2014

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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ABSTRACT

The Shoshone-Bannock Tribes (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. During phase I, the Tribes are attempting to return 1,000 adults through a combination of techniques include releasing smolts and outplanting hatchery adults. The results of the program are monitored by trapping juveniles at a rotary screw trap and capturing returning adults at a picket weir. The Tribes estimate 70,389 juvenile Chinook salmon migrated past the screw trap from April 4 through November 4, 2014. This estimate includes 1,187 (± 820) BY 2012 smolts, 49,014 (± 11,932) BY 2013 parr, and 20,188 (± 3,439) BY 2013 pre-smolts. Adult trapping began on June 19 when a temporary picket weir was installed near Pole Flat Campground. The first adult Chinook salmon was trapped June 21 and the last fish was trapped on September 14. Overall, 237 adult Chinook salmon were trapped at Pole Flat weir, with 87.6% being natural-origin and 12.4% hatchery-origin. In addition, we trapped 136 adult bull trout and 2 adult sockeye salmon. All fish trapped at the weir were released above the weir for natural spawning. We also obtained 221 live, hatchery-origin Chinook salmon from Sawtooth Fish Hatchery and successfully outplanted them in upper Yankee Fork for natural spawning and nutrient enrichment. Additionally, 872 hatchery-origin Chinook salmon carcasses were outplanted in mainstem Yankee Fork and tributaries for nutrient enrichment. A Tribal fishery was held in July and harvest accounted for the mortality of six natural-origin Chinook salmon. Intensive spawning ground surveys were completed from August 13 – September 25 and a total of 53 redds were observed, of which 4 were located below Pole Flat weir. An additional 36 redds were observed in the enclosure in Eightmile Creek. Using mark-recapture principles, we estimate 243 (±11) adults escaped past Pole Flat weir for an overall trap efficiency of 96.3%. Using an expansion factor of 4.83 adults/redd, we estimated 19 fish contributed to spawning below Pole Flat weir. This results in a total of 262 adult Chinook salmon (32 hatchery and 230 natural) returning to Yankee Fork. Overall, there was an in-river total abundance of 483 Chinook salmon (262 naturally migrating and 221 hatchery outplants) in the Yankee Fork watershed that produced a total of 89 redds.

PROGRAM PERSONNEL

Personnel included Lytle Denny, Manager/Biologist, William Youmans, Biologist, David Evans, Biologist, Ryan Blackadar, Biologist, Carlos Lopez, Technician III, Justin Guardipee, Technician II, Rocco Chacon Jr., Technician II, and the following seasonal technicians: Michael Pahvitse, Joi Thomas, Noah Suppah, Steven Ponzo, Leon Grant, and Keith Moore.

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ACKNOWLEDGEMENTS

The Shoshone-Bannock Tribes (Tribes) provided the administrative framework and support for the Yankee Fork Chinook Salmon Program (YFCSP) to be successful. We are thankful to those individuals within the Tribal government that enabled us to successfully implement this program. This includes the Fort Hall Business Council (FHBC) for approving funding, Chad Colter (Fish and Wildlife Director) for supporting and understanding the challenges and complexities operating a vast program, located far away from home (e.g., Fort Hall, Idaho). In addition, we thank our full-time technicians for their commitment to the program, as it can be extremely difficult working so far away from home and being away for extended periods of time. Lastly, we would like to thank the numerous people that volunteered for the program; this additional help was greatly appreciated.

The YFCSP is funding by the United States Fish and Wildlife Service - Lower Snake River Compensation Plan (LSRCP) Office. We would like to thank everyone at the LSRCP Office for their continued support, including Steve Yundt, Chris Starr, Joe Krakker, Margaret Anderson, and Tammy Froscher. What a great group of individuals to work with and this project would not be possible without their support.

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In addition, we must thank the following agencies which supported the YFCSP including the United States Forest Service (FS), Bonneville Power Administration (BPA), National Oceanic and Atmospheric Administration - National Marine Fisheries Service (NOAA Fisheries), and Idaho State University's (ISU) Stream Ecology Center.

INTRODUCTION

Yankee Fork of the Salmon River (Yankee Fork) is an important spawning and rearing stream for Chinook salmon (*Oncorhynchus tshawytscha*). Historically, the system supported a large Tribal salmon fishery (Reiser and Ramey 1987), but this diminished as the number of salmon returning to the Yankee Fork declined. Ultimately, Yankee Fork salmon have decline due to anthropogenic impacts occurring both within the basin (e.g., dredge mining) and out-of-basin (e.g., hyrdropower). This has ultimately constrained the Tribes ability to exercise their reserved Treaty rights, which in turn has significantly impacted Tribal cultural and subsistence-based linkages to this resource. As such, restoring a Chinook salmon fishery in Yankee Fork is of upmost importance to the Tribes.

It cannot be understated how important it is to the Tribes to be able to harvest salmon in Yankee Fork, and throughout the Salmon River basin for that matter. Prior to the 1970's, Tribal salmon fisheries occurred throughout the Salmon River basin, managed solely under the authority of the Fort Bridger Treaty of July 3, 1868 (Treaty). During this period of time, Tribal fisherman targeted wild salmon stocks, or fish that are produced naturally without hatchery influence. During this period of time, the Tribes salmon fisheries were in flux and by the end of this decade, the mighty salmon runs were lost to folklore.

By the 1980's, the majority of salmon runs in Idaho were fully depressed and Tribal harvest opportunities were severely constrained, both in space and time. During this decade, the Tribes identified sanctuary and non-sanctuary (i.e., fishery) areas. Sanctuary areas included most, if not all of the wild production areas (e.g., Middle Fork), while fishery areas included places like Yankee Fork, the upper Salmon River, East Fork Salmon River, and the South Fork Salmon River; essentially where hatchery fish were released. As a result, numerous Tribal members grew accustomed to hunting for salmon in these designated hatchery-influenced fishery areas. Extremely few salmon were harvested in this period of time and drastic measures were taken to maintain some level of fishing. By the mid 1980's, two "bathtub" fisheries occurred. The "bathtub" fisheries were nothing more than directed harvest on hatchery fish outplanted into controlled environments in Yankee Fork and Panther Creek. Although salmon harvest was constrained in sanctuary areas, wild fish abundance continued to decrease, indicating factors outside of the basin were limiting.

By the 1990's, Tribal fisherman use patterns fully transitioned to the hatchery-influenced fishery areas (e.g., Yankee Fork, South Fork Salmon River, upper Salmon River). In 1992, the Snake River spring/summer Chinook salmon Evolutionarily Significant Unit was listed under the Endangered Species Act (ESA). This listing directly impacted the Tribes ability to promulgate fisheries because of their direct-take method (i.e., spear fishing). As a result all of the wild production fisheries were restricted by the FHBC in order to help rebuild the runs and prevent litigation. As a result, Tribal fishing effort and harvest reached an all-time low. Tribal policy directives focused on restoring natural fish populations by rebuilding habitat and managing harvest. Neither of these actions resulted in any considerable increase in fish abundance.

By the 2000's, salmon runs in Idaho began to increase, especially for hatchery stocks. This resurrected Tribal fishing interest and provided a significant change in fishing opportunity. During this period, Tribal members continued to focus their fishing efforts in the hatchery-influenced areas (Denny et al. 2009, Brandt et al. 2009, Brandt et al. 2010). However, several non-tribal fisheries were developing (e.g., upper Salmon River, South Fork Salmon River) and competition for fishing sites, camping locations, and general use of the resource were at an all-time high. Tribal and non-tribal fisherman interactions in these areas were generally negative which ultimately led to limited Tribal use of the resources. In this era, Tribal policy makers realized this issue and directed attention to implementing an artificial propagation program in Yankee Fork that could help offset Tribal harvest needs. In response, the Tribes developed the YFCSP to increase the number of Chinook salmon returning to Yankee Fork.

By 2004, a sub-group of the United States vs. Oregon Production Advisory Committee, including NOAA Fisheries, IDFG, and the Tribes, met to discuss and plan an artificial propagation program for spring Chinook in Yankee Fork. Over a series of meetings, the sub-group reviewed the historic and current adult abundance trends, the artificial propagation history, several regional plans, and the desired management objectives. When planning the YFCSP, NOAA Fisheries, IDFG, and the Tribes met on numerous occasions to ensure the artificial propagation strategy would meet each agencies goals and objectives. There was broad consensus to reintroduce a more closely related stock in Yankee Fork, since the extant stock was identified to be highly differentiated genetically; likely a reflection of the outplanting of Rapid River stock in this tributary (ICTRT 2003; ICTRT 2007a). This sub-group further determined the appropriate donor stock would need to be from the upper Salmon River and likely hatchery-origin, since all other natural-origin populations were still at high risk of extinction. The hatchery stock at Sawtooth was identified as the appropriate source for broodstock since it is located 31.7 rkm upriver from Yankee Fork. The group further agreed that the reintroduction effort would occur over the next several years and focus on a strategy of outplanting hatchery smolts and pre-spawn adults, then shifting to local broodstock collection within Yankee Fork, on adults returning from these efforts.

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 of the YFCSP is to return 2,000 adult Chinook salmon annually to the Yankee Fork for harvest, cultural, and broodstock objectives. To accomplish this, the program has three implementation phases: (I) reintroduction; (II) propagation; and (III) conservation. Each phase has different goals and objectives and currently the YFCSP is implementing phase I - reintroduction, while planning and preparing for phase II - propagation.

During Phase I reintroduction, juvenile and adult hatchery fish (Sawtooth stock) are released in Yankee Fork and allowed to spawn naturally. Juvenile hatchery fish are released as smolts in the spring, where they migrate to the Pacific Ocean and rear for 1 – 3 years. When these fish return as adults they are allowed to spawn naturally in Yankee

Fork. In addition, excess adults that return to Sawtooth are transported to Yankee Fork and released to spawn naturally. These excess adults are from hatchery juveniles released at Sawtooth for LSRCP mitigation. The goal during Phase I is to return 1,000 hatchery and natural adults annually. We intend to acheive this goal by releasing 200,000 - 400,000 smolts and outplanting up to 1,500 pre-spawn adults annually. The adult return goal will be measured by estimating the number of hatchery adults that return from smolt releases and the number of naturally produced adults that return from natural spawning. In this phase, the Tribes may collect broodstock in Yankee Fork as a contingency plan for meeting the smolt release objective, when insufficient adults return to Sawtooth to meet both program needs. We plan to transition to phase II when Crystal Spring Fish Hatchery (Crystal Springs) is constructed. However, we plan to continue to utilize Sawtooth to rear smolts for the YFCSP to help meet LSRCP adult mitigation goals in the upper Salmon River.

In 2008, the Tribes began designing Crystal Springs to produce 600,000 spring Chinook salmon smolts for the YFCSP. The design for Crystal Springs includes a satellite facility with a permanent weir, adult holding ponds, facility accommodations, and juvenile acclimation ponds. In Phase II, the YFCSP will shift to collecting broodstock in the Yankee Fork from locally-adapted Chinook salmon returning from Phase I efforts. The outplanting of Sawtooth stock smolts and adults will cease, but Sawtooth will continue to rear smolts (Yankee Fork stock) for the YFCSP. The goal during Phase II is to return 2,000 hatchery and natural adults annually. The adult return goal will be measured by estimating the number of hatchery adults that return from smolt outplants and the number of naturally produced adults that return from naturally spawning fish. A broodstock management sliding-scale schedule will be developed to determine the appropriate number of adults to release above the weirs for natural spawning, while also meeting the cultural objective of having fish spawn naturally. The Tribes anticipate construction of Crystal Spring and Yankee Fork Satellite Facility in 2017.

During Phase I and II efforts, the Tribes plan to implement a detailed monitoring, research, and evaluation plan (see draft, Denny and Beamesderfer 2013) to address viable salmonid population (VSP) criteria and life-cycle monitoring. If the Tribes determine that VSP parameters reach a point where the Tribes' harvest and cultural objectives can be met through natural production, then the Tribes will transition to implementing a segregated conservation program, or Phase III conservation.

Regardless of phase, the Tribes will manage harvest in Yankee Fork 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 the Salmon River basin in a manner that promotes recovery of the listed species while protecting, preserving, and enhancing rights reserved under the Treaty and any inherent rights. Annual harvest guidelines are developed for natural and hatchery-origin Chinook salmon following the harvest rate schedules identified in the TRMP. The harvest rate schedules are flexible and are based upon annual adult abundance. Harvest monitoring is conducted to determine catch per unit effort and overall harvest impact rates.

Project Background

Hatchery adults that contribute to the Phase I goal are those that return to Yankee Fork, which were released as smolts. Natural adults that contribute to this goal are the progeny of hatchery or natural fish, which have spawned naturally. Although we directly outplant excess hatchery adults from Sawtooth, they do not count towards the Phase I adult return goal; their offspring do.

Hatchery smolts are released in Yankee Fork, where they are allowed to return as adults to spawn naturally. The first hatchery smolt releases occurred in 2006, with additional smolt releases in 2010, 2011, and 2012. However, poor hatchery adult returns to Sawtooth in 2005-2007 and also in 2011 inhibited broodstock collection and hence no smolts were available for release in 2007-2009 or 2013 (Table 1). Overall, a total of 1,129,242 smolts have been released in Yankee Fork. In 2014, age^5 and age^4 hatchery adults were expected to return from 2011 and 2012 smolt releases, respectively.

Table 1. YFCSP smolt releases from 2006 – 2013 and expected adult return years. Adults returning in 2014 are shaded in grey.

