°, W 114.773000°	N 44.396850°, W 114.812140°	4.87
10	Jordan / YF confluence	1.18 km above confl.	N 44.378251°, W114.721001°	N 44.387238°, W 114.726120°	1.18
11	Eightmile / YF confluence	1.52 km above confl.	N 44.426312°, W 114.620585°	N 44.435720°, W 114.628960°	1.52
Total					***49.87***

Observers were provided standard gear (i.e., polarized sunglasses, data sheets, gps unit, ribbon, permanent markers, backpack, and genetic sampling kit) and covered the same area over the duration of the spawning season to increase the accuracy and precision of data collected. Chinook salmon redds were identified, recorded, and marked with an iridescent ribbon directly lateral to the apex of the redd. Observers recorded the following information on the ribbon: date, observer initials, redd number, and stream position: (1) left bank, (2) middle, or (3) right banki. This information was linked to the

data sheets, vials containing operculum punches (for genetic sampling), and otolith samples.

Carcasses encountered during the surveys were examined for fin clips, operculum punches, and external/internal tags following standard weir trapping protocols. We identified three categories for processing carcasses: (1) operculum punched, (2) not operculum punched, and (3) natural-origin. If the carcass showed a pre-existing operculum punch, staff recorded gender, origin, fork length (cm), and percent spawned, noting that the fish was previously marked and handled. If the carcass was not marked with a pre-existing operculum punch, the following biological data was collected: gender, origin, fork length (cm), percent spawned, and genetic tissue sample (0.5 cm^2). If the carcass was a naturally produced Chinook salmon, biological data was collected as prescribed under categories one or two. The caudal fin was removed from all sampled carcasses and the carcass was placed back in the stream for nutrient enrichment.

Spawning ground surveys were conducted from August 8 – October 15 in correlation with past observed spawn timing in Yankee Fork, but extended this season due to a group of late outplanted fish. Mainstem Yankee Fork survey reaches were surveyed four to six times and smaller tributaries (e.g., Eightmile Creek) were surveyed once or twice. The number of passes each survey reach received was adjusted to correlate adult fish distribution and spawn timing. There were 235 total redds identified in 49.87 rkms surveyed multiple times resulting in an average of 4.16 redds/km (Table 13). We observed the majority of redds in survey reach 5 (Five Mile Creek – Eightmile Creek) with 109 total redds and 22.38 redds/km. The average survey reach was 4.53 km. The average number of redd per survey reach was 21.4 redds. No redds were observed in Jordan or Eightmile creeks indicated spawning commences in mainstem Yankee Fork and major tributary West Fork. We didn't observe a significant increase in redds/km below the weirs. This indicates Pole Flat and Five Mile weir did not impede fish migration.

Table 13. Spawning Ground Survey Statistics.

Survey Reach	Length (km)	Total Redds	Redds per km
1	5.23	16	3.06
2	5.83	23	3.95
3	5.60	2	0.36
4	5.05	20	3.96
5	4.87	109	22.38
6	5.53	49	8.86
7	4.01	5	1.25
8	6.18	8	1.29
9	4.87	3	0.62
10	1.18	0	0
11	1.52	0	0
Total	**49.87**	**235**	
Average	**4.53**	**21.36**	**4.16**

Spawning ground surveys have been completed in Yankee Fork since 1952. From 1952 – 1984, single-pass aerial surveys were completed by IDFG to monitor the population status. Since 1984, the Tribes have supplemented these surveys by completing multiple-pass ground surveys. Over this time period, there were no redds were observed in 1984 and 1995. The highest counts were observed in 2008 (n = 660) and 1968 (n = 615), respectively (Figure 19). Over the entire period (61 years) an average of 125 redds have been observed each year. Prior to initiating the YFCSP in 2008, the 10 year average (1998-2007) was 53.6 redds/year. Since initiating the YFCSP, the average has increased to 272 redds/year.

