THE CHIEF JOSEPH HATCHERY PROGRAM
2014 ANNUAL REPORT

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This report includes both hatchery production/operations and the corresponding monitoring activities completed through April of 2015. It is structured to meet the RM&E technical report formatting requirements for BPA, and therefore the hatchery production portion is included in Appendix A.

Reports, program descriptions, annual review materials and background information, news and contact information can be found on our website at: www.colvilletribes/cjhp.

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The list of people responsible for planning, designing, building, funding and implementing the brand-new Chief Joseph Hatchery (CJH) is too long to mention here. None of the authors of this report were involved in the initial efforts to convince the Federal government to fund this endeavor, but we are grateful for the efforts. As are the Colville Tribal fishermen and other fishermen from Alaska, British Columbia, the Washington Coast, and all through the Columbia River who will benefit from the fish production for many generations to come. We wish to acknowledge Randall Friedlander, CCT Fish & Wildlife Program Director, Kirk Truscott, CCT Anadromous Division Manager, the Colville Business Council and the Natural Resource Committee for their policy direction and program guidance. This hatchery program would not exist today if not for the vision and dedicated efforts of a variety of current and former employees of CCT and BPA, particularly the former CCT Fish and Wildlife Program Manager, Joe Peone and the former CCT Anadromous Division Manager, Jerry Marco. Additionally, expert contributions, counsel, and examples came from a variety of staff from management agencies (WDFW, USFWS), groups (Mid-C HCP hatchery committees), and contractors to the Colville Tribes. Some of the tables, formatting, and table header text were copied from the CPUD/GPUD 2013 annual report to provide continuity with reporting for other populations in the Upper Columbia River and past reporting in the Okanogan River.

We want to thank our skilled and dedicated CJHP staff who cared for the fish, collected the data, maintained the equipment and generally did whatever was necessary for the project to be successful. We appreciate their willingness to work long hours under adverse conditions to get the job done.

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Table of Contents

Figures

Tables

ABSTRACT

The Chief Joseph Hatchery Program is comprised of both operations and maintenance of the Chief Joseph Hatchery, located near Bridgeport, Washington and the monitoring and evaluation of natural- and hatchery-origin Chinook salmon in the Okanogan Subbasin. In 2014, the Chief Joseph Hatchery released 44,267 yearling and 186,050 subyearling integrated Chinook from the Omak acclimation pond, and 265,656 subyearling segregated Chinook from the hatchery. Full production potential was not met at the hatchery for brood year 2014 because of higher than anticipated pre-spawn mortality in the broodstock. The total Chinook spawn in 2014 included, 132 hatchery-origin Spring Chinook (66 male, 66 female)(21% of full program), 498 natural-origin summer/fall Chinook (250 male, 248 female)(83% of full program), and 453 hatchery-origin Summer/Fall Chinook (223 male, 230 female)(92%). Two hundred thousand Spring Chinook parr were received in late October at the Riverside Acclimation Pond from the Winthrop National Fish Hatchery (100% of full production). These fish will be released in the spring of 2015 and mark the beginning of implementation of the non-essential experimental population under section 10(j) of the Endangered Species Act.

Monitoring and evaluation consist primarily of operating rotary screw traps on the Okanogan River to monitor juvenile production and outmigration, beach seining and PIT tagging operations at the confluence of the Okanogan and Columbia Rivers, the operation of an adult pilot weir on the Okanogan River, and redd and carcass surveys on the Okanogan and Similkameen rivers. In 2014, the rotary screw traps captured 22,073 natural-origin Chinook, and estimated total juvenile outmigration was 3,265,309 (95% C. I. = 1,809,367-4,721,251). Via the beach seine, 9,133 juvenile Chinook were captured, and 8,226 were released with an implanted PIT tag. 2,324 adult Chinook were encountered in the weir trap, of which 318 were hatchery-origin and 2,006 were natural-origin. All natural-origin fish were released upstream of the weir unharmed, except for 76 which were taken for broodstock. All but four of the hatchery-origin fish encountered in the trap were removed for pHOS management. Redd surveys detected 4,253 Summer/Fall Chinook redds, which led to a spawner escapement estimate of 12,164 Chinook. 2,452 carcasses were recovered (2,123 natural-origin and 329 hatchery-origin), and the proportion of hatchery-origin spawners was 0.12.

EXECUTIVE SUMMARY

The Chief Joseph Hatchery (CJH) is the fourth hatchery obligated under the Grand Coulee Dam/Dry Falls project, originating in the 1940s. Leavenworth, Entiat, and Winthrop National Fish Hatcheries were built and operated as mitigation for salmon blockage at Grand Coulee Dam, but the fourth hatchery was not built, and the obligation was nearly forgotten. After the Colville Tribes successfully collaborated with the United States to resurrect the project, planning of the hatchery began in 2001 and construction was completed in 2013. The monitoring program began in 2012 and adult Chinook Salmon were brought on station for the first time in June 2013. Bonneville Power Administration (BPA) is the primary funding source for CJH, and the Mid-Columbia PUDs (Douglas, Grant and Chelan County) have entered into cost-share agreements with the tribes and BPA in order to meet some of their mitigation obligations.

The CJH production level was set at 100% in 2014 during the second year of operation for the Spring and Summer/Fall Chinook programs. Leavenworth National Fish Hatchery (LNFH) provided 640 Spring Chinook broodstock in June 2014. The Leavenworth Spring Chinook program broodstock survival was 23.2% for females, 44.2% for males and 80% for jacks with a combined survival of 39.8%. The total green egg take for the Leavenworth Spring Chinook program was 250,800 (21% of full program). Green egg to eyed egg survival was 89.6%. This survival was slightly lower than the standard (90%). In order to try and meet full production goals for the segregated spring Chinook program, we queried USFWS for potential excess eggs within the Columbia corridor. While LNFH had excess eggs, the ELISA profiles were too high of a risk to make this option viable. Carson National Fish Hatchery did however, have an excess of eggs that had an acceptable disease profile, and on October 17th, CJH staff transported 352,900 eyed eggs from CNFH to CJH. Survival from incubation to ponding for both the Carson and Leavenworth groups was 98.2%. With the addition of eggs from the Carson facility and higher than anticipated hatchery survival of eggs and juveniles the segregated spring Chinook program was increased to 83% of full program. The 10(j) spring Chinook reintroduction program received its full component of 200,000 eyed eggs from the Winthrop NFH.

In July and August the CCT used a purse seine vessel to collect 1,129 summer/fall Chinook as broodstock that were a continuation and expansion of the previous Similkameen Pond program. Additionally, 76 summer/fall Chinook were collected at the Okanogan adult weir in September. The summer/fall and spring Chinook program's production level did not meet full production as planned, due to higher than expected pre-spawn mortality on both the summer/fall brood and the segregated spring Chinook brood. The cumulative pre spawn holding survival, for all Summer/Fall brood collected, was 77.2% for hatchery-origin broodstock (HOB) and 71.3% for natural-origin broodstock (NOB). Neither brood met the survival standard (90%) except Jacks, which are not included in the stated cumulative survival. Total green egg take for the season was 2,390,000 (95% of full program). Egg survival from green egg to eyed egg averaged 92.8% for NOB and 90.6% for HOB, both exceeding the survival standard (90%) for this life stage. Ponding survival for the integrated program ranged from 96% to 98% and averaged 97% across all groups which exceeded the survival standard (95%) for this life stage.

2014 was the first year for Summer/Fall Chinook subyearling hatchery releases from the new CJH programs, however, yearlings released from Similkameen and Omak acclimation ponds were from brood year 2012 and therefore had not been reared at the CJH central facility. In April, 44,267 integrated yearling summer/fall Chinook were released from the Omak acclimation pond. Subsequently, subyearlings from BY2013 were transferred to Omak Pond for short term acclimation and 186,050 were released in May (62% of full program). Additionally, 265,656 subyearling segregated Chinook were released directly from Chief Joseph Hatchery (66% of full program).

The CJH monitoring project collected field data to determine Chinook population status, trend, and hatchery effectiveness centered on five major activities; 1) rotary screw traps (juvenile outmigration, natural-origin smolt PIT tagging) 2) beach seine (natural-origin smolt PIT tagging, smolt to adult return) 3) lower Okanogan adult fish pilot weir (adult escapement, proportion of hatchery-origin spawners [pHOS], broodstock) 4) spawning ground surveys (redd and carcass surveys)(viable salmonid population [VSP] parameters) 5) eDNA collection (VSP parameter—distribution/spatial structure).

Rotary screw trap operations began on March 31 and continued through June 28, capturing 22,073 natural-origin Chinook and 6,765 hatchery-origin Chinook. After conducting 24 mark-recapture events, the efficiency of the trapping configuration was calculated to be approximately 1%. This translated to an overall juvenile natural-origin Chinook outmigration estimate of 3,265,309 with 95% confidence intervals of 1,809,367 to 4,721,251. 987 steelhead (*O. mykiss*) were also captured in the rotary screw trap including 396 natural origin and 591 hatchery origin. Other species commonly caught in the rotary screw traps included sockeye (*O. nerka*) (3,578), mountain whitefish (*Prosopium williamsoni*)(2,709), common carp (*Cyprinus carpio*)(788).

Nine thousand, one hundred and thirty-three juvenile Chinook salmonids were collected with the beach seine, and 8,226 (90%) were PIT tagged and released. Pre- and post-tag mortality was 4.9% and 5.3% respectively. About 10% of the released juveniles were detected at the Rocky Reach juvenile bypass system in July. Less than 3% of them were detected at the lower dams, including McNary, John Day, and Bonneville in August.

The Okanogan Adult Fish Weir was deployed on August 4 when discharge was 1,350 cfs. The thermal barrier was present in the lower Okanogan after installation for a three-week period. On August 23 the thermal barrier began to break down, allowing Chinook to migrate up the Okanogan. The majority of Chinook (98%) were trapped between August 26 and September 11. Most of the trapped fish were released back into the river. Seventy-six natural-origin Chinook were transported to the hatchery and held as broodstock for the integrated program. About 14% of the Chinook spawning escapement was detected in the trap. All Chinook and sockeye mortality encountered at the weir was categorized as impinged on the upstream side, indicating that they most likely died upstream and floated down onto the weir. There was also not an increase in the number of Chinook mortalities after trapping operations began. An acoustic evaluation of sockeye passage at the weir indicated that their mean travel time was significantly faster before the weir was deployed by 29 minutes. No conclusions were made on the biological significance of this delay in sockeye migration. The head differential, river velocity, and trap capacity were within the NOAA standard operating criteria. Water quality information, including dissolved oxygen, turbidity, and total dissolved solids, was collected to assess potential impacts to increased fish mortality. Weir trapping operations ceased on September 25.

Adult summer/fall Chinook spawning escapement in 2014 was estimated to be 12,164, with 10,602 natural-origin spawners, which exceeded the recent five-year and long-term averages. The values for pHOS (0.12) and proportion of natural influence (PNI) (0.89) in 2014 exceeded the objectives (<0.30 and >0.67), but the five-year averages fell short of the long-term goals (0.32 and 0.62, respectively).

An Annual Program Review (APR) was held in March 2015 to share hatchery production and monitoring data, review the salmon forecast for the upcoming year, and develop action plans for the hatchery, selective harvest, and monitoring projects. Based on a strong pre-season forecast of 73,000 Upper Columbia summer/fall Chinook, the plan for 2015 is to operate the hatchery at full program levels of 2 million summer/fall Chinook and 900,000 spring Chinook. To maximize PNI, broodstock for the integrated program would be 100% natural-origin broodstock (NOB) and CCT would plan to harvest their full allocation with the selective harvest program removing as many adult hatchery Chinook as possible with the purse seine, the weir, and at the hatchery ladder.

INTRODUCTION

Salmon (*Oncorhynchus* spp.*)* and steelhead (*O. mykiss*) faced many anthropogenic challenges ever since European settlement of the Pacific Northwest. Harvest, hydropower development, and habitat alteration/disconnection have all had a role in reducing productivity or eliminating entire stocks of salmon and steelhead (MacDonald 1894; UCSRB 2007). These losses and reductions in salmon had a profound impact on Native American tribes, including the Confederated Tribes of the Colville Reservation. Hatcheries have been used as a replacement or to supplement the wild production of salmon and steelhead throughout the Pacific Northwest. However, hatcheries and hatchery practices can pose a risk to wild populations (Busack and Currens 1995; Ford 2002; McClure et al. 2008). As more studies lead to a better understanding of hatchery effects and effectiveness, hatchery reform principles were developed (Mobrand et al. 2005; Paquet et al. 2011). The CJHP is one of the first of its kind to be structured using many of the recommendations emanating from Congress's Hatchery Reform Project, the Hatchery Science Review Group (HSRG) and multiple independent science reviews. Principally, the success of the program is not based on the ability to meet the same fixed smolt output or the same escapement goal each year. Instead, the program is managed for variable smolt production and natural escapement. Success is based on meeting targets for abundance and composition of natural escapement and hatchery broodstock (HSRG 2009). Chief Joseph Hatchery Program (CJHP) managers and scientists are accountable for accomplishments and/or failures, and therefore, have well-defined response alternatives that guide annual program decisions. For these reasons, the program is operated in a manner where hundreds of variables are monitored, and activities are routinely and transparently evaluated. Functionally, this means that directed research, monitoring, and evaluation (RM&E) are used to determine status and trends and population dynamics, and are conducted to assess the program's progress in meeting specified biological targets, measure hatchery performance, and in reviewing the key assumptions used to define future actions for the entire CJHP.

The actions being implemented by the Colville Tribes, in coordination with regional management partners, represent an extraordinary effort to recover Okanogan and Columbia River natural-origin Chinook Salmon populations. In particular, the Tribes have embraced hatchery program elements that seek to find a balance between artificial and natural production and address the often-conflicting goals of increased harvest and conservation.

Two hatchery genetic management plans (HGMPs) were initially developed for the CJH during the Northwest Power and Conservation Council (NPCC) three-step planning process – one for summer/fall Chinook (CCT 2008a) and one for spring Chinook (CCT 2008b). Each of the two plans included an integrated and a segregated component. Integrated hatchery fish have a high proportion of natural origin parents, are released into the Okanogan River system and a proportion of these fish are expected to spawn in the natural environment. Segregated fish have primarily hatchery parents, are to be released from CJH directly into the Columbia River and adult returns are targeted exclusively for harvest.

In 2010 the CCT requested that the National Marine Fisheries Service (NMFS) designate a non-essential experimental population of spring Chinook in the Okanogan utilizing section 10(j) of the Endangered Species Act (ESA). In order to obtain a permit to transfer ESA listed fish from the Methow to the Okanogan, a new HGMP was developed (CCT 2013). Biological Opinions (BiOps) and permits have been issued by NMFS for the 2008 HGMPs, and CCT acquired a BiOp and permit for the 2013 spring Chinook in 2014. The program will be guided by all three HGMPs.

At full program the facility will rear up to 2 million summer/fall Chinook and 900,000 spring Chinook. Up to 1.1 million summer/fall Chinook will be released in the Okanogan and Similkameen Rivers as an integrated program and 900,000 will be released from CJH as a segregated program. Up to 700,000 segregated spring Chinook will be released from CJH and up to 200,000 Met Comp spring Chinook from the Winthrop National Fish Hatchery (WNFH) will be used to reintroduce spring Chinook to the

Okanogan under section 10(j) of the ESA. In 2014, the summer/fall and spring Chinook program's production level was set at full production capacity.

The CJHP will increase harvest opportunity for all anglers throughout the Columbia River and Pacific Ocean. Additionally, the Colville Tribes and other salmon co-managers have worked with the mid-Columbia Public Utility Districts to meet some of their hydro-system mitigation through hatchery production (CPUD 2002a; CPUD 2002b; DPUD 2002).

In order to make full use of the best science available the program operates on the following general principles[1]:

1. Monitor, evaluate and adaptively manage hatchery and science programs
2. Manage hatchery broodstock to achieve proper genetic integration with, or segregation from natural populations
3. Promote local adaptation of natural and hatchery populations
4. Minimize adverse ecological interactions between hatchery- and natural-origin fish
5. Minimize effects of hatchery facilities on the ecosystem
6. Maximize survival of hatchery fish in integrated and segregated programs
7. Develop clear, specific, quantifiable harvest and conservation goals for natural and hatchery populations within an "All-H" (Hatcheries, Habitat, Harvest and Hydro) context
8. Institutionalize and apply a common analysis, planning, and implementation framework
9. Use the framework to sequence and or prioritize actions
10. Hire, train, and support staff in a manner consistent with successful implementation of the program
11. Conduct annual reviews to include peers, stakeholders, and regional managers, and
12. Develop and maintain database and information systems and a highly functional informational web-presence.

The CJHP annual RM&E activities were focused on five primary field activities to provide data for answering key management questions. These activities included:

1. Rotary screw traps (juvenile outmigration, natural-origin smolt PIT tagging)
2. Beach seine (natural-origin smolt PIT tagging)
3. Lower Okanogan adult fish pilot weir (adult escapement, pHOS, broodstock)
4. Spawning ground surveys (redd and carcass surveys)(VSP parameters)
5. eDNA collection (VSP parameter—distribution/spatial structure)

[1] Adapted from the Hatchery Reform Project, the Hatchery Science Review Group reports and independent science review.

Additional data compilation activities occurred and were necessary in conjunction with our field efforts to answer the key management questions. These included:

1. Harvest (ocean, lower Columbia, terminal sport, and CCT)
2. Query RMIS for coded wire tag (CWT) recoveries to evaluate strays and stock composition
3. Query PTAGIS for PIT tag returns at mainstem dams and tributaries
4. EDT model estimates for abundance and productivity (from OBMEP)

In-hatchery monitoring/data collection was focused in five areas (see Appendix A):

1. Broodstock collection and bio-sampling
2. Life stage survival
3. Disease monitoring
4. Tagging, marking, and release
5. Ladder surplus / pHOS reduction

Study Area

The primary study area of the CJHP lies within the Okanogan River Subbasin and Columbia River near Chief Joseph Dam in north central Washington State (Figure 1). The Okanogan River measures approximately 185 km long and drains 2,316,019 ha, making it the third-largest subbasin to the Columbia River. Its headwaters are in Okanagan Lake in British Columbia, from which it flows south through a series of four lakes before crossing into Washington State at Lake Osoyoos. Seventy-six percent of the area lies in Canada. Approximately 14 km south of the border, the Okanogan is joined by its largest tributary, the Similkameen River. The Similkameen River watershed is 510 km long and drains roughly 756,096 ha. The Similkameen contributes approximately 75% of the flow to the Okanogan River. The majority of the Similkameen is located in Canada. However, part of its length within Washington State composes an important study area for CJHP. From Enloe Dam (Similkameen rkm 14) to its confluence with the Okanogan, the Similkameen River contains important Chinook pre-spawn holding and spawning grounds. Downstream of the Similkameen confluence, the Okanogan River continues to flow south for 119 km until its confluence with the Columbia River at Columbia River km 853, between Chief Joseph and Wells dams, near the town of Brewster, Washington.

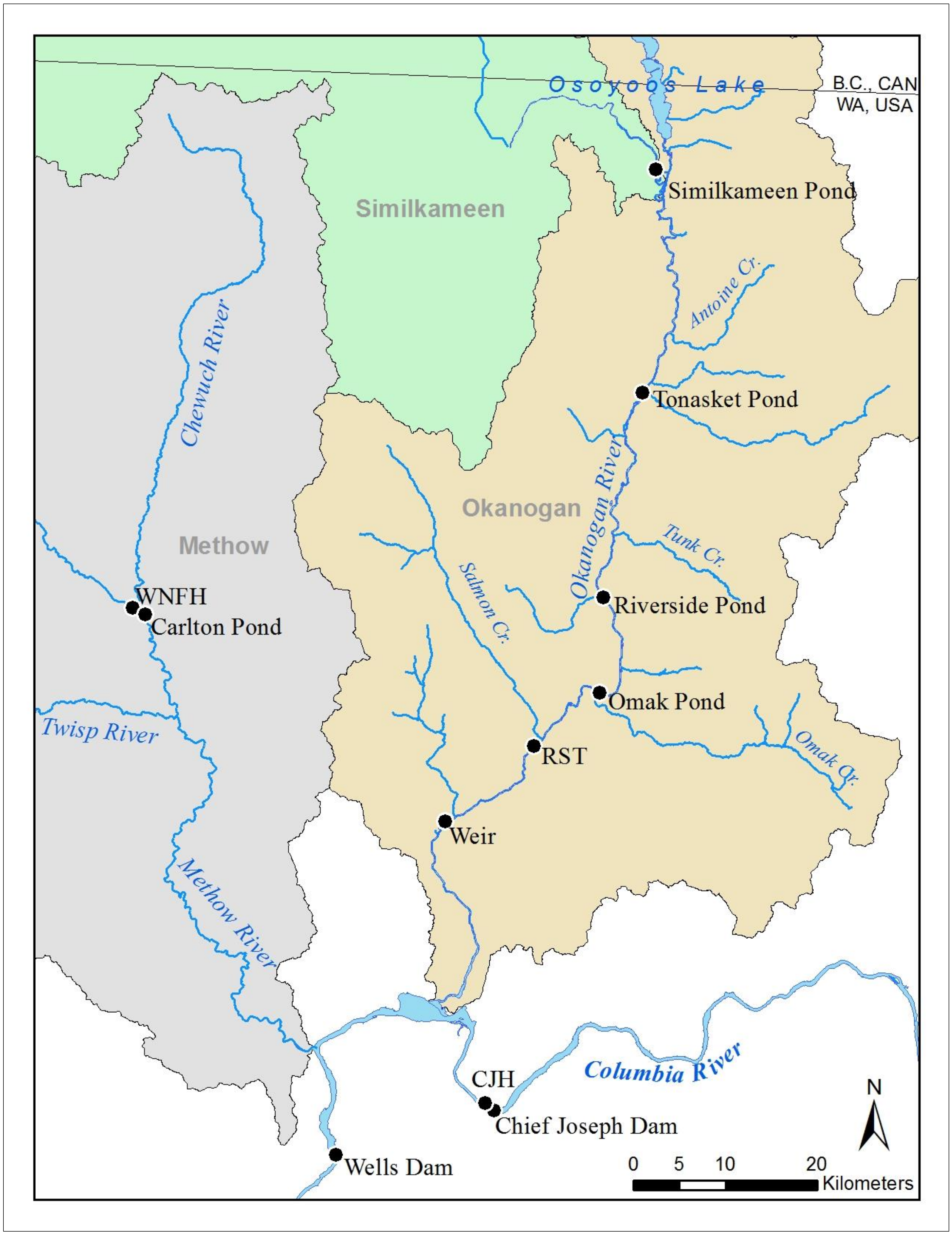


Figure 1. Map of the U.S. portion of the Okanogan River Basin, the Chief Joseph Hatchery (CJH), Winthrop National Fish Hatchery (WNFH), Okanogan adult weir (Weir), Rotary screw trap (RST), and Chinook Salmon acclimation sites. Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Similar to many western rivers, the hydrology of the Okanogan River watershed is characterized by high spring runoff and low flows occurring from late summer through winter. Peak flows coincide with spring rains and melting snowpack (Figure 2). Low flows coincide with minimal summer precipitation, compounded by the reduction of mountain snowpack. Irrigation diversions in the lower valley also contribute to low summer flows. As an example, at the town of Malott, Washington (rkm 27), Okanogan River discharge can fluctuate annually from less than 1,000 cfs to over 30,000 cfs (USGS 2005).

The Okanogan Subbasin experiences a semi-arid climate, with hot, dry summers and cold winters. Water temperature can exceed 25° C in the summer, and the Okanogan River surface usually freezes during the winter months. Precipitation in the watershed ranges from more than 102 cm in the western mountain region to approximately 20 cm at the confluence of the Okanogan and Columbia Rivers (NOAA 1994). About 50% to 75% of annual precipitation falls as snow during the winter months.

For most of its length, the Okanogan River is a broad, shallow, low gradient channel with relatively homogenous habitat. There are few pools and limited large woody debris. Fine sediment levels and substrate embeddedness are high and large woody debris is rare (Miller et al. 2013). Towns, roads, agricultural fields and residential areas are adjacent to the river through most of the U.S. reaches.

Near its mouth, the Okanogan River is affected by the Wells Dam on the Columbia River, which creates a lentic influence to the lowermost 27 km of the Okanogan River. Water level fluctuates frequently because of operational changes (power generation, storage) at Wells Dam.

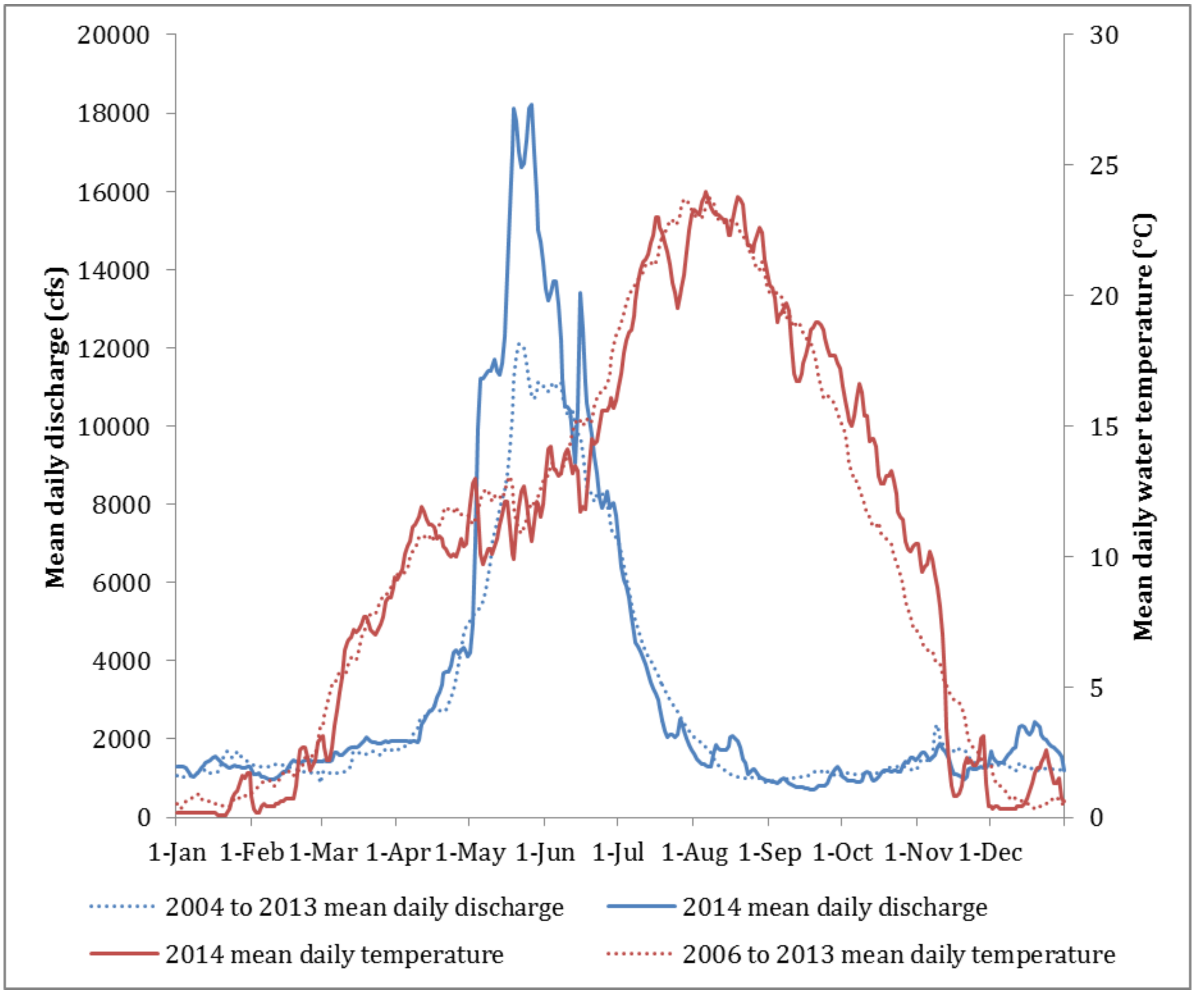


Figure 2. Okanogan River mean daily discharge (blue lines) and water temperature (red lines) at Malott, WA (USGS Stream Gage 12447200).

METHODS

Tag and Mark Plan

HATCHERY SUMMER/FALL CHINOOK. —All summer/fall hatchery-origin Chinook were marked with an adipose fin clip to ensure differentiation from natural-origin fish in the field and in fisheries. Additionally, all summer/fall Chinook raised for the integrated program have been/will be tagged with a CWT (with distinct codes differentiated by release location), which is inserted into the snout of fish while in residence at the hatchery. A batch of 200,000 summer/fall Chinook in the segregated program will receive a CWT, so the presence or absence of a CWT in adipose-clipped fish is a partial diagnostic as to which program an ad-clipped, hatchery-origin fish belongs (Table 1). This will allow for selective efforts in broodstock collection, purse seining, and hatchery trapping activities to be program specific by determining the presence or absence of a CWT in the field. It was decided that losing some resolution on field differentiation of the segregated and integrated populations was a good tradeoff in order to get the harvest information back from the batch of 200,000 CWT in the segregated program.

Under this strategy, a returning adult from the CJH with an adipose fin clip and CWT would be considered part of the integrated program and either collected for broodstock in the segregated program, allowed to escape to the spawning grounds (if pHOS is within acceptable levels), or removed from the population (for harvest or pHOS management). If a fish has an adipose fin clip but no CWT, then it is assumed from the segregated program (or a stray from another hatchery program) and removed for harvest or pHOS management. In this way, CWTs assist with in-season management of hatchery-origin stocks in the field. The 200,000 segregated fish with a CWT represent about 15% of the combined segregated (900,000) and integrated (1.1 million) hatchery fish with a CWT. If smolt to adult survival and adult holding/migration behaviors are identical, this would mean that 15% of the subsequent generation of segregated fish would have a segregated parent and would not be consistent with the 'stepping stone' approach. However, segregated fish should spend less time holding at the mouth of the Okanogan and therefore have a lower probability of being collected as broodstock in the purse seine. CWT monitoring from broodstock collections during the first several years of returns will provide insight to this tradeoff.

Coded wire tags are also recovered later in the year from salmon carcasses on the spawning grounds within the Okanogan Basin. All recovered CWTs are sent to WDFW for extraction, reading, and data upload to the Regional Mark Processing Center operated by the Pacific States Marine Fisheries Commission (PSMFC)[2]. These data are used to develop estimates of total recruitment, rate of return to point of release (homing), contribution to fisheries, survival rates, mark rate, and other parameters, helping inform future management and production decisions within the CJHP.

[2] website: http://www.psmfc.org/Regional_Mark_Processing_Center_RMPC

Table 1. General mark and tag plan for Chief Joseph Hatchery summer/fall Chinook.

Mark Group	Target max smolt released	Life-stage released	% CWT	Adipose Fin-Clip	PIT tag
Okanogan Integrated	1,100,000				
Similkameen	250,000	Yearling	100%	100%	
Riverside Pond	275,000	Yearling	100%	100%	
Omak Pond	275,000	Yearling	100%	100%	5,000
	300,000	Subyearling	100%	100%	5,000
Chief Joseph Segregated	500,000	Yearling	20%	100%	5,000
	400,000	Subyearling	25%	100%	5,000
Natural-Origin	RST and Confluence Seine	N/A	0%	0%	≤ 25,000

In addition to the adipose fin-clip and CWT, a subset of hatchery-origin fish will be PIT-tagged to further assist with fish monitoring efforts in subsequent years.

Table 1 represents the general plan at full production.

HATCHERY SPRING CHINOOK. —The general tag and mark plan for spring Chinook can be seen in Table 2. 2014 was the first year for tagging or marking of spring Chinook for the program.

Table 2. General marking and tagging plan for Okanogan spring Chinook as part of the Chief Joseph Hatchery Program.

Mark Group	Smolt released	Life-stage released	% CWT (#)	Adipose Fin-Clip	PIT tag
Chief Joseph Segregated	700,000	Yearling	29% (200,000)	100%	5,000
Reintroduction (§10(j) fish from Winthrop)					
Tonasket or Riverside Pond	200,000	Yearling	100%	100%	5,000
Natural-Origin	RST	Yearling	0%	0%	≤ 5,000

NATURAL-ORIGIN FISH TAGGING. —The RM&E plan called for up to 25,000 PIT tags in juvenile natural-origin summer/fall Chinook parr/smolts. PIT tagging of natural-origin summer/fall Chinook occurred at the rotary screw trap and the juvenile beach seine in 2014. Please see those sections for details.

Genetic Sampling/Archiving

The CJHP collects and archives genetic samples for future analysis of allele frequency and genotyping of naturally spawned and hatchery Chinook populations. Genetic samples (fin clips) from outmigrant juvenile Chinook were collected during rotary screw trap operations. Samples were preserved in 200-proof molecular grade ethanol and are currently archived at USGS Snake River Field Station, Boise, ID. No genetic analyses are currently being conducted. Annual tissue collection targets are at least 200 samples for: (1) natural-origin sub-yearling Chinook handled at the rotary screw trap/beach seine; (2) natural-origin yearling (>130 mm) Chinook handled at the rotary screw trap/beach seine and (3) natural- and hatchery-origin (200 each) Chinook encountered during carcass surveys on the spawning grounds.

The CJHP has also complied with requests from Columbia River Inter-tribal Fish Commission (CRITFC) to provide genetic samples (caudal punches) from CJH summer- and spring-Chinook broodstock to aid in the development of a Columbia River Parentage Based Tagging (PBT) program. Samples were preserved on pre-labeled Whatman (GE Healthcare, Pittsburg, PA, USA) cellulose chromatography paper and shipped to CRITFC Lab in Hagerman, ID, USA. Genetic samples will continue to be collected from all hatchery broodstock at CJH.

Rotary Screw Traps

One 2.4 m and one 1.5 m rotary screw trap (RSTs) were deployed from the Highway 20 bridge near the City of Okanogan (rkm 40) (Figure 3). The RSTs were operated from March 31 to June 28, 2014. Trapping typically occurred for 18 hours, 5 days a week from 2000-1400 Monday through Friday, and for 12 hours, 2 days a week from 2000-0800 Saturday and Sunday. Trapping operations were suspended on May 3-4, 19, and 24-25 due to high river discharge and debris load. To continue trapping operations in varying river conditions, traps were operated in one of three trapping configurations: 2.4 m only, 1.5 m only, and both traps operational.

Figure 3. 2.4-m (left) and 1.5-m (right) traps fishing in the Okanogan River. The boat is used by technicians to access the 2.4-m trap. Photo by CCT.

During operation, the trap locations were adjusted in the river to achieve between 5-10 revolutions per minute. The traps were checked every two hours unless a substantial increase in flow (≥ 500 cfs in a 24-hour period) or debris load occurred, in which case they were checked and cleaned more frequently. All fish were enumerated, identified to species, and life stage, origin (adipose fin present or absent), and disposition (whether the fish was alive or dead), and a subsample of natural-origin Chinook was measured. The fork lengths of the first 10 unmarked Chinook of each 100 encountered in the live well were measured to the nearest mm and released during each trap check. Steelhead smolts were not measured in order to minimize handling and stress of ESA-listed species. Unmarked (adipose fin present) Chinook captured in the RST that were ≥ 65 mm total length received a 12 mm full duplex PIT tag. A tissue sample (fin clip) was collected from (1) all fish that received a PIT tag and (2) any yearling unmarked Chinook for future genetic analyses.