Brood Year	Release Year	Release Date	Total Released	Expected Adult Return Year		
				Age ^{3}	Age ^{4}	Age ^{5}
2004	2006	Apr 21	135,934	2007	2008	2009
2005	2007					
2006	2008					
2007	2009					
2008	2010	Apr 20	398,444	2011	2012	2013
2009	2011	Apr 19	397,828	2012	2013	2014
2010	2012	Apr 03	197,036	2013	2014	2015
2011	2013					
Total			**1,129,242**			
Average			**282,311**			

Sawtooth hatchery adults are outplanted in Yankee Fork and allowed to spawn naturally. The naturally produced progeny from these outplants contribute to the Phase I adult return goal. The first hatchery adults were outplanted in 2008, with additional outplants occurring in 2009, 2012, and 2013 (Table 2). Poor hatchery adult returns to Sawtooth in 2010 and 2011 prevented us from outplanting hatchery adults in those years. Overall, a total of 4,290 hatchery adults have been outplanted in Yankee Fork, with an average of 1,073 adults outplanted per year. In 2014, we expected to trap age^5 adults returning from the 2009 outplants (Table 2). We did not anticipate many age^4 or age^3 adults in 2014, since hatchery adults were not outplanted in 2010 or 2011 and natural escapement was very low. However, we expected to capture naturally produced smolts and parr at the rotary screw trap, given we outplanted adults in 2012 and 2013, respectively.

Table 2. YFCSP hatchery adult releases from 2008 – 2013 and subsequent juvenile life stage and adult return years shaded in grey.

Release Year	Total Released	Juvenile Life Stage		Expected Adult Return Year		
		Parr	Smolt	Age 3	Age 4	Age 5
2008	1,438	2009	2010	2011	2012	2013
2009	1,517	2010	2011	2012	2013	2014
2010						
2011						
2012	1,054	2013	2014	2015	2016	2017
2013	281	2014	2015	2016	2017	2018
Total	**4,290**					
Average	**1,073**					

From 2008-2013, a total of 910 adult salmon have been trapped at Pole Flat weir, of which 569 were natural and 341 were hatchery (Table 3). On average, 152 adults are trapped each year with 95 being natural-origin or 66.7% of the catch. Despite the large numbers of hatchery smolts being released (Table 1), these fish only account for 33.3% of the yearly catch with an average of 57 hatchery adults trapped per year. Overall, the most fish were trapped in 2013 (n = 291) and fewest in 2010 (n = 17).

Pole Flat weir is a temporary structure that cannot be installed until streamflows are conducive. As a result, information obtained from Pole Flat weir represents a sample from the larger salmon population. Since inception, the YFCSP has implemented a mark-recapture modeling technique to estimate the total number of natural and hatchery salmon returning to Yankee Fork annually. Our population estimates indicate that a total of 1,669 adult salmon have returned to Yankee Fork since 2008, with an average of 278 adults returning per year. The overall population has ranged from a low of 65 adults in 2010 to a high of 424 adults in 2013. Our natural fish population estimate suggests that these fish comprise 64.3% of the run (as compared to 66.7% derived from weir trapping). Similarly, our hatchery fish population estimate suggests that these fish comprise 35.7% of the run (as compared to 33.3% derived from weir trapping). Over the entire sample period, trap efficiency has ranged from as low as 34% in 2010 to as high as 93.5% in 2009, with average trap efficiency at 71.5%.

Since initiating the YFCSP, natural-origin adult returns have increased but remain below the Interior Columbia Technical Recovery Team (ICTRT) viability threshold of 500 spawners (ICTRT 2007a; ICTRT 2007b). Although Yankee Fork Chinook salmon are not classified as a population that must meet "highly viable" status, the YFCSP is successfully increasing natural-origin fish abundance, which meets the criteria for a "maintained" population. On average, the YFCSP has achieved 27.8% of the Phase I adult return goal (Table 3). These numbers have ranged from a low of 6.5% of the adult return goal in 2010 to a high of 49.7% in 2008.

Table 3. Number and percentage of natural and hatchery-origin adult Chinook salmon trapped at Pole Flat weir from 2008 – 2013, weir efficiency, and mark-recapture population estimates.

Year	Natural		Hatchery		Total	Weir Efficiency	Natural Pop. Estimate		Hatchery Pop. Estimate		Total Pop. Estimate	% of Goal
	n	%	*n*	%			*n*	%	*n*	%		
2008	43	18.9	185	81.1	228	65.0	88	17.7	409	82.3	497	49.7
2009	29	59.2	20	40.8	49	93.5	59	48.0	64	52.0	123	12.3
2010	17	100	0	0	17	34.0	65	100.0	0	0.0	65	6.5
2011	70	54.7	58	45.3	128	84.1	116	52.7	104	47.3	220	22.0
2012	162	82.2	35	17.8	197	69.6	279	82.1	61	17.9	340	34.0
2013	248	85.2	43	14.8	291	82.9	361	85.1	63	14.9	424	42.4
Total	**569**		**341**		**910**		**968**		**701**		**1669**	
Average	**94.8**	**66.7**	**57**	**33.3**	**152**	**71.5**	**161**	**64.3**	**117**	**35.7**	**278**	**27.8**

Based on trap data, more males return to Yankee Fork than females. However, this is likely biased as females tend to return sooner than males and the main reason trap efficiency is low is because we cannot install the temporary weir until streamflows are conducive. From 2008 – 2013, the average percentage of males returning to Yankee Fork is 62.9%, while the average return of females is 37.2% (Table 4). The overall percentage of males returning to Yankee Fork has ranged from a low of 51% in 2009 to a high of 86.7% in 2011 (Tardy and Denny 2010, Tardy and Denny 2012). The overall female percentage has ranged from a low of 13.3% in 2011 to a high of 49% in 2009. The average natural-origin fish percentage is 64.9% male to 35.1% female. The average hatchery-origin fish percentage is 60.2% male to 39.8% female.

Table 4. Sex ratio of natural and natural Chinook salmon trapped at Pole Flat weir from 2008 – 2013.

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
2012	59.4	40.6	46.7	53.5	53.1	47.0
2013	57.7	42.3	60.5	39.5	58.1	41.9
Average	**64.9**	**35.1**	**60.2**	**39.8**	**62.9**	**37.2**
St. Err	**3.8**	**3.8**	**10.3**	**10.3**	**6.2**	**6.2**

This report covers the operation and maintenance and monitoring and evaluation activities associated with the YFCSP in 2014. In addition, the Salmon River Basin Nutrient Enrichment (SRBNE) Program collaborated with the YFCSP to conduct a study to evaluate the effects of various nutrient enrichment methodologies on fish production in Yankee Fork. Specifically, three tributaries in Yankee Fork were treated with different nutrient enrichment methods: live adult fish, carcasses, salmon carcass analog (SCA); one additional stream was established as a control. The YFCSP outplanted hatchery adult carcasses into Ramey Creek and live hatchery adults into Eightmile Creek. Results from these efforts will be reported under the BPA funded Supplementation Project and SRBNE.

Study Area

The Yankee Fork Salmon River is a major tributary to the Salmon River located in central-Idaho (Figure 1) within the Salmon-Challis National Forest. Yankee Fork flows through narrow mountainous canyons interconnected with moderate sized valleys in a forest consisting of lodgepole pine (*Pinus contorta*) (Reiser and Ramey 1987). The Yankee Fork flows 41.8 river-kilometers (rkm) from north to south and enters the 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 catchment contains 313.8 km^2 and includes Yankee Fork proper and West Fork Yankee Fork (Figure 1). Precipitation comes primarily through snow between October through May and the annual average accumulation is 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 which prompted human settlements and as such mining has become part of the rich history in Yankee Fork. Additional mining booms occurred in the 1930s and 1950s resulting 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 (Reiser and Ramey 1987, Konopacky et al. 1985). The dredged portion of the Yankee Fork floodplain is sparsely vegetated with long sections containing riparian habitat only near the stream and bank interface (Reiser and Ramey 1987, Lyon et al. 2011). However, the rest of the Yankee Fork watershed remains in adequate condition for the production of anadromous fish.

Within the entire drainage, the number of Chinook salmon redds have ranged as high as 660 in 2008 (Denny and Tardy 2010) to as low as zero in 1984 and 1995 (Denny et al. 2013, Figure 20). Chinook salmon destined to the Yankee Fork return to the Columbia River during April through July with spawning occurring in August and October (Bjornn 1960, Denny et al. 2013). 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 May. Juveniles rear in freshwater until the spring (March-April) of their second year, prior to migrating to the ocean. The majority of juveniles leave Yankee Fork as a 0^+ subyearlings with a much smaller percentage leaving in the spring as 1^+ smolts (Tardy and Denny 2010, Tardy and Denny 2011, Tardy and Denny 2012, Denny et al. 2013).

Other fish species present in the Yankee Fork include bull trout (*Salvelinus confluentus*), westslope cutthroat trout (*O. clarki lewisii*), resident and anadromous rainbow trout (*O. mykiss*), mountain whitefish (*Prosopium williamsoni*), shorthead sculpin (*Cottus confuses*), and sockeye salmon (*O. nerka*, Konopacky et al. 1985, Konopacky et al. 1986, Denny et al. 2013).

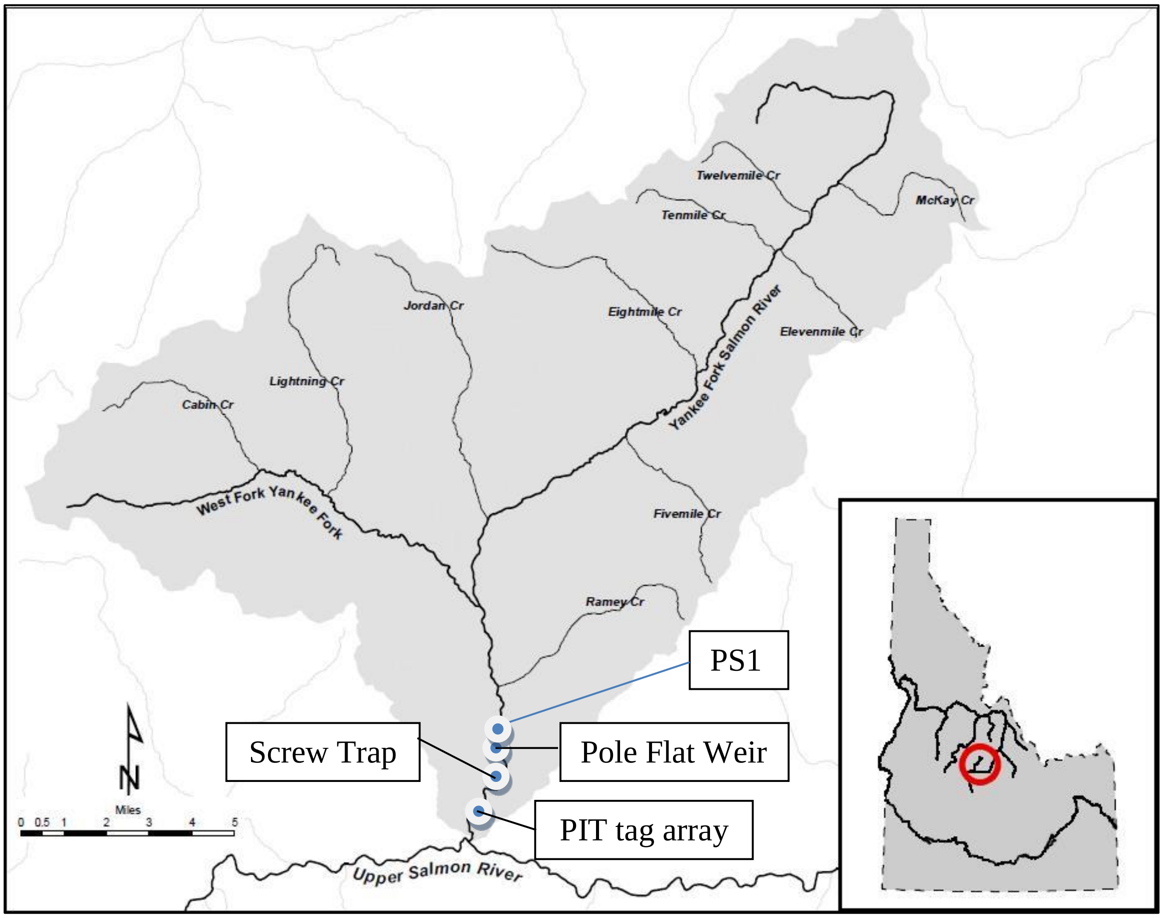

Figure 1. Map of Yankee Fork Salmon River, Idaho and weir, screw trap, & PIT tag array locations.

SMOLT RELEASE AND ACCLIMATION STUDY

This was the fifth year that the YFCSP released Chinook salmon smolts in the Yankee Fork. The annual smolt release target is based upon an agreed-to sliding-scale production table developed specifically to address smolt release targets for the YFCSP and Sawtooth. The BY 2012 smolt release objective was set at 200,000 juveniles and broodstock to accomplish this release was collected from hatchery-origin Chinook salmon adults returning to Sawtooth in 2012.

In 2014, we initially planned to evaluate the survival benefit of releasing smolts in semi-acclimation ponds versus direct stream release. However, we chose to release all smolts in Pond Series 1 (PS1) because they were not split into separate raceways prior to PIT tagging at Sawtooth. Therefore, all smolts in 2014 were released into PS1 and acclimated for a period of 48 hours using block nets.

In collaboration with Sawtooth, approximately 192,577 Chinook smolts from BY2012 were released into PS1 of Yankee Fork from April 24 – 25 (Figure 1). All Chinook smolts were marked with coded-wire tags (CWT) and approximately 2,386 were also marked with PIT tags. In addition, all of the smolts are genetically marked through parentage-based tagging techniques. At the time of release, smolts averaged 15.79

fish/pound and 144 mm fork length. Water temperature of Yankee Fork mainstem at the time of smolt release was ~4.5°C and discharge of the Yankee Fork mainstem was moderately high at ~12.7 m^3s^{-1}.

JUVENILE TRAPPING

The Tribes installed a rotary screw trap (screw trap) in Yankee Fork in 2014 to monitor and evaluate yearling (BY 2012) and sub-yearling (BY 2013) juvenile Chinook salmon production. The screw trap was installed on April 4 and removed on November 4. Overall, the screw trap was operated 170 days out of the 214 day season. The screw trap was temporarily removed during high spring runoff events (flows >1,200 cfs) and/or when hatchery smolts were being released.