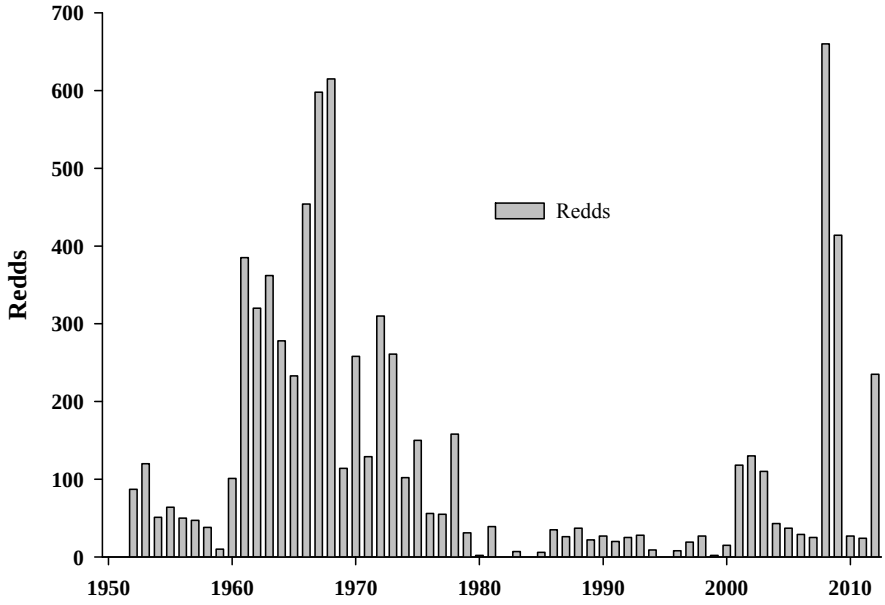


Figure 19. Chinook salmon redds in Yankee Fork, 1956 - 2012.

Carcass Surveys

Carcass surveys were completed concurrently during spawning ground surveys, and from fish recovered on the upstream side of both weirs during weir surveys. Surveys were conducted from August 8 – October 15. Staff collected a total of 285 carcasses from the confluence of Yankee Fork to Twelvemile Mile Bridge (Table 12). Of the carcasses recovered 192 were from hatchery outplanted adults and therefore were not included in mark-recapture population estimates. The other 93 carcasses were naturally immigrating fish, of which 16 were hatchery smolt release returns, 74 were natural origin, and three were unknown. There were 10 carcasses collected containing PIT tags. All carcasses containing PIT tags were fish tagged at Lower Granite Dam.

MARK-RECAPTURE EVALUATION

The Tribes acknowledge the presence of un-trapped returning adults in Yankee Fork. To determine the total escapement to Yankee Fork, the Tribes utilized a mark-recapture

study to apply an efficiency rate to recovered unmarked adults to estimate a total escapement number.

The mark-recapture study was conducted with natural immigrating returns between the Pole Flat weir and Twelve Mile Creek and West Fork. There were 197 naturally migrating salmon released above Pole Flat weir (2 of which were not included in calculations due to marking error). A total of 93 carcasses were recovered during spawner surveys and 83 were used in the mark-recapture analysis. Of the ten fish excluded from the mark-recapture analysis, five were recovered below Pole Flat weir and five were too decomposed to identify whether they were marked. We used 57 marked carcasses (right operculum punched) and 26 unmarked carcasses to estimate escapement above Pole Flat weir using the Peterson Estimator (Chapman 1951) where adult escapement is equal to the equal to the total number of Chinook salmon marked (*M*) at Pole Flat weir times the total number of fish recovered (*C*) during spawning ground surveys or found on the weir faces, divided by the total number of marked fish recovered (*R*) during spawning ground surveys or found on the weir faces, as

$$AE = \left[\frac{(M+1)(C+1)}{(R+1)}\right] - 1$$

Using the method described by Chapman (1951), we estimate 283 salmon (±34) escaped past Pole Flat weir. We used the hatchery (17.8%) and natural (82.2%) fraction observed at Pole Flat weir to estimate origin. This results in an estimate return of 233 natural and 50 hatchery-origin fish. Overall trapping efficiency therefore equaled 69.6% (197 trapped ÷ 283 estimated escaped above).

FISH PER REDD ESTIMATION

Pole Flat to Five Mile Weir

Although we estimated escapement above Pole Flat weir, we observed 16 redds below the weir that are not included in the mark-recapture escapement estimate. To estimate total escapement to Yankee Fork, we had to calculated a fish per redd value to estimate the number of fish that returned to Yankee Fork that spawned below Pole Flat weir.

Since a large number of hatchery-origin fish were outplanted in upper Yankee Fork (above Five Mile weir), we decided that we needed to exclude this area when developing our fish/redd expansion factor. The most realistic fish/redd expansion factor was determined to be in the area between Pole Flat and Five Mile weirs (survey reaches 2, 3, 4, and West Fork) which contained a total of 56 redds.