EFFICIENCY ESTIMATES. — An estimate of the daily number of juvenile out migrants passing the trap location requires an estimate of the proportion of fish caught by the traps. This was accomplished using mark-recapture methodologies developed by Rayton and Wagner (2006), maintaining continuity with the techniques employed at this RST operation in previous years. This mark-recapture procedure (hereafter referred to as an efficiency trial) was conducted using both natural-origin sub yearling Chinook and hatchery-origin yearling Chinook. Only fish with a fork length of at least 45 mm were used in efficiency trials.

After collection from both the 2.4 m and 1.5 m rotary screw traps, fish were marked in 5 gal buckets with Bismarck Brown dye at a concentration of 0.06 g/gal, held for 10-15 minutes with aeration and transported in buckets via a truck for release. Fish were released at night (typically between 0000 and 0330) approximately 1.6 river km upstream by the Oak Street Bridge. Fish were distributed evenly on both sides of the river to allow for equal distribution across the channel. The probability of capture was assumed to be the same for hatchery-origin fish as it was for natural-origin fish.

Because of variable flow and debris conditions, at any given moment, one of several trapping configurations could have been employed, in which either one, both, or neither of the 2.4 and 1.5 m screw traps could be operating. In order to derive an ultimate out migrant estimate, efficiency estimates for all of these configurations were calculated.

Trap efficiency was calculated by the equation

$$E_{ti} = \sum R_{ti} / \sum M_i$$

where E_{ti} is the trap efficiency for trapping configuration t in sampling period i, $\sum Rti$ is the sum of marked fish that are recaptured in trap configuration t during sampling period i, and $\sum M_i$ is the sum of marked fish released during the sampling period i.

Trap efficiencies were recorded for each individual trap as it operated, and for both traps operating in unison. Trap efficiencies for each individual trap were further refined by including results for each individual trap while both traps were in operation. For example, if 100 marked fish were released, and 1 was recaptured in each trap, each individual trap displays an efficiency of 1%, and the efficiency of both traps operating simultaneously is 2%. This relies on the assumption that the efficiency of each trap is unaffected by whether the other is operating or not.

RST ANALYSIS. — Hourly catch was expanded to an hourly outmigration estimate based on measured trap efficiency by using the Lincoln-Peterson mark-recapture model with a Chapman modifier, which can improve estimates when recapture rates are low (Seber 1982). This model relies on the following assumptions:

1.) All marked fish passed the screw trap or were recaptured during time period *i*
2.) The probability of capturing a marked or unmarked fish is equal
3.) All marked fish recaptured were correctly identified as a marked fish
4.) Marks were not lost or overlooked between time of release and recapture

Total juvenile Chinook emigration was calculated for each trap configuration using a pooled Peterson estimator with a Chapman modification, such that

$$\hat{N} = \left[\frac{(M_p + 1)(C_p + 1)}{(R_p + 1)}\right] - 1$$

Where $\hat{N}$ is total emigration estimate, M_p is the total number of marked individuals during the trapping season, C_p is the total number of fish caught during the trapping season, and R_p is the total number of recaptured fish during the trapping season.

An approximately unbiased estimate of the variance of the population, $\hat{V}[\hat{N}]$, is calculated by the equation

$$\hat{V}[\hat{N}] = \frac{(M_p + 1)(C_p + 1)(M_p - R_p)(M_p - R_p)}{(R_p + 1)^2(R_p + 2)}$$

The precision of the population estimates was assessed by including 95% confidence intervals calculated by the equation

$$\hat{N} \pm 1.96\sqrt{\hat{V}[\hat{N}]}$$

Estimates and confidence intervals were calculated for all trapping configurations and then summed to generate an overall estimate for the trapping season. During periods when neither trap was operating, an estimate was calculated based on the average catch of an equal time period immediately prior and following the inoperable period. For example, no traps were operable on May 19, and so catch for that day was estimated to be the average of total catch on May 18 and May 20.

Trapping efficiency and outmigration estimation was also examined using a smolt abundance estimator provided by WDFW and developed for its efforts in the Wenatchee River that incorporates stream flow (Murdoch et al. 2012; Ryding 2000).

Juvenile Beach Seine/PIT tag effort

Portions of the following text describing the methods were taken directly from a draft DPUD report (DPUD 2014).

Beach seining took place from June 30 to July 23 in the area near the confluence of the Okanogan and Columbia Rivers. Efforts focused on beaches along the North bank of the Columbia River, downstream of the mouth of the Okanogan (48° 6'12. 46"N, 119°44'35. 48"W) (Figure 4). In 2014, Gebber's Landing was the only area used for collection. This location provided reasonable catch rates, limited bycatch, and provided suitable substrates (limited debris loads/underwater snags) for efficient sampling. Juvenile Chinook from this location were likely primarily fish originating from the Okanogan River; however, it is possible that offspring from mainstem Columbia River spawning could also be included.

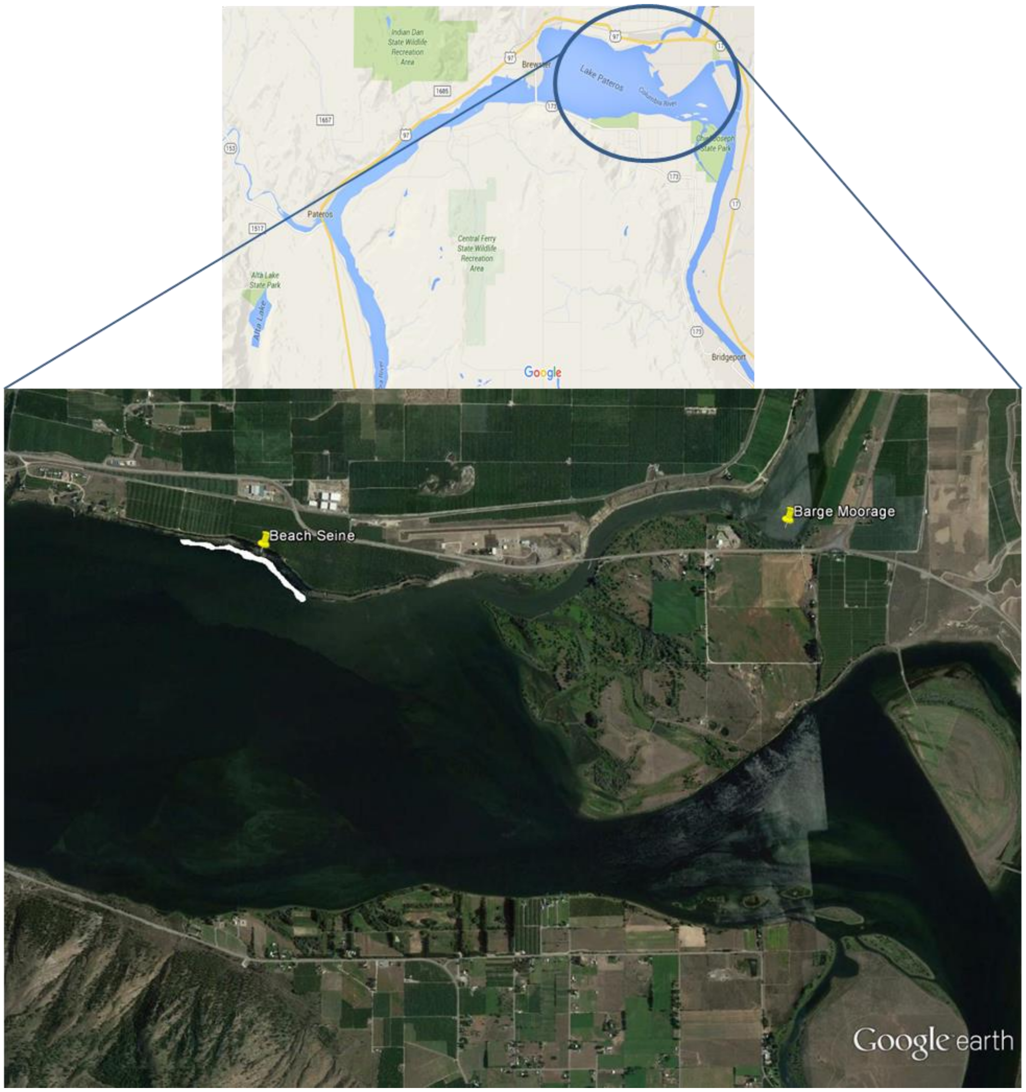


Figure 4. Seining location downstream of the confluence.

A single beach seine (30.49 m × 3.05 m with a 28.32 m^3 'bag'; Christensen Net Works, Everson, WA) was used to capture fish. Netting was Delta woven 6.4 mm mesh with "fish-green" treatment. Weights (3-5 kg) were attached to each end of the seine to help keep it open during retrieval.

To capture fish, one end of the seine was tied off to shore, while the other was towed out by boat until the seine was stretched perpendicular to shore. The boat would then pull the seine upstream and return to shore, causing the seine to form a semi-circle intersected by the shore line (Figure 5). The seine bridle was handed from the boat to a shore crew that would retrieve the seine. Juvenile Chinook were transferred to a 10-gallon tub filled with river water and transferred to a nearby floating net pen. Handling/holding time in the tub was generally <15 minutes. Floating net pens were approximately 5 m^3 and consisted of a PVC pipe frame covered with black 19.1-mm and 3.2-mm mesh. The mesh allowed for adequate water exchange, retained juvenile Chinook and prevented the entrance of predators. Noticeable bycatch, most commonly three-spine stickleback (*Gasterosteus aculeatus*) were released from the seine without enumeration. Any bycatch inadvertently transferred to the floating net pen were later sorted and released during tagging (untagged).

Figure 5. Juvenile beach seine being retrieved by CCT staff near the confluence of the Okanogan and Columbia Rivers.

Juvenile Chinook were held 24 hours prior to tagging to assess capture/handling effects. Chinook ≥ 65mm were tagged with a full duplex 12 mm PIT tag and returned to a floating net pen for 24 hours post-tagging to assess tag loss and tag application/handling mortality rates. Fish were then released to the Columbia River (Wells Pool) several hundred meters downstream of their capture location.

TAGGING PROCEDURES. —Tagging was conducted by CCT staff with support from USGS using a mobile tagging station (Biomark, Co., Boise, ID, USA). The tagging station consisted of an approximately 1 m^2 aluminum work surface with a trough for holding fish during the tagging process as well as all the necessary electronics (computer, scale, tag reader, and antenna) needed for tagging. Water was pumped directly from the river using a ¼ horsepower pump and radiator system to keep water temperatures ambient with river temperatures. When river temperatures were >19 °C, ice was added to the anesthetic solution to decrease the temperature. A solution of 40 g Tricaine methanesulfonate (MS-222) per 1 L of water was used to anesthetize fish prior to tagging. The applied concentration of MS-222 would sedate fish to the desired level of stage-2 anesthesia in approximately 3 to 4 minutes. All fish were tagged within 10 minutes of the initial exposure. Recovery time was approximately 1 to 2 minutes.

Each tagging location had two net pens: one containing the fish to be tagged, and an empty pen for holding fish post-tagging. Fish to be tagged were collected from the respective net pens using a dip net and placed into an 18.9 L bucket of water. Up to 40 fish at a time were then transferred from the bucket using a smaller dip net and placed into the trough containing the anesthetic solution.

Fish were tagged with 12.5 mm 134.2 kHz ISO PIT tags using pre-loaded, 12-gauge hypodermic needles (BIO12.BPLT) fitted onto injection devices (MK-25). 12.5 mm PIT tags were used to maximize detection at downstream locations, particularly the Rocky Reach Juvenile Bypass and the Bonneville Dam Corner Collector. Detection efficiencies at both of the former sites would dramatically suffer when using the smaller PIT tags available. The tagging crew consisted of one fish sorter, one tagger and one data collector. The data collector interrogated the tag in each tagged fish, recorded its fork length with an electronic wand on a digitizer board, and noted any anomalies. Tagged fish were transferred to the recovery/holding pen via a PVC pipe with flowing water.

Data collected during tagging were stored using PITTAG3 (P3) software (Pacific States Marine Fisheries Commission). After completion of the tagging events, tag files were consolidated, uploaded to PTAGIS (www.pitagis.org), and submitted to Douglas PUD.

Fish Releases. —Tagged fish were released the morning after they had been tagged. Prior to release, the net pen was opened and all observed mortalities and moribund fish were removed. Once the mortalities were removed the net pen was tilted to allow the fish to volitionally exit. PIT tags were recovered from dead/moribund fish, the associated tag codes were marked as "Mortalities" in the tag files and the tag codes were deleted. Expelled tags were recovered from the mesh floor via a powerful magnet.

Lower Okanogan Adult Fish Pilot Weir

The Okanogan adult fish pilot weir (herein referred to as the 'weir') was in its third year of design modifications and testing in 2014. Continued operation and improvements to the weir, are a central part of CCT's strategy for the successful implementation of the CJHP summer/fall Chinook Salmon programs. Pilot weir test results are essential for updating key assumptions, operations and design of the weir.

Objectives for the pilot weir in 2014 included:

1. Install the weir in early August and operate until late September under allowable flow conditions (<3,000 cfs);
2. Document environmental effects of the weir through collection of physical and chemical data in the vicinity of the weir;
3. Test weir trapping operations including live Chinook capture, handling, release and selective harvest;
4. Direct observations and fish counts for estimating species composition, abundance, health, and timing to inform management decisions and future program operations;
5. Measure survival of broodstock collected at the weir.

The lower Okanogan fish weir was installed approximately 1.5 km downstream of Malott, WA (48°16'21.54 N; 119°43'31.98 W). Weir installation began on August 4th at a river flow of 1,360 cfs and was complete on August 11th. An aluminum trap was installed near the center of the channel at the upstream end of the deep pool in the thalweg of the channel. The trap was 3 m wide, 6 m long and 3 m high (Figure 6). The wings of the weir stretched out from either side of the trap towards the river banks. The wings consisted of steel tripods with aluminum rails that supported the 3 m long Acrylonitrile butadiene styrene (ABS) pickets. Each panel was zip-tied to the adjacent panel for strength and stability. Sand bags were placed at the base to support the tripod legs and between panels when needed to fill gaps that exceeded the target picket spacing. Picket spacing ranged from 2.5 to 7.6 cm (1 to 3 inch) in 1.2 cm (half-inch) increments (Figure 7). Pickets were manually forced into the river substrate daily to prevent fish passage under the weir.

The river-right wing consisted entirely of 2.5 cm picket spacing. A 3-m gap between the last panel and the right shoreline remained to allow for portage of small vessels around the weir. This was a very shallow gravelly area and under most flow conditions it did not appear to be a viable path for adult salmon passage. However, a block net was set up from the last panel to the river-right shore to limit escapement via this route. The river left wing had variable picket spacing to accommodate non-Chinook fish passage through the pickets. The primary objective of the wider picket spacing was to allow Sockeye (*O. nerka*) to pass through the weir and reduce the number of Sockeye that would enter the trap. River left was selected for this spacing to better accommodate observation/data collection regarding successful passage of smaller fish through the panels.

In 2014, CCT conducted an acoustic evaluation of sockeye passage at the lower Okanogan weir. The study took a closer look at behavior and travel time in proximity to the Okanogan weir. Results from the study were provided to the Chief Joseph Monitoring and Evaluation Program to supplement ongoing evaluations of the weir. Methods used for the study can be found in Appendix C.

Figure 6. Lower Okanogan adult fish pilot weir, 2014.

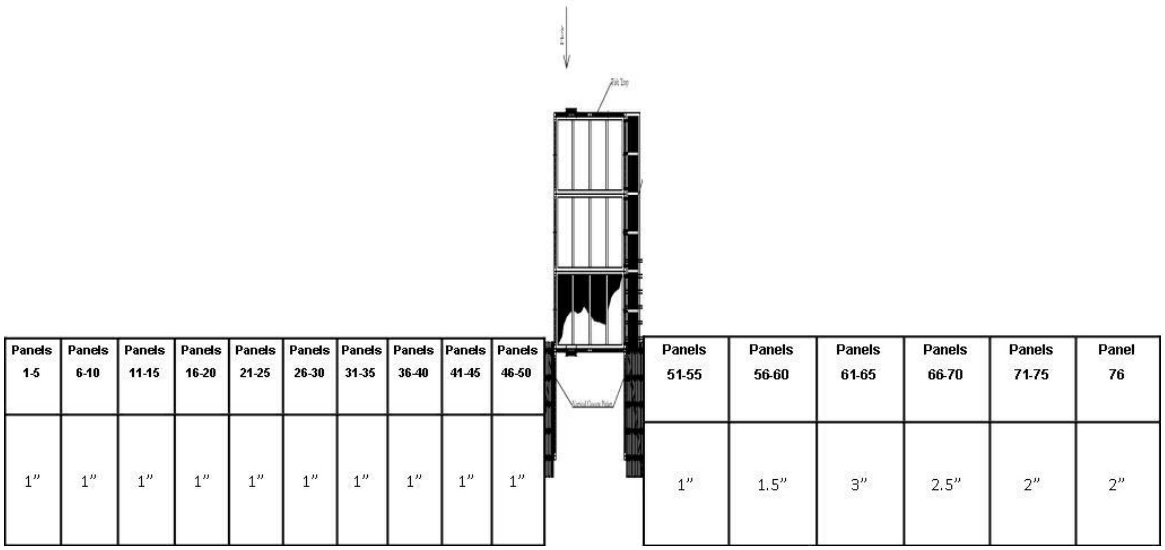


Figure 7. Picket (ABS pipe) spacing within each panel (or set of five panels) at the Lower Okanogan adult fish pilot weir in 2014.

Physical and chemical data were collected in the vicinity of the weir including the water depth (ft.) inside the trap, water velocity (ft./sec) above and below the weir, dissolved Oxygen (mg/L), total dissolved solids (TDS)(ppm), turbidity (NTU), temperature (°C), discharge (cfs) and head differential (cm). Temperature and discharge were taken from the online data for the USGS gage at Malott (http://waterdata.usgs.gov/wa/nwis/uv?site_no=12447200). When river temperature exceeded 22.5° C, trapping operations ceased and weir pickets on panels adjacent to the trap on both sides were raised to allow for unrestricted passage by Chinook.

Algae and debris were cleared off of the weir at least once per day, generally in the morning. Dead fish on the upstream side of the weir were enumerated, identified to species and the presence and extent of injuries were noted. The tail was cut off of each mortality before they were tossed downstream of the weir so that they would not be double counted during snorkel surveys.

A 4.6 m high observation tower was placed on the upstream side of the weir on the left bank to better accommodate visual observations of fish behavior. Observations were made for 30 minute intervals one or more times per day. Observers visually estimated the center, left and right thirds of the channel then captured fish observations within those spatial units. Types of behaviors that were documented include searching (spent the majority of time erratically moving up, down, and/or side-to-side in an apparent attempt to pass the weir), stationary (spent the majority of time relatively stationary), contacting (times spent contacting or jumping at the weir panels), guided to the trap entrance, swam upstream and swam upstream.

Snorkel surveys downstream of the weir occurred daily between August 11 and September 5. Three to four snorkelers surveyed from the weir downstream to Chiliwist Creek (1.5 river km). Observations of live and dead fish were enumerated for each species. To supplement our observations below the weir, we also conducted two, ten-minute bank observations approximately 0.8 rkm downstream of the weir from September 8 to 25.

Weir efficiency, a measure of the proportion of total spawning escapement encountered by the weir, was calculated by the general equation;

$$X = \frac{W_T}{T}$$

where X was weir efficiency, W_T was the number of summer/fall Chinook encountered in the weir trap, and T was the total summer/fall Chinook spawning escapement for the Okanogan River Basin. This was further adjusted by prespawn mortality (10%) with the following equation;

$$X_{adj} = \frac{(1 - PS_{mort})W_T}{(HOS + NOS) + (1 - PS_{mort})W_T}$$

where X_{adj} was the adjusted weir efficiency, PS_{mort} was the proportion of prespawn mortality, HOS was the total hatchery origin spawners, NOS was the total natural origin spawners, HOR_{WR} was the number of hatchery origin fish removed from the weir trap, and NOR_{WR} was the number of natural origin fish removed from the trap.

Weir effectiveness was a measure of the proportion of the hatchery Okanogan summer/fall Chinook run encountered in the weir trap removed from the population as a form of adult fish management. It was calculated by the general equation;

$$Y = \frac{W_H}{W_H + HOS}$$

where Y was weir effectiveness, W_H was the number of hatchery-origin fish removed at the weir trap, and HOS was the total number of hatchery-origin spawners. This was also further adjusted by prespawn mortality (10%) with the following equation;

$$Y_{adj} = \frac{(1 - PS_{mort})W_H}{HOS + (1 - PS_{mort})W_H}$$

where Y_{adj} was the adjusted weir effectiveness, W_H was the number of hatchery-origin fish removed at the weir trap, and HOS was the total number of hatchery-origin spawners.

Trapping operations were conducted 24 hours under allowable temperature conditions (≤22.5° C). From August 15 to September 25 when fish entered the trap during an active trapping session, the downstream gate was closed and fish were identified and either released, surplussed or collected for brood. Seventy-six natural origin Chinook were collected from the weir trap from September 2 to September 25, transported to shore via a fish boot (rubber tire inner tube) and immediately taken to a 2500-gallon hatchery truck. The fish were then transported approximately 32 km to Chief Joseph Hatchery where they were held in the broodstock raceways until the first week of spawning in the first week of October.

Underwater video cameras were operated outside the trap entrance to determine the number, time of day, and species that passed through the trap during trapping and non-trapping hours. Two Seemate™ Pro underwater video cameras from IAS Products were placed outside the trap, on the downstream trap wings from August 7 to September 25. Underwater lights (17 in SeeBrite™ LED; 325-500 milliamps) were used near each camera to facilitate night time data collection. Video imagery was collected by a DV-IP server, SD Advanced (Dedicated Micros) and reviewed daily on a PC or laptop computer through a wireless network connection and the NetVu Observer software. While reviewing video imagery on shore, hourly species and counts were logged for each day.

Spawning Ground Surveys

The objectives for spawning surveys were to:

1. Estimate total spawning escapement based on the number of Chinook redds per reach
2. Estimate the proportion of natural spawners composed of hatchery-origin recruits (pHOS)
3. Estimate pre-spawn mortality and mean egg retention for wild- and hatchery-origin spawners
4. Determine the origin (rearing/release facility) of hatchery-origin spawners (HOS) in the Okanogan and estimate the spawner composition of out of population and out of ESU strays (immigration)
5. Estimate out-of-population stray rate for Okanogan hatchery Chinook and estimate genetic contribution to out-of-basin populations (emigration)
6. Determine age composition of returning adults through scale analysis
7. Monitor status and trends of demographic and phenotypic traits of wild- and hatchery-origin spawners (age-at-maturity, length-at-age, run timing, SAR)

Redd Surveys

A primary metric used to monitor the status and trends of salmonid populations is spawning escapement. Estimates of spawning escapement can be calculated based on redd counts and expanded by sex-ratios (Matthews and Waples 1991, Gallagher et al. 2007).

This requires intensive visual survey efforts conducted throughout the spawning area and over the course of the entire spawning period. Visual redd surveys were conducted to estimate the number of redds per survey reach from the mouth of the Okanogan River to Zosel Dam (river km 124); the Similkameen River from its confluence with the Okanogan River upstream to Enloe Dam (river km 14); and in the mainstem Columbia River from the mouth of the Okanogan River upstream to Chief Joseph Dam (Table 3). Weekly surveys were timed to coincide with spawning in the basin, generally beginning the last week of September or the first week of October and ending approximately the second week of November. Redds were counted using a combination of fixed-wing aerial flight surveys and inflatable raft float surveys.

Aerial surveys occurred once weekly throughout the spawning season, each covering the entire survey area. Aerial surveys were flown at low elevation and at moderate speeds to accommodate visual identification of redds. From the aircraft, a trained observer recorded the number and GPS coordinates of all new redds as the plane passed overhead. All data were recorded directly into a YUMA rugged computer tablet (Trimble Navigation, Ltd.). Aerial surveys were primarily used to document redds in areas inaccessible to rafts, or in areas of low redd densities, such that they did not warrant weekly float surveys. All data points were visualized in ArcGIS (ESRI, Inc.), and quality controlled to ensure that redd counts were not duplicated during float surveys. Aerial surveys also served a secondary function of informing research crews where to focus weekly carcass recovery efforts (see below section on Carcass Surveys).

Float surveys occurred once daily, 5 days per week throughout the spawning season. Float surveys consisted of three 2-person teams using inflatable rafts to count redds while floating downstream. Each team was responsible for covering one-third of the river width, (1) left bank, (2) center, and (3) right bank. Each individual redd was counted and its position recorded directly into a YUMA rugged computer tablet (Trimble Navigation, Ltd.).

Table 3. Reach names and locations for the Okanogan and Similkameen for summer/fall Chinook Salmon spawning and carcass surveys.

Stream	Code	Reach Description	River km
Okanogan	O1	Mouth to Malott Bridge	0.0-27.0
	O2	Malott Bridge to Okanogan Bridge	27.0-41.8
	O3	Okanogan Bridge to Omak Bridge	41.8-49.1
	O4	Omak Bridge to Riverside Bridge	49.1-65.1
	O5	Riverside Bridge to Tonasket Bridge	65.1-90.9
	O6	Tonasket Bridge to Zosel Dam	90.9-124.0
Similkameen	S1	Mouth to Oroville Bridge	0.0-8.0
	S2	Oroville Bridge to Enloe Dam	8.0-14.0
Canada	C*x*	TBD	TBD

All redds were classified as either a:

1. *Test-redd* (disturbed gravel, indicative of digging by Chinook, but abandoned or without presence of Chinook; generally, this classification is reserved for early season redd counts, before substantial post-spawn mortalities have occurred as indicated by egg-voidance analysis of recovered carcasses). Test-redds do not contribute to annual redd counts.
2. *Redd* (disturbed gravel, characteristic of successful Chinook redd construction and/or with presence of Chinook).

Redds per reach were calculated for each week as the combined number of new redds counted during aerial- and float-surveys for a given week. Post-season analysis consisted of summing the combined aerial- and float-survey weekly redd totals to calculate annual redd totals per reach, and per total survey area. Estimated total spawning escapement was then calculated by multiplying the total redd count by the expansion factor for the current year (2.86 for 2014). The expansion factor = 1 + the number of males per female as randomly collected for broodstock at Wells Dam (1.86:1.00 in 2014). Assumptions include:

Assumption I – Each redd was constructed by a single female Chinook, and each female Chinook constructed only one redd

Assumption II – The male: female ratio on the spawning grounds was the same for wild- and hatchery-origin Chinook, and is equal to the male:

female ratio as randomly collected for broodstock at Wells Dam

Assumption III - Every redd was observable and correctly enumerated

Escapement into Canada

Video systems operated by OBMEP and located in the fishways of Zosel Dam allow observation of salmonids passing over Zosel Dam and potentially into the British Columbia portion of the Okanagan River Basin. For detailed methods within a particular year please see the Okanogan Basin Monitoring and Evaluation Program (OBMEP) annual reports posted at (http://www.colvilletribes.com/obmep_publications.php).

Passage over Zosel Dam can occur via the fishways or through the open dam gates. OBMEP assumes that any gate level > 1 foot is high enough for fish to pass upstream through the open gate rather than through the fish ladders and video arrays. In high water years, Chinook have the opportunity to pass through the gates rather than through the fishways. The estimates of Chinook escapement past Zosel Dam do not account for fish moving through the gates rather than the fishways. In 2014 pit detections of Chinook in the fishways indicated that smaller fish were able to fall back through the small openings in the Zosel Dam gates and then reascend through the fishways. A fallback/reascension rate was applied to the total Zosel estimate for the season. A fallback adjustment (AFA) was calculated as the ratio of the number of unique PIT tagged fish (N_{PIT}) ascending the fishways, divided by the total number of their ascents:

$$AFA = \frac{N_{PIT}}{\sum_{i-1}^{N_{PIT}} a_i}$$

where,

N_{PIT} = number of unique PIT-tagged fish ascending the ladder(s),

a_i = number of ascents made by the ith PIT-tagged fish (i= 1, …, = 1, …, N_{PIT}).

The video count (C) multiplied by the AFA provided an estimate of the total passage abundance (N):

$$N = C \cdot AFA$$

Fallback/reascension is likely an underestimate of actual fallback since not all fallback re-ascend. Actual fallback is unknown.

There were times when the video system was inactive for routine maintenance and cleaning. To estimate missed fish observations during this period, an average was taken of passage events during the hour before and after the inactive period. Spring Chinook were also removed from the total estimate based on run timing at Zosel.

Escapement into Canada was reported as part of the Similkameen Pond Hatchery monitoring program. Data and discussion presented herein are intended to begin the process of understanding what is known, what is not known, and what the possibilities are for obtaining a reliable estimate of summer/fall Chinook spawners in the Canadian portion of the Okanogan River.

CARCASS SURVEYS

Carcass surveys provide important biological samples for evaluation of hatchery- and natural-origin fish on the spawning grounds, including:

1) Spawner composition
    a. pHOS
    b. out of population hatchery strays (immigration)
    c. distribution of CJ hatchery fish among spawning reaches
2) Length
3) Sex
4) Age
5) Egg retention

The target annual carcass recovery sample size was 20% of the spawning population within each reach (Hillman et al. 2014). Carcass recovery efforts occurred simultaneously with redd float surveys. Recovered carcasses were transported within inflatable rafts downstream until a suitable beach site was reached for processing. If a carcass was too degraded to sample for biological data, it was returned to the river, unsampled. All adipose absent carcasses were assumed to be of hatchery-origin, and all carcasses displaying an intact adipose fin were assumed to be of natural-origin[3]. Biological data collected from carcasses included sex, fork length (FL) and post-orbital hypural length (POH) to the nearest cm, and estimated egg retention for all females (0 to 5,000 max; visually estimated). All eggs that were not detected within a carcass were assumed to have been successfully deposited. Any female carcass containing an estimated 5,000 eggs were considered a pre-spawn mortality. Forceps were used to remove five scale samples from all natural-origin Chinook. Scales were adhered to desiccant scale cards for preservation and identified by sample number and sample date. At the conclusion of spawning season, scales were sent to WDFW for post-hoc age analysis. Age analysis data were used to assess age-at-return (run-reconstruction), and combined with biological data to assess length-at-age. All Chinook were scanned for passive integrated transponder (PIT) tags and all PIT detections

[3]There could have been some hatchery-origin fish with an intact adipose fin. Although all summer/fall Chinook hatchery programs in the Upper Columbia strive for a 100% adipose fin clip rate, a small percentage (~1%) may not receive the fin clip due to mechanical failure in the marking trailer. Additionally, not all fall Chinook programs, such as Priest Rapids Hatchery, clip the adipose fin of their releases.

were recorded and later uploaded to PTAGIS. Carcasses were scanned with a T-wand (Northwest Marine Technology, Inc., Shaw Island, WA USA) for coded wire tags (CWT). If present, the snout portion was removed and individually bagged and labeled with species, origin, FL, river of recovery and date. After sampling each carcass, the caudal fin was removed before the carcass was returned to the river to avoid resampling on subsequent surveys. All data collected in the field were input directly into a YUMA rugged computer tablet (Trimble Navigation, Ltd.). Weekly carcass recovery totals were summed post-season to calculate annual carcass recovery totals per reach and per survey area.

Some key assumptions for carcass surveys included:

Assumption I –	All carcasses had the same probability of being recovered on the spawning grounds (despite differences in sex, origin, size or spawning location)
Assumption II –	The diagnostic unit in which a carcass is recovered is the same as the reach in which the fish spawned
Assumption III –	Sampled carcasses are representative of the overall spawning composition within each reach

pHOS and PNI

pHOS was first calculated using the straightforward method of calculation for the population-level pHOS by simply dividing the number of hatchery-origin spawners by the total spawners, such that:

$$pHOS = \frac{HOS_O}{HOS_O + NOS_O}$$

where HOS_O is the total recovered hatchery-origin carcasses and NOS_O is the total recovered natural-origin carcasses. This simple algorithm does not account for hatchery fish effectiveness (i.e., relative reproductive success) nor does it account for spatial variation in pHOS and unequal sampling effort across reaches. For example, reach S1 tends to have a higher pHOS than other reaches because the Similkameen acclimation site is located in the reach. Likewise, the probability of recovering carcasses in low density spawning reaches is lower than in reaches with high density spawning. We have attempted to account for each of these factors.

Relative reproductive success has not been estimated for summer/fall Chinook in the Okanogan. One of the key assumptions in the In-Season Implementation Tool was that first-generation hatchery fish are less effective natural spawners than natural-origin fish. Currently, the hatchery fish effectiveness assumption for the Okanogan population is that first generation hatchery-origin spawners are 80% as effective as natural-origin fish as contributing genes to the next generation[4]4 This assumption is based on research conducted by Reisenbichler and McIntyre (1977) and Williamson et al. (2010). Therefore, the pHOS calculation was amended in 2013 to account for the reduction in hatchery spawner effectiveness, such that:

$$Effective\ pHOS = \frac{0.8\ HOS_O}{0.8\ HOS_O + NOS_O}$$

Further refinement of the pHOS calculation was needed to account for non-random sampling of carcasses and variable pHOS across reaches. This was done by weighting each reach's overall contribution to system-wide pHOS according to the overall proportion of summer/fall Chinook redds that occurred within that reach.

First, the proportion of redds that corresponded to each reach was calculated by the equation:

$$redd_{p,r} = \frac{redd_r}{redd_O}$$

where, $redd_r$ is the number of documented redds that occur within reach *r*, $redd_O$ is the total number of redds documented in the U.S. portion in the Okanogan River Basin, and $redd_{p,r}$ is the proportion of total redds that were documented in reach *r*.

Next, Effective pHOS was calculated separately for each sampled reach, *r*, so that:

$$pHOS_r = \frac{0.8HOS_r}{0.8\ HOS_r + NOS_r}$$

where $pHOS_r$ is the Effective pHOS calculation for reach *r*, and HOS_r *and* NOS_r are the total recovered carcasses of hatchery- and natural-origin within that reach. Finally, Effective pHOS was corrected for the proportion of redds in each reach to determine an adjusted Effective pHOS, such that:

$$Effective\ pHOS = \sum_{i=1}^{n} pHOS_r(redd_{p,r})$$

where *n* is the total number of sampled reaches that compose the Okanogan River Basin. These calculations assumed that sampled carcasses were representative of the overall spawning composition within each reach; that no carcasses were washed downstream into another reach; that all carcasses had an equal probability of recovery; and that all fish within origin types had equal fecundity. While it is unlikely that all of these assumptions

[4] This 80% correction factor has also been suggested by the HSRG as a default value when no direct estimates are available (HSRG 2009). Also see HSRG 2014 for a discussion about the definition and calculation effective pHOS.

were correct, the modified calculation results in a better representation of the actual census pHOS.