A 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 2). The screw trap was attached to a cable suspension system consisting of 5 cm braided, steel cable spanning approximately 20 m across the river, connected to a large boulder on the west bank of the river and a live, conifer tree on the east bank. The screw trap was attached to the main cable system using a cinch block pulley connected to a 15 m cable which is attached to each pontoon islet (Figure 2). The cinch block pulley allows the trap to be adjusted laterally across the stream thalweg. Two portable 12v winches were attached to the cinch block pulleys to promote lateral movement during high flows.

The screw trap was located approximately 5.0 rkm upstream from the confluence with the Salmon River (Figure 1, Figure 2). BY 2012 yearling estimates were derived from data acquired on fish which were greater than 70 mm fork length trapped during April 4 through May 31. BY 2013 sub-yearling estimates were derived from data acquired on fish which were less than 70 mm fork length trapped from April 4 through May 31and from data on all fish trapped from June 1 to November 4.

The YFCSP staff uses a fish tagging trailer improve tagging conditions (Figure 3). The trailer is equipped with plug in outlets and two overhead florescent lights powered by a 3300 cc Honda generator (Figure 3). The trailer is outfitted with two storage cabinets set above a countertop fitted with a 15” x 15” sink and drain. 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 solution of eugenol and water. 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 propane connected to a heating element.


Figure 2. Yankee Fork rotary screw trap, 2012.

Juvenile Chinook salmon were processed following our standard program protocol. The screw trap was checked on a daily basis between 07:00 – 11:00 hours. Non-target species were enumerated, recorded, and released directly downstream of the trap with minimal handling. The daily catch of juvenile Chinook salmon was loaded into several 18.9 L buckets filled with fresh river water and transported to our tagging trailer. Each bucket of fish was fitted with a Frabil© bucket aerator to increase oxygenation. Temperature and staff gauge measurements were recorded when the screw trap was checked.

Our trapping protocol was established to conduct mark-recapture trials on two groups of fish; those ≥ 70 mm fork length and those ≤69 mm fork length. Fish ≤69 mm fork lengths are typically too small to tag with passive integrated transponder (PIT) tags and are therefore batch marked with Bismark Brown, whereas fish ≥ 70 mm fork length are tagged with PIT tags. We set a daily target to PIT tag 20 juvenile Chinook salmon per day to be used in mark-recapture evaluations. Biological data were acquired from all PIT tagged fish, including fork length (1 mm), weight (0.01 g), and tissue sample (5 mm^2). PIT tagged juveniles were released 1 rkm upstream of the screw trap at Maternity Hole to estimate trap efficiency. Recaptured PIT tagged fish were transported downriver 0.2 rkm to the release site near 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.

We also conducted mark-recapture trials on juvenile Chinook salmon ≤69 mm twice weekly using Bismark Brown stain. On Tuesdays and Fridays, fish were stained in Bismark Brown and used in mark-recapture trials. During Bismark Brown trails, Chinook salmon were sub-sampled for biological data (13 individuals per species). Marking consisted of an aerated bucket containing 15.1 L of water mixed with 0.6 g of Bismark Brown stain; fish were stained for 30 – 45 minutes to reduce stress. We tested the 30 minute Bismark Brown mark duration in-season, and found the mark to still be visible four days after marking. After staining, fish were released 1.0 rkm upstream of the screw trap at Maternity Hole. Similar procedures were followed for recaptured fish from these trials as described above for PIT tag recaptured fish. On days when Bismark Brown trails were not conducted, Chinook salmon ≤69 mm were enumerated and released near Pole Camp Creek.

In the spring season, our staff made multiple attempts to increase trapping efficiency by adjusting the lateral positioning of the trap, installing new anchor positions, a winch, and ~ 200 sandbags. Although low trapping efficiency prevented us from meeting our tagging quotas, we acquired sufficient recaptures to estimate migrants.

The screw trap was installed on April 4 and operated for 20 days until hatchery Chinook salmon smolts were released. The screw trap was reinstalled on May 9, after steelhead smolt releases ceased and operated for 8 days until stream discharge levels became unmanageable due to spring run-off on May 17. When flows receded, the screw trap was reinstalled on June 2 and operated for an additional 156 days until removal on November 4. During this period, the trap was not operated for 16 days for various logistical reasons.

Figure 3. Yankee Fork fish tagging trailer.

In 2014, there were 5,405 juvenile Chinook salmon captured in screw trap operations with 114 (2.1%) mortalities recorded. Captures in 2014 were significantly down from the 15,740 juvenile Chinook captured in 2013 and from the 34,706 juvenile Chinook captured in 2010. However, the 5,405 captured juvenile Chinook in 2014 were higher than the 1,587 and 1,625 captured in 2012 and 2011, respectively. Of the 5,405 juvenile

Chinook captured, 87 were BY 2012 smolt (1.6%), 8 were BY 2013 fry (0.1%), 2,962 were BY 2013 parr (54.8%), and 2,348 were BY 2013 pre-smolt (43.4%, Figure 4). A total of 678 juvenile Chinook >70mm were PIT tagged and tissue sampled for mark-recapture purposes and/or parentage-based tagging, respectively. Of the 678 juveniles PIT tagged, 32 were recaptured, for an overall trap efficiency of 4.72%. Additionally, a total of 1,256 juvenile Chinook salmon <70mm were stained with Bismark Brown for mark-recapture analysis. We recaptured 136 stained juvenile Chinook <70mm for an average trap efficiency of 10.8%.

We used the Peterson estimator (Chapman 1951) to estimate the number of juvenile Chinook moving passed 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 1,187 (± 820) BY 2012 smolts, 49,014 (± 11,932) BY 2013 parr, and 20,188 (± 3,439) BY 2013 pre-smolts migrated passed the screw trap from April 4 through November 4. An overall estimate of BY2013 fry migrants could not be calculated due to insufficient recaptures. Our overall minimum estimate for the 2014 juvenile migration season is 70,389 Chinook salmon juveniles.

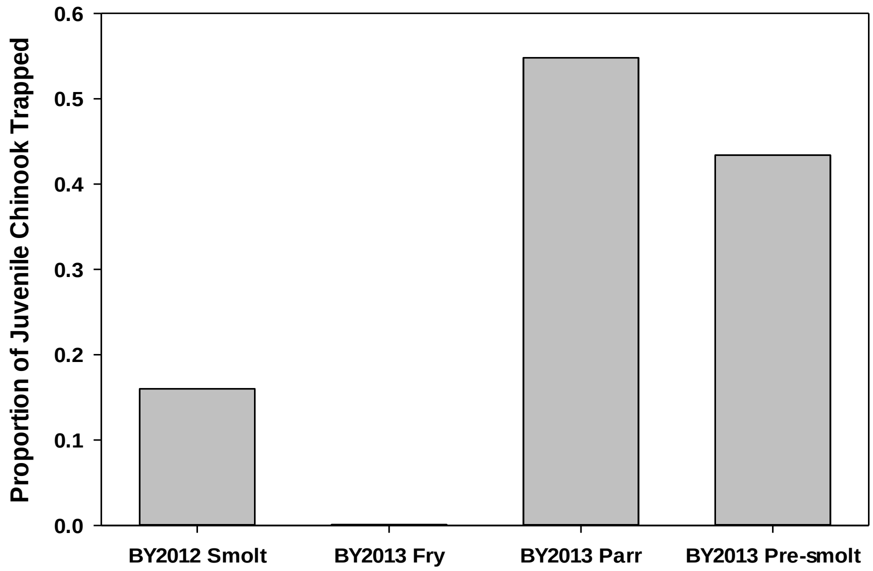

Figure 4. Proportion of life-stage specific juvenile Chinook salmon trapped at the screw trap in 2014.

We observed four primary peaks in fish movement and they occurred in late-July, mid-August, mid-September, and early-October (Figure 5). We caught very few fish during spring flows as mentioned above. The BY 2012 smolts were primarily trapped in mid-April. BY 2013 0^+ juveniles first arrived at the screw trap in late June and their migrations ceased in late October. Interestingly, our peak movement of 0^+ juveniles occurred on August 23 when a summer rainstorm dropped stream temperatures by 5.4°C (17°C - 11.6°C) in seven days. Overall, our data indicate the 10^{th}, 50^{th}, and 90^{th} percentiles of fish movement were observed on July 27, August 26, and October 11 (Figure 5) as compared to July 17, September 7, and October 4 in 2013.

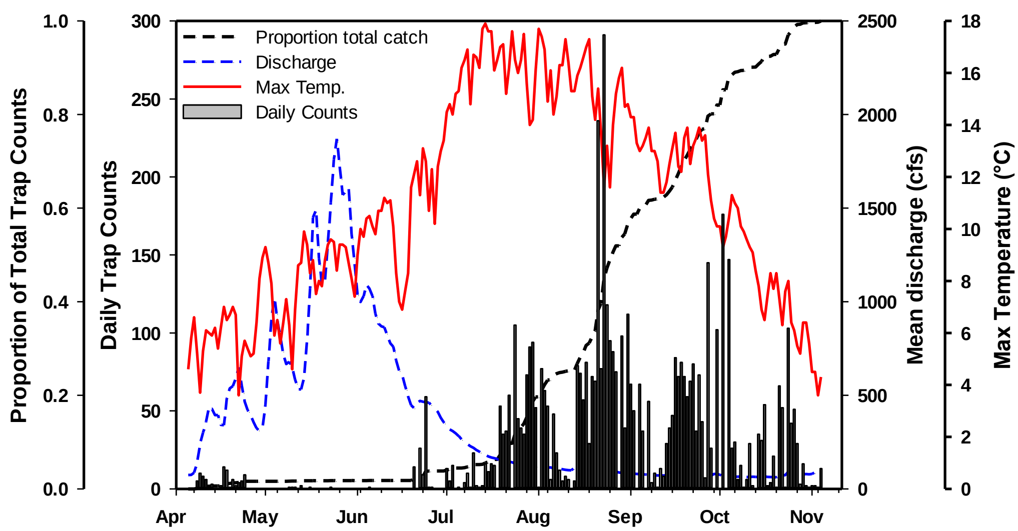

Figure 5. Daily trapping frequency and proportion of juvenile Chinook salmon observed at the screw trap in comparison to daily discharge and max temperature.

Length weight relationships were acquired from a sub-sample of juveniles. 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. 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. 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).

The length-weight relationship for migrating juvenile Chinook in 2014 was significant (Figure 6). The *b* value of 3.05 indicates positive allometric growth meaning that juveniles were growing progressively larger with increasing length and food appears to be abundant (Halseth et al., 1990). This is similar to results from 2013 (*b* value 3.10), however, the *b* value in 2012 was 2.59 indicating negative allometric growth and juveniles were becoming progressively thinner with increasing length. Ultimately, juvenile Chinook salmon migrating from the Yankee Fork in 2014 exhibited positive growth and this relationship was significant.

The length frequency of juvenile Chinook salmon in 2013 ranged from 34 - 187 mm fork length and averaged 71.7 mm (*n* = 1,461, Figure 7). In comparison, 2013 juveniles ranged from 35 – 178 mm fork length with an average of 73.7 mm and 2012 juveniles ranged from 30 - 170 mm fork length with an average 81.6 mm. The length frequency data is likely biased for fish < 71 mm fork length since the majority of these fish were not handled. The distribution is also right skewed because this includes two broodyear classes of fish.

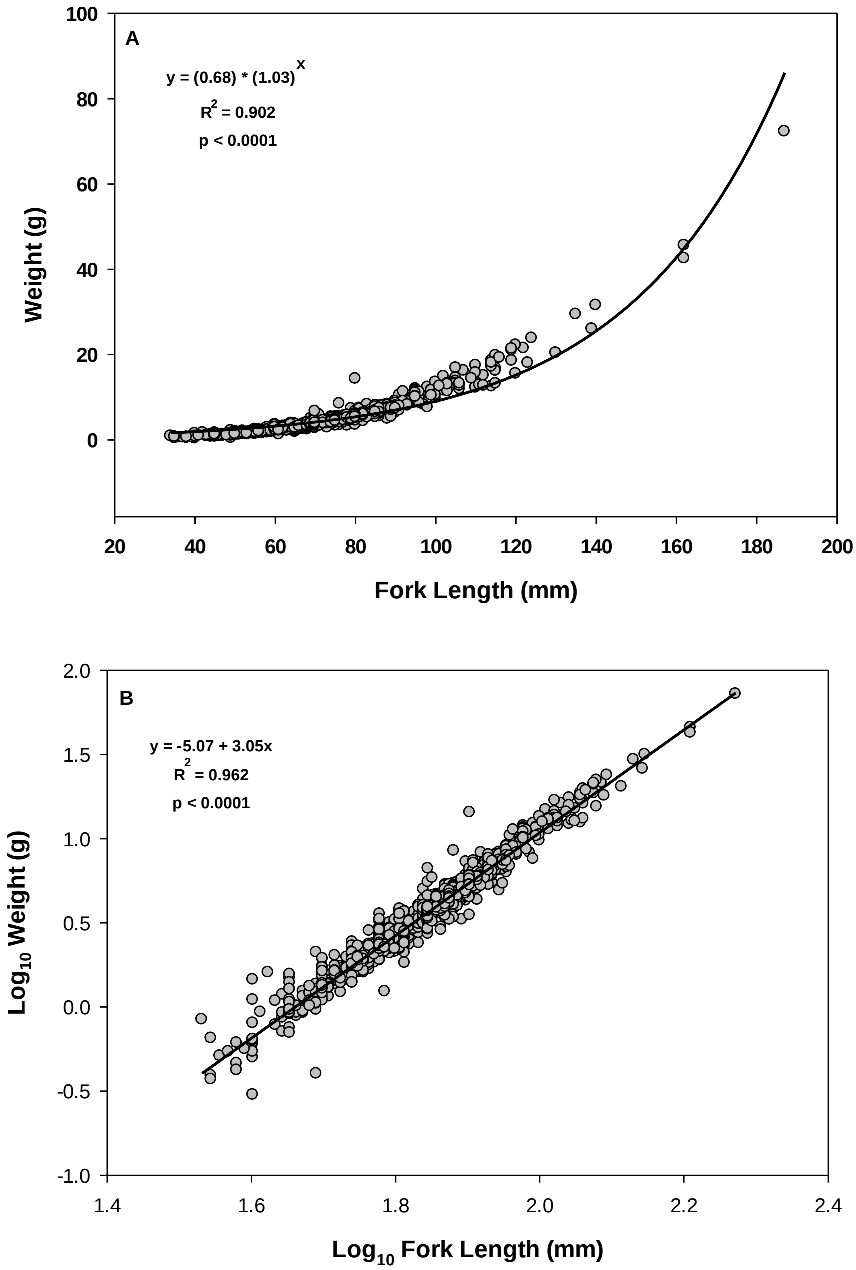

Figure 6. Length-weight relationship of juvenile Chinook salmon observed at the screw trap in normal (A) and $\log_{10}$ transformation (B).