In order to figure out how many fish spawned in between Pole Flat and Five Mile weirs (survey reaches 2, 3, 4, and West Fork), we had to estimate the number of fish that passed Five Mile weir, to exclude these fish from our calculation. We were able to estimate Five Mile weir escapement by using the percent of carcasses (26.5%) found above such were that were used in the mark-recapture evaluation. We applied this percentage (26.5%) to

the Pole Flat weir escapement estimate of 283 adults and estimated that 75 fish likely passed Five Mile weir. Therefore, the number of live fish within the Pole Flat weir to Five Mile weir, including West Fork equates to 208 fish. In the future, we plan to implement a secondary mark at Five Mile weir to improve our ability to estimate escapement into upper Yankee Fork. A secondary mark-recapture study will improve our fish/redd calculations between Pole Flat and Five Mile weirs.

Again, we observed 56 redds between Pole Flat and Five Mile weirs, including West Fork and we estimate that 208 adults produced these redds. However, carcass surveys in these reaches identified a 7.14% pre-spawn mortality rate in female fish, resulting in an estimate loss of ten female fish before successful spawning. This results in 198 total spawners available to produce the 56 redds recorded. Male pre-spawn mortality is difficult at best to estimate in the wild and was not estimated, although observationally we are confident some male pre-spawn mortality occurred. These calculations result in an adjusted fish per redd ratio of 3.54 fish/redd (208 adults/56 redds). To determine escapement below Pole Flat weir, we applied the adjusted fish/redd ratio (3.54) to the number of redds observed below Pole Flat weir (n = 16) and estimate 57 fish were in this reach.

Above Five Mile Weir

Hatchery outplanted fish were subject to considerably different conditions than naturally migrating fish, such as additional handling, and in some groups of outplanted fish, significantly delayed spawning time due to holding in hatchery facilities. Additionally fishing pressure was much higher on the hatchery outplanted fish. Due to these factors, fish/redd estimates and pre-spawn mortality were calculated separately for the area above Five Mile weir.

Yankee Fork is a relatively clear stream and fish are visible even in deeper pools. Therefore, Tribal members were quickly able to locate groups of outplanted fish holding above Five Mile weir and focused their fishing efforts there. The Tribal fishery accounted for and estimated harvest of 199 outplanted and 43 natural-origin fish. This results in 855 outplanted fish (1,054 - 199) and 32 naturally returning fish (75 - 43) available for spawning.

Of the 1,054 fish outplanted from Sawtooth Fish Hatchery 608 (57.7%) were males and 446 females (42.3%). Carcass surveys identified 144 males (75.4%) and 47 females (24.6). All outplanted fish were uniquely marked with a left operculum punch at Sawtooth, counted then transplanted to upper Yankee Fork. Therefore, the number of left punched fish is a census rather than an estimate. This group of fish then provides an excellent opportunity to test the accuracy of carcass surveys for sex composition estimates. Prior to carcass surveys YFCSP personnel hypothesized carcass surveys would be bias towards over counting males. Males typically travel between spawning events, fertilizing more than one redd and frequently wash up in riffles. Females tend to stay close to redd sites until death and often drop to the bottom of deeper pools and other areas where their carcasses are harder to locate. The actual outplant male:female ratio compared to the observed carcass male:female ratios support these observations, with

higher male:female ratios found in carcass surveys than in the actual census. This pattern was also observed in the ratio of fish found on the upstream side of weir faces, likely representing moving fish, compared to carcass ratios found on foot surveys (fish staying near redd sites). In these surveys the male:female ratios were disproportionately higher on the weir faces. Because of this, all male:female ratios in this study were conducted from live fish as opposed to carcass counts.

Of the 47 female outplanted carcasses recovered, five (10.6%) died before spawning (all had full egg sacs). Assuming this calculation represents the pre-spawn mortality rate for all outplanted females, we estimate an additional 47 females died before spawning (446 * 0.106), reducing the spawner abundance to 808 outplanted fish.