PNI was calculated as:

$$PNI = \frac{pNOB}{Effective\ pHOS + pNOB}$$

where *pNOB* was the proportion of broodstock that were natural-origin Okanogan returns, and *Effective pHOS* was the reach weighted effective pHOS defined previously. To determine an Okanogan specific pNOB, we applied the results of a radio tracking study, which estimated that 90% of the natural-origin fish detected near the mouth of the Okanogan River in 2011 and 2012 ended up spawning in the Okanogan Basin (Mann and Snow 2013). Therefore, we assumed that 90% of the NOB collected in the purse seine (2010-2013) were of Okanogan origin.

In years prior to 2010 all of the broodstock for the Similkameen program were collected at Wells Dam. That program strived for 100% pNOB and did achieve >95% pNOB in 7 of the last 8 years (Hillman et al. 2014). However, the Wells Dam broodstock collection efforts composited natural-origin fish from the Okanogan and Methow populations as well as fish originating from downstream populations[5]. We made a correction for non-Okanogan NOB for all years when Wells Dam was used for brood collection using the formula:

$$Adjusted\ Wells\ Dam\ pNOB = Wells\ Dam\ pNOB\ * (\frac{Okanogan\ NOS}{Okanogan\ NOS + Methow\ NOS})$$

where the *Adjusted Wells Dam pNOB* was estimated based on the proportion of natural-origin spawners (NOS) that were in the Okanogan compared to the Methow for that particular year. This correction was made for a portion of the broodstock in 2010 and 2011 and all of the broodstock previous to 2010. This correction did not account for stray NORs from downstream populations or NORs that would have remained in the Columbia River above Wells Dam. Although the radio tracking study provides an estimate of this for 2011 and 2012, there was uncertainty regarding the applicability of the radio tracking data for years prior.

Origin of Hatchery Spawners

Snouts from adipose fin clipped fish were removed, individually labeled, frozen, and delivered to the WDFW for CWT extraction and reading. The Regional Mark Information System (RMIS; http://www.rmis.org/rmis) was queried in January 2015 to assess the

[5] A radio tracking study showed that fewer than 50% of the natural-origin fish tagged at Wells Dam ended up in the Okanogan in 2011 and 2012 (Mann and Snow 2013).

rearing facility of hatchery-origin Chinook recovered on the Okanogan spawning grounds, the in-to-basin stray rate, and the out-of-basin stray rates. RMIS data queries are described in detail in the 2013 CJHP Annual Report (Baldwin *et al.* 2016)

Smolt-to-adult Return

The smolt to adult return rate (SAR) was estimated as:

$$SAR = \frac{expanded\ CWT\ recoveries}{CWT\ released}$$

where expanded CWT recoveries included estimated expanded recoveries on the spawning grounds, at hatcheries and in fisheries. Two expansions were applied. First the number of recoveries was expanded to account for the proportion of the release group that wasn't tagged. For example, with a 99% CWT mark rate the recoveries would be increased by 1%. Second, the recoveries were expanded based on the proportion of the population that was sampled. For example, if carcass surveys recovered 20% of the estimated spawners then the number of CWT recoveries was expanded by 80%. The number of CWT fish released were simply the hatchery release data including all tag codes for CWT released fish (CWT + Ad Clip fish and CWT-only fish).

Spring Chinook Presence and Distribution

Smolt releases of CJH Spring Chinook will not occur in the Okanogan until April, 2015. Therefore, pre-reintroduction monitoring for spring Chinook currently consists only of environmental DNA (eDNA) sampling and analysis at tributary and mainstem Okanogan sites to determine the baseline distribution, prior to the reintroduction. Additionally, monitoring programs throughout the Columbia Basin are implanting PIT tags into both hatchery- and natural-origin spring Chinook as juveniles that might stray to the Okanogan as returning adults. The WDFW monitoring program at Wells Dam tags returning adult Spring Chinook, which greatly increases the probability of encountering a spring Chinook with a PIT tag in the Okanogan. For 2014, the presence and distribution of spring Chinook were evaluated by querying the PTAGIS database using an interrogation summary for all PIT detection sites in the Okanogan and Similkameen Rivers, including Canada. Once a list of tag codes was obtained, a second query was run to determine if any of the fish had a final detection outside the Okanogan. The Lower Okanogan River array (OKL) was installed in the fall of 2013, therefore 2014 was the first year when this site was available throughout the calendar year.

RESULTS

Rotary Screw Traps

The rotary screw traps captured 28,838 Chinook subyearlings, including 6,765 hatchery- and 22,073 natural-origin. Pulses of high catch rates coincided with periods of increased streamflow in mid-May and June (Figure 8). The mean length of Chinook increased throughout the trapping season, but the number of natural-origin smolts that were large enough (>65 mm) to PIT tag was small (n=382) (Figure 10). One of these measured 141 mm and was likely a yearling Chinook. Dorsal fin clips were removed and archived on all tagged fish for genetic identification to determine if they were spring or summer/fall Chinook at a future date.

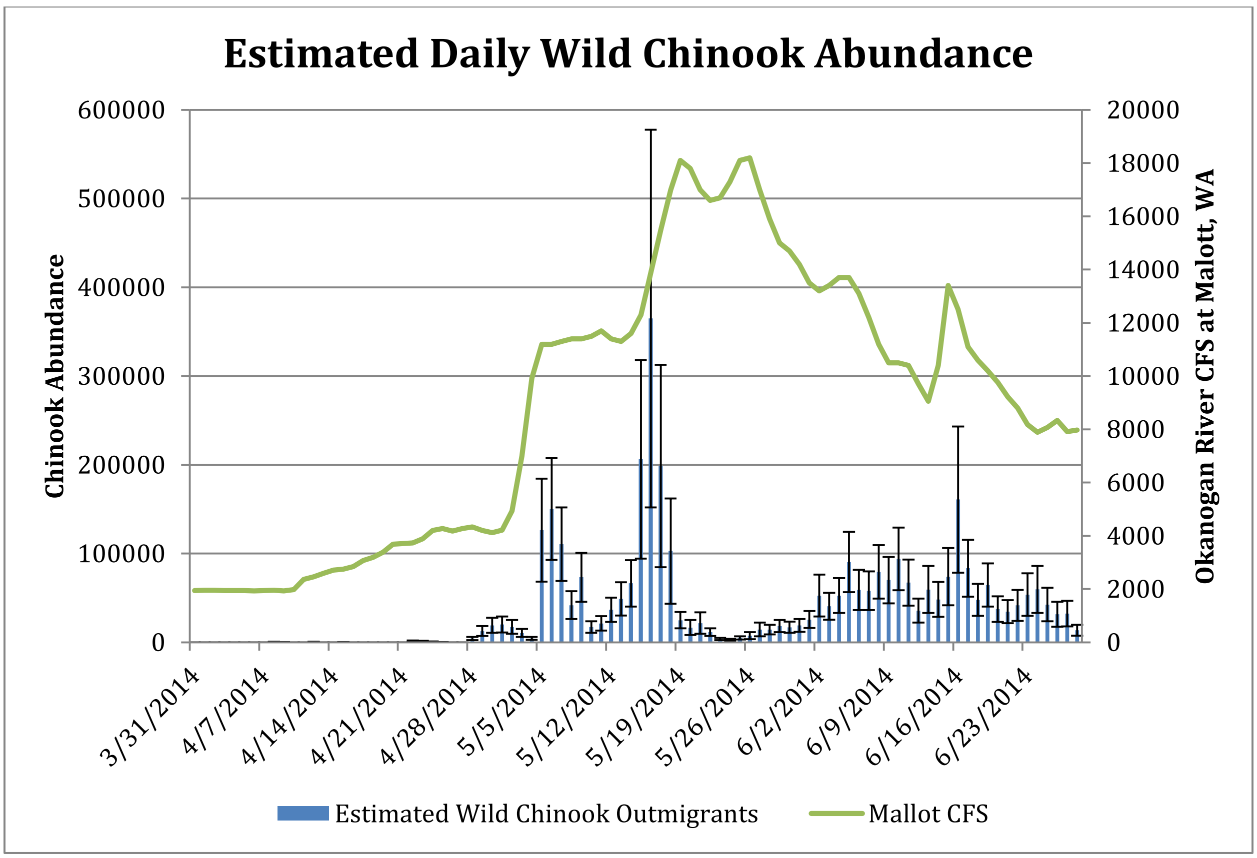


Figure 8. Daily natural-origin subyearling juvenile outmigration estimates with 95% confidence intervals on the Okanogan River in 2014.

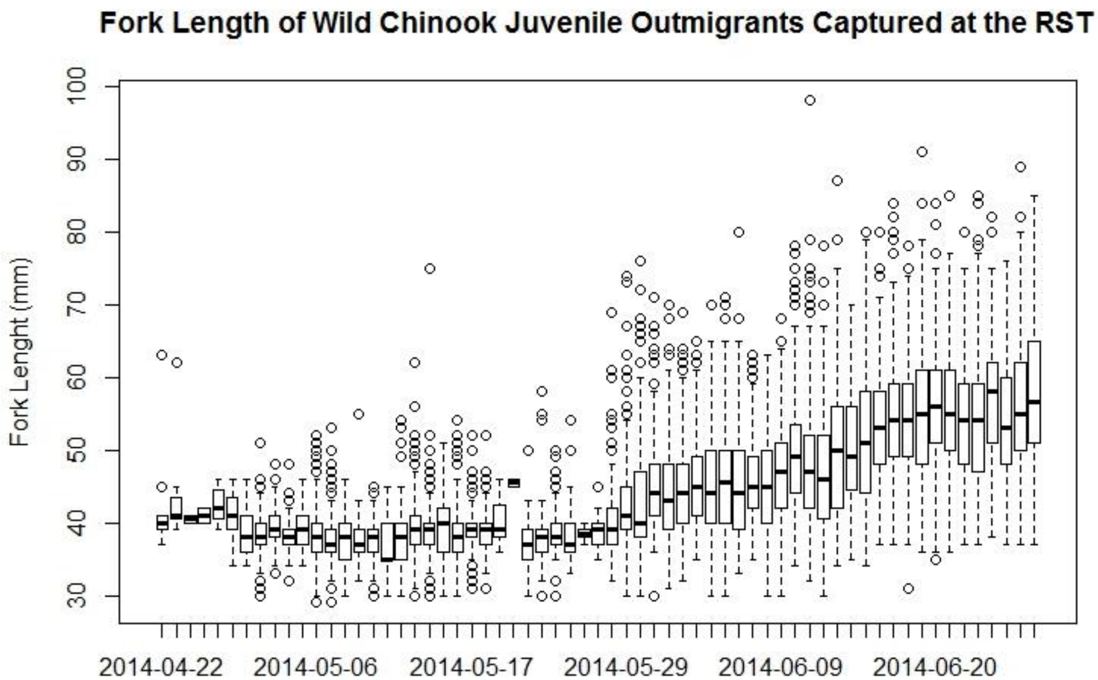


Figure 9. Natural-origin subyearling Chinook size distribution (n= 12,535) from the rotary screw traps on the Okanogan River in 2014.

Following Chinook, the next most abundant species captured in the RST were Sockeye, mountain whitefish (*Prosopium williamsoni*) and carp (*Cyprinus carpio*) (Table 4). 396 adipose fin present steelhead and 591 adipose clipped steelhead were removed from the trap and released immediately into the river. There were three juvenile steelhead mortalities (1 adipose fin present and 2 adipose clipped) at the trap resulting in a 0.3% handling mortality rate. The encounter of 591 adipose clipped and 396 adipose present (assumed natural-origin) and mortality of three (3) assumed natural-origin steelhead are within the take limits identified in the authorizing ESA Section 10(a)(1)(A) Permit for the rotary screw trap operation (Permit 16122).

Table 4. Number of juvenile fish trapped at the Okanogan River rotary screw traps in 2014.

Species	Total Trapped
Black Bullhead	1
Black Crappie	4
Bluegill	62
BridgeLip Sucker	36
Brook Trout	5
Brown Bullhead	23
Burbot	1
Common Carp	788
Longnose Dace	24
Mountain Whitefish	2,709
Northern Pikeminnow	418
Peamouth	3
Pumpkinseed	12
Sculpin	9
Smallmouth Bass	7
Three Spine Stickleback	3
Unknown Crappie	5
Unknown Sucker	4
White Crappie	1
Yellow Bullhead	16
Yellow Perch	379
Non-salmonid	4,510
Adipose Clipped Steelhead	591
Adipose Present Steelhead	396
Hatchery Chinook Subs	3,776
Hatchery Chinook Yearling	3,001
Sockeye	3,578
Wild Chinook Subs	22,073
Wild Chinook Yearling	1
Salmonid	33,416

Twenty four efficiency trials were conducted with natural origin subyearling Chinook between 4,120-14,900 cfs (Table 5). Because streamflow was not a significant variable in explaining variation of efficiency between trials (Figure 10), the WDFW smolt abundance calculator was not used.

Table 5. Efficiency trials conducted on natural-origin Chinook subyearlings at the Okanogan rotary screw traps in May and June 2014.

Trap Date	River Flow @ USGS Malott	Total Chinook Marked	Total Chinook Released	Total Chinook Recaptured	Trap Efficiency
5/1	4,120	7	7	0	0.00
5/7	11,200	17	17	0	0.00
5/8	11,300	5	5	0	0.00
5/14	11,400	1	1	0	0.00
5/17	14,900	55	55	0	0.00
5/31	14,400	98	98	0	0.00
6/1	13,800	36	36	0	0.00
6/2	13,200	233	233	1	0.00
6/3	13,200	183	183	3	0.02
6/4	13,600	75	75	0	0.00
6/5	13,800	39	39	0	0.00
6/6	13,300	120	120	0	0.00
6/7	12,400	154	154	2	0.01
6/8	11,700	160	160	0	0.00
6/9	10,600	178	178	0	0.00
6/10	10,400	200	200	6	0.03
6/11	10,500	200	200	2	0.01
6/16	13,200	180	180	2	0.01
6/18	10,700	190	190	4	0.02
6/19	10,400	140	140	2	0.01
6/20	9,900	100	100	0	0.00
6/21	9,500	108	108	1	0.01
6/22	9,040	120	120	2	0.02
6/23	8,460	150	150	1	0.01
Total		**2,749**	**2,749**	**26**	**0.01**

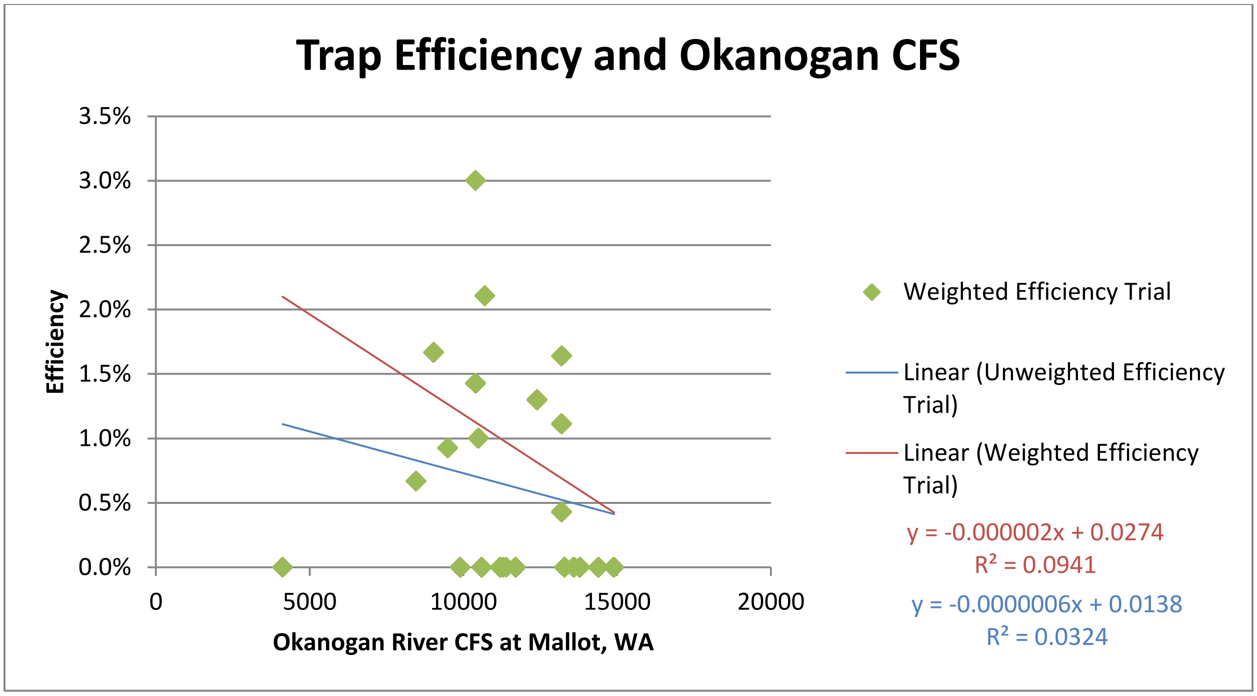


Figure 10. Okanogan River CFS was not predictive of RST efficiency, and so was excluded as a variable from juvenile production estimates.

To explore the possibility of using hatchery-released fish as a surrogate for wild fish, efficiency trials were conducted on April 15-May 14 using hatchery yearlings and on May 28- June 8 using hatchery subyearlings from the Omak Pond (Table 6). Only 4 hatchery yearlings and 12 hatchery subyearlings were recaptured.

Since streamflow did not affect trapping efficiency, efficiency trials were pooled to calculate overall trap efficiency for both natural- and hatchery-origin fish (Table 7). Hatchery-origin Chinook were more likely to be recaptured, especially in the 2.4m trap. Overall efficiency estimates for natural- and hatchery-origin fish were low, leading to a relatively imprecise estimate of total emigration (Table 8).

Table 6. Efficiency trials conducted on hatchery-origin Chinook smolts at the Okanogan rotary screw traps in May and June 2014

Trap Date	River Flow @ USGS Malott	Total Chinook Marked	Total Chinook Released	Total Chinook Recaptured	Trap Efficiency
4/15	2,750	36	36	0	0.00
4/16	2,850	30	30	0	0.00
4/17	3,070	44	44	1	0.02
4/20	3,690	34	34	2	0.06
5/1	4,210	57	57	1	0.02
5/7	11,300	47	47	0	0.00
5/8	11,400	40	40	0	0.00
5/14	11,600	31	31	0	0.00
5/28	15,900	216	216	6	0.03
5/29	15,000	236	236	2	0.01
5/30	14,700	100	100	0	0.00
5/30	14,700	50	50	3	0.06
5/31	14,200	70	70	0	0.00
6/1	13,500	40	40	0	0.00
6/2	13,200	46	46	0	0.00
6/3	13,400	46	46	0	0.00
6/4	13,700	25	25	0	0.00
6/5	13,700	9	9	0	0.00
6/6	13,100	5	5	0	0.00
6/7	12,200	5	5	0	0.00
6/8	11,200	3	3	0	0.00
Total		**1,170**	**1,170**	**15**	**0.01**

Table 7. Pooled efficiency trail results for all trap configurations.

		Mark-Released	Recaptured	Efficiency
2.4 m Trap	Hatchery Chinook	1170	14	1.20%
	Wild Chinook	2694	17	0.63%
1.5 m Trap	Hatchery Chinook	969	2	0.21%
	Wild Chinook	2592	9	0.35%
Combined Traps	Hatchery Chinook	969	12	1.24%
	Wild Chinook	2537	26	1.02%

Table 8. Population estimates for hatchery- and natural-origin juvenile Chinook salmon in the Okanogan River Basin.

Species	Population Estimate	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Hatchery-origin Chinook*	494,088	261,100	727,076
Natural-origin Chinook	3,265,309	1,809,367	4,721,251

* A total of 356,403 hatchery-origin Chinook were released into the Okanogan River system upriver from the screw trap site in 2014. 44,267 were released from the Omak acclimation pond from April 4-18, 114,000 were released from the Similkameen hatchery from April 15 – May 5, and 198,136 were released from the Omak acclimation pond on May 28.

Juvenile Beach Seine and Pit Tagging

In 2014, 9,133 juvenile salmonids were collected in 207 sets for a total catch per unit effort of 44 salmonids per seine haul (Table 9). Thousands of three-spined stickleback (*Gasterosteus aculeatus*) were also collected but not enumerated. Out of the 9,133 collected, 8,226 (90%) were subyearling Chinook that were PIT tagged and released (Figure 11). Pre- and post-tag mortality was 4.9% and 5.3% respectively. Thirteen shed tags were recovered from the net pens prior to release. Nine of the sheds were from post-tag mortalities and 4 of them were from live released fish. In addition to stickleback, bycatch consisted of 75 adult Sockeye and one ad-present adult steelhead. Fish size increased through the second and fourth week of tagging but the number of available fish to tag decreased (Figure 12). At that time temperatures in the Columbia River at Gebber's Landing were > 18°C. We suspect that subyearling Chinook may have migrated to deeper, cooler water making it difficult to collect them via beach seine. Overall size distribution for tagged fish was skewed towards smaller size ranging from 65-80 mm in length (Figure 13).

Table 9. Summary of juvenile Chinook beach seining effort at Gebber's Landing in 2014. CPUE represents (target species and bycatch) per set.

Week start	No. sets	No. collected	CPUE (total/set)
6/30/2014	17	2,026	119
7/7/2014	65	2,375	37
7/14/2014	63	3,261	52
7/21/2014	62	1,471	24
Total	**207**	**9,133**	**44**
Mean	**52**	**2,283**	**58**

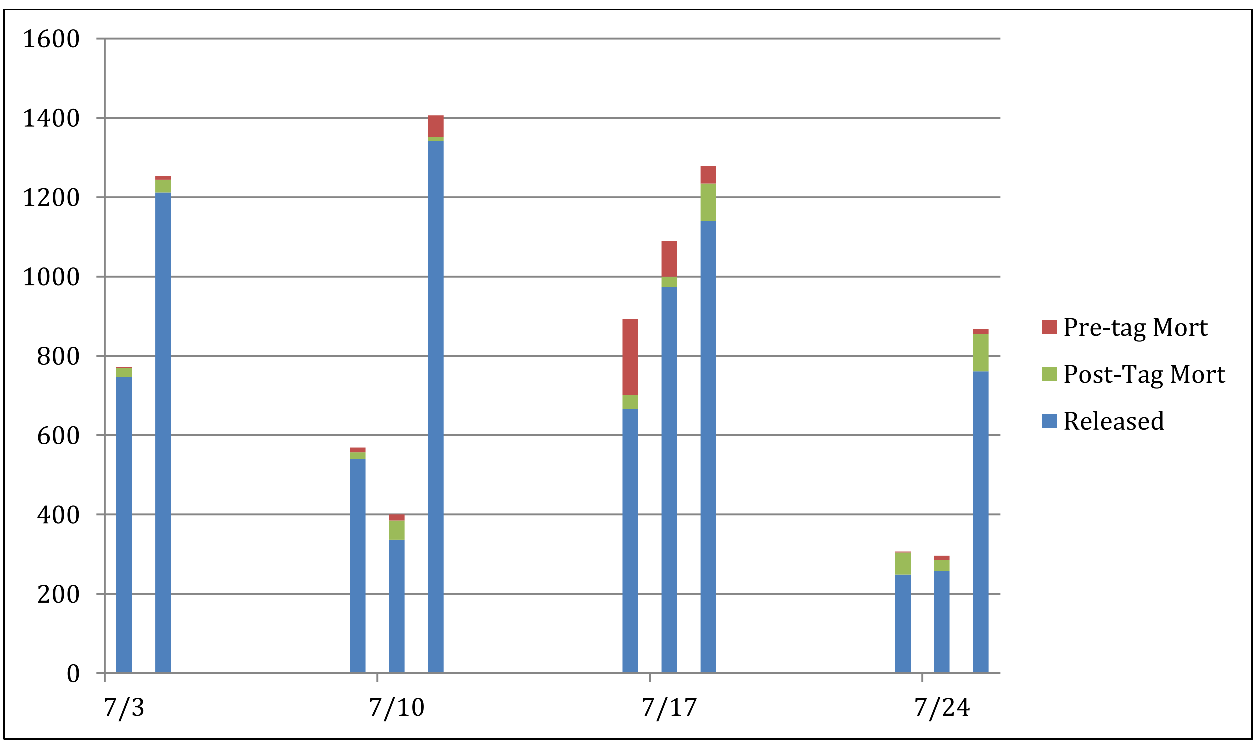


Figure 11. Total mortality and number of released natural-origin subyearling Chinook in July 2014.

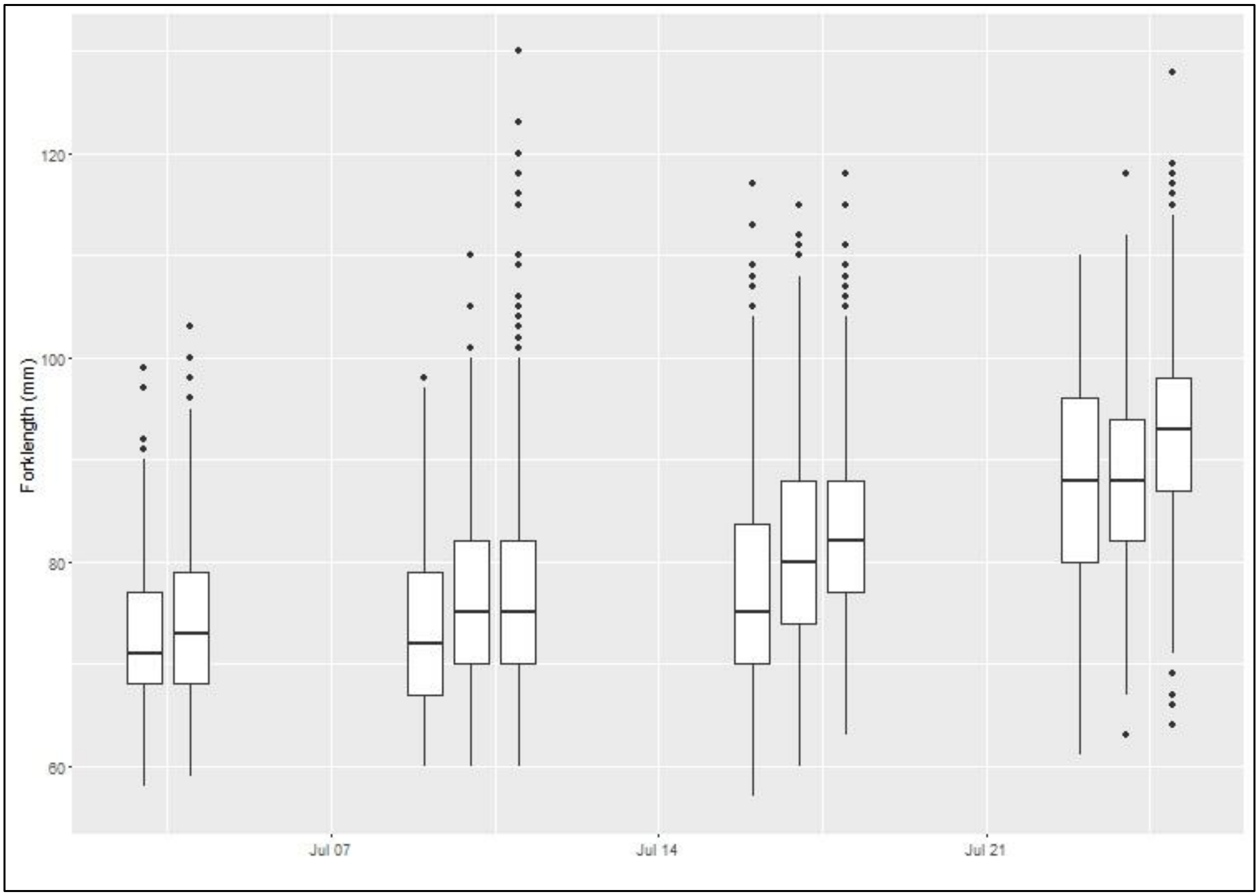


Figure 12. Size distribution of PIT tagged juvenile Chinook by release date from the beach seine effort in 2014.

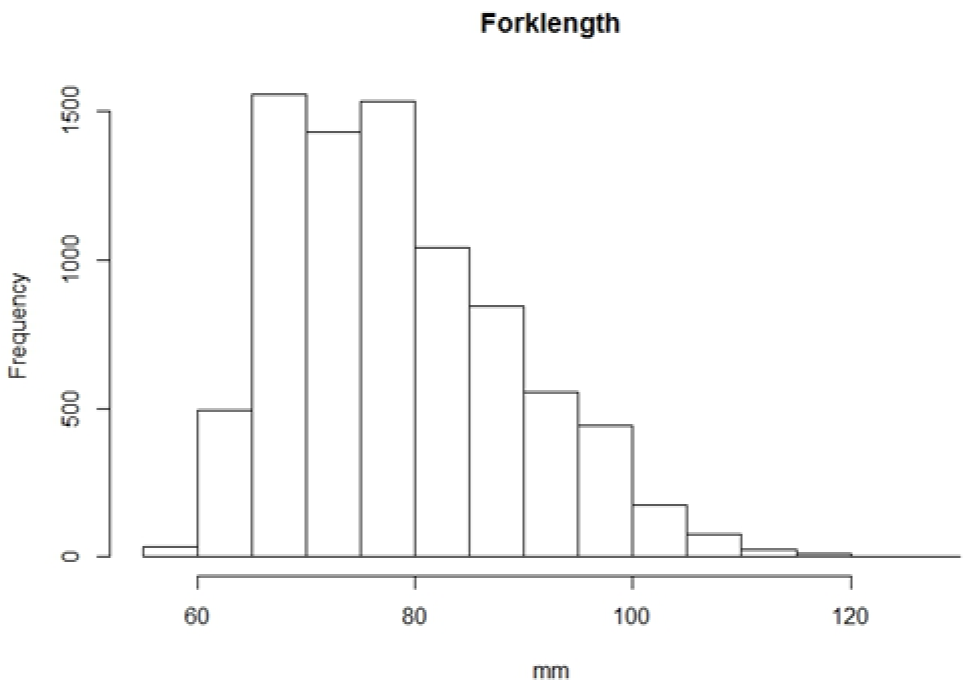
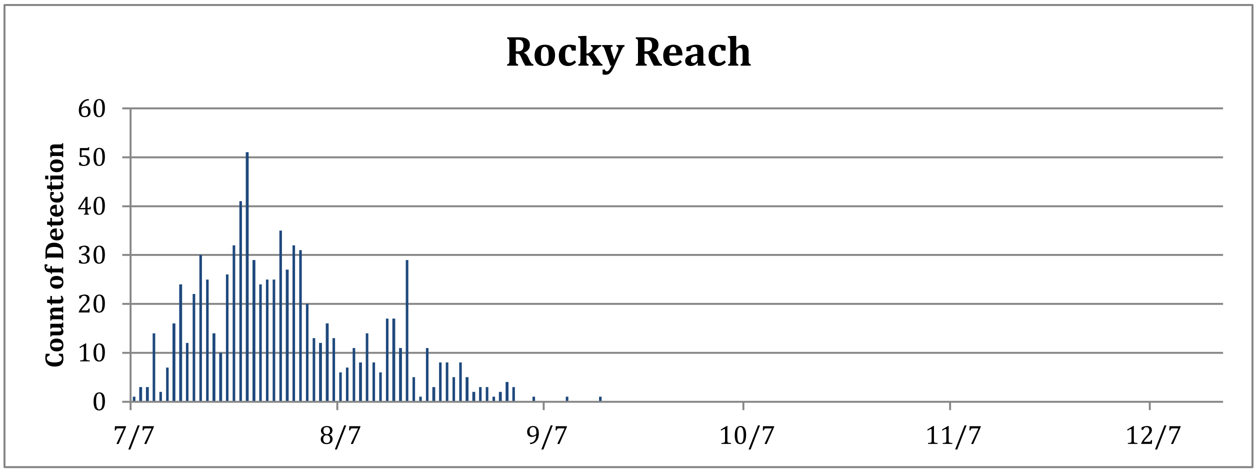
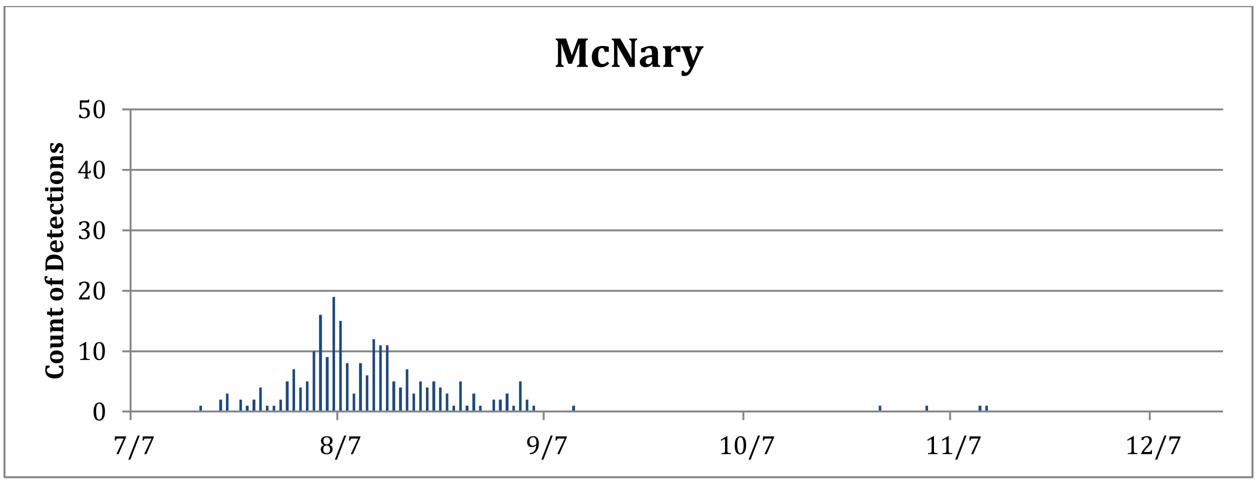
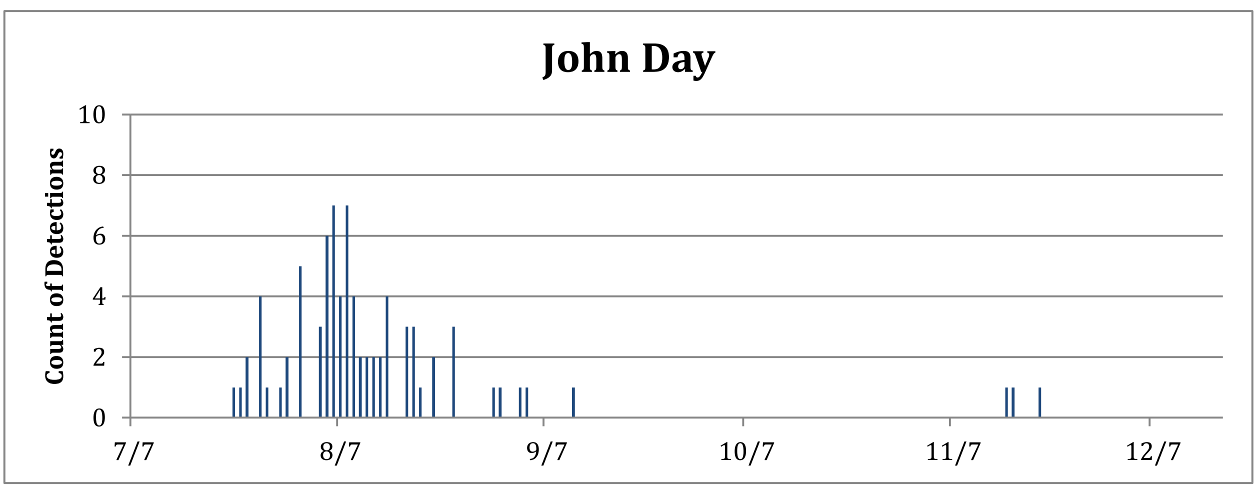


Figure 13. Size distribution of natural origin subyearling Chinook tagged during the beach seining effort in 2014.