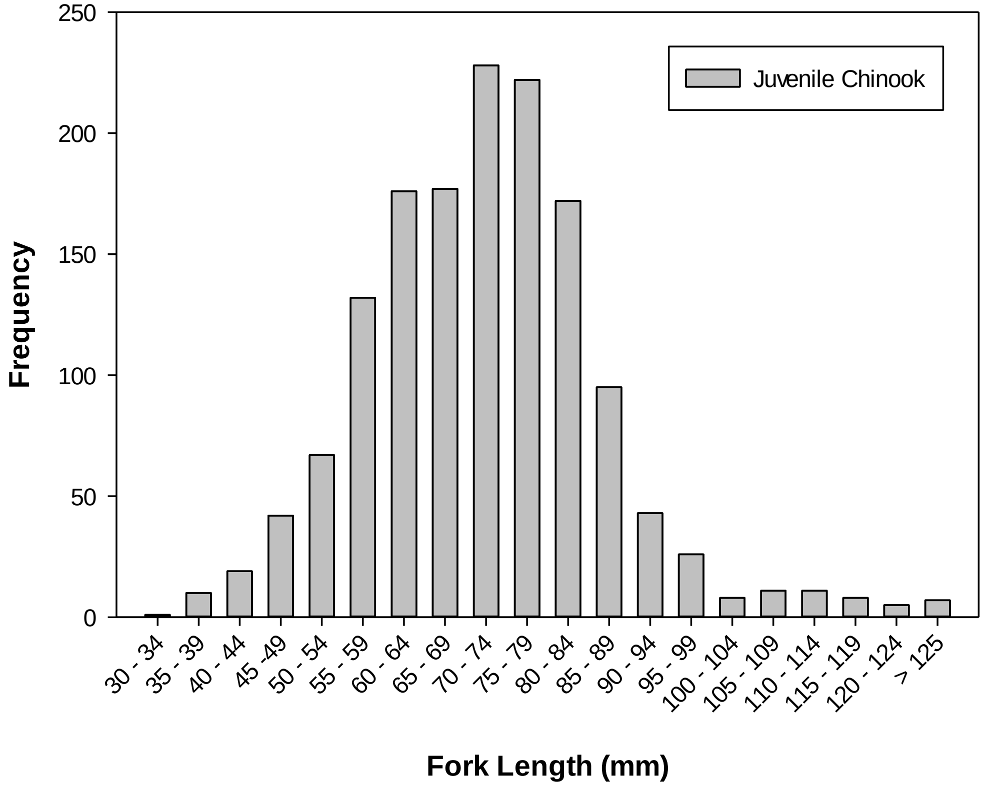

Figure 7. Length frequency of juvenile Chinook salmon measured at the screw trap (*n* = 1,461).

ADULT TRAPPING

We installed and operated one portable picket weir in Yankee Fork for the purposes of managing the adult Chinook salmon return during 2014. Pole Flat weir was installed to enumerate all adult Chinook salmon that enter the watershed. Natural and hatchery-origin fish trapped at Pole Flat weir were directly released above the weir after biological data was collected.

Pole Flat Weir

Pole Flat weir is located approximately 5.22 rkm upstream from the confluence with the Salmon River (Figure 1). It is a temporary structure consisting of two v-shaped picket weirs attached to an in-stream fish trap which supports a dry work station (Figure 8) (Denny et al. 2013). YFCSP personnel are responsible for installing and removing this device and have determined that Pole Flat weir can be safely installed around ~14.1 m^3s^1 (~500 cfs). In 2014, Pole Flat weir was installed on June 19 when discharge reached 12.7 m^3s^{-1} (~450 cfs). The weir was installed in the same location as in 2013, which was 20 m downstream of the 2012 site, in a location where the channel is deeper and thalweg more pronounced (Figure 8).

Figure 8. Pole Flat weir, catwalk, fish trap, live-wells, and work station.

Over the past several years, YFCSP personnel have made annual modifications to improve trapping operations. Our first modifications occurred during the 2008 trapping season and included constructing additional picket weir panels and a larger in-stream trap box with a trapping device (Denny and Tardy 2010). These modifications immediately improved trapping operations; however salmon were able to jump out of the trap box or escape downstream through the fish trapping device. In addition, this in-stream trap box was difficult to enter and fish processing was slow. In 2009, we completely rebuilt the fish trap and trapping device (Tardy and Denny 2010). The new trap box worked much better, but the trapping device was still not fully containing fish. In 2010, we determined that a tapered proboscis and dry workstation would improve trapping configurations and fish handling (Tardy and Denny 2011). In 2011, we added a catwalk and two in-stream live-wells (Tardy and Denny 2012) and the device seemed to be working properly. However, from 2009 – 2011, very few adults were trapped to effectively test these configurations. In 2012, the numbers of fish increased and we noticed that adult salmon seemed to be trap-shy. We believed this issue was the direct result of the length of the entryway into the fish trap. Since trapping was already in progress, we removed the proboscis, shortened the device, and adjusted attraction flow (Denny et al. 2013). We observed immediate results and trapping continued under these configurations for the duration of the 2012 season. However, in 2012 we trapped more bull trout and salmon than the previous three years and in doing so observed dis-proportionate mortality rates for smaller size fish (<45 cm). Modifications were made to Pole Flat weir in 2013 primarily to decrease mortality on smaller migratory fish, to increase attraction flow at the entrance of the fish trap, and to improve the entryway into the fish trap. To accomplish this, the panel on the downstream side of the trap box was completely rebuilt. The major change in the new panel included pre-drilling picket holes at 3.8 cm on the center as compared to 5.1 cm in the previous panel. We also shorted the v-shaped entryway to the fish trap, which reduced the overall length of the trapping device.

With these new configurations, the v-shaped picket weir was used to funnel upstream migrating adult Chinook salmon and non-target species to the inlet of the fish trap. We equipped the weir with a dry workstation to improve fish handling and stress (Figure 8). The workstation was supplied with a locked jobox, cooler, table, measuring board, and several buckets. The locked jobox contained a hand-held PIT tag reader, CWT wand, DNA vials, balance, batteries, eugenol, multiple O_2 diffusers, clipboard, data sheets, and hole punch.

We used one in-stream recovery live-well to resuscitate and temporarily hold adult fish (Figure 8). Natural and hatchery-origin adults were gently placed into the instream live-well through the bottomless bucket, and allowed to volitionally leave through an upstream or lateral 12.7 cm passage way.

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 an insulated cooler holding 75.6 L of fresh river water. Fish were anesthetized in the cooler using approximately 1 ml of solution (50:50 solution of eugenol and water) per 18.9 L of water.

Chinook salmon and non-target species were visually examined for phenotypic characteristics and to collect morphometric data. Each fish was visually examined to determine species, gender, measured to the nearest 0.5 cm, weighed to the nearest 0.1 kg, inspected for fin-clips, pre-existing marks, and injuries, scanned for external and internal tags, and tissue-sampled for DNA analysis. 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 our mark-recapture evaluation for estimating total escapement above the weir. All Chinook salmon were volitionally or directly released by hand above Pole Flat weir for natural spawning.

The YFCSP has observed an increase in the number of bull trout returning to Yankee Fork. To understand residency, abundance, age structure, and migration timing, adult bull trout are PIT tagged when trapped at Pole Flat weir.

Once all fish were enumerated, the weir structure was cleaned and checked to ensure proper function. Staff snorkeled and/or walked the upstream and downstream periphery of the weir to ensure the structure was sealed and functioning properly. In addition, YFCSP personnel collected carcasses that had washed up on the weir face. All carcasses were visually examined for phenotypic characteristics and to collect morphometric data. All carcasses were used in the mark-recapture evaluation and processed for biological data. The caudal fin was removed from the carcass to prevent duplicate counting and the fish was distributed below the weir for nutrient enrichment.

Adult Trapping

Pole Flat weir was installed on June 19 and the first Chinook salmon was trapped on June 21. The last fish was trapped on September 14 and the weir was removed five days later on September 19**.** Overall, 237 Chinook salmon were trapped of which 234 were "new" fish and three were "recaptured" fish, which were previously sampled at the weir. In addition, we trapped 136 adult bull trout and two sockeye salmon. Overall, we trapped 29 hatchery and 205 natural Chinook salmon (Table 5)

Table 5 - Chinook salmon trapping summary observed at Pole Flat weir in 2014.

Gender	Hatchery		Ad-Intact (Natural)	Total
	Ad-Intact/CWT	Ad-Clipped		
Males	12	1	87	100
Females	13	3	118	134
Total	25	4	205	234

Run-Timing

Natural and hatchery-origin Chinook salmon exhibited similar migration patterns in 2014 (Figure 9). The first natural-origin Chinook salmon was trapped on June 21 and the last fish was trapped on September 14 for an overall migration period of 86 days. The 10th, 50th, and 90th percentile passage dates for natural-origin fish occurred on June 29, July 22, and August 28. The first hatchery-origin Chinook salmon was trapped on June 29 and the last hatchery-origin fish was trapped on September 4 for an overall migration period of 68 days. The 10th, 50th, and 90th percentile passage dates for hatchery-origin fish occurred on July 1, August 13, and August 26.

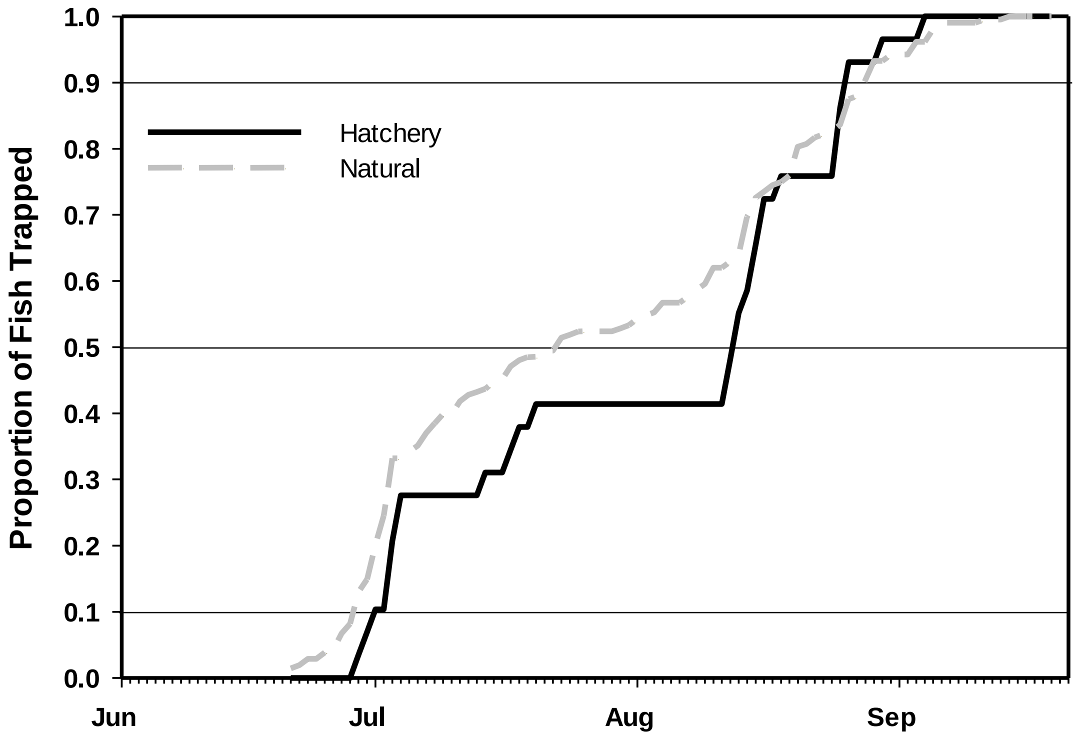

Figure 9. Run-timing of natural and hatchery-origin Chinook salmon at Pole Flat weir.

Returning Chinook salmon exhibited strong bi-modal run-timing distribution with peak counts occurring on July 3 (n = 21) and August 14 (n = 13) (Figure 10). The salmon run, as usual, coincided with the declining hydrograph. During the trapping period, temperature was inversely correlated with discharge, and daily trapping counts appeared to be effected by water temperature. We reached peak water temperature in mid-July and this corresponded with a decrease in daily trap counts during the first mode. Once temperatures declined in mid-August, spawning was triggered and the second mode of run was observed at the weir (Figure 10).