Carcass ratio calculations estimate 75 fish naturally migrated past Five Mile weir; however 43 of these were also captured in the Tribal fishery, resulting in a spawner abundance of 31 in this area. Therefore, the total number of adult spawners above Five Mile weir was estimated to be 839 fish. There were 163 redds in this region resulting in a fish/redd estimate of 5.15. This calculation supports the observation that hatchery outplanted adults were not spawning as successfully as naturally returning fish. In addition, this observation was primarily driven by a group of late outplanted fish (n = 309) that were acquired after hatchery broodstock goals at Sawtooth were met. This late outplant group likely had higher pre-spawn mortality rates and produced fewer redds.

Incidentally, if this late outplant group of fish was dropped from the fish/redd calculation, the number of fish/redd in this area drops to 3.31, which is very similar to the adjusted estimate from sections 2 – 4, and West Fork. Therefore, it is possible that hatchery outplanted adults had similar redd production when allowed to follow their natural spawn timing. This inference would of course have to be verified by further study. Unique batch marking of each group of outplanted fish would allow us to possibly track specific outplant group survival.

TOTAL ESCAPEMENT

Overall, we estimate a total of 340 natural and hatchery salmon returned to Yankee Fork in 2012. We estimate that 283 of these fish passed Pole Flat Weir and 57 remained below the weir to spawn. Of this return, 279 were fish were natural-origin (82.2%) and 61 were hatchery-origin (17.8%). We further estimate that 202 fish were male and 138 fish were female. In addition to what returned naturally to Yankee Fork, we outplanted 1,054 adult hatchery fish obtained from Sawtooth, producing in an in-river total abundance of 1,394 Chinook salmon. However, harvest surveys estimated 242 fish were taken out of upper Yankee Fork above Five Mile weir in the Tribal fishery, (43 natural and 199 hatchery) leaving an adult escapement of 297 naturally migrating salmon (wild and hatchery origin) and 855 adult hatchery outplants, for a total of 1,152 fish. Female pre-spawn mortality rates indicate an additional 57 females died before spawning (10 naturally migrating and 47 outplants). This results in an estimated spawner abundance of 1,095 salmon in the Yankee Fork watershed that produce a total of 235 redds. This equates to an overall fish/redd ratio of 4.66 fish/redd.

DISCUSSION AND RECOMMENDATIONS

The YFCSP is designed to incorporate habitat restoration, harvest management, and artificial propagation to achieve the long term goal of returning 2,000 adults and is annually operated to identify adaptive management strategies within and between seasons.

Hatchery smolt releases were conducted to investigate survival differences between direct stream and acclimated releases. Overall survival for the entire group was not significantly different to Lower Granite Dam. This is likely the result of the acclimated group not actually being acclimated. Between groups, the acclimated release also showed similar travel time to Lower Granite Dam. These results were atypical of what has been observed with the BY 08 and BY 09 smolt releases. YFCSP personnel will need to re-evaluate the possibility of releasing BY11 hatchery smolts earlier in April to ensure juveniles imprint to Yankee Fork and thereby reduce straying. In addition, we need to carefully plan the Yankee Fork component of the Crystal Springs Fish Hatchery to address the issue on straying and acclimation. In addition, now that a PIT tag array exists in lower Yankee Fork, we need to closely look at in-basin survival between acclimated and direct stream released smolts. We will also need to ensure that any future acclimation releases are appropriately acclimated by properly securing the block nets.

Although we released a significant amount of BY 08 and BY 09 smolts in 2010 and 2011, hatchery-origin adult returns to Pole Flat weir were far short of expectations. There were significant BY 08 ad-intact/CWT adult strays to Sawtooth in 2011 and again in 2012, indicating smolts are not imprinting appropriately to Yankee Fork. Due to non-differential marking of the ad-clipped juveniles released at Sawtooth and Yankee Fork in 2010 and 2011, stray rates could not be determined for this group at this time. Stray rates for the ad-clipped group can and will be determine later through parent based tagging. Consistent with results in 2011, we trapped a higher frequency of ad-intact CWT adults (82.9%) as compared to ad-clipped adults (17.1%). The majority of these fish were from the BY 08 smolt release, which included fish released directly into Yankee Fork (not acclimated). Very few BY 09 adults return in 2012, indicating poorer survival for these fish.

Weir operations have improved dramatically since initiating the program in 2008. Staff has continually completed structural modifications to the weir and fish trap structures and have become confident installing the weir structures in higher flows. We have dramatically improved our ability to trap, capture, handle, and process returning Chinook salmon adults. A higher proportion of natural-origin males versus females is a clear indication that late trap installation is consistently missing the front portion of the run. Although this was not the case in 2012, we definitely need to ensure the fish trap and weir is properly secured on a daily basis by snorkeling the weir structures.