Eight-hundred and forty-four PIT tagged juvenile Chinook were detected at the Rocky Reach juvenile bypass system, which was 10.3% of total fish tagged and released. Two-hundred and forty (2.9%), eighty (1.0%) and forty-six (0.6%) were detected at the McNary, John Day and Bonneville Dams respectively. Detections for subyearlings occurred primarily in July at Rocky Reach and in August for the other lower river dams (Figure 14). There were 36 detections (3%) in the lower river dams from September through December.


Rocky Reach
Count of Detection
60
50
40
30
20
10
0
7/7
8/7
9/7
10/7
11/7
12/7


McNary
Count of Detections
50
40
30
20
10
0
7/7
8/7
9/7
10/7
11/7
12/7


John Day
Count of Detections
10
8
6
4
2
0
7/7
8/7
9/7
10/7
11/7
12/7

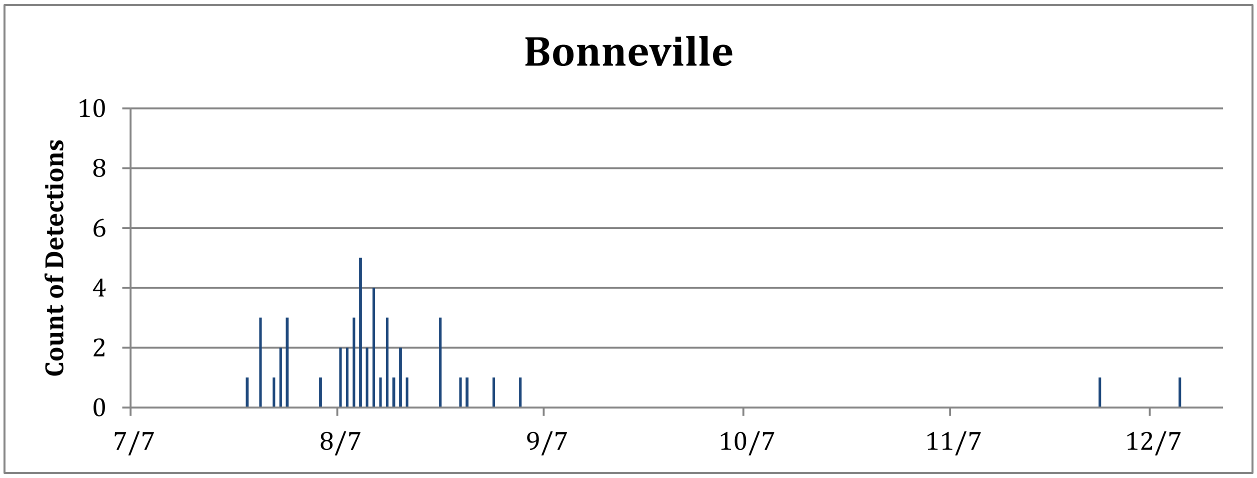


Figure 14. Daily distribution of detections of PIT-tagged subyearling Chinook at Rocky Reach, McNary, John Day, and Bonneville Dams in 2014.

Travel time from release to Rocky Reach Dam was the slowest compared to travel time from release to the other lower river dams (Table 10). Larger fish travelled faster to Rocky Reach Dam (Figure 15). This is similar to what was reported in 2011-2013 by Douglas County PUD.

Table 10. Mean travel time (d) and rate (km/d) for PIT tagged subyearling Chinook released near Gebber's Landing and detected at Columbia River hydro dams.

	Rocky Reach (762)		**McNary (470)**		**John Day (347)**		**Bonneville (235)**	
Location (River KM)	Travel Time (d)	Rate (km/d)	Travel Time (d)	Rate (km/d)	Travel Time (d)	Rate (km/d)	Travel Time (d)	Rate (km/d)
Release (856)	18.6 (SE = 0.4; n=844)	7.8	30.6 (SE = 2.19; n=240)	14	34.8 (SE = 2.31; n=80)	17.3	35.6 (SE= 3.48; n=46)	21
Rocky Reach (762)			13.2 (SE = 1.05; n=73)	26.9				
McNary (470)					11.72(SE = 7.24; n=11)	28		
John Day (347)							2.2 (SE = 0.2; n=5)	52.3

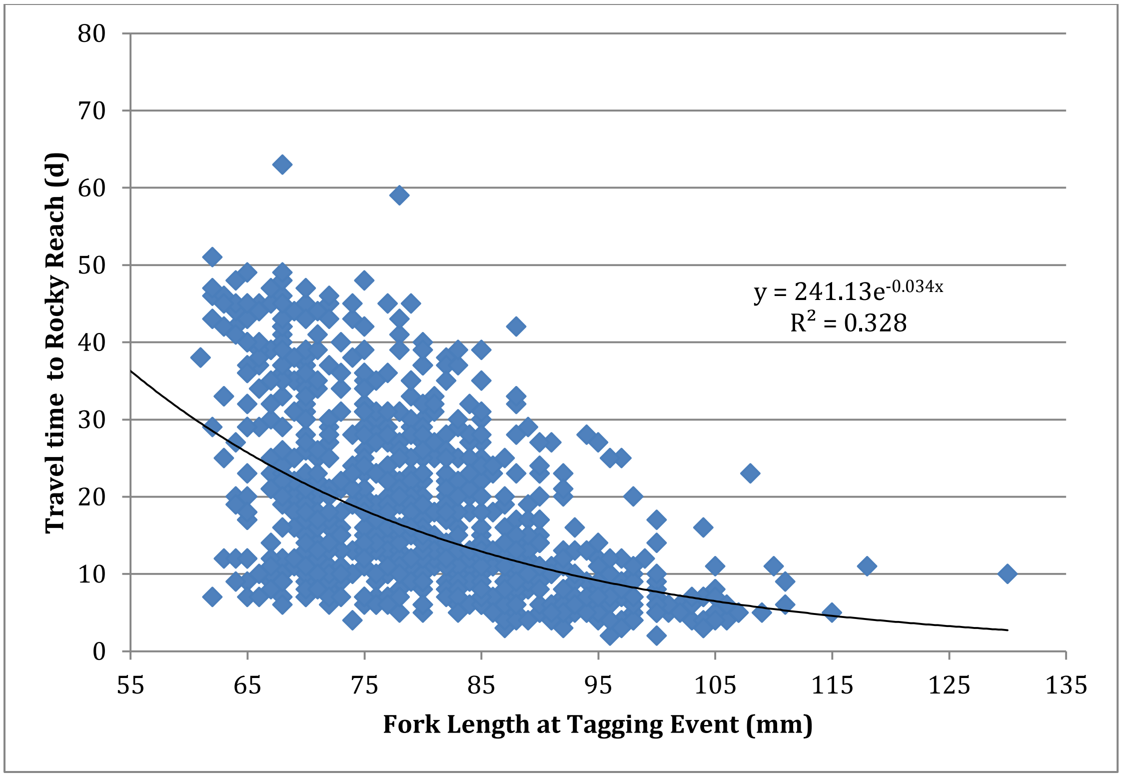


Figure 15. Fish size (fork length) and travel time of tagged Chinook to Rocky Reach Dam.

Lower Okanogan Adult Fish Pilot Weir

The Okanogan River (at Malott) discharge was around the norm in 2014 and dropped to 2,000 cfs on July 28, 2014. Staff were able to safely enter the river and begin installation on August 4 when discharge was 1,350 cfs (Figure 16). Discharge continued to drop rapidly throughout the installation period until August 9 when it increased approximately 700 cfs over a two-week period, presumably due to water management releases from Lake Okanagan designed to improve pre-spawn holding conditions for Sockeye in Lake Osoyoos. Discharge levels stayed below 1,200 cfs for the rest of the season. Weir operations ceased on September 25, 2014.

Migration of Sockeye and summer Chinook is generally affected by a thermal barrier that is caused by warm water temperatures (≥~22 °C) in the lower Okanogan River. The thermal barrier is dynamic within and between years, but generally it sets up in mid-July and breaks down in late August. In some years, the Okanogan River will temporarily cool off due to a combination of interrelated weather factors including rainstorms, cool weather, cloud cover or wildfire smoke. This 'break' in the thermal barrier can allow a portion of the fish holding in the Columbia River to enter the Okanogan and migrate up to thermal refuge in the Similkameen River or Lake Osoyoos. In 2014, temperatures were similar to, though often slightly higher than the median daily temperatures from the last 9 years (Figure 17).

Temperature surpassed 22.5 °C on July 15 when flow was 3,260 cfs. Temperatures stayed above 22.5 °C until July 19 but then increased above 22.5 °C again on July 30. Temperatures stayed above 22.5 °C for a three-week period. A steady decrease in temperatures from a high of 24.0°C to a low 21.3 °C occurred from August 20 to 25. On August 29 temperatures stayed below 22.5 °C for the rest of the season.

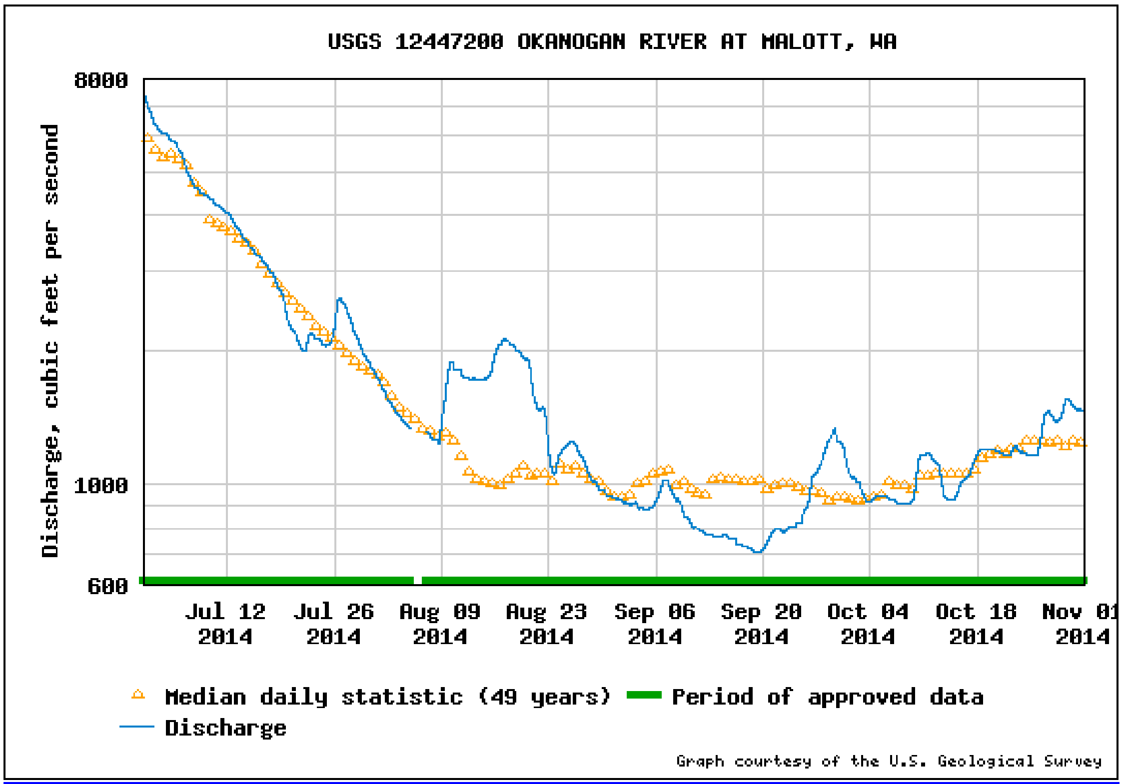


Figure 16. Discharge of the Okanogan River between July 1 and October 31, 2014. This figure was copied directly from the USGS website (http://nwis.waterdata.usgs.gov/wa).

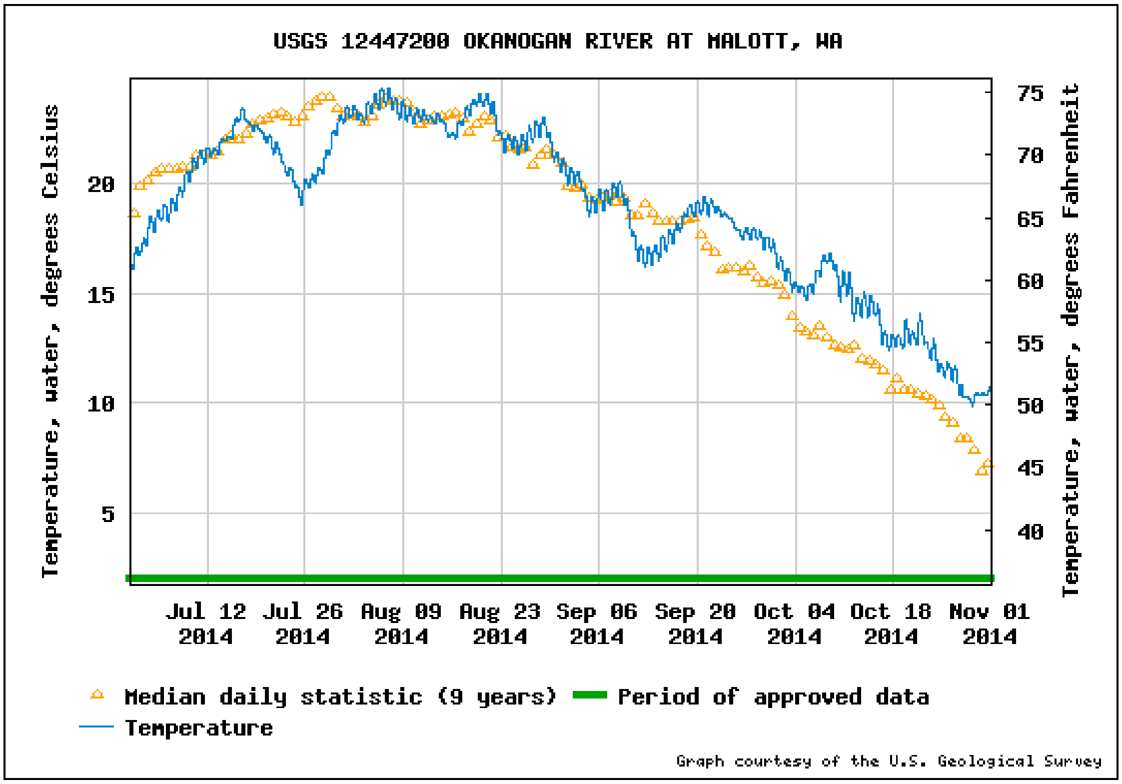


Figure 17. Temperature of the Okanogan River between July 1 and October 31, 2014. This figure was copied directly from the USGS website (http://nwis.waterdata.usgs.gov/wa).

Dissolved Oxygen varied from 6.3 to 11.6 mg/L, total dissolved solids varied from 120-136 ppm and turbidity varied from 0.6 and 3.6 NTUs (Table 11). The head differential ranged from 0-12 cm across the weir panels (Table 12). The maximum water velocity measured was 2.9 ft./sec. (Table 13).

Table 11. Water quality data at or near the lower Okanogan weir in 2014. Temperature and discharge were taken from the USGS gage at Malott.

Date	Trap Depth (ft.)	Dissolved Oxygen (mg/L)	Total Dissolved Solids (ppm)	Turbidity (NTU)	Mean Temperature (°C)	Mean Discharge (cfs)
8/20	2.6	6.9	121	3.6	23.7	1,780
8/21	2.5	6.3	121	3.5	23.5	1,500
8/22	2.3	6.4	122	2.7	22.5	1,390
8/25	2.0	8.6	125	1.7	21.7	1,240
8/26	2.0	9.4	122	2.6	22.0	1,220
8/27	2.0	8.4	123	1.6	22.3	1,130
8/28	1.9	9.9	120	1.1	22.6	1,030
8/29	1.9	8.2	123	1.6	22.4	988
8/30	1.9	8.9	123	1.6	21.4	956
9/01	1.9	8.7	127	0.8	20.4	922
9/02	1.8	9.2	127	0.9	20.3	905
9/03	1.8	9.4	128	1	19.9	901
9/04	1.8	11.6	128	1.1	19.0	884
9/05	1.8	10.6	127	0.8	19.2	898
9/06	2.0	10.2	125	0.7	19.3	973
9/07	2.0	10	126	1.3	19.5	1,010
9/08	2.0	9.2	126	0.9	19.7	940
9/09	2.0	9.2	121	0.9	19.4	874
9/10	2.0	10.1	124	0.9	18.1	822
9/11	1.6	10.4	123	0.9	17.0	799
9/12	1.7	10.7	126	0.6	16.7	781
9/15	1.7	10.1	126	1.2	17.4	763
9/16	1.7	9.4	134	1	17.7	748
9/17	1.7	9.2	133	0.9	18.1	734
9/18	1.7	8.7	136	1.1	18.7	718
9/19	1.7	9.3	135	1.1	18.8	710
9/22	1.7	8.6	135	0.9	18.9	794
9/23	1.7	9	136	1.1	18.7	808
9/24	1.7	9.1	135	1.1	18.4	816
9/25	1.8	9.5	135	1	18.0	882

Table 12. Head differential across the different picket spacings. If differential exceeded 10 cm, pickets were cleaned immediately. Measurements are in cm.

Date	1.0"	1.5"	2.0"	2.5"	3.0"
8/11	2.5	0.0	2.5	0.0	0.0
8/12	4.0	4.0	4.0	0.0	2.5
8/13	0.0	0.0	1.0	0.0	0.0
8/14	2.5	2.5	0.0	0.0	0.0
8/15	0.0	0.0	0.0	0.0	0.0
8/18	4.0	2.5	1.0	0.0	0.0
8/19	2.5	1.0	1.0	0.0	0.0
8/20	0.0	0.0	0.0	0.0	0.0
8/21	10.0	0.0	0.0	0.0	0.0
8/22	11.0	5.0	4.0	2.0	2.0
8/25	12.0	7.0	5.0	6.0	2.0
8/27	11.0	7.0	2.0	1.0	7.0
8/29	1.0	1.0	1.0	1.0	1.0
8/30	6.0	3.0	0.0	2.0	3.0
9/2	2.0	3.0	2.0	1.0	1.0
9/3	3.0	2.0	2.0	1.0	1.0
9/4	6.0	4.0	2.0	1.0	4.0
9/5	9.0	5.0	0.0	2.0	3.0
9/6	4.0	6.0	1.0	4.0	4.0
9/7	5.0	4.0	1.0	2.0	4.0
9/8	2.0	2.0	0.0	0.0	1.0
9/9	3.0	2.0	2.0	1.0	1.0
9/10	4.0	5.0	1.0	3.0	5.0
9/11	4.0	2.0	1.0	0.0	3.0
9/12	2.0	1.0	1.0	0.0	0.0
9/17	2.0	2.0	0.0	1.0	2.0
9/22	3.0	4.0	0.0	0.0	2.0
9/23	4.0	3.0	0.0	3.0	2.0
9/24	3.0	2.0	0.0	2.0	2.0

Table 13. Water velocity upstream (US) and downstream (DS) of the weir and in the trap. Trap depth is also included. Velocity should not exceed 3.5 ft./sec. Measurements are in ft./sec.

Date	River Left US	US Center	River Right US	River Left DS	DS Center	River Right DS	Trap Velocity
8/12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8/13	1.6	1.7	2.0	1.5	1.6	1.8	0.9
8/14	1.6	1.8	2.2	2.5	1.5	1.4	0.7
8/15	1.3	1.2	2.0	1.7	1.2	1.7	0.4
8/18	2.3	1.7	2.2	2.7	1.6	1.6	1.3
8/19	2.4	1.7	2.3	2.2	1.2	1.5	0.9
8/20	2.0	1.7	2.0	2.9	1.0	2.0	1.1
8/21	2.2	1.5	2.0	2.5	1.1	2.0	1.0
8/22	1.8	1.5	2.0	2.2	0.7	2.1	0.7
8/25	1.7	1.3	2.0	2.3	0.8	2.0	0.7
8/26	2.1	1.4	2.0	2.5	0.8	1.6	0.5
8/27	2.0	1.3	2.0	2.5	1.0	1.4	0.6
8/28	1.6	1.1	1.7	2.1	0.9	3.7	0.5
8/29	1.6	1.3	1.6	2.5	1.5	1.7	0.6
8/30	1.5	1.4	1.6	2.5	1.7	1.8	0.7
9/1	1.2	1.2	1.7	1.4	2.1	1.6	0.9
9/2	1.5	1.3	1.8	2.0	1.8	1.6	0.8
9/3	1.3	1.3	1.6	2.2	1.7	1.8	1.1
9/4	1.5	1.4	1.5	2.2	1.5	1.7	1.0
9/5	1.6	1.4	1.6	2.8	1.5	1.9	0.8
9/6	1.7	1.0	1.7	1.9	1.6	1.4	0.6
9/7	1.7	1.6	1.8	1.9	1.6	1.9	0.9
9/8	1.5	1.3	1.4	1.4	1.6	1.8	0.8
9/9	1.9	1.5	1.5	1.5	1.1	1.7	1.0
9/10	1.5	1.4	1.7	1.8	1.0	1.6	1.0
9/11	1.6	1.3	1.4	1.5	1.1	1.4	1.1
9/12	1.5	1.3	1.6	2.5	2.2	1.5	1.1
9/15	1.6	1.3	1.6	2.0	0.9	1.4	0.6
9/16	1.6	1.4	1.6	2.2	0.8	1.3	0.9
9/17	1.5	1.3	1.7	1.3	1.6	1.4	0.8
9/18	1.7	1.1	1.5	1.2	1.2	1.6	1.2
9/19	1.7	1.4	1.6	1.3	1.6	1.6	1.0
9/22	1.7	1.1	1.8	1.5	1.4	1.2	0.9
9/23	1.7	1.3	1.7	1.8	1.7	1.9	0.7
9/24	1.8	1.3	1.7	1.4	1.8	1.7	0.8
9/25	1.7	1.1	1.7	2.1	1.9	1.9	0.5
Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max	2.4	1.8	2.3	2.9	2.2	2.1	1.3

Two hundred and two dead fish were removed from the weir between August 6 and September 25 (Table 14). Sockeye and Chinook Salmon were the most commonly encountered species. All fish were impinged on the upstream side of weir indicating that they had most likely died upstream and floated down onto the weir. There was not an increase in the number of Chinook carcasses after the first Chinook was encountered in the trap (Figure 18). The higher mortality observed on August 16-17 was not due to Chinook being handled in the trap. There were also no observations of fish caught between pickets in a head upstream direction, which would have indicated that a fish got stuck and died while trying to push through the pickets.

Table 14. Date and species of fish mortalities observed at the lower Okanogan fish weir in 2014.

Date	Black Bullhead	Bridgelip Sucker	Carp	Chinook	Mountain Whitefish	Northern Pikeminnow	Sockeye	Unknown Sucker
8/6							1	
8/7							2	
8/8				1				
8/10				1				
8/12							1	
8/14				1				
8/15							1	
8/16				9			3	
8/17				7	1		5	6
8/18		1		1	1		6	
8/19		1		2	8	1	8	
8/20		2		2	3		7	
8/21				1	6		4	
8/22			1	2	4		1	1
8/23				1	2			2
8/24				2			5	1
8/25		1		1			2	
8/26				1			3	
8/27		3					2	
8/28				5			3	
8/29		1					2	
8/30		1			1		2	
8/31				2	1		1	
9/1				1			1	
9/2			1	2				1
9/3				3				
9/4				2			1	
9/6				2				
9/7				4				
9/8					1		2	
9/9	1		1				2	
9/10		1		2				
9/11							1	
9/15		1					2	
9/16					1			
9/17				1			2	
9/18		1					1	
9/19		1				1		
9/22	1	1		3	2		2	
9/23		1		1			1	
9/25								1
Total	**2**	**16**	**3**	**60**	**31**	**2**	**74**	**12**

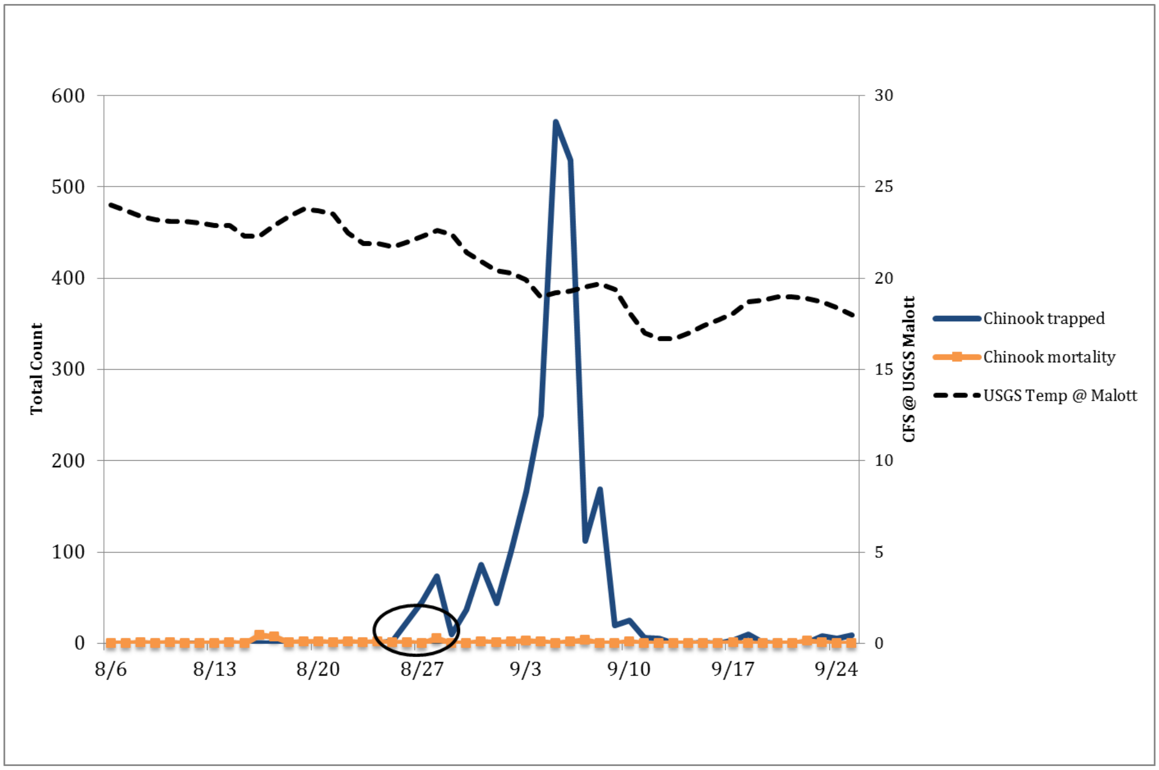


Figure 18. Total number of Chinook trapped and total number of Chinook carcasses collect off the weir panels. There was no drastic increase in Chinook carcasses at the weir after Chinook were encountered in the trap, as indicated by the circle.

In 2014 CCT conducted an acoustic evaluation of sockeye passage at the lower Okanogan weir to provide information on sockeye behavior and travel time in proximity to the weir. Sockeye were implanted with acoustic tags at Wells Dam, and were detected at buoys located near the Monse bridge, ~300 m downstream of the weir, and ~300 m above the weir. Results from the study were provided to the Chief Joseph Monitoring and Evaluation Program to supplement ongoing evaluations of the weir. The majority of the acoustic tagged sockeye (84%) passed the weir before it was installed and the rest passed the weir over a three-week period from mid-August to early September. The mean travel time between buoys that straddled the weir was significantly faster (df=14, $p<0.001$) pre-weir (~9 minutes) than during the weir (~38 minutes). Sockeye passing the weir site did so 29 minutes slower during the post weir time period (Appendix C). The mean travel time of sockeye travelling from Monse Bridge to the acoustic receiver just downstream of the weir was also significantly faster (46%) pre-weir than post-weir. For full details of the results of this study please see Appendix C.

Four fish were observed during the snorkel surveys, including 2 live Chinook Salmon within the first 700 m downstream of the weir. Only one dead Chinook Salmon was observed during snorkel surveys. Tower observations conducted in August and September provided information about the behavior of fish approaching the weir. We were unable to accurately quantify the broad array of behaviors across the river, because it was difficult to track the same fish in the 30-minute period, especially during periods of high wind, increased cloud cover, and the position of the sun. Generally, fish were observed searching, or milling, below the weir between August 11-September 12 and September 15-25. The estimate of fish milling between August 11-September 12 ranged from 5-600 daily and between September 15-25 ranged from 5-300 daily. Daily hours of observations occurred from 0600-2000. About 98% of the fish observations were classified as Chinook Salmon; 2% of them were classified as Sockeye. Bank observations conducted in September provided additional information on the level of fish activity ~500 m below the weir. The number of observations ranged from 20-100 in a ten-minute period from September 10-25.

Trapping operations were conducted from August 15 to September 25 when river temperature was ≤ 22.5 °C . The total fish trapped at the weir in 2014 was 2,477 with 94% of them being Chinook Salmon (Figure 19). Most of the Chinook trapped were released back into the river (Figure 20). Seventy-six natural-origin Chinook were transported to the hatchery and held in the broodstock ponds concurrently with the fish taken for broodstock from the purse seine. These adults experienced 10.6% pre-spawn mortality.

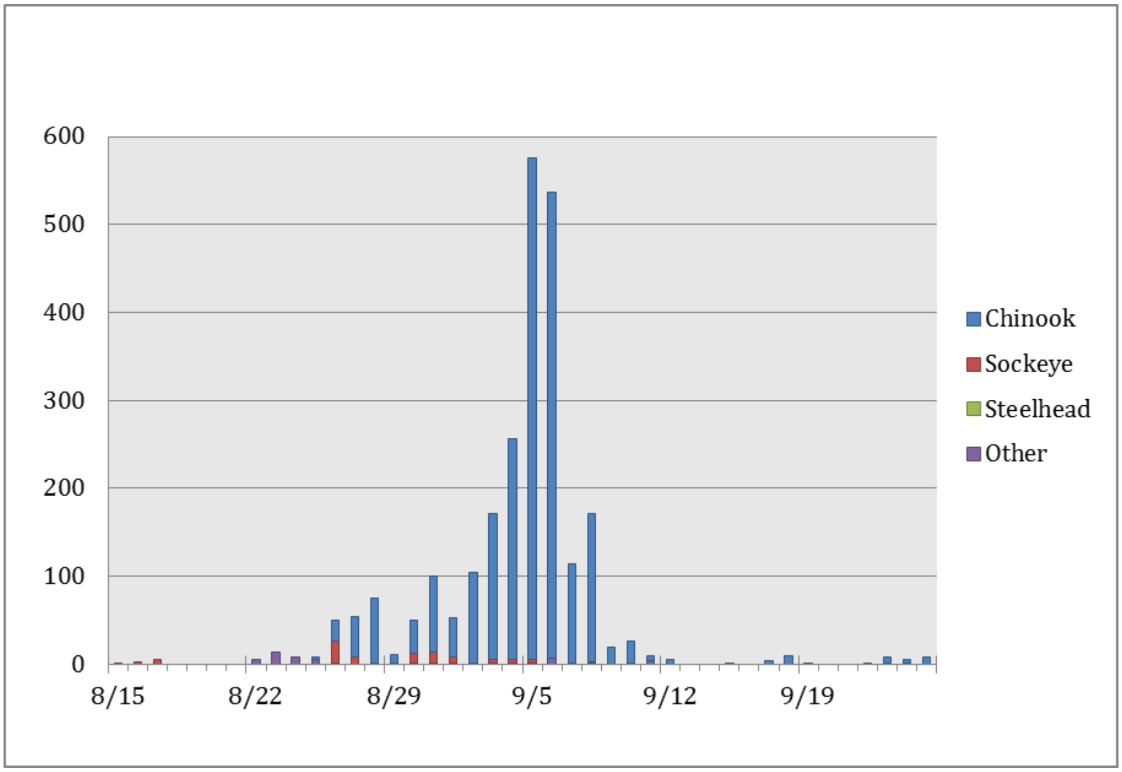


Figure 19. Total number of fish trapped at the Okanogan weir in 2014.

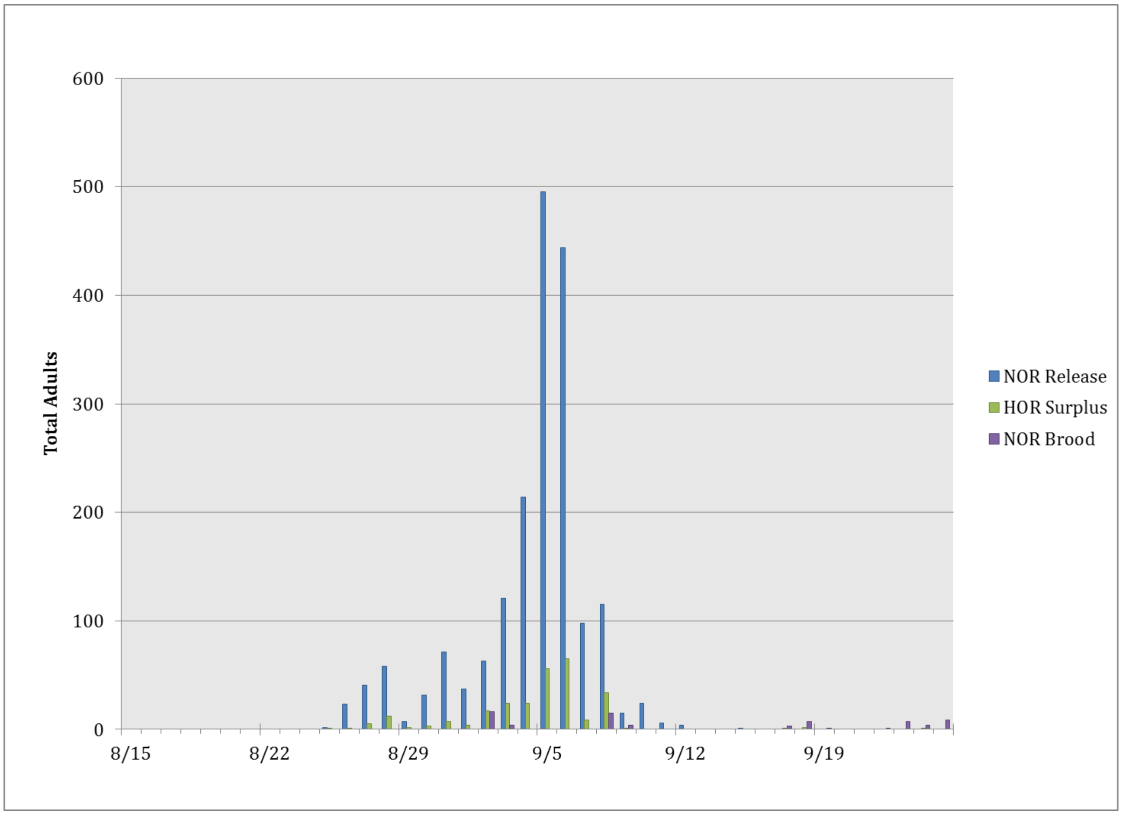


Figure 20. Final destination of Chinook adults captured in the weir trap during trapping operations in 2014.