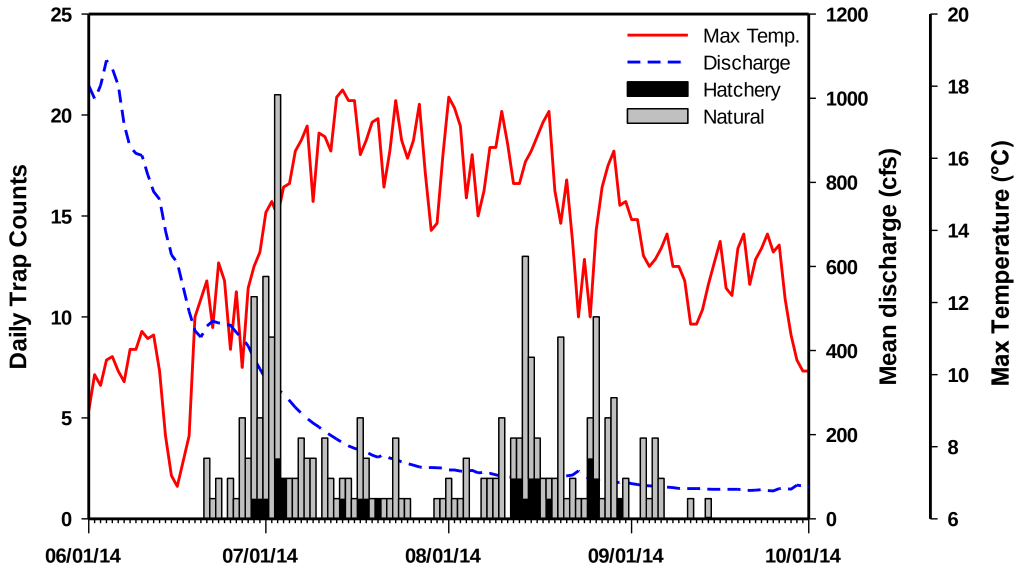

Figure 10. Daily trapping counts of natural and hatchery-origin Chinook salmon at Pole Flat weir.

Morphology and Gender

The average length or weight of a Chinook salmon is typically a function of age, but may also be a function of origin or gender. In 2014, we measured fork lengths for all 234 unique fish trapped at Pole Flat weir to compare difference between hatchery and natural fish and males and females. We hypothesized that hatchery fish might be smaller than natural fish and conducted a student's t-test to compare difference between means. Hatchery-origin fish had smaller fork lengths than natural fish, however the difference was not significant (t = -1.51, df = 232, p = 0.06) (Figure 11A). Interestingly, natural origin fish had greater weights than hatchery-origin fish and the difference was significant (t = -2.25, df = 229, p = 0.01) (Figure 11B).

We also wanted to determine whether females were larger than males, since males usually return earlier than females. Females had greater fork lengths (cm) than males and the difference was significant (t = 3.434, df = 232, $p < 0.0001$) (Figure 12A). Additionally, females were significantly heavier than males (t = 2.948, df = 229, p = 0.002) (Figure 12B).

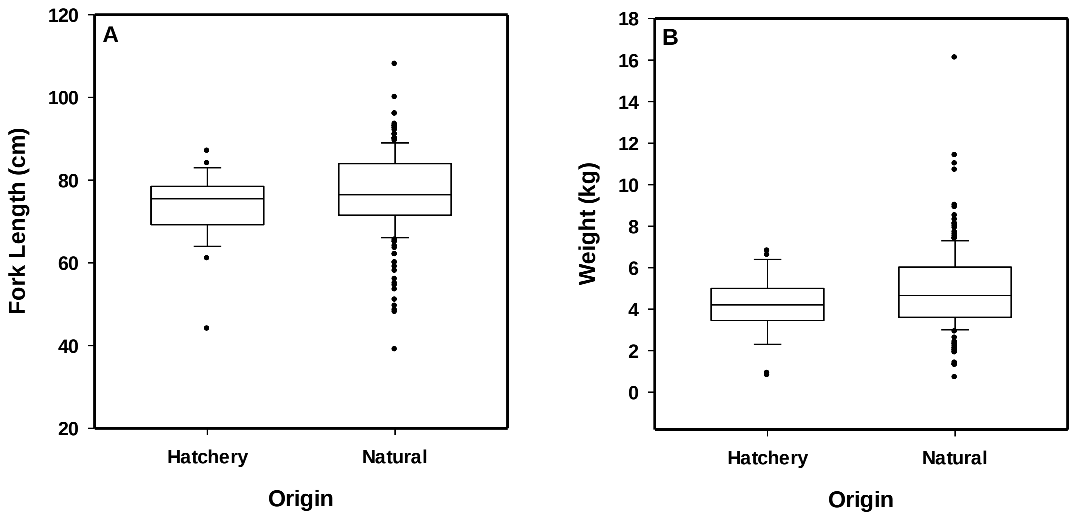

Figure 11. Hatchery (*n* = 29) and natural-origin (*n* = 205) fork length (cm) (A) and weight (kg) (B) of Chinook salmon trapped at Pole Flat weir in 2014.

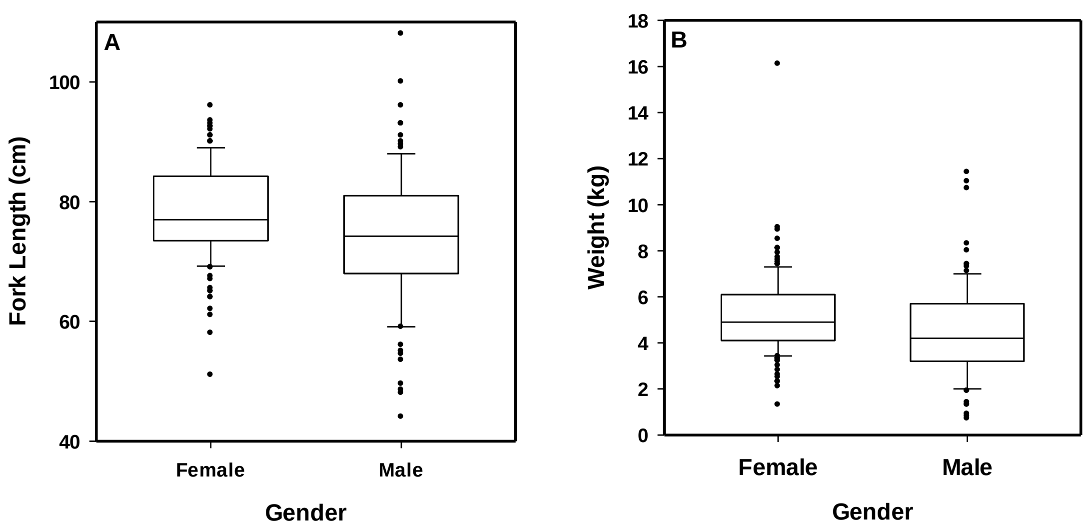

Figure 12. Fork length (cm) (A) and weight (kg) (B) of female (*n* = 134) and male (*n* = 100) Chinook salmon trapped at Pole Flat weir.

We plotted the length frequency of hatchery (*n* = 29) and natural-origin Chinook salmon (*n* = 205) to describe the overall length distribution of these two groups of fish. The average length of hatchery-origin fish was 73.8 cm and ranged from 44 – 87 cm, while the average length of natural-origin fish was 76.7 cm and ranged from 39 – 108 cm (Figure 13).

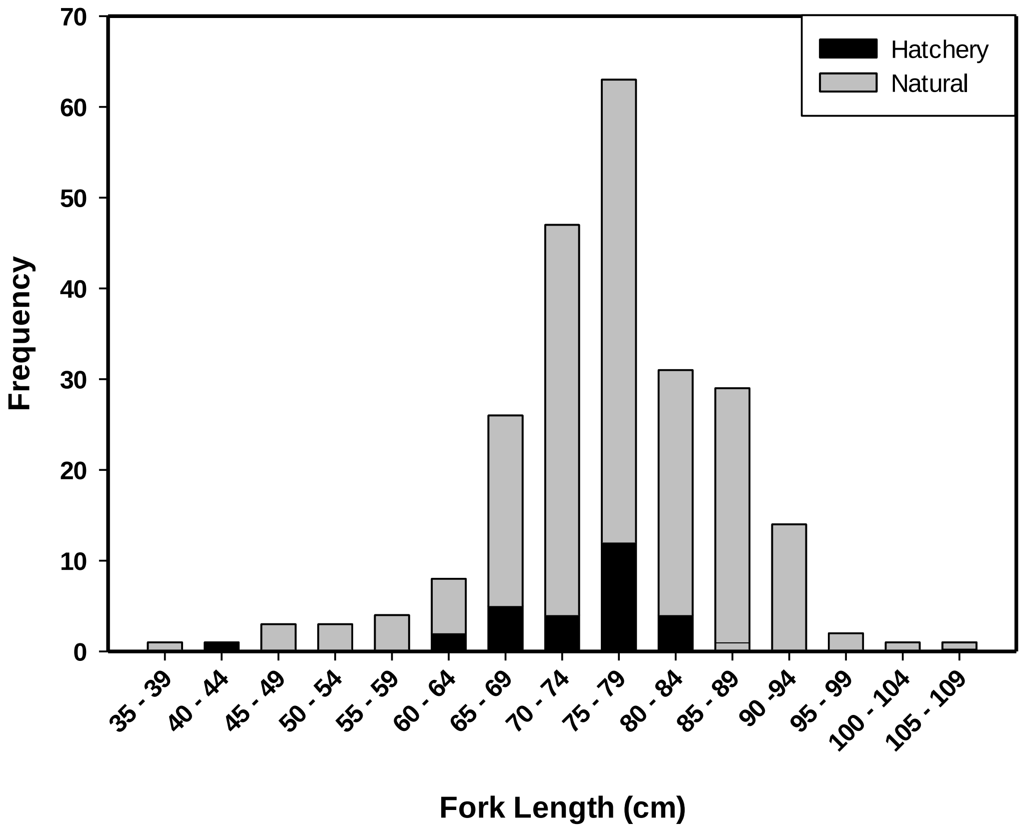

Figure 13. Length frequency of hatchery (*n* = 29) and natural-origin (*n* = 205) Chinook salmon trapped at Pole Flat weir.

We determined gender and origin from all 234 fish that were trapped at Pole Flat weir (Table 6). Hatchery fish were comprised of 55.2% females and 44.8% males. Natural fish were comprised of 57.6% females and 42.4% males. Overall, the Chinook salmon run was comprised of 57.3% females and 42.7% males**.** Hatchery fish comprised 12.4% of the return and natural fish comprised 87.6%. The hatchery to natural ratio is important for our mark-recapture evaluation.

Table 6. Sex ratio of hatchery, natural-origin, and all fish observed at Pole Flat weir.

	Hatchery		Natural		Overall	
Gender	Count	Sex Ratio	Count	Sex Ratio	Count	Sex Ratio
Females	16	55.2%	118	57.6%	134	57.3%
Males	13	44.8%	87	42.4%	100	42.7%
Totals	29	12.4%	205	87.6%	234	100%

Out of the 234 fish trapped, approximately 233 were marked with a right operculum punch. One fish was accidentally marked with a left operculum punch and therefore excluded from the mark-recapture analysis. We also collected approximately 215 tissue samples that will be used in future parent-based tagging studies examining the relative reproductive success of hatchery and natural fish spawning naturally.

Of the total 234 fish trapped, approximately 231 were weighed to the nearest 0.1 kg. Fish weighed an average of 4.8 kg and ranged from 0.7 kg to 16.1 kg. The length-weight relationship for all adult Chinook salmon was significant (Figure 14). The *b* value of 2.81 indicates negative allometric growth. Ultimately, adult Chinook salmon in Yankee Fork exhibited exponential growth and this relationship was significant ($p > 0.0001$) (Figure 14).

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 7). These fork length categories are used to assign age to fish trapped at Pole Flat weir, since fish returning are either direct or indirect progeny of Sawtooth stock. Using the methodology listed above 20 fish were age^{3}, 154 fish were age^{4}, and 60 fish were age^{5} (Table 7). Similar to other years, adult Chinook salmon primarily returned as age^{4} adults with 65.8% of the return in this age class.

Table 7. Age class totals for all Chinook salmon trapped at Pole Flat weir.

Fork Length (cm)	Year Class	Number	Percent
≤ 64	age^{3}	20	8.6%
65-82	age^{4}	154	65.8%
≥ 83	age^{5}	60	25.6%

In 2014, we anticipated a moderate return of age^{5} hatchery-origin Chinook salmon produced from BY 09 smolts that were released in 2011 (Tardy and Denny 2011). Additionally, we expected a large return of age^{4} hatchery-origin Chinook salmon produced from BY 10 smolts that were released in 2012 (Tardy and Denny 2012). Because we did not release any BY 11 hatchery smolts in 2013, we did not expect any returning age^{3} hatchery-origin jacks (Denny et al. 2013).

We also expected a robust return of age^{5} natural-origin adults originating from 414 redds observed during spawning ground surveys in 2009. Furthermore, we expected a much smaller return of age^{3} and age^{4} natural-origin adults that originated from 27 and 24 redds observed in 2010 and 2011, respectively.

Our data indicate that the hatchery-origin adult return was primarily composed of age^{4} adults (Figure 15). This result is consistent with our initial expectation of returning hatchery-origin adults composed of BY 10 smolts that were released in 2012. In addition, we observed three hatchery-origin age^{5} adults composed of BY 09 smolts that were released in 2011. We observed three hatchery-origin age^{3} jacks which are likely strays or errors in our length-at-age categories.