YFCSP personnel collected juvenile Chinook salmon emigration data at the screw trap when it was operational. We were unable collect sufficient mark-recapture data to fully estimate BY 10 smolts and BY 11 fry. This is the direct result of a temporary cable

system that was drastically improved once discharge receded, but is not a new issue. Future juvenile trapping efforts need to focus on the ability to manipulate the screw trap during higher flow periods. In addition, we need to ensure program personnel are properly implementing the protocols at the screw trap to ensure recaptured fish are detected. That said, results from screw trap operations, again confirm that the majority of juveniles are migrating from Yankee Fork as pre-smolts and a smaller proportion as parr.

Adult outplanting activities were well planned and implemented in 2012. The majority of outplanted fish were males and this occurred later in the season. The majority of females were outplanted in July when the Tribal fishery was on-going. The targeted harvest on outplanted adults was a success and numerous Tribal members were encouraged by the YFCSP, but future efforts need to ensure equal harvest on males and females.

Lastly, spawning ground surveys were completed throughout Yankee Fork in all areas where adult Chinook salmon spawn. Future efforts need to be made to improve the number of carcasses recovered during these surveys. In addition, efforts can be improved to start surveys in the late morning to improve our ability to detect redds and located carcasses. Now that everyone is properly trained and familiar with the survey transects, spawning ground surveys will improve.

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APPENDIX A: Regional Participation

Dates	Meeting	Location
10/4/2011	IDFG Mark/Tag Meeting	Boise, Idaho
10/5/2011	Supervisor's Meeeting	F & W Dept.
10/7/2011	Yankee Fork Tributary Assessment Meeting	F & W Dept.
10/10/2011	Fish and Wildlife Department Manager's Meeting	F & W Dept.
10/11/2011	YF PIT Tag Array Tour	Yankee Fork, Idaho
10/20/2011	Salmon/Challis National Forest Coordination Meeting	F & W Dept.
10/24/2011	Panther Creek Broodstock Selection	F & W Dept.
10/24/2011	Yankee Fork Pond Series 2 & 3 Habitat Enhancement and M&E Plan	F & W Dept.
10/26/2011	YF PIT Tag Array Site Test	Yankee Fork, Idaho
10/27/2011	YF Interdisciplinary Team Meeting	Challis, Idaho
10/29/2011	NOAA ESA Section 10 Permit Modification Meeting	F & W Dept.
11/3/2011	Yankee Fork Tributary Assessment Fish Data Exchange Conference Call	F & W Dept.
11/3/2011	Yankee Fork Pond Series 2 & 3 Restoration Project and M&E Design Meeting	F & W Dept.
11/4/2011	USFWS/SBT Coordination on Hagerman NFH Meeting	Hagerman, ID
11/7/2011	Program Staff Meeting	F & W Dept.
11/8/2011	NOAA 1127 & 16298 Permit Modification Conference Call	F & W Dept.
11/9/2011	ISU Outdoor Program & Yurt Construction/Assembly Planning Meeting	Pocatello, Idaho
11/14/2011	Yankee Fork Tributary Assessment Biological Data Gap Conference Call	F & W Dept.
11/15/2011	Yankee Fork Tributary Assessment Limiting Factors Analysis Meeting	F & W Dept.
11/15/2011	Yankee Fork Coordination Meeting	Water Res. Dept.
11/21/2011	Program Staff Meeting	F & W Dept.
11/28/2011	Crystal Springs FH Coordination – Internal Staff Meeting	F & W Dept.
11/30/2011	Crystal Springs FH Coordination – Design/Build, Concept Plans Meeting	F & W Dept.
12/2/2011	Timekeeping Training	Tribal Business Chamber
12/5/2011	Abernathy Fish Technology Center Genetics Research– Conference Call	F & W Dept.
12/5/2011	Technical Staff Meeting	F & W Dept.
12/5-6/2011	*U.S. v Oregon* Technical Advisory Committee Forecast – Conference Call	F & W Dept.
12/6/2011	Biomark Coordination for Yankee Fork PIT Tag Arrays – Conference Call	F & W Dept.
12/7/2011	Mitchell Act Pre-Meeting	F & W Dept.
12/7/2011	Mitchell Act DEIS Preferred Alternative – Conference Call	F & W Dept.
12/7/2011	SBT M&E Plan – Conference Call	F & W Dept.