Weir efficiency and effectiveness were metrics for evaluating the potential for the weir to contribute to future CJHP population management goals. In 2014, 14.9% of total spawning escapement was detected in the trap (i.e., weir efficiency) (Table 15). The potential weir effectiveness (if we had been removing all of the HOR encountered) was 0.136.

Table 15. The number of hatchery- and natural-origin Chinook Salmon encountered at the lower Okanogan weir in 2014. Weir efficiency and effectiveness were metrics for evaluating the potential for the weir to contribute to the CJHP population management goals in the future.

Survey Year	Number of summer/fall Chinook carcasses					
	Chinook Adults Encountered in the Weir Trap		Chinook Spawning Escapement Estimates[c]		Weir Metrics	
	Natural Origin (NOR)	Hatchery Origin (HOR)	Natural Origin (NOS)	Hatchery Origin (HOS)	Weir Efficiency[a, d]	Weir Effectiveness[b,d, e]
2014	2,006	318	10,532	1,632	0.147	0.148

[a] Estimates for weir efficiency are adjusted for prespawn mortality and include Chinook that are harvested, released, and collected for brood.

[b] Estimates for weir effectiveness are adjusted for prespawn mortality and include Chinook that are harvested or removed for pHOS management.

[c] Estimates do not include Chinook Zosel Dam counts.

[d] For the Efficiency and Effectiveness metrics, pre-spawn mortality was assumed to be 10%.

[d] To calculate weir effectiveness, HORs removed from the weir trap for management purposes were used (n=314)

Redd Surveys

In 2014, 4,253 summer/fall Chinook redds were counted in the Okanogan and Similkameen rivers using a combination of ground and aerial surveys (Table 16, Figure 21). The number of redds counted in 2014 was higher than the long-term or more recent 5-year average (Table 16). The majority of Chinook redds were located in S1 (40.8%) and O6 (23.7%), and overall distribution across the reaches was similar between 2014 and most previous years (Table 17, Figure 22).

Estimated spawning escapement was 12,164 (4,253 redds × 2.86 fish per redd) (Table 18). During the survey period 1989 through 2014, the summer/fall Chinook spawning escapement within the U.S. portion of the Okanogan River Basin averaged 5,386 and ranged from 473 to 13,857 (

Table 18).

The majority of summer/fall Chinook redds were counted during spawning ground surveys between October 13 -17 (Table 19). No spawning ground surveys were conducted beyond November 8.

Escapement into Canada

In 2014 there were 1,188 adult summer/fall Chinook counted in the fishways of Zosel Dam (Table 20). While not the highest count on record, 2014 continued a trend showing increasing escapements above Zosel. 10% of the Chinook observed at Zosel Dam had a clipped adipose fin (i.e., hatchery-origin).

Table 16. Total number of redds counted in the Okanogan River Basin, 1989-2014 and the averages for the total time series and the most recent 5-year period.

Survey Year	Number of summer Chinook redds		
	Okanogan River	Similkameen River	Total Count
1989	151	370	521
1990	99	147	246
1991	64	91	155
1992	53	57	110
1993	162	288	450
1994	375*	777	1,152
1995	267*	616	883
1996	116	419	535
1997	158	486	644
1998	88	276	364
1999	369	1,275	1,644
2000	549	993	1,542
2001	1,108	1,540	2,648
2002	2,667	3,358	6,025
2003	1,035	378	1,413
2004	1,327	1,660	2,987
2005	1,611	1,423	3,034
2006	2,592	1,666	4,258
2007	1,301	707	2,008
2008	1,146	1,000	2,146
2009	1,672	1,298	2,970
2010	1,011	1,107	2,118
2011	1,714	1,409	3,123
2012	1,613	1,066	2,679
2013	2,267	1,280	3,547
2014	2,231	2,022	4,253
Average	1,046	989	1,979
5-yr Average	***1,767***	***1,377***	***3,144***

* Reach-expanded aerial counts.

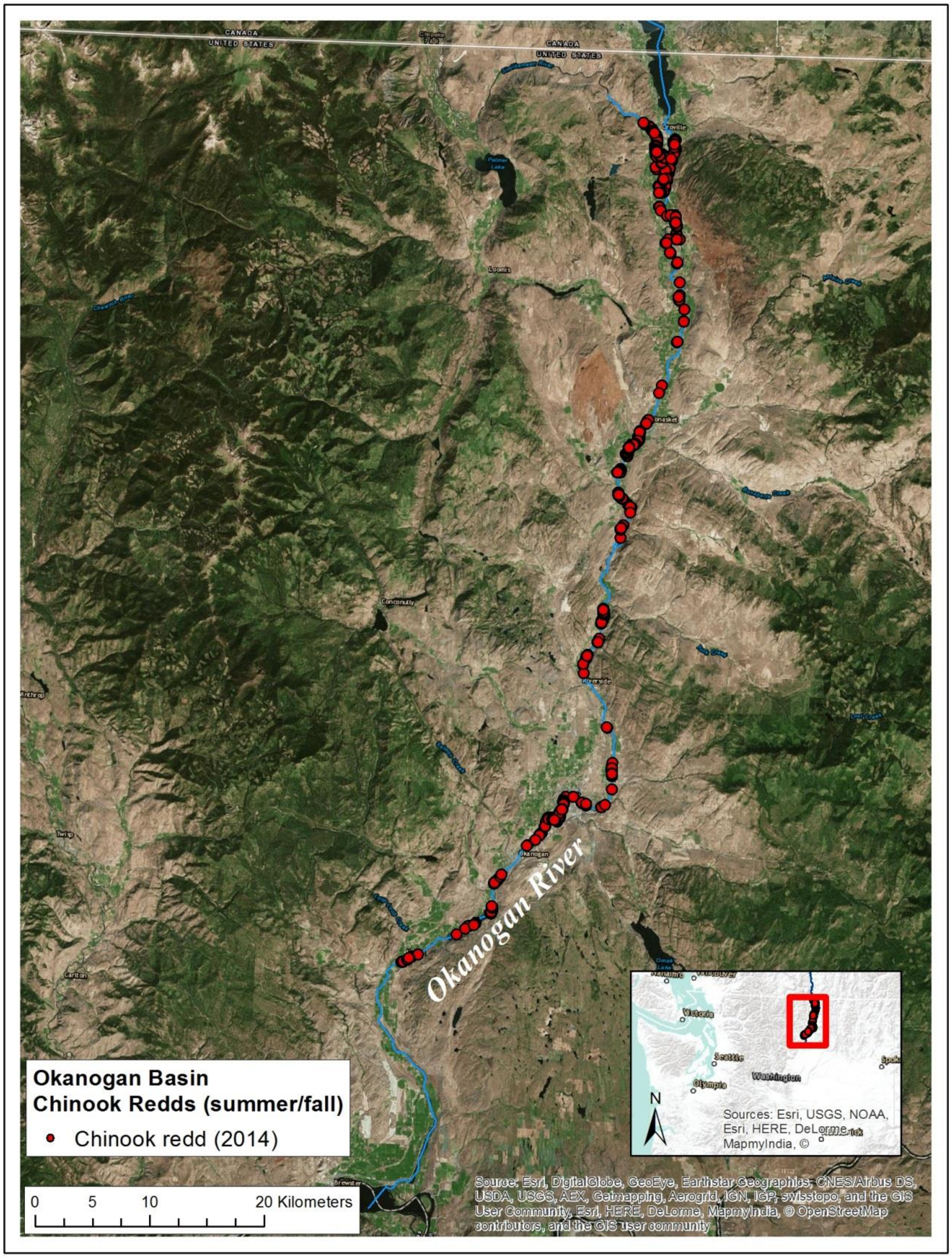


Figure 21. Distribution of summer/fall Chinook redds in 2014. Individual redds are identified by red circles. Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Table 17. Annual and average abundance of summer/fall Chinook redds in each reach of the Okanogan (O1-O6) and Similkameen (S1-S2) Rivers from 2006-2014.

Return Year	Number of Summer Chinook Redds								
	Okanogan						Similkameen		Total
	O-1	O-2	O-3	O-4	O-5	O-6	S-1	S-2	
2006	10	56	175	145	840	1366	1277	405	4274
2007	3	16	116	63	549	554	624	86	2011
2008	4	51	59	96	374	561	801	199	2145
2009	3	32	91	138	619	787	1091	207	2968
2010	9	58	67	89	357	431	895	212	2118
2011	3	20	101	55	593	942	1217	192	3123
2012	12	54	159	68	555	765	914	152	2679
2013	3	2	158	46	397	1661	1254	26	3547
2014	11	57	191	111	851	1010	1737	285	4253
Average		***38***	***124***	***90***	***571***	***897***	***1090***	***196***	***3013***

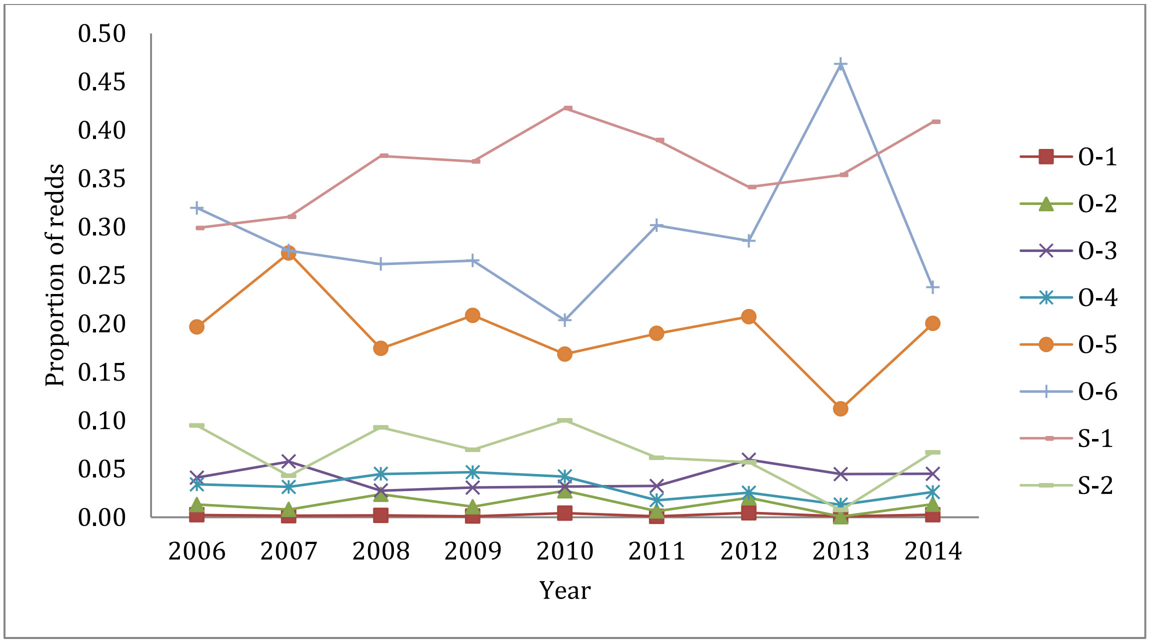


Figure 22. Proportion of redds in each reach of the Okanogan and Similkameen Rivers from 2006 to 2014.

Table 18. Spawning escapements for summer/fall Chinook in the Okanogan and Similkameen Rivers for return years 1989-2014.

Return Year	Fish/Redd Ratio	Spawning Escapement		
		Okanogan	Similkameen	Total
1989*	3.3	498	1,221	1,719
1990*	3.4	337	500	837
1991*	3.7	237	337	574
1992*	4.3	228	245	473
1993*	3.3	535	950	1,485
1994*	3.5	1,313	2,720	4,033
1995*	3.4	908	2,094	3,002
1996*	3.4	394	1,425	1,819
1997*	3.4	537	1,652	2,189
1998	3	264	828	1,092
1999	2.2	812	2,805	3,617
2000	2.4	1,318	2,383	3,701
2001	4.1	4,543	6,314	10,857
2002	2.3	6,134	7,723	13,857
2003	2.42	2,505	915	3,420
2004	2.25	2,986	3,735	6,721
2005	2.93	4,720	4,169	8,889
2006	2.02	5,236	3,365	8,601
2007	2.2	2,862	1,555	4,417
2008	3.25	3,725	3,250	6,975
2009	2.54	4,247	3,297	7,544
2010	2.81	2,841	3,111	5,952
2011	3.1	5,313	4,368	9,681
2012	3.07	4,952	3,273	8,225
2013	2.31	5,237	2,957	8,194
2014	2.86	6,381	5,783	12,164
Average	***2.98***	***2,656***	***2,730***	***5,386***
5-Year Average	***2.83***	***4,945***	***3,898***	***8,843***

* Spawning escapement was calculated using the "Modified Meekin Method" (i.e., 3.1 × jack multiplier).

Table 19. Number and timing of summer Chinook redd counts in reaches of the Okanogan and Similkameen Rivers in 2014.

Reach	River mile	Oct 6-10	Oct 13-17	Oct 20-24	Oct 27-31	Nov 3-8	Redd Count	Percent
Okanogan River								
O1	0.0-16.9	0	0	0	0	11	11	0%
O2	16.9-26.1	2	15	11	8	21	57	3%
O3	26.1-30.7	90	87	8	0	6	191	9%
O4	30.7-40.7	23	63	7	18	0	111	5%
O5	40.7-56.8	404	392	42	13	0	851	38%
O6	56.8-77.4	378	495	107	30	0	1010	45%
Total		***897***	***1052***	***175***	***69***	***38***	***2231***	***100%***
Similkameen River								
S1	0.0-1.8	1108	424	142	63	0	1737	86%
S2	1.8-5.7	87	174	20	4	0	285	14%
Total		***1195***	***598***	***162***	***67***	***0***	***2022***	***100%***

Table 20. Count of run escapement of adult summer/fall Chinook at Zosel Dam using video monitoring in the fishways.

Chinook Passage at Zosel Dam		
Year	**Video Count**	**% Hatchery**
2006	481	1%
2007	455	40%
2008	267	29%
2009	256	17%
2010	359	29%
2011	1415	36%
2012	826	24%
2013	2275	14%
2014[a]	1188	10%
Average	***836***	***22%***

[a]2014 data were adjusted for fallback/re ascension, down camera time, and differentiation of spring Chinook from summer/fall Chinook.

Carcass Surveys

In 2014, 2,452 carcasses were recovered including 2,123 natural-origin and 329 hatchery-origin[6]. The carcass recovery rate was 20% of the total spawning escapement. Genetic samples (tissue punches) were collected from a portion of the summer/fall Chinook carcasses in 2014. Samples are archived at the USGS Snake River Field Station Genetics Lab in Boise, ID. The majority (n=1,553; 63%) of carcasses were collected from reach O6 and S1 (Figure 23, also see Appendix E). The proportion of natural-origin carcasses recovered in 2014 was slightly lower in reaches O5, O6 and S1 compared to the 10-year average (Figure 23, panel A). The proportion of hatchery-origin carcasses recovered in 2014 was lower in O5, O6, S1 and S2 compared to the 10-year average (Figure 23, panel B).

[6]Origin assignments take into account all scale, ad-mark, coded wire tag and PIT tag information available at time of publication.

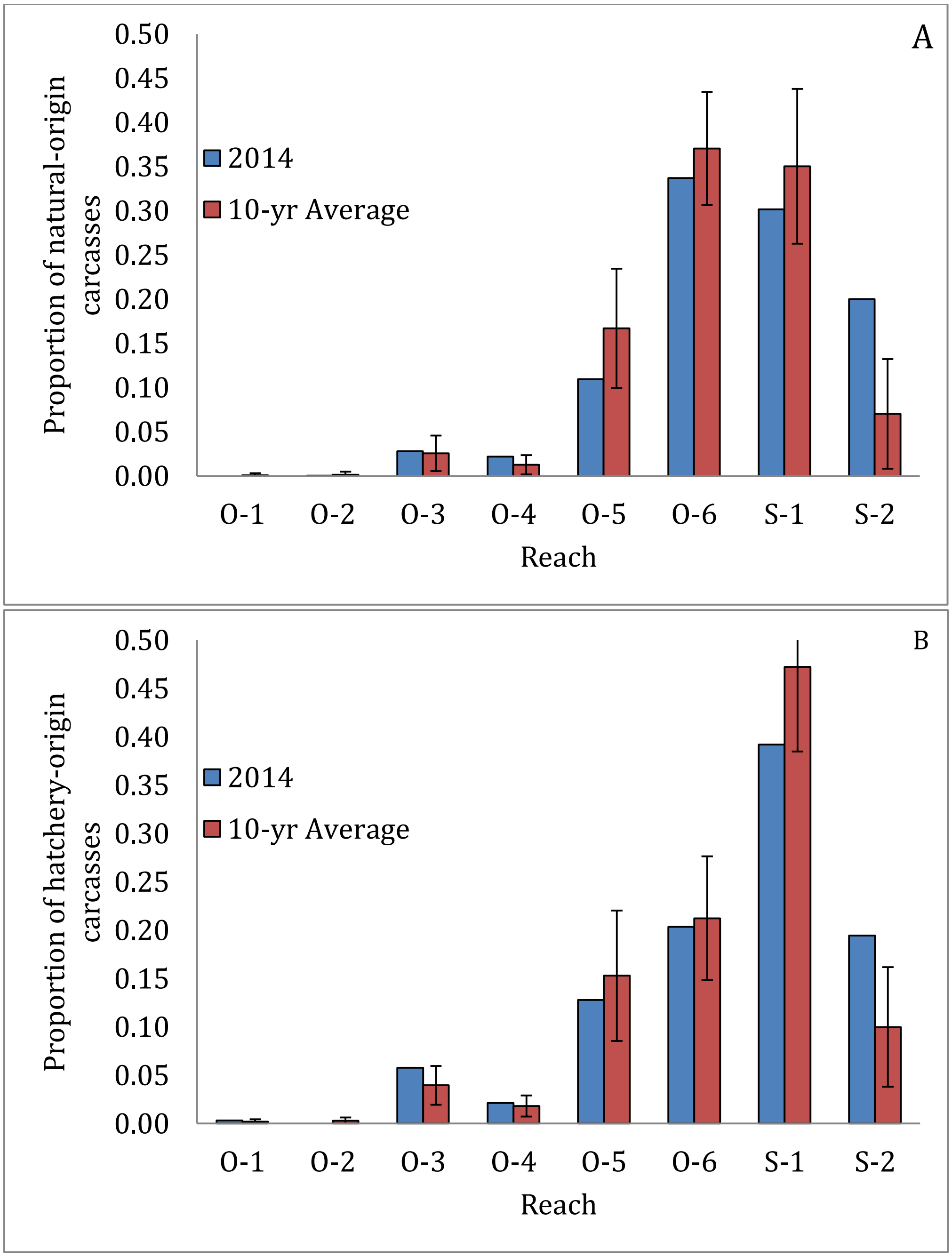


Figure 23. Distribution of natural-origin (A) and hatchery-origin (B) summer/fall Chinook carcasses recovered in the Okanogan (O1-O6) and Similkameen (S1-S2) Rivers in 2014 and the 10-year average (2005-2014).

In the Okanogan basin, 19 sampled female carcasses contained 5,000 eggs, so pre-spawn mortality was estimated to be 1.4% for natural-origin females and 1.8% for hatchery-origin females (Table 21). Less than 10% of eggs were retained in sampled females overall in 2014.

Table 21. Egg retention and pre-spawn mortality of sampled summer/fall Chinook carcasses in the Okanogan Basin.

Year	Origin	Total carcasses sampled	Female carcasses sampled	Potential egg deposition	Eggs retained	[a]Egg retention rate	[b]Pre-spawn mortality rate
2013	Natural-origin	613	326	1,630,000	6,152	0.4%	0.0%
	Hatchery-origin	297	237	1,185,000	10,970	0.9%	0.0%
	Total	910	563	2,815,000	17,122	0.6%	0.0%
2014	Natural-origin	2123	1136	5,680,000	373,708	6.6%	1.4%
	Hatchery-origin	329	166	830,000	81,105	9.8%	1.8%
	Total	2452	1302	6,510,000	454,813	7.0%	1.5%

[a]Assuming fecundity of 5,000 eggs per female, egg retention rate is calculated as: (# eggs estimated remaining in sampled female carcasses) / (# female carcasses sampled * 5,000 eggs each)

[b]A pre-spawn mortality is determined when a female retains the assumed 5,000 eggs on the spawning grounds.

PHOS AND PNI

There was a decrease in the proportion of hatchery-origin spawners (pHOS) across all reaches in the Okanogan and Similkameen rivers in 2014 compared to the 10-year average with the exception of reach O1 (Figure 24), which was based on the recovery of only a single carcass. Hatchery-origin spawners comprised 13% of the spawn escapement estimate in the U.S. portion of the Okanogan, which was the lowest (unadjusted) pHOS observed since 1992 (Table 22). After corrections for hatchery fish effectiveness assumptions (0.80 relative reproductive success rate for hatchery-origin spawners) and reach weighting, the final effective, reach weighted pHOS for 2014 was 0.11, which was considerably less than the five-year average (0.32) (Table 22). Although the five-year average failed to meet the biological objective for pHOS (<0.3), recent years' data reveal a trend toward the objective (Figure 25).

The proportion of natural-origin broodstock (pNOB) in 2014 was 99% and the pNOB for Okanogan origin fish was 89% (Table 23). The resulting PNI for 2014 was 0.89, with a 5-year average PNI of 0.76, both meeting the Biological Objective (>0.67) (Figure 26).

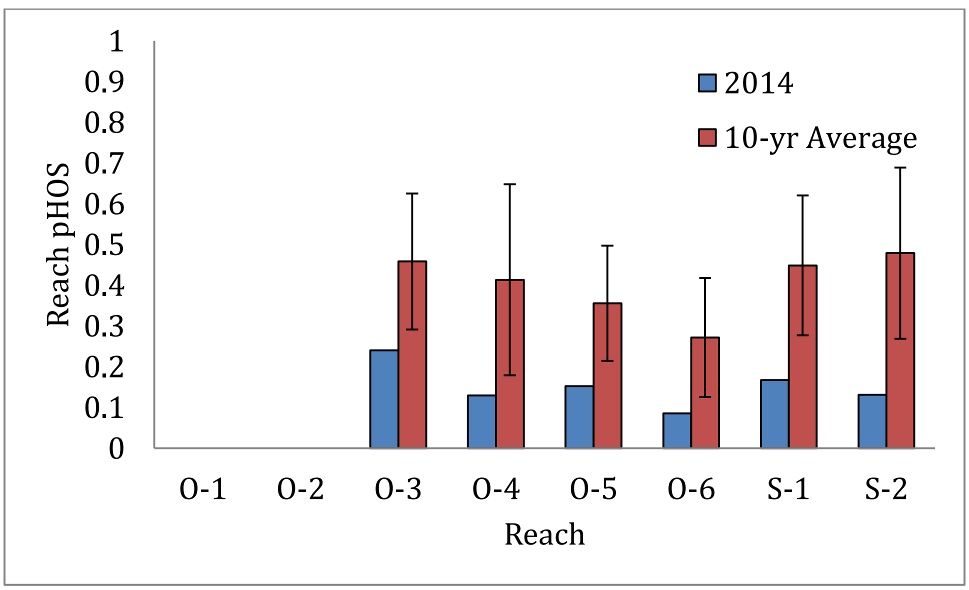


Figure 24. Okanogan (O1-O6) and Similkameen River (S1-S2) summer/fall Chinook unadjusted pHOS by reach for 2014 and 10-year average (2005-2014). Reaches with fewer than 10 carcasses recovered were not shown.

Table 22. Natural- (NOS) and hatchery- (HOS) origin spawner abundance and composition for the Okanogan River Basin, brood years 1989-2014.

Brood Year	Spawners				
	NOS	**HOS**	**Unadjusted pHOS**	**Effective pHOS**	**Effective, Reach-weighted pHOS**
1989	1,719	0	0	0	-
1990	837	0	0	0	-
1991	574	0	0	0	-
1992	473	0	0	0	-
1993	915	570	0.38	0.33	-
1994	1,323	2,710	0.67	0.62	-
1995	979	2,023	0.67	0.62	-
1996	568	1,251	0.69	0.64	-
1997	862	1,327	0.61	0.55	-
1998	600	492	0.45	0.40	-
1999	1,274	2,343	0.65	0.60	-
2000	1,174	2,527	0.68	0.63	-
2001	4,306	6,551	0.60	0.55	-
2002	4,346	9,511	0.69	0.64	-
2003	1,933	1,487	0.43	0.38	-
2004	5,309	1,412	0.21	0.18	-
2005	6,441	2,448	0.28	0.23	-
2006	5,507	3,094	0.36	0.31	0.18
2007	2,983	1,434	0.32	0.28	0.32
2008	2,998	3,977	0.57	0.51	0.54
2009	4,204	3,340	0.44	0.39	0.40
2010	3,189	2,763	0.46	0.41	0.41
2011	4,642	5,039	0.52	0.46	0.47
2012	4,840	3,385	0.41	0.36	0.40
2013[a]	5,520	2,674	0.33	0.28	0.27
2014	10,532	1,632	0.13	0.11	0.12
Average	***3,002***	***2,384***	***0.44***	***0.39***	***0.33***
5-year Average	***5,744***	***3,099***	***0.35***	***0.30***	***0.32***

[a]2013 data have been updated to reflect origin data acquired from coded wire tag and scale reading since the publication of the 2013 Annual Report.

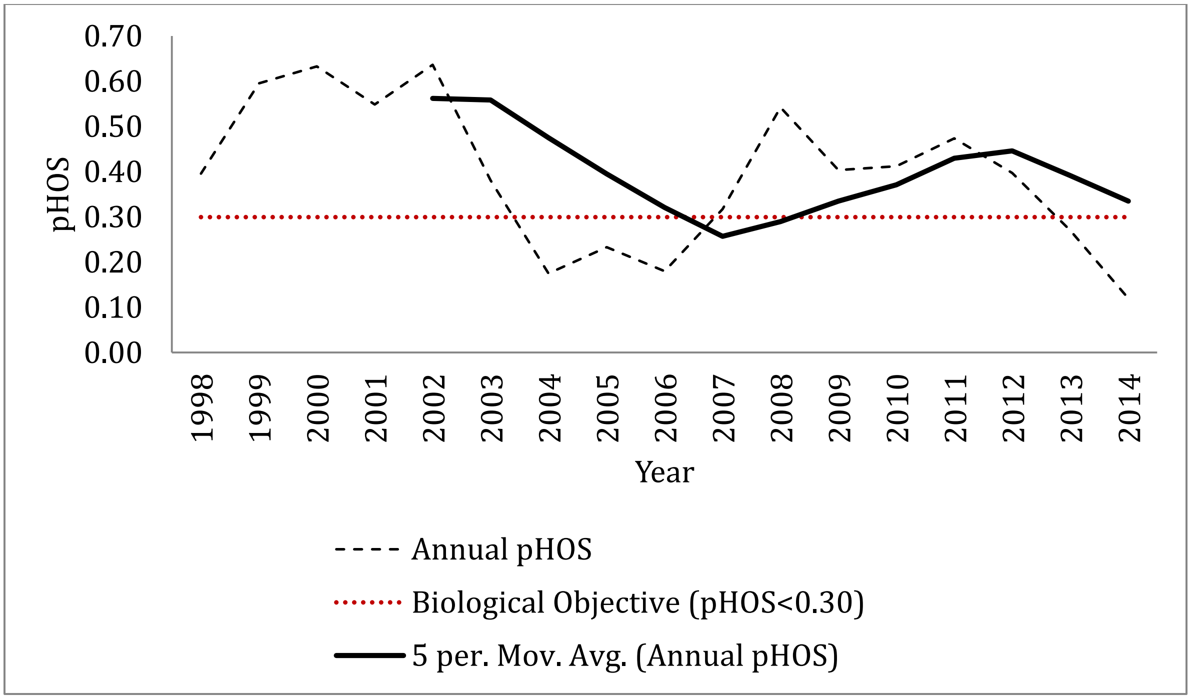


Figure 25. The proportion of hatchery-origin spawners (pHOS) in the Okanogan and Similkameen River (combined) from 1998-2014. pHOS values represent the effective, reach-weighted pHOS, adjusted for the hatchery fish effectiveness assumption (0.8; all years) and the proportion of redds in each reach (2006-2014).

Table 23. Okanogan River summer Chinook spawn escapement and broodstock composition, and calculated pHOS and PNI for Brood Years 1989-2013.

Brood Year	Spawners			Broodstock					PNI	Okan. PNI
	NOS	HOS	pHOS[a]	NOB	Okan. NOB	HOB	pNOB	Okan. pNOB		
1989	1,719	0	0.00	1,297		312	0.81		1.00	
1990	837	0	0.00	828		206	0.80		1.00	
1991	574	0	0.00	924		314	0.75		1.00	
1992	473	0	0.00	297		406	0.42		1.00	
1993	915	570	0.33	681		388	0.64		0.66	
1994	1,323	2,710	0.62	341		244	0.58		0.48	
1995	979	2,023	0.62	173		240	0.42		0.40	
1996	568	1,251	0.64	287		155	0.65		0.50	
1997	862	1,327	0.55	197		265	0.43		0.44	
1998	600	492	0.40	153	77	211	0.42	0.21	0.51	0.35
1999	1,274	2,343	0.60	224	112	289	0.44	0.22	0.42	0.27
2000	1,174	2,527	0.63	164	82	337	0.33	0.16	0.34	0.21
2001	4,306	6,551	0.55	12	46	345	0.03	0.13	0.06	0.19
2002	4,346	9,511	0.64	247	124	241	0.51	0.25	0.44	0.29
2003	1,933	1,487	0.38	381	191	101	0.79	0.40	0.67	0.51
2004	5,309	1,412	0.18	506	253	16	0.97	0.48	0.85	0.73
2005	6,441	2,448	0.23	391	196	9	0.98	0.49	0.81	0.68
2006	5,507	3,094	0.18	500	250	10	0.98	0.49	0.85	0.73
2007	2,983	1,434	0.32	456	228	17	0.96	0.48	0.75	0.60
2008	2,998	3,977	0.54	359	202	86	0.81	0.45	0.60	0.46
2009	4,204	3,340	0.40	503	254	4	0.99	0.50	0.71	0.55
2010	3,189	2,763	0.41	484	242	8	0.98	0.49	0.71	0.54
2011	4,642	5,039	0.47	467	332	26	0.95	0.67	0.67	0.59
2012	4,840	3,385	0.40	107	96	0	1.00	0.90	0.72	0.69
2013	5,520	2,674	0.27	353	318	0	1.00	0.90	0.79	0.77
2014	10,532	1,632	0.11	499	449	5	0.99	0.89	0.90	0.89
Average	***2,701***	***2,414***	***0.47***	***417***	***203***	***163***	***0.76***	***0.43***	***0.62***	***0.48***
5-Year Average	***4,479***	***3,440***	***0.39***	***383***	***248***	***8***	***0.98***	***0.64***	***0.71***	***0.62***

[a]pHOS values are effective from 1989-2006 and Effective, Reach-weighted pHOS from 2006-2014

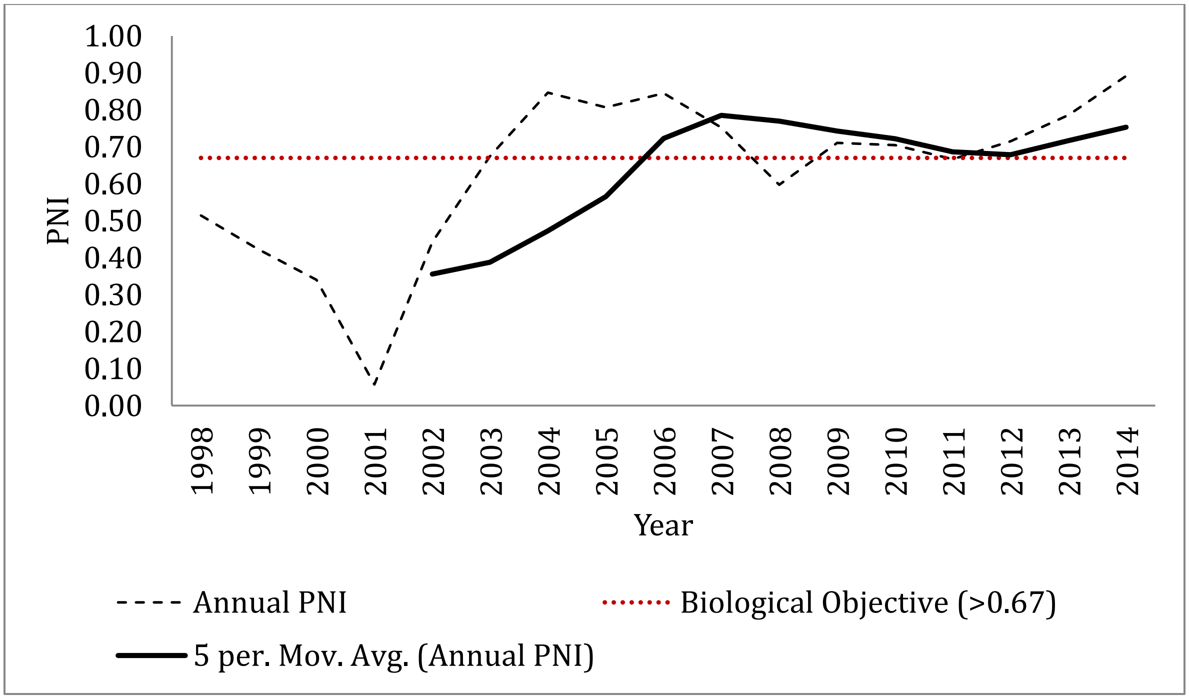


Figure 26. The proportionate natural influence (PNI) in the Okanogan and Similkameen Rivers (combined) from 1998 to 2014.