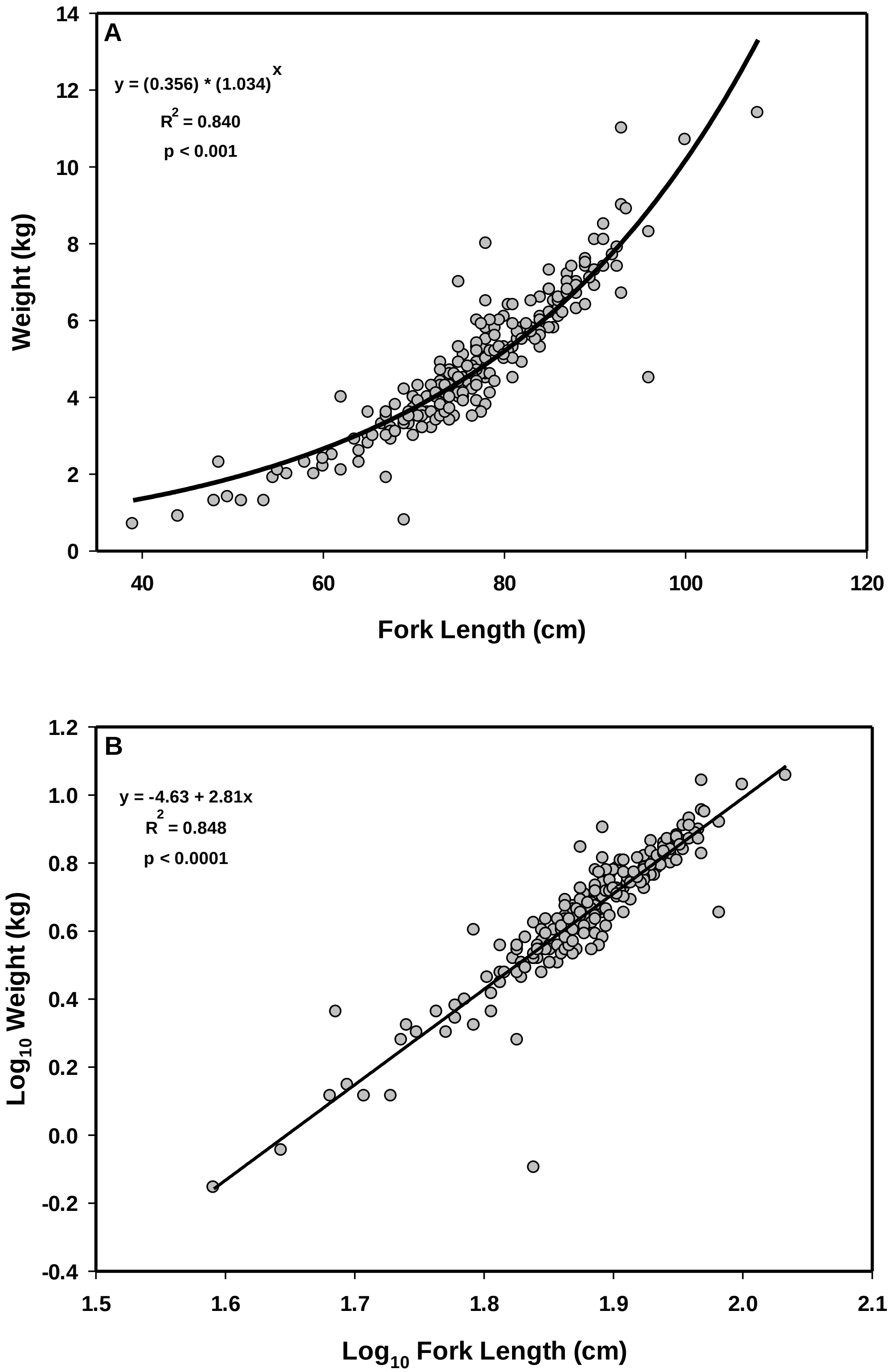

Figure 14. Length-weight relationship of all adult Chinook salmon trapped at Pole Flat weir in normal (A) and $\log_{10}$ transformation (B).

The natural-origin fish return was primarily composed of age[4] adults (n = 131), which were produced by adults spawning in 2010 when 27 redds were identified (Tardy and Denny 2010). Consistent with our expectation, we observed a moderate return of age[5] natural-origin adults (n = 57) produced from the 414 redds recorded in 2009. Lastly, we observed a total of 17 age[3] natural-origin jacks produced from 24 redds in 2011.

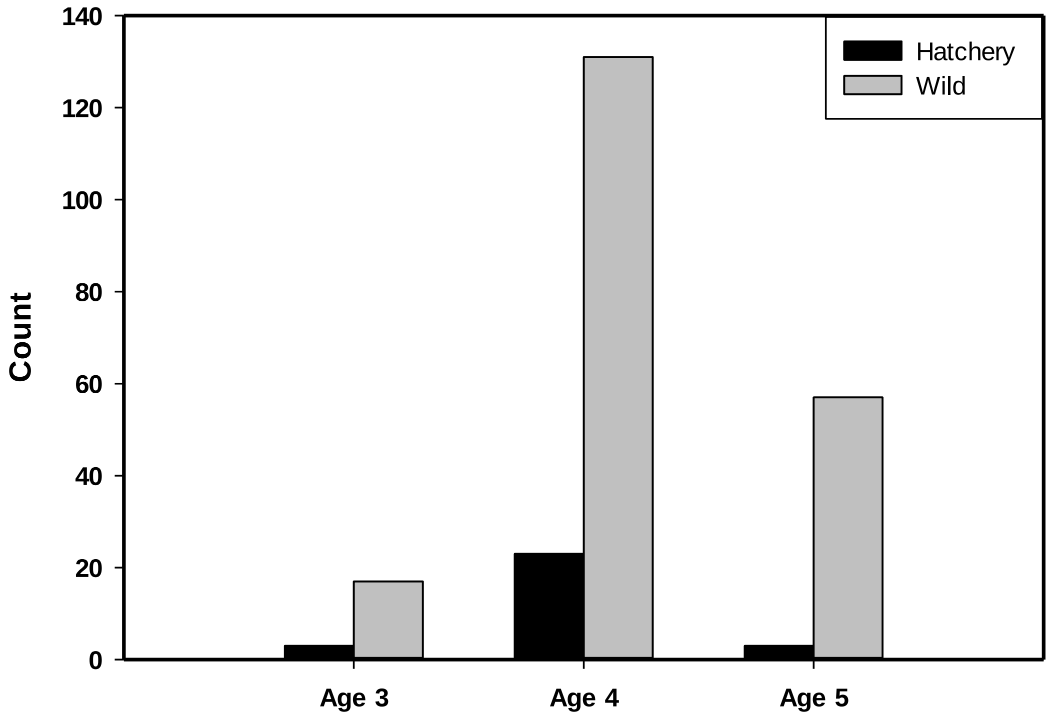

Figure 15. Age structure of hatchery and natural-origin Chinook salmon trapped at Pole Flat weir.

Non-target Species

Our first bull trout was trapped on June 23 and the last fish was trapped on August 28. We trapped a total of 136 bull trout, and approximately three were recaptured (Figure 16). Bull trout ranged from 29.5 – 77 cm fork length and average 46.9 cm. Bull trout averaged 1.16 kg and ranged from 0.1 – 5.3 kg. We PIT tagged 72 adults and acquired tissue from 122 individuals. Gender was determined on 60 individuals of which 37 were males (61.7%) and 23 were females (38.3%). The majority of these fish arrived in June and early July, coinciding with the onset of the BY 2013 juvenile Chinook salmon migration.

A large number of adults began to accumulate on the upstream face of the weir and we pulled several pickets to promote downstream passage. In July, approximately seven pickets at the weir/streambank interface were removed for two hours to allow passage during mid-day when Chinook salmon migrations are low (Denny 2010). Staff confirmed that bull trout were using the temporary breach in the weir to move downstream (W. Youmans pers. comm.) and this was repeated as necessary.

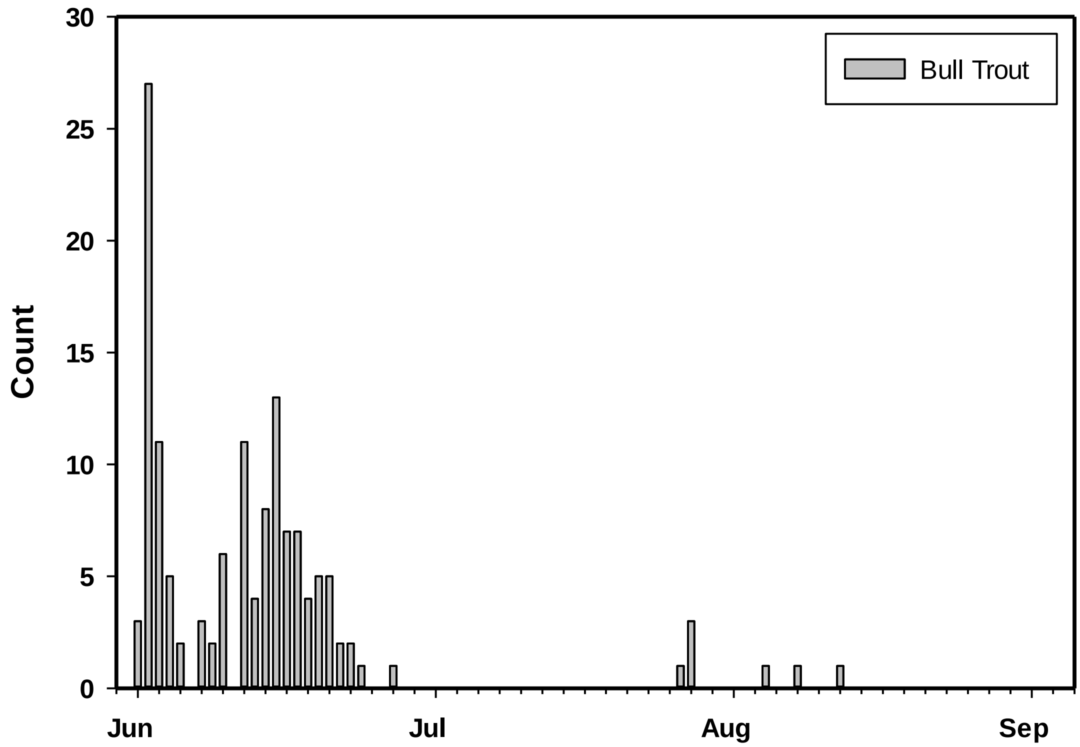

Figure 16. Daily counts of adult bull trout trapped at Pole Flat weir in 2014.

HATCHERY ADULT OUTPLANTS

Sawtooth Hatchery Outplants

The Tribes and IDFG reached agreement to outplant excess hatchery-origin adults trapped at Sawtooth 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 2014, 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 a tanks mounted on ¾ ton pick-up trucks provided by the YFCSP or 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 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 where they were released using nets.

The Tribes and IDFG outplanted 221 hatchery-origin Chinook salmon adults in Yankee Fork on August 5, August 6, August 13, and September 5 (Table 8). Overall a total of 173 males (78.2%) 48 females (21.8%) were outplanted. The Eightmile Creek outplanting location received the most adults (*n* = 171) followed by Elevenmile Bridge (*n*

= 50). The hatchery fish outplanted in Eightmile Creek were enclosed in a 500 meter reach by two portable picket weirs as part of an experiment with the SRBNE Program to evaluate the effects of various nutrient enrichment methodologies on fish production. The last group of outplants on September 5 were placed in the upper reaches of Yankee Fork, late in the spawning season where no adult fish were spawning. This allowed us to estimate redd production for outplanted fish.

Table 8. Number, location, and percentage of hatchery-origin male and female Chinook salmon outplanted in upper Yankee Fork.

Date	Males	Females	Morts	Total	Outplant Location	GPS Coordinates [1/]
8/5/2014	45	30	0	75	Eightmile Creek	N 44.426312° W -114.620585°
8/6/2014	57	0	0	57	Eightmile Creek	N 44.427973° W -114.620474°
8/13/2014	39	0	0	39	Eightmile Creek	N 44.426630° W -114.620767°
9/5/2014	32	18	0	50	Elevenmile Bridge	N 44.466786° W -114.580179°
Total	**173**	**48**	**0**	**221**		
Percent	**78.2%**	**21.8%**	**0%**			

[1/] GPS coordinates are in decimal degrees

Of the 221 fish obtained from Sawtooth FH, the average fork length was 70 cm and ranged from 42 to 90 cm (Figure 17). Length frequency and age structure analysis indicates all three brood years (2009 – 2011) were outplanted. Most of the outplanted fish were from BY 2010 age^4 adults followed by BY 2011 age^3 jacks (Figure 18).

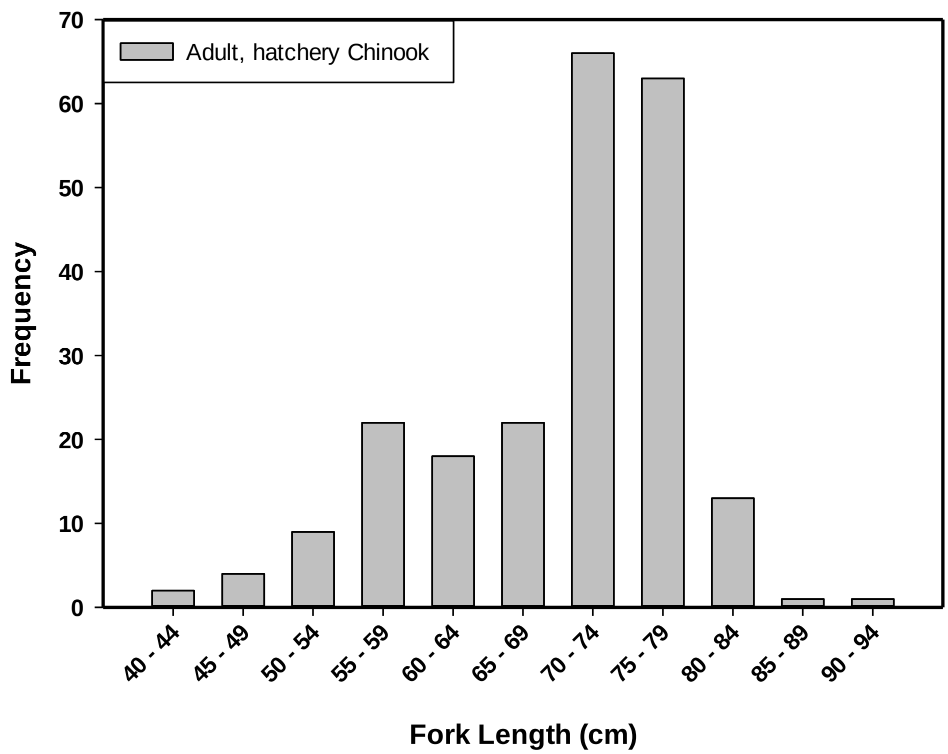

Figure 17. Length frequency of hatchery-origin Chinook salmon obtained from Sawtooth.