12/8/2011	IDFG/SBT Anadromous Fish Coordination – Meeting	F & W Dept.
12/8/2011	ISU Outdoor Program Yurt Set-up – Meeting and Site Tour	Pocatello, Idaho
12/13/2011	RMETOC – Conference Call	F & W Dept.
12/16/2011	Coordinated Assessments – Conference Call	F & W Dept.
12/20/2011	LSRCP Steelhead Program Review – Conference Call	F & W Dept.
12/21/2011	Wells Fargo Training for Approvers & Secondary Approvers – Training	Tribal Business Chamber
12/28/2011	Program Staff Meeting	F & W Dept.
1/3/2012	Harvest Monitoring and Evaluation Plan Coordination – Conference Call	F & W Dept.
1/9/2012	Program Staff Meeting	F & W Dept.
1/10/2012	Panther Creek Broodstock Selection Paper – Conference Call	F & W Dept.
1/11/2012	LSRCP Steelhead Program Review – Conference Call	F & W Dept.
1/12/2012	EPA Action on Idaho Human Health Fish Consumption Guidelines - Meeting	F & W Dept.
1/12/2012	RM&E and Crystal Springs FH – Conference Call	F & W Dept.
1/17/2012	RM&E Plan Pre-bid Meeting	F & W Dept.
1/18/2012	Program Staff Meeting (Fish Identification Test)	F & W Dept.
1/20/2012	Yankee Fork Habitat and Supplementation M&E – Conference Call	F & W Dept.
1/25/2012	*US v Oregon* Production Advisory Committee	Portland, Oregon
1/26/2012	Columbia River Compact Hearing	Portland, Oregon
1/27/2012	Abernathy Fish Technology Center – Genetics Meeting	Longview, Washington
1/27/2012	Biomark – Meeting	Boise, Idaho
1/30/2012	Crystal Springs Fish Hatchery – Conference Call	F & W Dept.
1/30/2012	Yankee Fork Habitat and Supplementation M&E – Conference Call	F & W Dept.
1/31/2012	LSRCP Coordination Meeting	F & W Dept.
2/1/2012	RM&E Plan RFP Screening Meeting	F & W Dept.
2/3/2012	Salmon River TRMP and E/A Scoping – Conference Call	F & W Dept.
2/7/2012	Nutrient Flux Study Meeting	F & W Dept.
2/8/2012	Cramer Fish Sciences Independent Contractor Agreement Review	F & W Dept.
2/8/2012	EA/NEPA response to NOAA and TRMP	F & W Dept.
2/9/2012	Yankee Fork PIT Tag Array - Go-to-Meeting	F & W Dept.
2/9/2012	Abernathy Fish Technology Center - Go-to-Meeting	F & W Dept.
2/13/2012	Crystal Springs Fish Hatchery – Conference Call	F & W Dept.
2/14/2012	RMETOC – Conference Call	F & W Dept.
2/14/2012	PCSRF Biologist or Manager Position Meeting	F & W Dept.
2/22/2012	*U.S. v Oregon* Production Advisory Committee – Conference Call	F & W Dept.
2/29/2012	Oregon Chapter of the American Fisheries Society - PIT Tag Workshop	Eugene, Oregon
2/29 -	Oregon Chapter of the American Fisheries Society	Eugene, Oregon