HATCHERY-ORIGIN STRAY RATES

Strays within the Okanogan*.*—The majority (95%) of hatchery-origin spawners recovered on the spawning grounds in 2014 were from Similkameen (90%) and Bonaparte (5%) pond releases (Table 24). This was very similar to the average (94%) of recent years (2006-2014). Strays from outside the Okanogan but within the Upper Columbia summer/fall Chinook ESU consisted of fish from Carlton Pond, Entiat NFH, Chelan Hatchery, Wells Hatchery and Turtle Rock. No strays from outside the ESU were encountered on the spawning grounds. Stray hatchery fish comprised 0.4% of total Okanogan spawner composition (i.e., stray pHOS) (Table 25). This was less than the recent (2006-2014) average of 2% and well under the biological target of < 5%.

Strays outside the Okanogan.—The most recent brood year that could be fully assessed (through age 5) for stray rate of Okanogan fish to spawning areas outside the Okanogan was 2009. The 2009 brood year had a stray rate of 1.3%, which was similar to the long term and recent five year averages (Table 26). RMIS queries revealed a total of 15 Okanogan hatchery-origin CWT codes from spawning ground recoveries in non-target spawning areas. Based on available data, Okanogan basin hatchery program strays comprise ≤1% to other basin population's spawner composition (in 2014 as well as long term average). Okanogan basin hatchery strays comprised ≤1% of either the Entiat or Chelan River spawning aggregates[7] (Table 27).

[7] The Entiat and Chelan River are evaluated separately here because they were not classified as independent populations within the ESU (Peven et al. 2010) and therefore may not be subject to the same biological targets as the Methow and Wenatchee populations.

Table 24. Estimated number (and percent of annual total) of hatchery-origin spawners from different release basins recovered on the Okanogan/Similkameen spawning grounds, based on CWT recoveries and expansions, for return years 2006-2014. For specific hatchery program releases contributing to strays in the Okanogan Basin see Appendix D.

Return Year	Release Site									
	Summer Chinook Run							Fall Chinook Run		
	Homing Fish		Straying Fish							
	Okanogan River Basin		Within ESU Stray					Out of ESU Stray		
	Okanogan River[a]	Similkameen River[b]	Methow River[c]	Wenatchee River[d]	Entiat River[e]	Chelan River[f]	Mainstem Columbia River[g]	Mainstem Columbia River[h]	Snake River[i]	Other[j]
2006	0 (0%)	709 (87%)	12 (2%)	12 (2%)	0 (0%)	0 (0%)	81 (10%)	0 (0%)	0 (0%)	0 (0%)
2007	0 (0%)	1121 (95%)	17 (1%)	5 (0%)	0 (0%)	0 (0%)	42 (4%)	0 (0%)	0 (0%)	0 (0%)
2008	0 (0%)	3224 (95%)	11 (0%)	24 (1%)	0 (0%)	4 (0%)	133 (4%)	3 (0%)	0 (0%)	0 (0%)
2009	0 (0%)	2733 (95%)	14 (0%)	14 (0%)	0 (0%)	9 (0%)	99 (3%)	0 (0%)	5 (0%)	4 (0%)
2010	4 (0%)	2165 (89%)	44 (2%)	35 (1%)	0 (0%)	110 (5%)	75 (3%)	0 (0%)	4 (0%)	0 (0%)
2011	219 (5%)	4196 (93%)	44 (1%)	5 (0%)	0 (0%)	34 (1%)	22 (0%)	0 (0%)	6 (0%)	0 (0%)
2012	379 (13%)	2397 (83%)	29 (1%)	23 (1%)	0 (0%)	17 (1%)	52 (2%)	0 (0%)	0 (0%)	0 (0%)
2013	254 (14%)	1437 (81%)	10 (1%)	54 (3%)	0 (0%)	0 (0%)	10 (1%)	0 (0%)	0 (0%)	0 (0%)
2014	55 (5%)	1023 (90%)	16 (1%)	0 (0%)	6 (1%)	12 (1%)	29 (3%)	0 (0%)	0 (0%)	0 (0%)
Average	***101 (4%)***	***2112 (90%0***	***22 (1%)***	***19 (1%)***	***1 (0%)***	***21 (1%)***	***60 (3%)***	***0 (0%)***	2 (0%)	0 (0%)

[a] Includes releases from Bonaparte Pond. Three spring Chinook recovered in 2008 from an Omak Creek release were excluded from analysis.

[b] Includes releases from Similkameen Pond

[c] Includes releases from Carlton Acclimation Pond

[d] Includes releases from Dryden Pond and Eastbank Hatchery

[e] Includes releases from Entiat NFH

[f] Includes releases from Chelan PUD Hatchery, Chelan River NFH, and Chelan Hatchery

[g] Includes releases of summer Chinook from Wells Hatchery, Turtle Rock Hatchery, and Grant County PUD Hatchery

[h] Includes releases of fall Chinook from Priest Rapids Hatchery

[i] Includes Releases from Oxbow Hatchery

[j] Includes releases from Glenwood Springs Hatchery

Table 25. Estimated percent of spawner composition of hatchery-origin spawners from different release basins recovered on the Okanogan/Similkameen spawning grounds, based on CWT recoveries and expansions, for return years 2006-2014. For specific hatchery program releases contributing to strays in the Okanogan Basin see Appendix D

Return Year	Release Site										HOS Stray Contribution to Total Spawning Escapement	pHOS
	Summer Chinook Run							Fall Chinook Run				
	Okanogan River Basin		Within ESU Stray					Out of ESU Stray				
	Okanogan River[a]	Similkameen River[b]	Methow River[c]	Wenatchee River[d]	Entiat River[e]	Chelan River[f]	Mainstem Columbia River[g]	Mainstem Columbia River[h]	Snake River[i]	Other[j]		
2006	0.0%	15.6%	0.3%	0.3%	0.0%	0.0%	1.8%	0.0%	0.0%	0.0%	2.3%	0.18
2007	0.0%	30.0%	0.5%	0.1%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	1.7%	0.32
2008	0.0%	51.5%	0.2%	0.4%	0.0%	0.1%	2.1%	0.1%	0.0%	0.0%	2.8%	0.54
2009	0.0%	38.4%	0.2%	0.2%	0.0%	0.1%	1.4%	0.0%	0.1%	0.1%	2.0%	0.40
2010	0.1%	36.5%	0.7%	0.6%	0.0%	1.9%	1.3%	0.0%	0.1%	0.0%	4.5%	0.41
2011	2.3%	43.9%	0.5%	0.1%	0.0%	0.4%	0.2%	0.0%	0.1%	0.0%	1.2%	0.47
2012	5.2%	32.9%	0.4%	0.3%	0.0%	0.2%	0.7%	0.0%	0.0%	0.0%	1.7%	0.40
2013	3.4%	19.5%	0.1%	0.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	1.0%	0.24
2014	0.5%	9.9%	0.2%	0.0%	0.5%	0.1%	0.3%	0.0%	0.0%	0.0%	1.0%	0.11
Avg.	1.3%	30.9%	0.3%	0.3%	0.1%	0.3%	1.0%	0.0%	0.0%	0.0%	2.0%	34.2%

[a] Includes releases from Bonaparte Pond. Three spring Chinook recovered in 2008 from an Omak Creek release were excluded from analysis.

[b] Includes releases from Similkameen Pond

[c] Includes releases from Carlton Acclimation Pond

[d] Includes releases from Dryden Pond and Eastbank Hatchery

[e] Includes releases from Entiat NFH

[f] Includes releases from Chelan PUD Hatchery, Chelan River NFH, and Chelan Hatchery

[g] Includes releases of summer Chinook from Wells Hatchery, Turtle Rock Hatchery, and Grant County PUD Hatchery

[h] Includes releases of fall Chinook from Priest Rapids Hatchery

[i] Includes Releases from Oxbow Hatchery

[j] Includes releases from Glenwood Springs Hatchery

Table 26. Number and percent (%) of hatchery-origin Okanogan summer/fall Chinook that homed to target spawning areas and en route hatcheries (Wells and Chief Joseph Hatchery), and number and percent that strayed to non-target spawning areas and non-target hatchery programs, brood years 1989-2009.

Brood Year	Homing				Straying			
	Target Stream		En Route Hatchery		Non-target Streams		Non-target Hatchery	
	Number	%	Number	%	Number	%	Number	%
1989	3,132	69.7%	1,328	29.6%	2	0.0%	31	0.7%
1990	729	71.4%	291	28.5%	0	0.0%	1	0.1%
1991	1,125	71.3%	453	28.7%	0	0.0%	0	0.0%
1992	1,264	68.5%	572	31.0%	8	0.4%	1	0.1%
1993	54	62.1%	32	36.8%	0	0.0%	1	1.1%
1994	924	80.8%	203	17.7%	16	1.4%	1	0.1%
1995	1,883	85.4%	271	12.3%	52	2.4%	0	0.0%
1996	27	100.0%	0	0.0%	0	0.0%	0	0.0%
1997	11,659	97.1%	309	2.6%	35	0.3%	2	0.0%
1998	2,784	95.4%	102	3.5%	31	1.1%	2	0.1%
1999	828	96.7%	18	2.1%	10	1.2%	0	0.0%
2000	2,091	93.8%	29	1.3%	94	4.2%	15	0.7%
2001	105	98.1%	2	1.9%	0	0.0%	0	0.0%
2002	702	96.2%	17	2.3%	11	1.5%	0	0.0%
2003	1,580	96.2%	47	2.9%	16	1.0%	0	0.0%
2004	4,947	94.4%	206	3.9%	85	1.6%	2	0.0%
2005	606	93.2%	22	3.4%	22	3.4%	0	0.0%
2006	5,210	97.6%	60	1.1%	68	1.3%	0	0.0%
2007	1,330	97.9%	19	1.4%	10	0.7%	0	0.0%
2008	3,577	98.3%	34	0.9%	22	0.6%	4	0.1%
2009	1,100	92.4%	75	6.3%	15	1.3%	0	0.0%
Total	***45,657***	***90.8%***	***4,091***	***8.1%***	***497***	***1.0%***	***60***	***0.1%***
5-year Total	***11,823***	***97.1%***	***211***	***1.7%***	***137***	***1.1%***	***4***	***0.0%***

Table 27. Number and percent (%) of spawning escapements that consisted of hatchery-origin Okanogan summer/fall Chinook within other non-target basins, return years 1994-2014.

Return Year	Wenatchee		Methow		Chelan		Entiat	
	Number	%	Number	%	Number	%	Number	%
1994	0	0.0%	0	0.0%	-	-	-	-
1995	0	0.0%	0	0.0%	-	-	-	-
1996	0	0.0%	0	0.0%	-	-	-	-
1997	0	0.0%	0	0.0%	-	-	-	-
1998	0	0.0%	0	0.0%	0	0.0%	0	0.0%
1999	0	0.0%	0	0.0%	0	0.0%	0	0.0%
2000	0	0.0%	6	0.5%	30	6.4%	0	0.0%
2001	12	0.1%	0	0.0%	10	1.0%	0	0.0%
2002	0	0.0%	3	0.1%	4	0.7%	5	1.0%
2003	0	0.0%	8	0.2%	22	5.3%	14	2.0%
2004	0	0.0%	0	0.0%	5	1.2%	0	0.0%
2005	5	0.1%	27	1.1%	36	6.9%	7	1.9%
2006	0	0.0%	5	0.2%	4	1.0%	2	0.4%
2007	0	0.0%	3	0.2%	4	2.1%	0	0.0%
2008	0	0.0%	9	0.5%	46	9.3%	4	1.3%
2009	15	0.2%	3	0.2%	11	1.8%	18	7.1%
2010	6	0.1%	0	0.0%	33	3.0%	0	0.0%
2011	0	0.0%	0	0.0%	45	3.5%	0	0.0%
2012	7	0.1%	5	0.2%	18	1.4%	0	0.0%
2013	0	0.0%	0	0.0%	0	0.0%	0	0.0%
2014	0	0.0%	4	0.2%	11	1.0%	0	0.0%
Total	***45***	***0.0%***	***73***	***0.2%***	***279***	***2.6%***	***50***	***0.8%***
5-year Total	***13***	***0.0%***	***9***	***0.1%***	***107***	***1.8%***	***-***	***0.0%***

SMOLT-TO-ADULT RETURN (SAR)

The most recent brood year that could be fully assessed (through age 5) for SAR was 2009. Based on expanded CWTs, the 2009 brood year had a SAR of 0.9%, which was below the long-term and 5-year averages, 1.4% and 1.3%, respectively (Table 28).

Table 28. Smolt-to-adult return rate (SARs) for Okanogan/Similkameen summer/fall Chinook, brood years 1989-2009.

Brood Year	Number of tagged smolts released[a]	Estimated adult captures[b]	SAR
1989	202,125	4,293	2.1%
1990	367,207	972	0.3%
1991	360,380	975	0.3%
1992	537,190	2,282	0.4%
1993	379,139	117	0.0%
1994	212,818	1,528	0.7%
1995	574,197	2,851	0.5%
1996	487,776	31	0.0%
1997	572,531	18,600	3.2%
1998	287,948	7,687	2.7%
1999	610,868	2,776	0.5%
2000	528,639	6,762	1.3%
2001	26,315	424	1.6%
2002	245,997	1,975	0.8%
2003	574,908	3,489	0.6%
2004	676,222	12,896	1.9%
2005	273,512	1,660	0.6%
2006	597,276	13,626	2.3%
2007	610,379	4,758	0.8%
2008	604,064	14,027	2.3%
2009	673,372	6,383	0.9%
Total	***5,036,128***	***70,080***	***1.4%***
5-year Total	***5,421,552***	***68,776***	***1.3%***

[a] Includes all tag codes and CWT released fish (CWT + Ad Clip fish and CWT-only fish).
[b] Includes estimated recoveries (spawning grounds, hatcheries, harvest, etc.) and observed recoveries if estimated recoveries were unavailable.

Spring-Chinook Presence and Distribution

Environmental DNA

CJHP collaborates with USGS to conduct Environmental DNA (eDNA) sampling and analysis in an effort to monitor status and trends in spring-Chinook spatial distribution throughout the Okanogan basin in response to the reintroduction of the experimental population. Monitoring began prior to the reintroduction in an attempt to assess the pre-management action spatial distribution of spring-Chinook, allowing CJHP to assess the status and progress of the reintroduction efforts. Analysis of eDNA data revealed that while spring-Chinook were listed as extirpated within the Okanogan ESU, the basin likely does have a limited distribution of spring-Chinook. Additionally, PIT tag detections confirm the presence of occasional strays from out of basin (*see PIT Tag Detections Section below*).

As a proof of concept, sampling was initiated in 2012 with 5 mainstem Okanogan River sites and 11 Okanogan tributary sites as well as 32 sites throughout the Methow basin (See Laramie et al. 2015a and CJHP 2013 Annual Report). Sampling was conducted in June and August 2012 at all sites. In 2013, sampling was conducted only in the Okanogan basin, at 8 additional tributary sites not visited during the proof of concept study. These sites were sampled in June and were located in tributary streams with potential for spring-Chinook recolonization. In 2014, all previously sampled sites in the Okanogan basin were re-visited and sampled (U.S. sites on 12-13 July, 2014, and Canada sites on 2 October 2014). All sampling was conducted following the methods and protocols described in Laramie et al 2015b, and available as PNAMP Method ID# 5476 (www.monitoringresources.org/Document/Method/Details/5476). See Appendix C for results from 2012 thru 2014 eDNA analyses. Several tributaries have produced consistent annual detection of Chinook eDNA, including Shingle Creek, Vaseux Creek, Salmon Creek and Omak Creek.

PIT Tag Detections

PTAGIS contained 59 records of spring-Chinook detected in the Okanogan basin in 2014, but we subsequently re-classified one as a summer-Chinook resulting in 58 known PIT tag detections of spring-Chinook (Table 22). The majority (n=45; 78%) were hatchery fish that had been tagged at Wells Dam as an adult then detected in the Okanogan, primarily at the lower Okanogan array. Fifteen of the fish detected in the Okanogan were re-detected in the Methow basin at a later date, nine of which had a final detection site at the Spring Creek Acclimation Pond (Table 22).

Spring Chinook were detected at the Lower Okanogan array between May 15 and September 6, 2014 with a median run timing of June 8. The two latest detections in the

Okanogan were at Zosel Dam on September 28 and 30. The fish detected at Zosel Dam on September 28 was a Winthrop Hatchery spring-Chinook that was tagged as a juvenile and had last been detected at Wells Dam on May 16. Three fish were considered for possible misclassification based on juvenile and adult detection timing. First, a fish detected at Zosel Dam on September 30 had been tagged as an adult spring-Chinook at Wells Dam on June 6. Although that is a late detection at Zosel it was not outside the range seen for known spring-Chinook and the arrival timing at Wells Dam was early enough that we did not believe reclassification was warranted. Second, an 80-mm wild Chinook was tagged and released in March of 2011 in the Entiat River and it was detected as a returning adult at Bonneville Dam on June 9, Wells Dam on July 11 and the lower Okanogan array on August 27, 2014. Although somewhat late arriving for a spring-Chinook it was not late enough to be reclassified as a summer-Chinook, particularly when considering that it as a yearling smolt. Finally, a 147-mm wild Chinook was tagged at the Rock Island bypass on May 23, 2013 and classified as a spring-Chinook. This fish did not arrive at The Dalles Dam until August 19, 2014 and it passed the lower Okanogan array on September 8, 2014. This very late entry into the Columbia River makes it highly unlikely that this fish was a spring-Chinook, therefore we reclassified it as a summer-Chinook that had a yearling freshwater life history. These fish illustrate the plasticity of juvenile and adult run timing in spring and summer-Chinook, making it difficult to clearly assign every fish to one group or the other.

There were zero PIT detections in the tributaries of the Okanogan in 2014. In past years, adult spring-Chinook have been detected in Salmon, Omak, Antoine, and Loup Loup creeks. In 2014 the tributary arrays were functioning in these creeks and several others and it is not clear why the fish detected at the lower Okanogan array did not get detected in a tributary.

Thirteen (22%) of the detections had been tagged and released as juveniles somewhere outside the Okanogan, including eight that were released from hatchery facilities in the Methow (Table 29). Two of the 13 detections of fish released as juveniles were detected in the same year, indicating that they were possibly residual hatchery fish. One of these fish was released from the Clark Flat Acclimation Pond in the Yakima basin on May 8 and then detected at the Zosel Dam adult fishway on May 21. It is unlikely that a juvenile Chinook could negotiate the hydrosystem in an upstream direction that quickly and further unlikely that there would not be any detections at any adult ladders in-between. We have no avenue for further evaluation of the validity of this detection so assume that this detection record was erroneous or due to an unexplained event such as avian transport. The second juvenile detected in the Okanogan had been detected leaving the Methow River in October 2013 and was detected at the lower Okanogan instream array on April 10, 2014.

Table 29. PIT tag detections in the Okanogan for spring-Chinook in 2014. OKC/VDS3 is at vertical drop structure 3 in British Columbia upstream of Lake Osoyoos. VDS3 was not functional for most of 2014.

Origin	Release Location	Final Detection Location(s)							
		Lower Okan. River	Lower Okan., then Methow	Zosel Dam	Salmon Ck.	Omak Ck.	Other U.S. Trib.	OKC/VDS3	B.C. Trib.
Hatchery Spring Chinook	Methow/Winthrop Juvenile	7	1						
	Wells Dam Adult	28	14	3					
	Other (Clark Flat)			1					
Natural Spring Chinook	Wells Dam Adult	1							
	Twisp R. Juv.	1							
	Entiat R. Juv.	1							
	Methow R. Juv.	1							
Summer Chinook (mis-classified)	Rock Isl. Dam Juv.	1							
	Total	40	15	4	0	0	0	0	

DISCUSSION

Rotary Screw Traps (RST)

The pooled trap efficiency of approximately 1% is similar to previous observations (Rayton and Arterburn 2008, Johnson and Rayton 2007; [http://www.colvilletribes.com/media/files/2006_Screw_Trap_Report_Final.pdf;](http://www.colvilletribes.com/media/files/2006_Screw_Trap_Report_Final.pdf) http://www.colvilletribes.com/media/files/2007RstReportFinal.pdf), but remains insufficient to precisely estimate juvenile production for the basin. Even so, the 95% confidence interval for hatchery-origin population captured the total known number of hatchery-origin fish released upstream of the RST (356,403). This indicates that, despite the difficulties in accurately estimating trap efficiency and juvenile production, the results of screw trapping activities in 2014 are likely to provide a much more accurate picture of actual conditions than the results of previous years.

NOAA Fisheries suggested a goal for precision of juvenile outmigration monitoring was to achieve a coefficient of variation (CV) of 15% or less (Crawford and Rumsey 2009). It is not clear that this level of precision is attainable in any large river system using conventional sampling methods such as a rotary screw trap (see Scofield and Griffith, 2014). Still, improving trap efficiency and narrowing juvenile emigration estimates remains the goal of CJHP such that informed management decisions can be made. Environmental factors such as river discharge, configuration, and trap size influenced the efficiencies of these trials. In order to mitigate these confounding variables, we suggest more frequent efficiency trials with larger release groups ($n \geq 500$).

An attempt was made in 2014 to collect the data necessary to use a new flow regression model that may be capable of a lower CV that meets the NOAA recommendation of 15% or less (Murdoch et al. 2012). However, because of the inability of river flow to explain variance in trap efficiency ($r^2 < .1$), we were unable to use the flow-based regression model. The CJHP will continue to improve capture techniques to increase the precision of juvenile production estimates.

Differing efficiency rates for trials involving yearling and subyearling fish indicate that using hatchery releases of yearling fish, as a surrogate to measure natural production would be inappropriate. However, in future years when wild spring Chinook yearlings are present, this possibility could be reexamined.

Finally, Pacific lamprey (*Entosphenus tridentatus*) were captured in the RST in both 2006 and 2007, but were not observed from 2008 to 2014. The status of this fish, an important cultural and ecological resource in the Okanogan River Basin is not examined in this report, but its disappearance from the RST is notable.

Juvenile Beach Seine

The CJHP took over the beach seining effort in 2014 adopting methods used by Douglas County PUD and Biomark in 2011-2013. Given the low catch rate of taggable summer/fall Chinook from the RST, beach seining appeared to be a more reliable opportunity to capture large numbers of taggable summer/fall Chinook juveniles. More than 9,000 subyearling Chinook were captured from Gebber's Landing over a four-week period. Of these fish, 8,226 were PIT tagged and released into the Columbia River in July. This is over twenty times more tagged fish than were released at the Okanogan RST.

Mortality related to capture, handling and tagging were low (9.0%) and would have been lower if loading densities and holding time were reduced after capture and before transfer to the net pens. Also maintaining water temperatures below 18 °C during tagging may have decreased our post tagging mortality. These methods will be implemented and assessed in 2015.

Fish size increased through the 2-3 week tagging period but the number of fish captured decreased in the fourth week. Ten percent of all released fish were detected at Rocky Reach Dam. The largest proportion of detected fish migrated in July (0.63) with detections continuing through September 15. The juvenile bypass system was turned off on October 29. One to four percent of detections at lower Columbia projects occurred between November and December, which could indicate that fish migrated past Rocky Reach Dam after the juvenile bypass was turned off. These detections at McNary, John Day and Bonneville occurred right up until their juvenile bypass systems were turned off in November or December. If some subyearlings migrate through the lower Columbia projects during periods when they cannot be detected, these tagged fish would not have equal detectability, and thus the juvenile survival through the hydrosystem would be underestimated.

Although capture locations in 2014 were limited, fish were captured in areas that could also be used by juveniles originating from Methow and Columbia River spawning areas. Therefore, future analyses of returning adults will need to take this into account by recognizing that some fish may not be destined for the Okanogan.

Lower Okanogan Adult Fish Pilot Weir

Temperature and discharge conditions on the Okanagan River in 2014 were fairly typical, allowing for installation and operation of the weir in early August and capture and observation of many Chinook and Sockeye. There was an abrupt break in the thermal barrier during the month of July but flows were too high (>3,000 cfs) for weir installation. In August, the thermal barrier did not appear to break down as abruptly. Temperature slowly dropped below 22.5 °C in late August and the day of greatest fish passage occurred about a week after the mean daily temperature dropped below 22.0 °C. With two years of data, further speculation regarding the relationship between temperature at Malott and the post thermal barrier passage of mid-late arriving summer Chinook is not merited. However, continued monitoring of Chinook passage through the weir with respect to temperatures should continue in order to better refine weir operations and future expectations for weir effectiveness. None of the water quality parameters monitored were at a level that would cause concern regarding an environmental effect of the weir on water quality.

Although the number (202) of dead fish at the weir may seem high, the reality was that dead 'wash ups' were not a good indicator of weir effects. A fish kill upstream that had nothing to do with the weir could cause many fish to wash up on the upstream side of the weir. Conversely, any adverse effects of the weir would not have been detected if fish carcasses were stranded on shore or taken by scavengers before washing up on the weir. However, behavioral observations and the lack of fish impinged between pickets (head upstream) were good indicators that this weir configuration and picket spacing were not a major cause of direct mortality. No data were collected to assess indirect mortality.

Weir trapping and fish handling commenced when temperatures dropped below 22.5 C (per the conditions of the HPA). Natural-origin Chinook were successfully trapped and released into the river. Hatchery-origin broodstock were successfully collected and there was 100% survival to spawning. Similar to 2013, many Sockeye were observed swimming through the 2.5 to 3.0-inch picket spacing that were intended for that purpose. Unfortunately there was no way to quantify the number of Sockeye that swam through the weir panels versus those that entered the trap. Jack and small adult Chinook were observed passing through the 2.5 and 3.0 weir panels but also could not be enumerated. Due to these observations, we recommend removing the 3.0 inch weir panels to increase the efficiency of Chinook trapping without causing too many Sockeye to also use the trap.

There was no way to know how many fish escaped past the weir before it was installed or how many fish swam through, around or jumped over the wings after it was installed (zero fish were observed attempting to jump over the weir). However, we were able to relate observations at the weir to estimates of total spawners and evaluate efficiency and effectiveness of the weir. The weir effectiveness measure of 14.8% shows high potential for using the weir as an important tool for pHOS management. Although only 13.7% of the Chinook trapped were hatchery origin, many more hatchery Chinook are expected to be removed when CJH adult Chinook return as of 2017. Continuing these evaluations in future years will be critical to determining the long-term viability of the weir as a fish management tool for summer Chinook.

Tower observations were limited to daylight hours and their quality and accuracy were affected by wind, cloud cover, and time of day (sunlight and shadows differentially affected river left in the morning). These effects were not quantified. The broad array of behavior types and the similarities between some of them limited the utility of the tower observation data. Tower observations were thought to be an important component of the fish monitoring data for weir effects and effectiveness, and perhaps they would have been if fish had responded differently to the weir. However, given the qualitative nature of the observations there is not much that can be said about the results. It seems intuitive that staff on site ought to be observing and recording data regarding fish presence/absence and activity when the weir is in active fishing mode, but this qualitative information may never prove to be very useful in a post-hoc assessment. In the future, we suggest an evaluation of the PIT detections at the Okanogan Lower Instream Array (rkm 25) to provide additional information about fish behavior downstream of the weir.

Snorkel surveys revealed relatively few fish observations. Limited visibility in deep/wide holding areas downstream of the weir did not allow a continuous view of the river bottom. Bank observations of breaching Chinook were more efficient than snorkel surveys and provided adequate downstream information regarding fish activity and carcasses. In the future, we suggest abandoning the snorkel surveys and instead making systematic bank observations in the two deep pools downstream of the weir.

The acoustic evaluation of sockeye passage at the weir provided additional insight and analysis to the investigation of the weir and its effects on one non-target species. This study was not adequate to prove that the weir itself caused a delay of sockeye salmon in their migration through the lower Okanogan River, but did offer strong evidence of a minor delay (29 minutes) for Sockeye. Temperature, flow, fish migration behavior, fish condition and holding effects and other factors were all different between the pre- and post-weir migration observations. For more details see Appendix C.

Broodstock collection at the weir was successful with little prespawn mortality (10.6%). The high survival rate provided confidence that the weir can be used for broodstock collection in the future. We suggest a continued risk-averse approach to broodstock collection at the weir in 2015, particularly if natural origin broodstock are collected. The effects on survival and egg viability due to prolonged prespawn holding in the Columbia River and late migration into the relatively warm Okanogan have not been evaluated.

RECOMMENDED WEIR AND TRAP CHANGES FOR 2015.—In January and February of 2015, the CJHP Science Program staff convened a post- season review group to discuss operations and recommendations for improvements/changes. The entire season was reviewed and subsequently, data were reviewed with results appearing in this report. The following recommendations are derived from the 2014 post- season analysis and the subsequent findings from CCT's research, monitoring and evaluation activities:

1. Install additional walkway access point section
2. Live box(s) fabrication
3. Walkway fish transport carts
4. Consider alternative power source locations
5. Consider alternative trap locations
6. Add two more sections of trap walk way
7. Trap ingress/egress ladder
8. Recessed video and lighting housings
9. Adjusting entry and crowder gate alignment
10. Install weir panels adjacent to trap box in direct water velocity through the trap
11. Install weir panels adjacent to river bank at access site to prevent bank erosion
12. Increase the quantity of cool well water via a hose from the bank to the trap entrance (running along the weir panels) to increase cold-water entrainment
13. Install the crowder to allow for partitioning of the trap volume
14. Move PIT detection system to trap exit gates
15. Perform downstream bank and boat surveys instead of snorkel surveys
16. Reduce the quantity of qualitative behavioral observation categories for the tower observations

Redd Surveys

Summer Chinook spawning activity was high in 2014, with the highest redd count observed in the Okanogan River Basin since 2006 and above average red counts in all reaches (Table 17).

The overall percent of natural-origin carcasses recovered in reach O6 dropped substantially from the previous year, while reach S2 increased in its' proportion of natural-origin returns. One objective of the new CJHP is to increase spawning distribution in the lower reaches of the Okanogan where a low proportion of the spawning activity has traditionally occurred. Continued monitoring of redd and carcass distribution will be critical to evaluation of this metric.

Although aerial surveys contributed a relatively small portion of the observed redds, they were very important for documenting that little to no spawning is occurring in areas not surveyed with a ground crew, and for enumerating redds in non-floated, low density spawning areas. We suggest that future aerial surveys extend into the second week in November to look for late spawning Chinook redds. Traditionally, there has been no documented effort with ground or aerial surveys to document or quantify late spawning Chinook. This effort is justified by the highest redd counts in O1 and O2 occurring the last week of surveys (Nov 3-8)(Table 19).

Redd surveys should have started earlier because the majority of redds were created by the second week of surveys. Ideally, redd surveys should begin at the onset of spawning to better asses the entire spawning period. Earlier redd count efforts would also help us to better assess pre-spawn mortality.

The fish per redd expansion was based on the sex ratio at Wells Dam. This method has been used since at least 1998 (Hillman et al. 2014) and is still being applied to both the Methow and Okanogan populations. However, there is uncertainty that the combined sex ratio of hatchery and wild summer Chinook at Wells Dam is representative of the Okanogan population because it includes Methow returns as well as mainstem released hatchery fish and downstream hatchery and wild fish. If the Okanogan has a different ratio of precocial males (jacks) than that of the Wells count, then the Okanogan abundance estimate would be biased. We suggest exploring other approaches to estimating the number of fish per redd in the Okanogan and Similkameen Rivers.

ESCAPEMENT INTO CANADA

Escapement of summer/fall Chinook into Canada had been largely overlooked until recently, when the video counts of Chinook passing over Zosel Dam increased to a level where OBMEP staff brought the results to the attention of CJHP staff. Spawning escapement in Canada is still unknown, as the video counts represent run escapement and the relationship between run escapement and spawn escapement is not clear. Informal discussions with Canadian biologists indicate that small numbers (i.e., substantially fewer than the Zosel Dam video counts) of Chinook spawners have been detected building redds in the Canadian portion of the Okanogan River (R. Bussanich, ONA, pers. comm., 2014). This discrepancy has at least three possible explanations that need to be further explored in the coming years.

1) Chinook can migrate downstream through Zosel Dam without being detected in the fishways video monitoring system.
2) Chinook are making it to spawning areas in the Canadian Okanogan and not being detected by Canadian spawning ground surveys. These surveys currently target sockeye, but the spawn timing and potential spawning areas are similar.
3) High pre-spawn mortality kills fish between passage at Zosel Dam and potential spawning grounds somewhere in Canada.

Some possible solutions to exploring these explanations include:

a) Evaluate PIT tag results for fish that might ascend through the fishways multiple times (this will not account for fish that fall back once and don't re-ascend).
b) Conduct more extensive surveys in Canadian Okanagan River of larger substrate areas during peak summer Chinook spawning (mid-late October). It is not clear where, when, or if there are gaps in time and space that would allow Chinook spawning to go undetected.

c) Conduct carcass surveys above Zosel Dam, throughout Lake Osoyoos and the Canadian Okanogan looking for pre-spawn mortality.
d) Capture and radio tag fish in the Zosel fishways.

Until a definitive method is developed for estimating spawn escapement in Canada, the CJHP will continue to monitor and report run escapement via video monitoring. However, we will not add run escapement past Zosel Dam to spawn escapement in the U.S. because this could overestimate total spawners if explanation 1 or 3 (see list above) are true.

Carcass Surveys

2,452 carcasses were recovered out of an estimated 12,164 spawners, which met the target carcass recovery rate of 20%. Zhou (2002) reported fish length as a significant factor in carcass recovery probability, with larger fish recovered at a higher rate than smaller fish. This is especially important as it relates to precocious males, or jacks, which are expected to occur with higher frequencies in hatchery-origin Chinook. Failing to assess and correct for biases and population discrepancies could lead to potential underestimation of hatchery-origin Chinook survival (resulting in inflated hatchery production) or over-estimation of wild-origin Chinook survival (masking potentially negative effects of the hatchery program) (Murdoch et al. 2010).

Egg retention and pre-spawn mortality results should be interpreted cautiously. Carcass collection for examination did not begin in 2014 until October 6. Redd surveys show this date to be later than the onset of spawning activity. The carcasses of fish that died prior to the onset of spawning and before sampling began may have been carried downstream of recovery floats, consumed by scavengers, or covered with sediment, making them unavailable for sampling or harder to detect and collect. This could result in an underestimation of pre-spawn mortality. The protocol assumes that each female may contain 5,000 eggs and were only considered pre-spawn mortality if they retained all 5,000 eggs. A static fecundity assumption may not be the best approach because younger and smaller females will likely have fewer eggs. Additionally, the current assumption used by the CJH during in-hatchery spawning activities for average fecundity is 5,000 eggs. We expanded the assessment to include an evaluation of fish that retained greater than 1,000 eggs as an attempt to capture some of the variability in fecundity and situations where fish died before depositing a biologically important portion of their eggs. We are not sure that 1,000 eggs are biologically important, but clearly there should be some amount of egg retention that matters besides 100%. We added a hatchery- versus natural-origin assessment of egg retention and propose that is the meaningful metric that should be continued in the future. We suggest continued review and modification of the egg retention estimation methods/protocol in the future.

pHOS and PNI

The biological target for CJHP is to maintain a 5- year average pHOS <0.3. Although the 5-year average (0.32) failed to meet this objective, pHOS was <0.3 in 2013 and 2014 (0.27 and 0.12, respectively). The 5-year mean is trending towards the objective. The program met the biological target for PNI (>0.67) for the second year in a row. Although the 5-year mean (0.71) failed to meet the objective, PNI is on a positive trend towards the objective. In the future, we suggest that continued aggressive removal of hatchery fish through selective fisheries and adult management at the weir and hatchery ladder can be important for the program to meet the biological targets for pHOS and PNI.