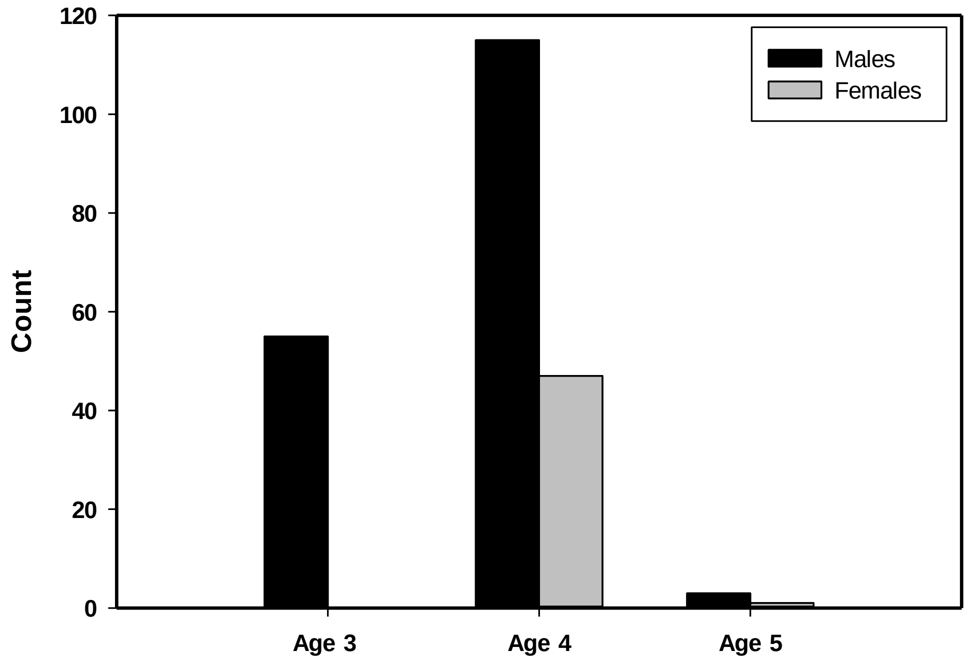

Figure 18. Age distribution of hatchery-origin Chinook salmon obtained from Sawtooth (2014).

CARCASS OUTPLANTS

A total of 872 adult Chinook salmon carcasses were outplanted into Yankee Fork to enrich the stream environment with marine-derived nutrients. Carcasses consisted of spawned adult Chinook salmon used for broodstock at Sawooth. These carcasses were put held in a freezer until we were ready to distribute them throughout Yankee Fork.

Chinook salmon carcasses were outplanted from September 5 – 7 (Table 9). A subsample of arcasses were measured to fork length (*n* = 244), listed as male or female, and had their tales cut off so they wouldn't be mistaken for a spawn mortality on a spawning ground surveys. Carcasses were distributed to nine predetermined locations in the Yankee Fork. An additional number of carcasses were outplanted into Ramey Creek as part of our collaboration with SRBNE Program.

Table 9. Date, location, and number of Chinook salmon carcasses outplanted in Yankee Fork in 2014.

Date	Site	Realease Location	Lat. (WGS 84.Dec.Deg.)	Lon.(WGS 84.Dec.Deg.)	Males	Females	Total
9/5/2014	1	2nd bridge Y.F.	44.335262	-114.721565	36	38	74
9/6/2014	2	3rd Bridge Y.F.	44.33886	-114.72234	45	55	100
9/6/2014	3	5th Bridge Y.F.	44.348603	-114.725245	73	25	98
9/6/2014	4	Bridge below Bonanza City	44.368125	-114.725021	52	48	100
9/6/2014	5	Bridge above Custer	44.395958	-114.675362	40	60	100
9/6/2014	6	5 Mile Bridge	44.409385	-114.645698	33	67	100
9/6/2014	7	Bridge below 8 Mile Bridge	44.416812	-114.625617	53	47	100
9/7/2014	8	Cearley Creek	44.345009	-114.724577	55	45	100
9/7/2014	9	1st Bridge Y.F.	44.287552	-114.720443	52	48	100
Total					**439**	**433**	**872**
Percent					**50.3%**	**49.7%**	

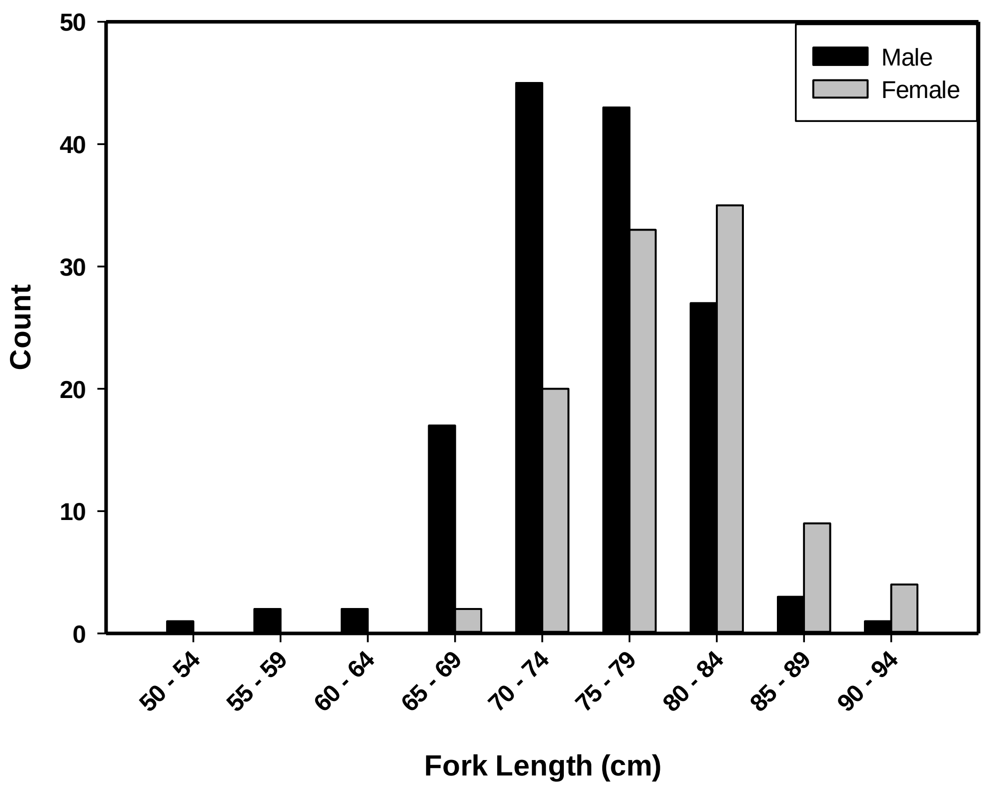

Figure 19. Length frequency of adult Chinook salmon carcasses outplanted in Yankee Fork (n=244).

Of the 872 fish obtained from Sawtooth FH, the average fork length was 76.5 cm and ranged from 51 to 93 cm (Figure 19). Male carcasses averaged 74.9 cm fork length and ranged from 51 – 91 cm. Female carcasses averaged 78.8 cm fork length and ranged from 68 – 93 cm. Carcasses weighed an average of 3.6 kg and ranged from 0.6 – 7.1 kg. Male carcasses averaged 3.8 kg and ranged from 0.6 – 7.1 kg, whereas female carcasses averaged 3.4 kg and ranged from 1.9 – 7.0 kg. The length frequency histogram and age structure analysis indicates all three brood years (2009 – 2011) were outplanted. Most of the outplanted carcasses were from BY 2010 age^4 adults followed by BY 2010 age^5 adults (Figure 19).

HARVEST MONITORING

Harvest guidelines for Yankee Fork were developed according to the TRMP (Denny et al. 2010) and include 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 (2007b) for basic, intermediate, and large populations. Using the in-season forecast, the Tribes developed a harvest guideline in 2014 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, once they pass Lower Granite Dam. The harvest rate was determined based on the anticipated forecast of 734 hatchery and 620 natural-origin fish returning to Yankee Fork. This resulted in a harvest guideline of 264 hatchery and 71 natural-origin Chinook salmon. Due to significantly less returning adults, an in-season run adjustment was conducted which reduced the predicted run size from 1,354 to 258 natural and hatchery-origin adults. The adjustment to the harvest regulations were developed on July 14 and Yankee Fork Salmon River was curtailed on three days later on July 17.

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 mid-June until the fishery was closed in July, 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. We completed 18 passes in Yankee Fork, observed 31 total fishermen, resulting in a total of 49 fishing days. Overall, a total of 6 fish natural-origin fish were harvested in 2014 (Table 10).

Table 10. Shoshone-Bannock Chinook salmon harvest in Yankee Fork from 2008 – 2014.

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
2013	3	4	7
2014	6	0	6
Total	**55**	**203**	**258**

SPAWNING GROUND SURVEYS

Redd Counts

Extensive spawning ground surveys were conducted in Yankee Fork and its major tributary, West Fork of Yankee Fork from August 13 – September 25 to determine spawn timing, redd enumeration and distribution, abundance of live fish, and to collect carcasses for biological information and mark recapture analysis. 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 is sub-divided into eight distinct strata for redd reporting to maintain consistency with our long-term data set which was initiated in 1984 (Konopacky et al. 1985, 1986) (Tardy and Denny 2010). However, the seven strata are based on distinct habitat units and do not always translate into realistic spawning ground survey sections, with some strata being too long to reasonably survey in a given day. Therefore, survey sections were established into walkable stream reaches with easy to locate start and stop points (Table 11). We divided Yankee Fork into eleven survey reaches with Sections 1 – 7 located in mainstem Yankee Fork, Sections 8 – 9 in West Fork Yankee Fork, and Sections 10 – 11 in two major tributaries known to provide some spawning habitat. The average survey section established is 5.45 km.

We developed a standardized sampling schedule based on pass number to enable year-to-year comparisons for spawning ground surveys. Spawning ground survey training occurred during August 5 – 6. Pass one occurred during the second week of August on the 12 – 13. Pass two occurred during the third full week of August on the 19 – 21. Pass three occurred during the fourth full week of August on the 26 – 27. Pass four occurred during the first full week of September on the 4 – 8. Pass five should have occurred in the second full week in September, but this did not occur due to other activities. Pass six occurred during the third full week of September. Lastly, pass seven occurred in the fourth full week of September. It should be noted that pass seven was a unique pass to look for redds from hatchery outplanted adults and was limited to Section 7.

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 located 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 bank. This information was recorded on 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 had 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.

Table 11. Spawning ground survey sections, descriptions, GPS coordinates, and length.

Survey Section	Start Description	End Description	Start GPS Coordinate	End GPS Coordinate	Length (km)
1	Pole Flat Weir	Yankee Fork Mouth	N 44.303037° W -114.720434°	N 44.269743° W -114.734579°	5.23
2	West Fork of Yankee Fork Confluence	Pole Flat Weir	N 44.349041° W -114.726489°	N 44.303037° W -114.720434°	5.83
3	Custer Pullout	West Fork of Yankee Fork Confluence	N 44.385455° W -114.701455°	N 44.349041° W -114.726489°	5.6
4	Fivemile Creek Confluence	Custer Pullout	N 44.404930° W -114.655340°	N 44.385455° W -114.701455°	4.73
5	Eightmile Creek Confluence	Fivemile Creek Confluence	N 44.426280° W -114.620670°	N 44.404930° W -114.655340°	5.1
6	Tenmile Bridge	Eightmile Creek Confluence	N 44.457979° W -114.590099°	N 44.426280° W -114.620670°	5.53
7	Twelvemile Bridge	Tenmile Bridge	N 44.483370° W -114.561270°	N 44.457979° W -114.590099°	4.01
8	Downstream of West Fork Canyon	West Fork of Yankee Fork Mouth	N 44.370960° W -114.754210°	N 44.349041° W -114.726489°	3.83
9	Cabin Creek Confluence	Downstream of West Fork Canyon	N 44.396930° W -114.828260°	N 44.370960° W -114.754210°	9.2
10	1.18 km upstream in Jordan Creek	Jordan Creek Confluence	N 44.378251° W -114.721001°	N 44.387238° W -114.726120°	1.18
11	1.52 km upstream in Eightmile Creek	Eightmile Creek Confluence	N 44.426312° W -114.620585°	N 44.430417° W -114.621316°	1.52
				Reaches 1-11 Total km	51.76
				2014 Total km (Reaches 1-9)	**49.06**

Stream sections 1 – 9 were walked approximately weekly during mid-day marking Chinook salmon redds and recovering carcasses when conditions allowed. For example, intense rainfall events in late-August caused high turbidity levels, which decreased water clarity substantially and some sections could not be completed weekly. Survey crews conducted three passes in section 8 – 9, four passes in sections 1 – 2 and 5, five passes in sections 3 – 4 and 6 – 7, and six passes in section 7. Jordan Creek (Section 10) was not surveyed and Eightmile Creek (Section 11) was surveyed by SRBNE Program.

We identified 53 total redds from natural spawning over the 49.06 rkms surveyed (Table 12). The majority of redds observed from natural spawning fish occurred in Section 5 with 14 total redds and 2.75 redds/km. We observed an average of 5.89 redds/section and 1.08 redds/km. It should be noted that four of these redds were identified in Section 1, which is located downstream of Pole Flat weir.