3/2/2012		
3/7/2012	Program Staff Meeting	F & W Dept.
3/13/2012	B-Run Steelhead Meeting with IDFG and LSRCP	Boise, Idaho
3/14/2012	Springfield Fish Hatchery Design Meeting	Eagle, Idaho
3/15/2012	Field Protocols Training	F & W Dept.
3/15/2012	Crystal Springs Fish Hatchery – Conference Call	F & W Dept.
3/16/2012	Treaty Rights Seminar	Tribal Business Chamber
3/19/2012	PCSRF Annual Meeting – Conference Call	F & W Dept.
3/23/2012	Research, Monitoring, & Evaluation Plan – kickoff meeting	F & W Dept.
3/27 - 29/2012	YF PIT Tag Array Installation	Yankee Fork, Idaho
4/2/2012	Fish & Wildlife Dept. Manager's Meeting	F & W Dept.
4/3/2012	Go-to-Meeting with Biomark	Stanley, Idaho
4/3/2012	Yankee Fork Tributary Assessment Open House Meeting	Challis, Idaho
4/9/2012	Program Staff Meeting	F & W Dept.
4/11/2012	Yankee Fork Tour with IDFG	Yankee Fork, Idaho
4/14/2012	Tribal Member Treaty Rights Workshop	Fort Hall, Idaho
4/16/2012	Program Staff Meeting	F & W Dept.
4/17/2012	Yankee Fork Coordination Meeting	Fort Hall, Idaho
4/17/2012	Pond Series III Conference Call	F & W Dept.
4/18/2012	Yankee Fork Tributary Assessment Open House	Tribal Business Chamber
4/21/2012	Boys Club Steelhead Fishing Trip	Yankee Fork, Idaho
4/23/2012	Yankee Fork B-run Steelhead Conference Call	F & W Dept.
4/24/2012	Crystal Springs Fish Hatchery Step II Kickoff Meeting	Boise, Idaho
4/25/2012	Meeting with LSRCP regarding Yankee Fork Weir	Boise, Idaho
4/25/2012	IDFG Nampa Research Coordination Meeting	Nampa, Idaho
4/26/2012	Steelhead Run Reconstruction Meeting	Lewiston, Idaho
4/30/2012	Program Staff Meeting	F & W Dept.
4/30/2012	U.S. v Oregon Technical Advisory Committee Conference Call	F & W Dept.
5/1/2012	Snake Basin Coordination Meeting	F & W Dept.
5/7/2012	US v Oregon Technical Advisory Committee Conference Call	F & W Dept.
5/8/2012	Snake Basin Coordination Meeting	F & W Dept.
5/8/2012	Yankee Fork and Panther Creek Satellite Facilities Conference Call	F & W Dept.
5/14/2012	US v Oregon Technical Advisory Committee Conference Call	F & W Dept.
5/14/2012	Program Staff Meeting	F & W Dept.
5/15 - 16/2012	LSRCP Hatchery Production Meeting	Boise, Idaho
5/17/2012	Yankee Fork Satellite Facility Tour with USFS	Yankee Fork, Idaho
5/21/2012	US v Oregon Technical Advisory Committee Conference Call	F & W Dept.
5/30/2012	Crystal Springs Fish Hatchery Meeting	F & W Dept.
6/1-3/2012	Swift Water Rescue Workshop	ISU/Blackfoot, Idaho
6/4/2012	Fish and Wildlife Manager's Meeting	F & W Dept.
6/5/2012	Snake Basin Coordination Meeting	F & W Dept.

6/8/2012	Departmental Staff Meeting	F & W Dept.
6/11/2012	Chinook salmon Harvest Management Meeting	F & W Dept.
6/13/2012	Tribal Fisherman's Meeting	Tribal Business Chamber
6/14/2012	Informal meeting w/ FHBC on Chinook salmon fishing season	Tribal Business Chamber
6/19/2012	Tour Lower Granite Dam Trapping Facilities	Clarkston, Washington
6/19/2012	Crystal Springs 30% Internal Hatchery Review Conference Call	Clarkston, Washington
6/20 - 21/2012	LSRCP Steelhead Program Review Symposium	Lewiston, Idaho
6/26/2012	Snake Basin Coordination Meeting	Stanley, Idaho
7/3/2012	Snake Basin Coordination Meeting	F & W Dept.
7/5/2012	Program Management Transition Meeting	F & W Dept.
7/9/2012	Yankee Fork Chinook Salmon Project Tour w/ IDFG and NOAA-Fisheries	Yankee Fork, Idaho
7/10/2012	Yankee Fork Chinook Salmon Project Tour w/ Larry Murillo	Yankee Fork, Idaho
7/13/2012	Program Staff Meeting	Yankee Fork, Idaho
7/18/2012	Biomark and Yankee Fork PIT tag array	Yankee Fork, Idaho
7/19/2012	Yankee Fork Chinook Salmon Project Tour w/ Sawtooth Fish Hatchery staff	Yankee Fork, Idaho
7/20/2012	Program Staff Meeting	Yankee Fork, Idaho
8/7-8/2012	Spawning Ground Survey Training	McCall, Idaho
8/14/2012	Program Staff Meeting	F & W Dept.
8/15/2012	Crystal Springs Fish Hatchery 30% Design Review	Boise, Idaho
9/17/2012	Fish and Wildlife Department Staff Meeting	F & W Dept.