Origin of Hatchery Spawners

Hatchery-origin fish recovered on the spawning grounds in the Okanogan Basin were predominantly (95%) from the Okanogan Basin releases. Stray hatchery fish from outside the Okanogan made up a very small percentage (<1%) of total spawners. Likewise, Okanogan Basin hatchery fish strayed to other areas at a low rate (1.3%) and were a small percentage of the spawner composition in other Upper Columbia tributaries. Stray rates and hatchery spawner composition were within the target levels for the program both within and outside the Okanogan Basin.

Smolt-to-adult Return

SAR for the most recent full brood returns (2009) was slightly below the 5-year and long-term averages. It is likely that the SAR estimate is biased low because some recovery efforts were not expanded within RMIS. We had no way to obtain information necessary to do these expansions or to even speculate as the magnitude of the potential error introduced because of it. In the future, we suggest also using PIT tags as an independent, additional estimate of SAR.

Adaptive Management and Lessons Learned

The Annual Program Review (APR)

Each year the CJHP hosts a workshop to review and present findings from the previous year and plan for the upcoming fish production and science monitoring cycle. The APR was convened in March 2015 with the purpose of reviewing data collection efforts and results from 2014 and developing the hatchery implementation and monitoring plan for 2015 (Figure 27). This effort is focused on using adaptive management to guide the program. After a series of presentations highlighting the data collection activities and results, the group (CJHP staff and invited guests from Federal, State, PUD, and other organizations) used the In-Season Implementation Tool (ISIT) during the "Analysis" step (Figure 28). The group reviewed the ISIT input parameters for key assumptions, status and trends and decision rules to be sure that the best available information was included in the model. ISIT then used the pre-season Upper Columbia summer/fall Chinook Salmon forecast to provide an estimate of how the program could be implemented with respect to broodstock collection, harvest, weir and hatchery ladder operations to achieve biological targets for 2015. APR materials with more details than what is provided within this report can be found at www.colvilletribes.com/cjhp.php.

Key Management Questions

Answering key management questions is an essential function of the CJHP and is central to the analysis and reporting steps in both the APR and this annual report. Management questions inform the development of the RM&E activities, the CJHPs Key Management Questions (KMQs) are:

1. What is the current status and recent historical trend of the naturally-spawning population in terms of Viable Salmonid Population (VSP) parameters[8]
2. What is the current status and recent historical trends for hatchery returns and harvest?
3. Is the hatchery program meeting target in-hatchery performance standards?
4. Are the hatchery post-release targets met for survival, catch contribution and straying?
5. Are targets for total catch contribution and selectivity for HORs met?
6. Are there negative effects of the hatchery on the natural population?
7. Are assumptions about natural production potential valid?
8. How should the program be operated in the coming year?

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[8] From McElhany, 2000 (NOAA), a viable salmonid population is an independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame. The four VSP parameters are abundance, productivity, spatial structure and diversity.

Figure 27. The Chief Joseph Hatchery's annual planning process and work flow.

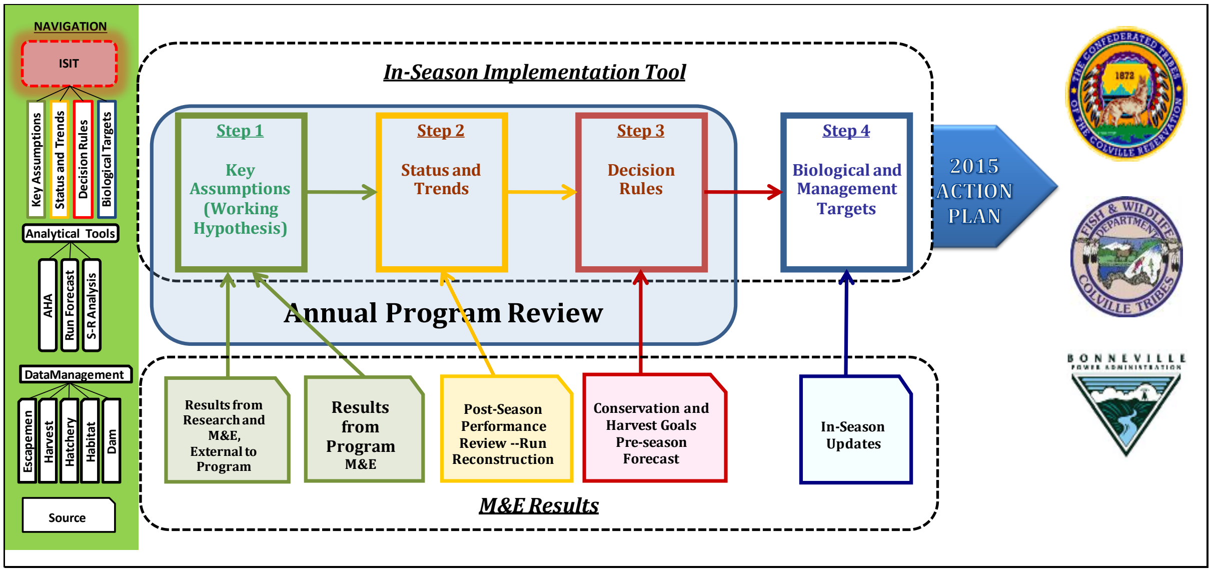

Figure 28. The Chief Joseph Hatchery's analytical work flow.

2015 Run Size Forecast and Biological Targets

Run-size forecasts and updates are an early indicator for the biological targets for the coming season, through the Decision Rules outlined in the ISIT. The preseason forecast is based on brood year escapement and juvenile survival indicators and is generated through the Technical Advisory Committee (TAC) to the *U.S. v. Oregon* fish management agreement. As the season nears, this information is supplemented with return data from downstream dam counts. The pre-season forecast for Upper Columbia summer Chinook Salmon was 73,000. The pre-season forecast, and subsequent run updates from early dam counts, were used to predict the NOR and HOR run size for the Okanogan population. Hatchery broodstock and selective harvest targets are determined based on these estimates and the objectives for pHOS (<0.30) and PNI (>0.67). A regression analysis conducted within ISIT in preparation for the APR predicted that the pre-season forecast of 73,000 upper Columbia would yield 10,196 NORs and 3,915 HORs (Figure 29). The harvest and broodstock collection goals were established from this prediction. With a NOR run size over 5,000 the broodstock collection recommendation for the integrated program was full production (613 NOB) with 100% pNOB (Figure 29). Likewise, the segregated program should achieve full production with 498 HOB. The model predicted that 539 HORs would be captured in the terminal (above Wells Dam) fisheries and that 1,656 HORs could be removed at the weir. These efforts could result in 9,494 NOS and 1,656 HOS for a pHOS of 12% and a PNI of 0.89. Under this modeling scenario the biological targets would be met in 2015. As run size updates become available (through TAC) the ISIT outputs will be double checked until the final in-season check point on July 15, 2015. At that time the run size at Wells Dam will be input into ISIT and the final plan for broodstock and harvest will be updated. If the July 15 update includes more hatchery and natural fish than predicted, then harvest and removal of surplus fish at the weir and the hatchery ladder will be implemented by CCT and WDFW (through their mark-selective sport fishery).

MANAGEMENT TARGETS

2014 **<-- Most recent year included in running averages**

Use **5** **year average**

Recent History:

Average NOB	**287**
Average HOB	**101**
Average pNOB	**74%**
Average NOS	**5,749**
Average HOS	**2,378**
Average pHOS	**29%**
Average PNI	**0.72**

Expected Returns to Wells Dam (most recent update):

NOR Return	**10,196**
HORs from Integrated Program	**3,915**
HORs from Segregated Program	**-**

Runsize Prediction for:	**2015**
Preseason forecast (Columbia)	**73,000**
Applies until:	**7/15**
Wells Dam Count thru 7/15	**-**
Okanogan NOR Forecast:	**10,196**
HOR Forecast:	**3,915**

Management Targets based on Okanogan NOR Forecast

Harvest*	HORs retained in Fisheries	539
	Incidental Loss of NORs	89
	**Partial source of broodstock*	
Hatchery and Weir*	Return of HORs to Hatchery	64
	HORs retained at Weir	1,656
	**Partial source of broodstock*	
Integrated Hatchery Program	Natural Origin Brood (NOB)	613
	Hatch. Origin Brood (HOB) -Okan	0
	Projected Annual pNOB-Okan	100%
	Cum pNOB	88%
	Smolt Release-Okanogan	1,100,000
Segregated Hatchery	Hatch. Origin Brood (HOB) -CJH	498
	Smolt Release-CJH	900,000
Natural Spawning Escapement	Nat. Origin Spawners (NOS)	9,494
	Hat. Origin Spawners (HOS)	1,656
	Total Number of Spawners	11,150
	pHOS	12%
	PNI	0.89

Projected Status of Biological Indicators*:

Average NOS	**7,010**
Average pHOS	**24%**
Average PNI	**0.79**

*Expected values of Biological Targets if Management Targets are met.

Terminology
Biological Targets are expressed in terms of Biological Indicators (NOS, pHOS, PNI). They don't change from year to year.
Management Targets are expressed in terms of controlled variables. They vary from year to year based on the Status and Trends data and forecasted adult returns.

Figure 29. The in-season updates management worksheet used to set biological targets for the upcoming year in the In-Season Implementation Tool.

2015 Key Assumptions

The CJHP reviews the key assumptions (working hypothesis) each year at the APR workshop. These assumptions directly affect the decision rules used to guide in-season management decisions. The program documents the changes and uses this information for future review and analysis (Figure 30).

Okanogan-Similkameen Summer Chinook			Biological				
Natural Production	Baseline		Targets	Transition 1	Transition 2	Long-term	Segregated Prog
Productivity (Smolts/Spawner)	969			969	969	969	
Capacity (Smolts)	807,784			807,784	807,784	807,784	
Juv Passage Survival	27.00%			27.00%	27.00%	27.00%	
Ocean Survival	4.10%			4.10%	4.10%	4.10%	
Adult Passage Survival	83.00%			83.00%	83.00%	83.00%	
Fitness	0.68			0.85	0.57	0.57	
PNI	0.56	<	0.67	0.70	0.42	0.42	
Total pHOS	50%	>	30%	43%	42%	42%	
Segr. pHOS	1%	<	5%	1%	2%	2%	
Ocean Harvest Rate	29%			29%	29%	29%	
Lower Columbia Harvest Rate (Zones 1-6, Mouth to MCN)	5%			5%	5%	5%	
Upper Columbia Harvest Rate (MCN to Wells)	2%			2%	2%	2%	
Terminal Harvest Rate (Post Wells)	1%			1%	1%	1%	
Natural Origin Spawners	3,454	<	5,250	3,639	3,296	3,296	
Hatchery Production							
Local Brood	324			613	562	562	337
Yearling Release	576,000			800,000	1,000,000	1,000,000	500,000
Sub-yearling Release	-			300,000	0	0	400,000
SAR (yearling)	1.43%			1.43%	1.43%	1.43%	1.43%
SAR (sub-yearling)	0.30%			0.30%	0.30%	0.30%	0.30%
Return Rate to Okanogan	98%			98%	98%	98%	20%
pNOB	50%			100%	30%	30%	
NOB	162			613	169	169	
Relative Reproductive Success	80%			80%	80%	80%	80%
Ocean Harvest Rate	29%			29%	29%	29%	29%
Lower Columbia Harvest Rate (Zones 1-6, Mouth to MCN)	10%			10%	10%	10%	10%
Upper Columbia Harvest Rate (MCN to Wells)	10%			10%	10%	10%	10%
Pre-terminal Harvest Rate (Ocean to Wells)	42%			42%	42%	42%	42%
Terminal Harvest Rate (Post Wells)	14%			14%	14%	14%	90%
Hatchery Surplus	6			3,494	4,773	4,773	3,479
Average Terminal HOR Run	4,766			6,620	8,275	8,275	4,137
Expected HOS	4,031			2,800	3,500	3,500	372
Fisheries and Weirs							
Weir Factor	0%			50%	50%	50%	
NOR Harvest Release Mortality	10%			10%	10%	10%	

Figure 30. The key assumptions worksheet used in the 2015 In-Season Implementation Tool for the CJHP planning at the Annual Program Review

2015 Status and Trends

The recent performance of the population is a primary driver for determining how the hatchery program should be operated in the future. This was accomplished by updating and reviewing the status and trend information within five categories: (1) natural production, (2) hatchery production, (3) harvest, (4) migration, and (5) habitat (Figure 31).

Return year		FPC Reported Dam Count at Wells thru 7/15	% of final count	PUD Counts at Wells Dam: NOR All Origins	PUD Counts at Wells Dam: HOR All Origins	Estimated Return of Okanogan Origin Fish: Okan. NORs	Estimated Return of Okanogan Origin Fish: Okan. HORs
1998	3	**1,060**	0.25	970	5,519	**899**	492
1999	4	**999**	0.11	2,708	4,580	**1,649**	2,343
2000	5	**2,266**	0.26	2,726	7,398	**1,475**	2,527
2001	6	**9,766**	0.24	10,266	19,195	**4,872**	6,551
2002	7	**23,221**	0.34	24,138	42,035	**5,168**	10,501
2003	8	**20,564**	0.40	9,194	7,373	**2,717**	2,698
2004	9	**14,762**	0.40	23,227	13,989	**8,086**	1,630
2005	10	**14,449**	0.42	18,911	15,164	**8,629**	2,801
2006	11	**12,563**	0.43	20,262	8,730	**8,842**	3,837
2007	12	**5,532**	0.37	7,088	7,789	**4,941**	1,984
2008	13	**8,838**	0.35	11,244	13,779	**4,640**	5,517
2009	14	**13,753**	0.46	15,184	14,187	**6,038**	5,352
2010	15	**12,264**	0.41	5,671	7,167	**4,880**	4,937
2011	16	**3,912**	0.12	12,139	19,164	**6,778**	5,616
2012	17	**10,113**	0.24	14,424	27,716	**6,932**	5,635
2013	18	**25,571**	0.38	34,965	30,179	**8,770**	4,556
2014	19	**26,010**	0.39	36,060	21,015	**13,819**	3,395
2015	20	-					
2016	21	-		-			

Return year		Terminal Harvest Above Wells – Tribal Harvest: Total Tribal Harvest	Total NORs	Total HORs	Okan. NORs	Okan. HORs	CJH HORs	Recreational Harvest: Total Rec. Harvest	Total NORs	Total HORs	Okan. NORs	Okan HORs
1998	3	-	0	0	-	-	-	-	-	-	-	-
1999	4	-	0	0	-	-	-	-	-	-	-	-
2000	5	-	0	0	-	-	-	-	-	-	-	-
2001	6	-	0	0	-	-	-	-	-	-	-	-
2002	7	**1,753**	653	1100	118	990	-	-	-	-	-	-
2003	8	**2,130**	785	1345	141	1,211	-	-	-	-	-	-
2004	9	**242**	0	242	-	218	-	**2,803**	1,895	908	1,706	817
2005	10	**784**	392	392	71	353	-	**1,419**	1,025	394	923	355
2006	11	**1,389**	563	826	101	743	-	**2,119**	1,809	310	1,628	54
2007	12	**1,078**	467	611	84	550	-	**1,803**	887	916	798	726
2008	13	**2,299**	588	1711	106	1,540	-	**1,665**	698	967	628	561
2009	14	**2,598**	363	2235	65	2,012	-	**1,062**	648	414	583	244
2010	15	**2,912**	354	2558	64	2,174	-	**1,019**	612	407	551	204
2011	16	**1,097**	449	648	81	577	-	**1,017**	200	817	180	556
2012	17	**3,184**	656	2528	118	2,250	-	**2,470**	829	1,641	746	1,264
2013	18	**3,176**	832	2344	150	2,110	-	**2,107**	179	1,928	161	1,735
2014	19	**2,963**	1508	1455	271	1,310	-	**1,383**	321	1,062	289	956
2015	20											
2016	21											

Return year		Broodstock – Okanog./Similk Integrated Program: Total NORs	Okan. NORs	Total HORs	Total Brood	Okanogan origin pNOB	Okanogan Natural Spawning Escapement: NOS	HOS	Census pHOS	Effective pHOS	PNI
1998	3	153	77	211	364	21%	600	492	45%	40%	35%
1999	4	224	112	289	513	22%	1,274	2,343	65%	60%	27%
2000	5	164	82	339	503	16%	1,174	2,527	68%	63%	20%
2001	6	91	46	266	357	13%	4,306	6,551	60%	55%	19%
2002	7	247	124	241	488	25%	4,346	9,511	69%	64%	28%
2003	8	381	191	101	482	40%	1,933	1,487	43%	38%	51%
2004	9	506	253	16	522	48%	5,309	1,412	21%	18%	73%
2005	10	391	196	9	400	49%	6,441	2,448	28%	23%	68%
2006	11	500	250	10	510	49%	5,507	3,094	36%	31%	61%
2007	12	456	228	17	473	48%	2,983	1,434	32%	28%	63%
2008	13	404	202	41	445	45%	2,998	3,977	57%	51%	47%
2009	14	507	254	-	507	50%	4,204	3,340	44%	39%	56%
2010	15	484	242	8	492	49%	3,189	2,763	46%	41%	55%
2011	16	467	332	26	493	67%	4,642	5,039	52%	46%	59%
2012	17	107	96	-	107	90%	4,840	3,385	41%	36%	71%
2013	18	353	318	-	353	90%	5,474	2,117	28%	24%	79%
2014	19	498	448	-	498	90%	10,532	1,632	13%	11%	89%
2015	20										
2016	21										

Figure 31. The status and trends worksheet in the In-Season Implementation Tool for CJHP planning at the Annual Program Review.

2015 Decision Rules

The decision rules determine the targeted size of the hatchery program and the management of natural escapement abundance and composition. The purpose of the Decision Rules is to assure that the CJHP manages the hatchery, terminal fisheries and weir to meet the guidelines for abundance, spawner composition, and distribution of the natural spawning escapement (Figure 32).

DECISION RULES

Criteria for transitions:

Current -> Transition 1	2014-Facilities completed and tested, full brood available
Transition 1 -> Transition 2	2019 or 5000 NORs (5-year rolling average)
Transition 2 -> Long Term	2027-

5-year running average NORs: 8,251

Select a Phase: Transition 1

Biological Targets for the Selected Phase ↓

		Transition 1	Baseline	Transition 1	Transition 2	Long-term
	Minimum NOR escapement	800	800	800	800	800
	Smallest viable hatchery program	100,000	100,000	100,000	100,000	100,000
	Max % of NOR used for Broodstock	30%	30%	30%	30%	30%
Integrated Program	Max Number Yearlings	800,000	215,000	800,000	1,000,000	1,000,000
	Max Number Sub-yearlings	300,000		300,000		
	pNOB Trigger (NOR run)	1,100	1,100	1,100	1,100	1,100
	pNOB	100%	100%	100%	30%	30%
Segregated Program	Max Number Yearlings	500,000	-	500,000	600,000	600,000
	Max Number Sub-yearlings	400,000		400,000		-
	Backfill w/ HORs (Y, N)	N	N	N	N	N

Biological and Management Targets based on Run Forecast and Decision Rules:

pHOS

Forecast return of CJH HORs to Wells: 0

Return of Okanogan HORs

NOR Return	1,000	2,500	3,915	6,000	7,000	8,000
600	36%	59%	69%	77%	80%	82%
800	30%	51%	62%	72%	75%	77%
1,000	30%	51%	62%	72%	75%	77%
1,100	30%	51%	62%	72%	75%	77%
1,200	29%	50%	61%	71%	74%	76%
1,300	27%	48%	59%	69%	72%	75%
2,000	20%	38%	49%	59%	63%	66%
2,500	15%	31%	41%	52%	56%	59%
3,500	11%	23%	32%	41%	45%	49%
10,196	3%	8%	12%	18%	20%	22%
6,000	6%	14%	20%	27%	31%	34%
8,000	4%	10%	15%	22%	24%	27%
10,000	3%	8%	12%	18%	20%	22%

PNI

Return of Okanogan HORs

NOR Return	1,000	2,500	3,915	6,000	7,000	8,000
600	-	-	-	-	-	-
800	-	-	-	-	-	-
1,000	77%	66%	62%	58%	57%	56%
1,100	77%	66%	62%	58%	57%	56%
1,200	78%	67%	62%	59%	57%	57%
1,300	79%	67%	63%	59%	58%	57%
2,000	84%	73%	67%	63%	61%	60%
2,500	87%	76%	71%	66%	64%	63%
3,500	90%	81%	76%	71%	69%	67%
10,196	97%	92%	89%	85%	83%	82%
6,000	94%	88%	83%	78%	77%	75%
8,000	96%	91%	87%	82%	80%	79%
10,000	97%	92%	89%	85%	83%	82%

Nat. Origin Spawners (NOS)

NOR Return	1,000	2,500	3,915	6,000	7,000	8,000
600	598	598	598	598	598	598
800	797	797	797	797	797	797
1,000	805	805	805	805	805	805
1,100	805	805	805	805	805	805
1,200	835	835	835	835	835	835
1,300	835	905	905	905	905	905
2,000	1,392	1,392	1,392	1,392	1,392	1,392
2,500	1,878	1,878	1,878	1,878	1,878	1,878
3,500	2,874	2,874	2,874	2,874	2,874	2,874
10,196	9,545	9,545	9,545	9,545	9,545	9,545
6,000	5,365	5,365	5,365	5,365	5,365	5,365
8,000	7,357	7,357	7,357	7,357	7,357	7,357
10,000	9,349	9,349	9,349	9,349	9,349	9,349

Total Number of Spawners

Return of Okanogan HORs

NOR Return	1,000	2,500	3,915	6,000	7,000	8,000
600	1,021	1,655	2,253	3,135	3,558	3,981
800	1,220	1,854	2,453	3,335	3,757	4,180
1,000	1,228	1,862	2,461	3,343	3,765	4,188
1,100	1,228	1,863	2,461	3,343	3,766	4,189
1,200	1,258	1,893	2,491	3,373	3,796	4,219
1,300	1,328	1,962	2,561	3,443	3,866	4,288
2,000	1,815	2,450	3,048	3,930	4,353	4,776
2,500	2,301	2,935	3,534	4,415	4,838	5,261
3,500	3,297	3,931	4,530	5,412	5,835	6,258
10,196	9,968	10,602	11,200	12,082	12,505	12,928
6,000	5,788	6,422	7,020	7,902	8,325	8,748
8,000	7,780	8,414	9,013	9,895	10,318	10,740
10,000	9,772	10,407	11,005	11,887	12,310	12,733

Figure 32. Screen shot of the decision rules in the In-Season Implementation Tool for CJHP planning at the Annual Program Review.

The Annual Program Planning Tool (APPT)

In 2014, the CJHP, in consultation with regional partners and experts, initiated an effort to systematize the CJHP's annual planning workshops. The result is a set of tools used to improve efficiency and coordination of integrated, all H-planning processes. The Annual Program Planning Tool (APPT) tools help link activities across the CJHP and the CCT's Anadromous Fish Division to management decisions, and bring the relationship to resource goals into focus.

The APPT tool consists of interconnected modules contained in an Excel-based environment and workbook. The completed APPT spreadsheet can be found in Appendix F. The purpose of the APPT is to:

- Link CJHP activities to Key Management Questions, hypotheses, indicators and variables;
- Identify the specific data necessary for use in the All-H Analyzer (AHA) and In-season Implementation Tool (ISIT) and other analyses;
- Schedule annual Chief Joseph Hatchery Program (CJHP), production and science program activities;
- Identify specific and integrated data input deliverables from harvest, hatchery, hydro and habitat Programs ("All-H" integration);
- ~~Assign staff responsible for leading each activity, and~~
- Produce output suitable for developing budgets, work and implementation plans, staffing levels, activity schedules and identification and linkages to BPA's Pisces work elements.

Data Gaps and Research Needs

In a partnership with USGS, WDFW and the ONA, the CJHP is working to identify data gaps and applied research needs within the Okanogan Basin that would better inform hatchery management, increase available data for resource management decision making, and benefit overall salmonid recovery in the greater Columbia River basin. If funded in the future, the tasks identified could directly inform CJHP and other natural resource managers and aid in the decision making process. Some of the data gaps and applied research needs that have been identified include:

1. Refined estimates (extent, fate, timing and location) of summer/fall Chinook using the mainstem Columbia River above Wells Dam for spawning (i.e. straying), rather than returning to their natal Okanogan River using radio or acoustic telemetry.
2. Extent, fate, timing and location of spawning Chinook in the Canadian portion of the Okanogan Basin.
3. Development and testing of a panel of microsatellites and/or single nucleotide polymorphisms (SNPs) for genotyping genetic stocks of Chinook salmon in the Okanogan Basin and upper-Columbia River, upstream of Wells dam, to identify and

differentiate Okanogan summer- vs. fall- vs. spring-Chinook, as well as hatchery × hatchery, hatchery × wild, and wild × wild crosses of these various life-history types.

4. Utilization of advancements in thermal imaging/LiDAR or other remote sensing technologies combined with in-stream temperature loggers and ArcGIS/R Statistical Program (STARS & FLoWs toolsets & SSN package) to map current thermal refugia in the Okanogan basin and model potential changes resulting from climate change scenarios.
5. Development and/or adaptation of existing methods for better estimation of fine sediment loads per reach length in the Okanogan River to quantify effects on Chinook salmon spawning redds and productivity.
6. Implementation and comparisons of the flow-based regression method for juvenile outmigration estimation compared to traditional mark-recapture estimates.
7. Design for testing fish tagging rate assumptions. PIT, radio and genetic tagging emphasis.
8. Post-release mortality for various capture techniques including the purse seine, hatchery ladder, sport fishing, the weir, etc.
9. Origin of summer/fall Chinook at the CJH ladder.
10. Abundance of Priest Rapids Hatchery fish at the Okanogan weir and CJH ladder.
11. Use of otolith microchemistry to determine origin and rearing locations of subyearling Chinook captured at various beach seining locations.

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APPENDIX A

HATCHERY OPERATIONS AND PRODUCTION

The CJH's central facility is a 15-acre facility located immediately below Chief Joseph Dam along the right bank of the Columbia River at rkm 872 near Bridgeport, WA. There are two CJH acclimation facilities on the Okanogan River, Omak (rkm 51) and Riverside (rkm 64) acclimation ponds. There is an additional acclimation facility on the Similkameen River (rkm 6.4) that is part of the CJH program but is operated by WDFW and funded by the CPUD.

Construction of the hatchery was completed in 2013 and broodstock were brought on station for the first time. The goal of the CJHP is to contribute to the increased abundance, productivity, temporal-spatial diversity, re-colonization of Chinook in the Okanogan Basin, and provide increased harvest for all fishers.

Production Objectives

Full program production totals 2.9 million Chinook Salmon, including 2 million summer/fall Chinook and 900,000 spring Chinook. The summer/fall Chinook program incorporates both an integrated program (1.1 million smolts) supported by Okanogan River natural-origin broodstock and a segregated program (900,000 smolts) supported by hatchery-origin adults returning from the integrated program. The spring Chinook program includes a segregated program (700,000 smolts) supported by Leavenworth National Fish Hatchery (LNFH) broodstock and a re-introduction program (200,000 smolts) supported by WNFH broodstock (Met Comp stock) to reintroduce spring Chinook to the Okanogan under section 10(j) of the ESA.

In 2014, the summer/fall and spring Chinook program's production level did not meet full production as planned, due to higher than expected pre-spawn mortality on both the summer/fall brood and the segregated spring Chinook brood. The 10(j) spring Chinook reintroduction program received its full component of eyed eggs from the Winthrop NFH.

Spring Chinook Salmon

BY 2013 LEAVENWORTH SPRING CHINOOK REARING AND RELEASE

A total of 566,854 fry were initially transferred out of incubation, with a ponding loss of 16,464 (2.9%). The Spring Chinook program is 100% ad clipped, with a 200k CWT group tagged. In addition, 5,000 PIT Tags were added to this group in November, and a total of 4,972 were released. This brood was reared in Pond A and released from April 15th, thru April 30th, 2015. Final conversion was 1.13.

On July 24, 2013 and again on August 30, 2013, USFWS DVM Joy Evered assisted hatchery staff with inoculations for all spring Chinook brood. Each female was inoculated with Gallimycin – 100 at a rate of .50 ml per 10 lbs. / fish IP, for reduction of BKD, and Vetrimycin – 200 (Oxytetracycline) IP, at the same dosages, for reduction of pre-spawn mortality due to furunculosis. Survival was 90% for females, 96% for males and 95% for jacks with a combined survival of 92.9% (Table A 3). This survival was higher than the standard (90%).

Table A 1. Chief Joseph Hatchery BY 2013 Spring Chinook rearing summary, April 2015.

	Total on hand	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
Month	**Total**	**Total**	**Total**	**Total**	**Total**
Mar. 31	549,195	1,195	343	552	96.88
Apr. 30	547,045	2,160	1,169	206	96.50
May 31	545,548	1,497	722	160	96.24
June 30	544,898	650	1,499	110	96.12
July 31	515,134*	8,206	1,777	80	97.40
Aug 31	515,065	69	2,767	65	97.39
Sept 30	514,959	106	4,231	35	97.37
Oct. 31	514,983	82	3,254	30	97.37
Nov. 30	514,884	99	2,861	25	97.36
Dec. 31	514,769	115	2,514	20	97.33
Jan. 31	514,705	64	2,198	17	97.32
Feb. 28	514,660	45	3,230	16	97.31
Mar. 31	514,633	27	1,831	15	97.31
April 30	514,596**	37	1,379	15	97.30
Cumulative	514,596	14,370	29,776	15	97.30

*Shortage of 21,558 at marking, adjusted in cumulative survival
**Released

Cumulative egg to smolt survival

The cumulative egg to smolt survival for the 2013 brood Leavenworth Spring Chinook was 94.37%. This includes ponding loss, rearing loss, and subtracting the shortage realized at marking. This overall survival metric will be a critical assessment of the hatchery's performance each brood year. The target egg to smolt survival identified in the original spring Chinook HGMP was 77% (CCT 2008a).

BY 2013 10J MET COMP SPRING CHINOOK REARING AND RELEASE

On November 3rd, 2014, CCT staff transported 200,000 Met Comp Spring Chinook from the USFWS Winthrop Hatchery to the Riverside Acclimation Pond. Under Permit No. 18928, issued by the National Marine Fisheries Service, this group is designated as an (10j) experimental population, for the reintroduction of Spring Chinook into the Okanogan Basin. The Riverside Acclimation Pond was used instead of the Tonasket Pond in 2014 because the program didn't utilize the Riverside Pond for the integrated summer chinook program. The CJHP was able to use this pond at no cost.

Temperatures at both Omak and Riverside dropped dramatically during December, and both ponds iced over. Over the course of the spring, temperatures rose steadily, and the fish growth stayed on target for release. These fish began volitional release on April 15th, with the final release on April 30th, 2015. Table A 2 illustrates feed fed, feeding rate, and mortality to date. After subtracting mortality and shed tags, a total of 4,902 PIT tags were released.

Table A 2. Riverside Acclimation Pond BY 2013 Integrated Spring Chinook rearing summary, April 2015.

	Total on hand	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
Month	**Total**	**Total**	**Total**	**Total**	**Total**
Nov. 30	199,949	51	528	28.0	99.9%
Dec. 31	199,502	447	154	28.0	99.7%
Jan. 31	197,200	2,302	176	28.0	98.6%
Feb. 28	197,163	37	1,188	33.0	98.5%
Mar. 31	197,010	153	2,112	20.3	98.4%
April 30	196,917*	93	1,540	15.3	98.4%
Cumulative	197,917	3,083	5,698	15.3	98.4%

2014 Brood Collection

The segregated spring Chinook production goal for the 2014 brood is a release of 700,000 yearlings in April of 2016. The calculated number of brood needed to meet this production was 640 adults, based on a 50/50 ratio of males and females. This includes 10% pre-spawn mortality, up to 20% culling for Bacterial Kidney Disease (BKD) management, 10% egg loss, and rearing mortality of 15%. The mortality per life stage estimates were based on LNFH data. As with any new facility, baseline data collected during initial production years will be the basis for adjusting broodstock requirements in future years.

A total of 640 spring Chinook broodstock were transferred from LNFH to CJH between June 11 and June 12, 2014; including 320 females, 310 males and 10 jacks (Table A 3). The 640 spring Chinook transferred represents 100% of the collection objective.

Transport water was obtained from LNFH to fill the transport trucks, at a temperature of 51° F and the adult holding pond temperature, at LNFH, was 48° F. Transport densities on both days were 0.60 lbs. /gal. (Table A 3) All transport included Vita Life at a rate of 500 ml per 2,000 gal., and supplemental oxygen at 8 L/min. There were no mortalities associated with the transport.

Broodstock were off loaded, via water-to-water transfer, into adult ponds #5 and #6, at CJH. The receiving water was 54.5° F. The adult pond had a flow rate of 380 gpm and an exchange rate of 60 minutes, representing a Flow Index (FI) of 0.42 and 0.20 for pond #5 and #6, respectively (

Table A 4). The Density Index (DI) was 0.04 and 0.02 for ponds #5 and #6, respectively. Both adult ponds were a mixture of well water and reservoir water, but as the reservoir water warmed, groundwater was gradually increased to maintain proper temperature profiles. Both ponds were treated a minimum of 3 days per week with formalin to control fungus, at a rate of 1:6000, for one exchange.

On June 26, 2014 and again on July 22, 2014, USFWS DVM Joy Evered assisted hatchery staff with inoculations for all spring Chinook brood. Each female was inoculated with Gallimycin – 100 at a rate of .50 ml per 10 lbs. / fish IP, for reduction of BKD, and Vetrimycin™ – 200 (Oxytetracycline) IP, at the same dosages, for reduction of pre-spawn mortality due to furunculosis. Unfortunately, the prevalence of furunculosis was extremely high in the reservoir water, and despite turning off that water source and switching to 100% well water, the pre-spawn mortality increased dramatically throughout the holding period. Survival was 23.2% for females, 44.2% for males and 80% for jacks with a combined survival of 39.84% (

Table A 5). Obviously, this survival was much lower than the standard (90%).

Table A 3. Chief Joseph Hatchery spring Chinook broodstock transfer summary for 2014.

			Males							
Date	**Trapping site**	**Receiving Facility**	**Adult**	**Jack**	**Total**	**Females**	**Total Broodstock**	**Holding Temp (°F)**	**Transport Temp. (°F)**	**Transport Density (lbs./gal)**
6/11/2014	LNFH	CJH	155	5	160	160	320	48	51	0.60
6/12/2014	LNFH	CJH	155	5	160	160	320	48	51	0.2
Total			**310**	**10**	**320**	**320**	**640**			

Table A 4. Spring Chinook broodstock adult holding conditions for 2014.