In collaboration with SRBNE Program, we identified 36 total redds over the 500 meter study section in Eightmile Creek (Section 11). These 36 redds were the direct result of releasing 171 live adult hatchery fish. An additional survey was conducted downstream of the blocking weirs in Eightmile Creek and no additional redds were observed (D. Richardson pers. comm.). We also observed two redds in Section 7 that are the result of outplanted hatchery fish. As noted above, these fish were outplanted into this section on September 5, after no fish, carcasses, or redds were observed for three consecutive passes. Stratum four contained the most Chinook salmon redds, followed by stratum 6 and 8 (Table 13).

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 observed in 1984 and 1995. The highest counts were observed in 2008 (*n* = 660) and 1968 (*n* = 615), respectively (Figure 20). Over the entire period (62 years) an average of 124 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 (2008 – 2014), the average has increased to 223 redds/year.

Table 12. Spawning Ground Survey Statistics.

Survey Reach	Length (km)	Total Redds	Redds per km
1	5.23	4	0.76
2	5.83	4	0.69
3	5.6	7	1.25
4	4.73	5	1.06
5	5.1	14	2.75
6	5.53	6	1.08
7	4.01	2	0.50
8	3.83	3	0.78
9	9.2	8	0.87
10	NA	NA	NA
11	0.5*	36*	72*
Natural Totals	**49.06**	**53**	**--**
Natural Average	**5.45**	**5.89**	**1.08**
Natural and Hatchery Total	49.56*	89*	--
Natural and Hatchery Average	4.956*	8.9*	8.17*

* Results included from outplanted live, hatchery adults in 500-meter reach in Eightmile Creek

Table 13. **Total number of redds observed by stratum.**

Stratum	Redds Observed	Comments
1	4	-
2	4	-
3	3	-
4	23	-
5	8	Survey ended at Twelve Mile bridge
6	11	-
7	NA	Not surveyed in 2014
8	0 (36*)	*Results from outplanted live, hatchery adults
Total Natural	**53**	Total natural spawning redds
Total Natural & Hatchery	**89***	*Total natural spawning and hatchery redds

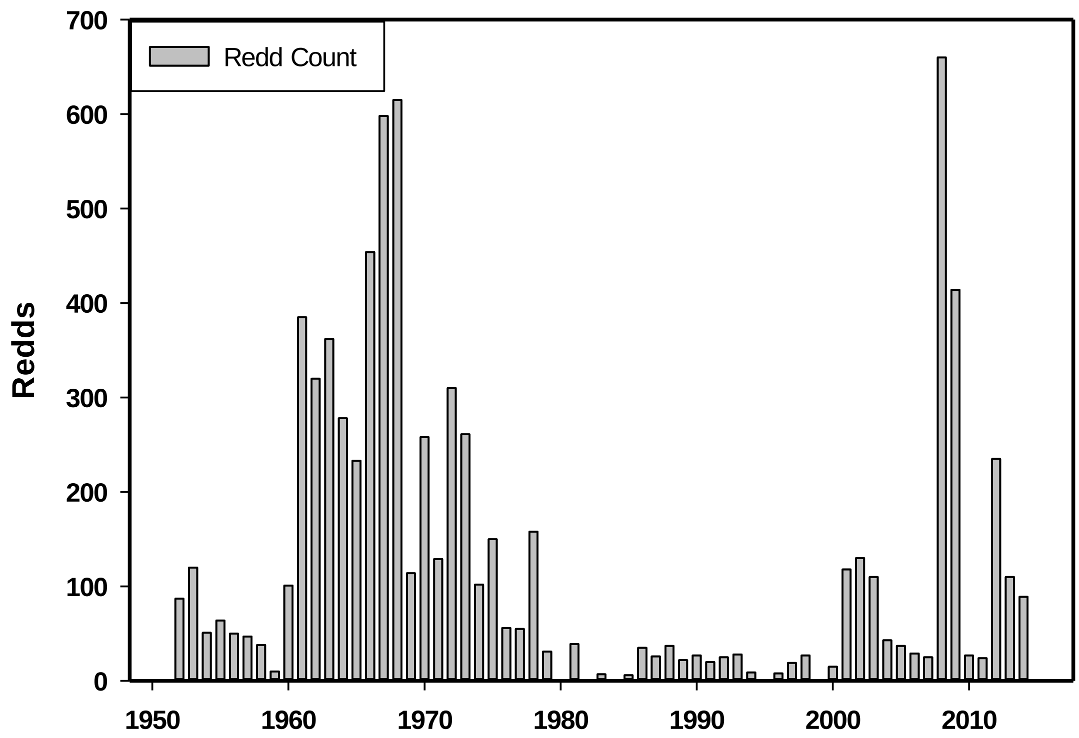

Figure 20. Chinook salmon redds in Yankee Fork, 1952 - 2014

Carcass Surveys

Carcass surveys were completed concurrently during spawning ground surveys and also from fish recovered on the upstream side of the Pole Flat weir during regular weir operation. Spawning ground surveys were conducted from August 13 – September 25 and a total of 19 carcasses were located and sampled during these surveys. Additionally, 39 carcasses were recovered and sampled from the Pole Flat weir from June 24 – September 17. This resulted in 58 total carcasses collected from the mouth of Yankee Fork to Twelvemile Bridge. We excluded four carcasses in the mark-recapture population estimates that were from hatchery-outplanted adults with clipped adipose fins and left operculum punches. We also excluded an additional carcass that was recorded as ‘unknown’ and could not be identified as ‘marked’ or ‘unmarked’ fish. This resulted in 53 carcasses from naturally immigrating fish, of which two were hatchery smolt releases with a coded-wire tag, and 51 were of natural origin. There were four carcasses collected containing PIT tags, of which three were tagged at Lower Granite Dam as returning adults and one with an unknown tagging location.

MARK-RECAPTURE EVALUATION

The YFCSP utilizes a mark-recapture methodology to determine total adult escapement above Pole Flat weir. The mark-recapture study was conducted with natural immigrating adults collected and marked at Pole Flat weir and subsequently recovered near the upstream face of this weir. There were 234 naturally migrating salmon released above Pole Flat weir. A total of 53 carcasses were used in the mark-recapture analysis and were recovered during spawning ground surveys and weir operations. Of the total carcasses recovered, 51 were marked carcasses (right operculum punches) and two were unmarked carcasses. We used the Peterson Estimator (Chapman 1951) to estimate escapement above Pole Flat weir, where adult escapement is 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 243 salmon (±11) escaped past Pole Flat weir. We used the hatchery (12.4%) and natural (87.6%) fraction observed at Pole Flat weir to estimate origin (Table 6). This results in an estimated return of 213 natural and 30 hatchery-origin fish. Given that we estimate escapement above Pole Flat at 243 adults and we trapped 234, overall trapping efficiency at Pole Flat Weir was 96.3%. We recognize that not all marked adults may have been available for recovery and this estimate maybe slightly bias.

FISH PER REDD ESTIMATION

Upstream of Pole Flat Weir

Although we estimate escapement above Pole Flat weir, we observed four redds below the weir that are not included in the mark-recapture escapement estimate. To estimate total adult escapement to the Yankee Fork, we calculated a fish per redd value from data above Pole Flat weir and used this value to extrapolate the number of adults that returned to Yankee Fork and stayed below Pole Flat weir.

As noted above, hatchery-origin fish were outplanted in Eightmile Creek and near Elevenmile Bridge. We exclude the redds and fish in these two areas (sections 7 and 11) when developing our fish/redd expansion factor as the most realistic fish/redd expansion factor in 2014 is the area between Pole Flat weir and Tenmile Bridge (survey sections 2 – 6 in mainstem Yankee Fork and sections 8 – 9 in West Fork Yankee Fork). In section 2 – 6 and 8 – 9, we observed a total of 47 redds (Table 12). We estimate 243 Chinook salmon passed Pole Flat weir and contributed to natural spawning in these sections. However, carcass surveys in these sections identified pre-spawn mortality in female fish to be 6.7%. This results in an estimated loss of sixteen female fish before spawning. After accounting for pre-spawn mortality, we estimate a total spawner abundance of 227 adult Chinook salmon, which created 47 redds for an overall fish per redd estimate of 4.83 (227 adults / 47 redds). To determine escapement downstream of Pole Flat weir (Section 1), we applied the fish/redd estimate (4.83) to the number of redds observed downstream of (n = 4) and estimate 19 fish.

We also estimated the fish/redd ratio for outplanted hatchery-origin adults. In Eightmile Creek (Section 11), 171 hatchery-origin adults were released and these fish produced 36 redds. All of the female fish in this section spawned resulting in 4.74 fish per redd (171 adults / 36 redds). In addition, 50 hatchery-origin adults were outplanted at Elevenmile Bridge located in Section 7 (Table 11) and we observed to 2 redds (Table 12). Pre-spawn mortality was 50% for this group of fish, resulting in an estimated loss of 25 fish prior to spawning. After accounting for pre-spawn mortality, there were 25 hatchery fish available to produce 2 redds and we estimate 12.5 fish per redd in this section.

TOTAL ESCAPEMENT

Overall, we estimate a total of 262 natural and hatchery-origin Chinook salmon returned to Yankee Fork in 2014. We estimate 243 of these fish passed upstream of Pole Flat weir and 19 remained downstream of the weir. Of this return, 230 fish were natural-origin (87.6%) and 32 were hatchery-origin (12.4%). Both natural and hatchery-origin fish were skewed towards females (approximately 57%) and we estimate 150 females and 112 males returned to spawn in 2014. In addition to what returned naturally to Yankee Fork, we outplanted 221 adult hatchery fish obtained from Sawtooth, producing an in-river total abundance of 483 Chinook salmon. We estimate six natural fish were harvested in the Tribal fishery, leaving an adult escapement of 256 naturally migrating (wild and hatchery origin) and 221 adult hatchery outplants, for a total of 477 fish. Pre-spawn mortality rates indicate an additional 41 adults died before spawning (16 naturally migrating and 25 hatchery outplants). This results in an estimated spawner abundance of 436 adult Chinook salmon in the Yankee Fork watershed that produced a total of 89 redds. This equates to an overall fish per redd ratio of 4.90 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. We are currently in phase I of our reintroduction approach and we are currently attempting to return 1,000 adult salmon.

Hatchery smolt releases of BY 2012 were conducted in 2014 and this was welcomed after not releasing BY 2011 smolts in 2013 because of insufficient adult returns to Sawtooth. All hatchery smolts were released in Pond Series 1 and acclimated for 48 hours. We are currently unsure of whether the 48 hour acclimation time is sufficient as the majority of hatchery adult released in Yankee Fork as juveniles, actually return to Sawooth FH, where they were raised. As a result, we plan to increase smolt acclimate for 72 hours in 2015 to help improve juvenile imprinting to Yankee Fork and adult returns to Yankee Fork. Additionally, we are planning to coordinate Chinook smolt release dates so that smolts arrive at Lower Granite after May 1, which is when transportation of juvenile fish begins. Therefore, we plan to release BY 2013 Chinook smolts in Yankee Fork on April 20 – 21, 2015 to maximize juvenile survival.

Juvenile Chinook salmon emigration data collected at the screw trap allowed for coarse estimation of life-stage specific production. Concurrent with previous results, the majority of juveniles migrated from Yankee Fork as parr and pre-smolts in 2014. However, we still are limited in our estimate of BY 12 smolts and BY 13 fry, which corresponds with difficulties operating the screw trap during higher flow periods. A data gap continues to exist during the spring snow melt high flow event. In 2014, an additional winch was added to the screw trap cable system so the trap could be moved laterally by one technician and successfully operated during higher flows. In high flows, capture efficiencies are low because of water volumes and the inability to fish the screw trap in stronger currents, but the winch installed in 2014 helped to keep the trap operating as long as possible during these conditions. We also continued to install sandbags and a rockbar to increase screw trap efficiency by diverting more flow into the screw trap during lower flow periods. Ultimately, in 2015 we will conduct thorough screw trap training to ensure protocols are followed and work diligently to capture juveniles during the spring season, estimate trap efficiency by period, and develop robust population estimates.

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. The entire front weir face and trap box was sandbagged in 2014, which appeared to correlate with higher trap efficiencies. In fact, we estimate overall trap efficiency of Pole Flat weir to be ~96% and adult trapping was extremely successful in 2014. Moreover, several weir modifications were successful in reducing bull trout mortalities. Marking data indicates running a small opening in the downstream right edge of the weir face resulted in some volitional migration of salmon upstream and downstream of the weir. This resulted in a minimal decrease in trap efficiency as only three Chinook salmon were captured on multiple occasions. However, it appears preferable to allow the volitional outmigration of spawning bull trout and potentially lose a small amount of trapping efficiency as weir/spawner survey mark recapture estimates still have high precision. We recommend continuing to run the weir panel opening during the 2015 field season.

Outplanting activities of live, adults and carcass of hatchery fish obtained from Sawtooth were very successful in 2014. In collaboration with SRBNE, various nutrient enrichment methodologies on fish production were evaluated in tributaries of the Yankee Fork. Specifically, four tributaries of Yankee Fork were treated with different nutrient enrichment methods: live adults, carcasses, salmon carcass analog (SCA), and a no-treatment control. This is exciting research and collaboration between the Tribes' programs facilitated this interesting study. We look forward to the results of this study and aim to continue collaboration within the Department.

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, which will improve our escapement estimates from mark-recapture data as well as increase DNA sample sizes used in genetic analyses. In 2014, we recovered 19 carcasses of the total 234 Chinook that naturally migrated upstream of Pole Flat weir. In 2015, we plan to complete spawning ground surveys weekly and increase our effort to collect as many carcasses as possible. This may be facilitated by completing additional surveys focusing specifically on carcass recovery. In addition, several members of the YFCSP will attend the IDFG redd training course and the Tribes will also conduct a comprehensive training to ensure protocols are followed and maximize sample collection.

The Tribes are also working with the BPA and the LSCRP to plan, design, and construct a permanent weir at Pole Flat campground as we prepare to implement Phase II of this project, which includes the construction of Crystal Spring Fish Hatchery. We continue to recommend all the features in this design, which includes a permanent weir, adult holding facility, employee facilities, and juvenile acclimation facilities.

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