		Males								
Transfer Date	**Adult Pond**	**Adult**	**Jack**	**Total**	**Females**	**Total Broodstock**	**Transport Temp (°F)**	**Holding Temp. (°F)**	**Flow Index**	**Density Index**
6/11/2014	#5	155	5	160	160	320	54.5	51	0.42	0.05
6/12/2014	#6	155	5	160	160	320	54.5	51	0.20	0.05

Table A 5. Chief Joseph Hatchery spring Chinook broodstock holding and survival summary for 2014. (M= adult males, J = jacks, and F = adult females). The survival standard for this life stage was 90%.

Beginning			Ending			Mortality			Cumulative Survival (%)		
M	**J**	**F**	**M**	**J**	**F**	**M**	**J**	**F**	**M**	**J**	**F**
310	10	320	173	8	74	137	2	246	44.2%	80%	23.2%

Spawning

Spring Chinook spawning occurred between August 19 and September 3, 2014 (Table A 6). The spawn consisted of 66 females and 66 males, with seven non-viable (green) females killed resulting in a green egg take of approximately 250,800 (Table A 6).

Spawning occurred inside the spawning shed adjacent to the adult holding raceways, and gametes were then transported to the main facilities egg entry room for processing. Each individually numbered female was fertilized with a primary male initially, and then a backup male was added to ensure fertilization. Each female's eggs were then placed in the corresponding numbered trey. The eggs from 2 females were culled due to high or moderate ELISA results (culled eggs from Elisa results are not included in Table A 6). This was approximately 3% of the females spawned and was less than planned for (up to 20%).

Incubation

Each female's eggs were initially incubated separately to facilitate culling based on ELISA results. Once eyed, egg mortality was removed and eggs were combined for hatching. All spring Chinook eggs were placed on varying degrees of chilled water. The water temperature was gradually dropped, on the first egg take, to 40° F degrees. This process was done over a several hour period the day after spawning. The second egg take was left on well water (54° F) until such time as the total numbers of temperature units (TUs) were earned to equal the first egg take, then the same procedure was used to lower water temperature to 40° F. This process provided the ability to control when, and how many, fish are brought out of the incubators and placed into early rearing. Green egg to eyed egg survival was 89.6% (Table A 6). This survival was slightly lower than the standard (90%).

As a result of the heavy pre-spawn mortality on Leavenworth stock spring Chinook adults, our ability to meet program goals was severely hampered. In order to try and meet full production goals, we queried USFWS for potential excess eggs within the Columbia corridor. While LNFH had excess eggs, the ELISA profiles were too high of a risk to make this option viable. Carson National Fish Hatchery did however, have an excess of eggs that had an acceptable disease profile, and on October 17th, CJH staff transported 352,900 eyed eggs from CNFH to CJH.

Rearing

Due to the manipulation of TUs, all groups of spring Chinook were brought out of incubation and transferred into early rearing troughs on February 3, 2015. During the month, this group was introduced to feed in the early rearing troughs, and reared for a period of two weeks. After the initial rearing period inside, this group was transferred outside to the standard raceways via the fry transfer line. No inventory was taken at this time to prevent excess handling stress. Survival from incubation to ponding was 98.2% which exceeded the standard (95%) for this life stage (Table A 7).

Table A 6. Chief Joseph Hatchery spring Chinook spawning and survival summary for 2014 (M = adult males, J = jacks and F = adult females). The target survival standard for this life stage was 90%.

	Total Adults Spawned			Green Egg Take	Eyed Egg	Mortality (Pick off)	Cumulative Survival (%)
Month	M	J	F	Total	Total	Total	Total
August 19	56	0	56	212,800	227,856	26,423	89.6%
August 26	9	0	9	34,200	*		
Sept. 3	1	0	1	3,800	*		

*The 2nd and 3rd spawn totals are combined with the 1st spawn data

Table A 7. Chief Joseph Hatchery spring Chinook ponding summary for BY 2014.

	Total Fry Ponded	Ponding Mortality	Monthly Feed	Monthly Mortality	Ponding Loss (%)	Cumulative Survival (%)
Production Group	Total	Total	Total	Total	Total	Total
LVNW	227,856	1,851	282	2,513	0.81%	98.0%
Sub-total	227,856	1,851	282	2,513	0.81%	98.0%
CARS	364,902	2,106	0	4,062	0.6%	98.3%
Sub-total	364,902	2,106	0	4,062	0.6%	98.3%
Total	592,758	3,957	282	6,575	0.66%	98.2%

The standard survival for this life stage was 95%.

Spring Chinook were fed Bio Vita diet(Bio-Oregon, Longview, WA), and converted at an average of 0.57:1. Post ponding rearing is on schedule, with no fish health issues and minimal mortality to date (Table A 8). Survival for this life stage will be reported in subsequent annual reports once all release information is available.

Table A 8. Chief Joseph Hatchery BY 2014 segregated spring Chinook rearing summary as of April 2015.

	Total on hand	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
Month	**Total**	**Total**	**Total**	**Total**	**Total**
LVNW					
Mar. 31	222,846	642	246	400	97.8%
Apr. 30	222,679	167	420	250	97.7%
sub-total	222,679	809	666	250	97.7%
CARS					
Mar. 31	358,331	403	534	350	98.2%
Apr. 30	358,134	197	752	200	98.1%
sub-total	358,134	600	1,286	200	98.1%
Cumulative	580,813	1,854	1,952	225	97.9%

Cumulative egg to smolt survival

This metric cannot be reported for the 2014 brood until 2016, when the yearlings are released. This overall survival metric will be a critical assessment of the hatchery's performance. The target egg to smolt survival identified in the original spring Chinook HGMP was 77% (CCT 2008a).

BY 2014 10J MET COMP SPRING CHINOOK

On October 31st, we received 218,881 eyed eggs from the USFWS Winthrop National Hatchery for our BY 14 integrated production. This group was placed on chilled water and was ponded in March. These fish are a continuation of the 10j experimental population for reintroduction of Spring Chinook into the Okanogan Basin. This group also experienced very low ponding loss, at 1.13%. Cumulative survival after ponding was 96.8% as of April (Table A 9).

Table A 9. Chief Joseph Hatchery Integrated Spring Chinook rearing summary as of April 2015.

	Total on hand	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
Month	**Total**	**Total**	**Total**	**Total**	**Total**
Mar. 31	212,514	3,891	169	350	97.1%
April 30	212,025	489	388	250	96.8%
Cumulative	212,025	4,380	557	250	96.8%

Summer/Fall Chinook Salmon

BY 2013 Summer/Fall Chinook Salmon Rearing and Release

A total of 489,166 subyearling summer/fall Chinook were brought out of incubation from January 21st, 2014 through mid-February. An addition 984,019 yearling summer/fall Chinook were also brought out of incubation from March 18th, 2014 through the end of April.

Rearing proceeded on schedule, with the marking and releasing of both the integrated and segregated subyearlings in May. On May 1st, a total of 197,516 integrated subyearlings were transferred to the Omak Acclimation Pond on May 1st, 2014, at 94 fish per pound (fpp). This group was released on May 28th, 2015, at 46 fpp, with a post transfer survival of 99.9% and a cumulative survival of 94.67%.

Table A 10. Chief Joseph Hatchery brood year 2013 Integrated summer/fall subyearling rearing summary.

	Total Planted	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
Month	**Total**	**Total**	**Total**	**Total**	**Total**
May 28	197,349	167	3,015	46.3	94.67
Cumulative	197,349	167	1,496	46.3	94.67

A total of 265,873 segregated summer/fall subyearlings were marked and transferred into rearing pond B, for final rearing and release. This group was released on May 21st, 2014, at 50 fpp. Cumulative rearing survival was 95.8%.

Table A 11. Chief Joseph Hatchery brood year 2013 Segregated summer/fall subyearling rearing summary.

	Total Planted	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
Month	Total	Total	Total	Total	Total
May 21	265,656	217	4,138	50.0	95.8
Cumulative	265,656	217	1,540	50.0	95.8

The yearling summer/fall Chinook rearing proceeded on schedule, with both the integrated and segregated groups being marked in July and August. Marking was completed, for both the integrated and the segregated programs, on August 29th, 2014. The segregated Summer Chinook were 100% ad-clipped, with a 100k CWT group tagged. The integrated Summer Chinook were 100% AD/CWT. As shown in

Table A 12, ponding and rearing mortality for the segregated program has been lower than anticipated, although both stocks were short of book numbers, at marking. The segregated production was marked into rearing ponds B & C, while the integrated program was marked into the lower raceways, and reared until transfer to the acclimation ponds in late October. Both groups were released from April 15th thru April 30th, 2015. Approximately 5,000 PIT tags were added to each group in November, 2014. After subtracting shed tags and mortality, a total of 5,018 PIT tags were released from the segregated group. Final conversion was 1.17.

Table A 12. Chief Joseph Hatchery BY 2013 Segregated Summer/Fall Chinook rearing summary.

	Total on hand	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
HORs					
Month	**Total**	**Total**	**Total**	**Total**	**Total**
Apr. 30	437,790	11,351	180	650	97.47
May 31	436,951	839	750	270	97.28
June 30	436,453	498	746	160	97.17
July 31	436,256	197	1,939	100	97.13
Aug. 31	*417,232	2,161	994	85	96.53
Sept. 30	416,991	241	3,203	30	96.46
Oct. 31	416,935	56	2,961	25	96.45
Nov. 30	416,816	119	2,493	20	96.44
Dec. 31	416,583	233	3,134	18	96.36
Jan. 31	416,383	200	2,683	15	96.32
Feb. 28	416,325	58	5,755	13	96.30
Mar. 31	416,304	21	6,219	12	96.30
April 30	416,289	15	4,048	10	96.29
Total	416,289	15,931	35,105	10	96.29

Omak Acclimation Pond

On October 30th, 2014 Chief Joseph Hatchery staff transferred 298,868 Integrated BY 13 Summer Chinook from Chief Joseph Hatchery to the Omak Acclimation Pond. At the time of transfer, the fish were approximately 26.7 fpp, and were programmed to be reared over winter, with a target size at release of 10 fpp. An additional 207,078 BY 13 Summer Chinook were transferred to WDFW's Similkameen Pond, as part of the cost share agreement. These fish began volitional release April 15th, and ended on April 30th, 2015. Table A 12 illustrates feed fed, feeding rate, and mortality to date for the integrated summer/fall Chinook transferred to the Omak Acclimation pond. Due to the late transfer date, and the colder water temperatures, the PIT tagged fish, transferred in late November, did not acclimate well and suffered high mortality. After subtracting mortality and shed tags, a total of 1,204 PIT tags were released.

Table A 13. Omak Acclimation Pond BY 13 Integrated Summer/Fall Chinook rearing summary.

	Total on hand	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
Month	Total	Total	Total	Total	Total
Oct. 31	298,868	0	0	26.7	100%
Nov. 30	301,255*	2,579	704	26.2	99.1%
Dec. 31	297,032	4,223	198	28.0	97.7%
Jan. 31	295,214	1,818	220	28.0	97.1%
Feb. 28	292,750	2,464	1,804	30.4	96.3%
Mar. 31	290,760	1,990	2,816	19.0	95.6%
April 30	290,665**	95	2,508	15.6	95.5%
Cumulative	290,665	13,169	8,250	15.6	95.5%

Riverside Acclimation Pond

Riverside Acclimation Pond was not used to rear BY 2013 summer/fall Chinook, but was utilized to rear BY 13 10j Spring Chinook, as noted above.

Similkameen Acclimation Pond

Similkameen Pond was used to rear yearling summer Chinook per the WDFW program funded by CPUD. Adult broodstock used to generate the juveniles for BY 2013 were collected via the CCT purse seine as part of the transition to the collaborative CJH program. On October 30th, 2014, Chief Joseph Hatchery staff transferred 207,078 summer/fall Chinook to the Similkameen Pond, with the assistance of WDFW's Eastbank Hatchery staff. At the time of transfer, the fish were approximately 26.7 fpp, and were programmed for over winter acclimation, with a target size at release of 10 fpp. These fish began volitional release on April 15th, with an end release date of April 30. Cumulative survival, at the date of transfer, was 96.39%. Survival from transfer to release was 99.42%.

Cumulative egg to smolt survival

The target egg to smolt survival identified in the original summer/fall Chinook HGMP was 77.5% for subyearlings and 73.5% for yearlings (CCT 2008b). The cumulative egg to smolt survival, for the BY 2013 subyearlings, was 89.17%. The cumulative egg to smolt survival, for the BY 2013 yearlings, was 88.03%.

2014 Broodstock collection

Collection of summer/fall Chinook for BY 2014 occurred between July 8 and August 25, 2014 via the CCT purse seine operation at the mouth of the Okanogan River. Both hatchery- and natural-origin brood were collected to supply the integrated and segregated production programs at CJH. As the seine was being pursed, 9 m transport barges approached the seine vessel and tied off on the opposite side. The broodstock transport barges have two transport tanks; a 300 gallon for HORs and a 600 gallon for NORs. Brood fish were removed from the seine and placed headfirst in a rubber tube, or boot, containing some water and handed to the staff on the barges for placement in the holding tanks. A maximum of 14 HOR and 28 NOR brood could be loaded per barge. Once full, or at the commencement of the purse seine haul, the barges returned to the offload area at Mosquito Park approximately 2 km away. The brood was then removed from the tanks by hand, placed into a boot, then delivered to one of two 2500 gallon tanker trucks and transported 16 km to the hatchery.

Water temperatures were of major concern during these operations and monitored to minimize trauma to the adult brood. Okanogan River temperatures during July ranged from 66° F (19° C) to 78° F (25.5° C). In order to limit the effects of the temperature changes we monitored the temperature of all transport vessels and strived to not expose brood to changes greater than 8° F. We accomplish this by utilizing both well water and surface water when filling the barges and transport tankers, and monitoring our raceway temperatures.

A weekly quota was developed to ensure that brood collections occurred across as much of the summer run timing as possible (Table A 14). If brood collection failed to meet the weekly quota it was adjusted the following week. The purse seine is only effective when there is a thermal barrier at the mouth of the Okanogan, therefore broodstock can only be collected there until late August or early September. Additional NOR collections, at the pilot weir, began on September 2nd, and concluded on September 25th. A total of 40 males and 36 females were collected. Broodstock were off loaded, via water-to-water transfer, into adult ponds at CJH. The receiving water was approximately 57° F. The adult ponds had a flow rate of 380 gpm, and an exchange rate of 60 minutes, representing a Flow Index (FI) of 0.15 and a Density Index (DI) of 0.02. Upon arrival, adult ponds were on a mixture of well water and reservoir water, but as the reservoir water warmed, the groundwater contribution was gradually increased to maintain proper temperature profiles. All adult ponds were treated a minimum of five days per week with formalin to control fungus at a rate of 1:6000, for one exchange. On July 22, USFW DVM Joy Evered assisted hatchery staff with inoculations for all summer/fall Chinook brood. Each female was inoculated with Gallimycin – 100 at a rate of .50 ml per 10 lb. / fish IP, for reduction of

BKD, and Vetrimycin – 200 (Oxytetracycline) IP, at the same dosages, for reduction of pre-spawn mortality to furunculosis. A total of 554 HOB were collected including 277 females, 270 adult males and 7 jacks (Table A 15). A total of 575 NOB was collected including 288 females, 278 adult males, and 9 jacks (Table A 16). No steelhead or Bull trout were encountered during broodstock collection efforts.

Table A 14. Chief Joseph Hatchery summer/fall Chinook weekly broodstock collection objectives and results for brood year 2014.

	Weekly Quota		Cumulative Proportion		Cumulative Collection	
Week	**Natural Origin** [b]	**Hatchery Origin** [c]			**Natural Origin**	**Hatchery Origin**
July 7 - July 13	22	22	0.03	0.04	22	22
July 14 - July 20	22	22	0.06	0.08	44	44
July 21 - July 27	108	104	0.23	0.27	152	148
July 28 - Aug. 3	108	104	0.39	0.46	260	252
Aug. 4 - Aug.10	132	126	0.59	0.69	392	378
Aug. 11 - Aug. 17	132	126	0.79	0.92	524	504
Aug. 18 - Aug. 24	36	36	0.85	0.98	560	540
Aug. 25 - Aug. 31	12	12	0.87	1.00	572	552
*Sept. 1 – Sept. 30	84		1.00		656	

[a]- Weekly collection short-fall to be added to following week's collection

[b]- Combined collection strategies in priority order (purse seine, tangle-net, Okanogan weir beach seine and CJH ladder

[c]- Combined collection strategies in priority order: purse seine, tangle-net, CJH ladder, Okanogan weir and beach seine

*NOR weir collections = 12.8% total NOR brood

Table A 15. Chief Joseph Hatchery summer/fall Chinook Hatchery-Origin Broodstock (HOB) transfer summary for brood year 2014.

Date	Trapping site	Receiving Facility	Males	Females	Jacks	Total Broodstock	River Temp (f0)	Barge Temp (F0)	Transport Temp. (F0)	Adult Pond Temp (f0)
7/8/2014	SEINE	CJH	2	0	0	2	70	62	58	57
7/9/2014	SEINE	CJH	8	10	0	20	70	62	58	57
7/14/2014	SEINE	CJH	9	9	0	38	72	62	58	57
7/15/2014	SEINE	CJH	1	5	0	44	72	66	60	57
7/21/2014	SEINE	CJH	13	19	1	77	74	64	59	57
7/22/2014	SEINE	CJH	30	39	0	146	74	64	59	57
7/28/2014	SEINE	CJH	8	5	0	159	74	64	59	57
7/29/2014	SEINE	CJH	1	1	0	161	74	64	59	57
7/30/2014	SEINE	CJH	11	9	0	181	74	64	59	57
7/31/2014	SEINE	CJH	6	1	1	189	74	64	59	57
8/1/2014	SEINE	CJH	35	28	0	252	74	62	58	57
8/4/2014	SEINE	CJH	3	1	0	256	74	62	58	57
8/5/2014	SEINE	CJH	19	7	0	282	72	62	58	57
8/6/2014	SEINE	CJH	13	19	0	314	72	66	60	57
8/7/2014	SEINE	CJH	18	9	1	342	74	64	59	57
8/8/2014	SEINE	CJH	16	20	0	378	74	64	59	57
8/11/2014	SEINE	CJH	17	17	0	412	74	64	59	57
8/12/2014	SEINE	CJH	3	2	0	417	74	64	59	57
8/13/2014	SEINE	CJH	5	6	0	428	74	64	59	57
8/14/2014	SEINE	CJH	2	2	1	433	74	64	59	57
8/20/2014	SEINE	CJH	14	7	1	455	74	64	59	57
8/21/2014	SEINE	CJH	29	56	2	542	74	64	59	57
8/25/2014	SEINE	CJH	7	5	0	554	74	64	59	57
Total			**270**	**277**	**7**	**554**				

Table A 16. Chief Joseph Hatchery summer/fall Chinook Natural-Origin Broodstock (NOB) transfer summary for brood year 2014.

Date	Trapping site	Receiving Facility	Males	Females	Jacks	Total Broodstock	River Temp (f0)	Barge Temp (F0)	Transport Temp. (F0)	Adult Pond Temp (f0)
7/7/2014	SEINE	CJH	2	0	0	2	70	62	58	57
7/8/2014	SEINE	CJH	3	4	0	9	70	62	58	57
7/9/2014	SEINE	CJH	7	5	1	22	72	62	58	57
7/14/2014	SEINE	CJH	12	10	0	44	74	66	60	57
7/21/2014	SEINE	CJH	58	48	2	152	74	64	59	57
7/28/2014	SEINE	CJH	21	27	0	200	74	64	59	57
7/29/2014	SEINE	CJH	4	3	0	207	74	64	59	57
7/30/2014	SEINE	CJH	30	24	0	261	74	64	59	57
8/4/2014	SEINE	CJH	8	11	0	280	74	62	58	57
8/5/2014	SEINE	CJH	40	32	3	355	74	62	58	57
8/6/2014	SEINE	CJH	18	19	1	393	72	62	58	57
8/11/2014	SEINE	CJH	46	48	2	489	74	66	60	57
8/12/2014	SEINE	CJH	5	14	0	508	74	64	59	57
8/13/2014	SEINE	CJH	1	17	0	526	74	64	59	57
8/19/2014	SEINE	CJH	17	16	0	559	74	64	59	57
8/20/2014	SEINE	CJH	0	3	0	562	74	64	59	57
8/25/2014	SEINE	CJH	6	7	0	575	74	64	59	57
Total			**278**	**288**	**9**	**575**				

Additionally, 76 hatchery Chinook were collected from the weir trap between September 2nd and September 25th 2014. Adults were transported to shore via a fish boot (rubber tire inner tube) and placed into a 800-gallon hatchery truck. The fish were then transported approximately 32 km to Chief Joseph Hatchery where they were held in the broodstock raceways until the first spawn date the first week in October. These adults experienced 10.6% pre-spawn mortality, and were 100% otolith sampled at spawning. The goal was to ensure that, prior to being included in the integrated production; there would be no unmarked Priest Rapids hatchery fish in this group. All fish sampled were true NORs, and were included in the integrated program.

The cumulative pre spawn holding survival, for all Summer/Fall brood collected, was 77.2% for HOB and 71.3% for NOB (Table A 17). Similar to the Spring Chinook, the Summer/Fall brood were also experienced an outbreak of Columnaris. As this epizootic became more widespread, and treatments were having little effect, we switched water sources to 100% well water. In all subsequent years, all arriving brood will be kept on 100% well water, in hopes of avoiding this issue. Neither brood met the survival standard (90%) except Jacks, which are not included in the stated cumulative survival. The majority of loss occurred with females in October, as spawning operations began with the additional stress of handling. Spawn timing of NOB was protracted when compared to HOB (approximately 14 days) and as a result, NOB were held longer and were subject to additional handling, which may have contributed to the HOB/NOB differential survival.

Table A 17. Chief Joseph Hatchery summer/fall Chinook Hatchery (HOB) and Natural (NOB) origin broodstock holding survival summary for brood year 2014. (M = adult males, J = jacks and F = adult females). The survival standard for this life stage was 90%.

	Beginning Month			Ending Month			Mortality			Monthly Survival (%)			Cumulative Survival (%)		
Month	**M**	**J**	**F**	**M**	**J**	**F**	**M**	**J**	**F**	**M**	**J**	**F**	**M**	**J**	**F**
HOR															
July	89	2	98	88	2	95	1	0	3	99%	100%	97%	99%	100%	97%
Aug.	269	7	274	265	7	267	4	0	7	98.6%	100%	97.5%	98.2%	100%	96.4%
Sept.	265	7	267	257	7	242	8	0	15	96.9%	100%	90.6%	95.1%	100%	87.3%
Oct.	257	7	242	227	7	196	30	0	46	88.3%	100%	80.9%	84.0%	100%	70.7%
Nov.	227	7	196	226	7	196	1	0	0	99.5%	100%	100%	83.7%	100%	70.7%
NOR															
July	137	3	121	137	3	119	0	0	2	100%	100%	97.6%	100%	100%	97.6%
Aug.	278	9	286	273	9	270	5	0	16	98.3%	100%	93.6%	97.9%	100%	92.5%
Sept.	273	9	270	260	9	242	13	0	28	95.2%	100%	89.6%	93.5%	100%	84.0%
Oct.	260	9	242	212	9	186	48	0	56	81.5%	100%	76.8%	76.2%	100%	67.1%
Nov.	212	9	186	210	9	186	2	0	0	99.0%	100%	100%	75.5%	100%	67.1%

Spawning

Spawning of Summer Chinook began on October 7th, 2014, and continued through November 12th, 2014. As with the Spring Chinook, the Summer Chinook program is also 100% ELISA sampled. For the 2014 brood, we experienced a much higher than normal disease profile, and as a result culled 34 females in 2014.

Total NOB spawned included 250 males, zero jacks, and 248 females. (Table A 18) Total HOR spawn included 223 males, zero jacks, and 230 females. In addition, five non-viable NOR females and two non-viable HOR females were spawned. Total eyed egg take for the season was 1,799,262. Egg survival from green egg to eyed egg for NOB averaged 92.8% (Table A 18). Egg survival for HOB averaged 90.6%. Survival was higher than the standard (90%) for this life stage.

Table A 18. Chief Joseph Hatchery brood year 2014 summer/fall Chinook spawning results.

	Total Adults Spawned			Green Egg Take	Eyed Egg	Mortality (Pick Off)	Cumulative Survival (%)
Month	**M**	**J**	**F**	**Total**	**Total**	**Total**	**Total**
NOR							
Oct. 7	40	0	40	200,000	159,584	17,899	90.00
Oct. 14	98	0	94	470,000	399,719	26,336	93.82
Oct. 21	74	0	75	375,000	292,350	19,928	93.62
Oct. 28	32	0	33	165,000	100,210	5,179	95.09
Nov. 4	5	0	5	25,000	5,702	79	98.64
Nov. 12	1	0	1	5,000	0	4,233	0
Sub-total	250	0	248	1,240,000	957,565	73,654	92.86
HOR							
Oct. 7	72	0	72	360,000	274,907	37,629	87.96
Oct. 14	77	0	79	395,000	322,656	18,556	94.56
Oct. 21	48	0	46	230,000	140,482	16,276	89.61
Oct. 28	22	0	29	145,000	96,029	13,306	87.83
Nov. 4	4	0	4	20,000	7,623	1,120	87.19
Sub-total	223	0	230	1,150,000	841,697	86,887	90.64
Total	473	0	478	2,390,000	1,799,262	160,541	91.80

Incubation

Eggs from each female summer/fall Chinook were placed in individual incubators (Heath Trays) and remained individually incubated until ELISA results were obtained. Once eye-up occurred, eggs from moderate and high ELISA were removed; a total of 34 females were discarded from the 2014 brood. This cull rate exceeded expectations as the production plan accounted for a cull rate 5% for segregated and 3% for integrated. After eye-up, egg mortality was removed and the eggs were inventoried and put into incubators at 5,800 eggs per tray for hatching. Incubation water temperatures were manipulated to the level necessary to synchronize the hatching and ponding of the spawn takes throughout October and November 2014 and to achieve the size-at-release target for both yearling and subyearling summer Chinook programs. On the day of spawning and over a several hour period, the incubation water temperatures were gradually reduced on yearling egg takes to a temperature of 40° F. Subyearling groups were not chilled until each take achieved 230 Temperature Units (TU). Once each take achieved 230 TUs, incubation temperatures were, manipulated to either advance or delay maturation. Variable incubation water temperatures were required to synchronize hatching dates associated with variable spawn dates throughout the spawn period within yearling and subyearling production groups and to achieve target hatching date associated with size-at-release targets, based on projected growth rates and release dates for the respective production groups.

Rearing

The first groups of subyearlings were brought out of incubation and transferred into early rearing troughs on January 21st, 2015. During the month of January, this group was introduced to feed in the early rearing troughs, and reared for a period of two weeks. Ponding continued into early February. After the initial rearing period inside, all groups were transferred outside to the standard raceways via the fry transfer line. No inventories were taken during transfers, to prevent excess handling stress. All subyearlings are released in the first spring of life, and after marking, both the integrated and segregated subyearlings will be released in May of 2015. The integrated subyearlings will be transferred to the Omak Acclimation pond after marking. In addition, both groups will also include a 5,000 PIT tag component. PIT tagging was contracted to USFWS, and was completed on April 24th, 2015.

Table A 19. Chief Joseph Hatchery brood year 2014 summer/fall Chinook sub-yearling ponding summary. The survival standard for this life stage was 95%.

	Total Fry Ponded	Ponding Mortality	Monthly Feed	Monthly Mortality	Ponding Loss (%)	Cumulative Survival (%)
Production Group	Total	Total	Total	Total	Total	Total
NOR						
Subs	312,311	7,378	453	3,677	2.2%	95.5%
Sub-total	312,311	7,378	498	7,220	2.2%	95.5%
HOR						
Subs	403,614	16,709	890	1,935	3.9%	94.8%
Sub-total	403,614	16,709	1,089	5,071	3.9%	94.8%
Total	715,925	24,087	1,587	12,291	3.2%	95.1%

Table A 20. Chief Joseph Hatchery brood year 2014 summer/fall Chinook sub-yearling rearing summary.

	Total on hand	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
Month	Total	Total	Total	Total	Total
HORs					
Mar. 31	402,553	1,061	908	200	94.3%
Apr. 30	375,414*	3,127	1,666	100	93.5%
sub-total	375,414	4,188	2,574	100	93.5%
NORs					
Mar. 31	311,750	561	1,141	250	95.2%
Apr. 30	301,171**	813	1,237	100	94.9%
Sub-total	301,171	1,374	2,378	100	94.9%
Cumulative	676,585	5,562	4,952	100	94.2%

The first group of integrated yearlings was brought out of incubation and transferred into early rearing troughs on March 23, 2015, and continued into April. Once ponded, all groups were introduced to feed in the early rearing troughs, and remained in early rearing for a period of two weeks. After the initial rearing period inside, groups were transferred outside to the standard raceways via the fry transfer line. Ponding survival ranged from 96% to 98% and averaged 97% across all groups which exceeded the survival standard (95%) for this life stage (Table A 21).

Post ponding rearing was on schedule as of April 2015, with no fish health issues to date with very (<1%) little mortality (Table A 22). Summer/fall Chinook were fed Bio Pro 2 diet, and were converting at an average of 0.61:1 to date.

Table A 21. Chief Joseph Hatchery brood year 2014 summer/fall Chinook ponding summary. The survival standard for this life stage was 95%.

	Total Fry Ponded	Ponding Mortality	Monthly Feed	Monthly Mortality	Ponding Loss (%)	Cumulative Survival (%)
Production Group	**Total**	**Total**	**Total**	**Total**	**Total**	**Total**
NORs						
March	278,096	1,359	87	1,913	0.48%	98.8%
April	362,560	1,941	772	5,404	0.53%	98.3%
Sub-total	640,656	3,300	859	7,317	0.51%	98.5%
HORs						
April	416,261	3,864	96	2,587	0.92%	98.3%
Sub-total	416,261	3,864	96	2,587	0.92%	98.3%
Total	1,056,917	7,164	955	9,904	0.71%	98.4%

Table A 22. Chief Joseph Hatchery brood year 2014 summer/fall Chinook rearing summary.

	Total on hand	Mortality	Feed Fed	Fish per pound	Cumulative Survival (%)
HORs					
Month	**Total**	**Total**	**Total**	**Total**	**Total**
Apr. 30	405,787	10,474	872	270	97.4%
Sub Total	405,787	10,474	872	270	97.4%
NORs					
Mar. 31	274,824	3,272	87	1,050	98.8%
Apr. 30	630,039	7,345	772	525	98.3%
Sub Total	630,039	10,617	859	525	98.3%
Total	1,035,826	21,091	1,731	397	97.8%

Chief Joseph Hatchery Ladder

The CJH fish ladder was put into operation on July 7th 2014, with the first adult management activities occurring on July 10th. The intention for the ladder is twofold; to collect Segregated Brood if needed, and to facilitate adult management by removing hatchery origin fish, and thereby potentially increasing PNI in the Okanogan. At this point the ladder is strictly for fish that volunteer in; there have been no releases from the facility and fish entering the ladder are most likely Similkameen or Wells Hatchery returns. All hatchery Chinook, in excess of any brood needs, are removed from the ladder and sent to Tribal distribution or processing. Any Sockeye that enter the ladder are also utilized for Tribal subsistence purposes. All steelhead, regardless of origin, are returned to the river, as were as all NOR Chinook.

From July thru November 2014, a total of 4,613 hatchery-origin Summer/Fall Chinook and 31 Sockeye were removed at the CJH ladder and utilized for Tribal subsistence purposes, and 1,106 natural-origin Summer/Fall Chinook, and 75 NOR steelhead were trapped, handled and released back to the Columbia River. (Table A 23). In October, 169 Coho Salmon were collected at the ladder and utilized for Tribal subsistence purposes. The HOR jack count includes 750 “mini” jacks (<15 inches). In addition to the NOR steelhead returned to stream, 64 male and 92 female HOR steelhead were also returned to stream.

The encounter/handling and release of 75 NOR steelhead represents 6.8 percent of the allowable incidental take provided in the Biological Opinion (BiOp) for Chief Joseph Hatchery collection facilities. (NMFS 2008). There were no observed steelhead mortalities during the ladder operations in 2014.

The ladder was closed and dewatered on November 4, 2014, for the season. The protocol was to sample 20% (one of five) of the adipose-clipped summer/fall Chinook for code-wire tags (CWT). Snouts with positive CWT detection were initially sent to the WDFW laboratory in Olympia for CWT extraction and reading, but due to the backlog of snouts and the subsequent delays in obtaining the data needed for management decisions, we elected to bring the snouts back and read them in-house. Results are not available yet but will be included in the M&E section of future reports.

Table A 23. Chief Joseph Hatchery adult ladder operations from July to November 2014.

Date	Trapping site	HOR Males Removed	HOR Females Removed	HOR Jacks Removed[a]	NOR Males RTS	NOR Females RTS	NOR Jacks RTS	Sockeye Removed	Male Steelhead RTS	Female Steelhead RTS
July/2014	Ladder	570	410	451	47	22	45	8	1	3
Aug/2014	Ladder	670	352	779	138	83	73	22	4	14
Sept/2014	Ladder	388	230	430	165	118	56	1	17	25
Oct/2014	Ladder	122	87	116	170	95	66	0	4	7
Nov/2014	Ladder	6	0	2	23	0	5	0	0	0
Total		**1,756**	***1,079***	***1,778***	***543***	***318***	***245***	***31***	***26***	***49***

[a]Includes mini-jacks

*RTS= Return to stream

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APPENDIX B

2015 Production Plan

Table B 1. Summer Chinook Early - Integrated Program (Similkameen Release)

Chief Joseph Hatchery Production Plan										
Brood Year:	2015						**Planting Goal:**	267,000		
Species:	Summer Chinook - Early						**Pounds:**	26,700		
Stock:	Okanogan									
Origin:	Wild									
Program:	Integrated									
Egg Take Goal:	360,000						**Adult Goal:**	158		
Estimated Release Data:										
Start Date:	**End Date:**	**Num Released**	**fish per lb.**	**Wt. grams**	**Total weight (lb.)**	**Total weight (kg)**	**Life Stage**	**Release Site**	**Mark Type**	**Tagged**
04/15/17	04/30/17	267,000	10	45	26,700	12,015	yearlings	Similkameen	Ad Clipped	CWT
Notes:	Egg take goal includes 3% for culling.									
	Adult Goal includes 10% pre-spawn mortality									
	10% Green to Eyed egg mortality									
	Rearing mortality is 16.7%									
Rearing Summary:										
Species	**Source**	**Date**	**Number Green Eggs**	**Number Eyed Eggs**	**Number Ponded**	**Fed Fry**	**Released**	**Location**		
EA SU Chinook YR	Okanogan	April	349,200	314,280	298,566	283,638	267,000	Similkameen		

Table B 2. Summer Chinook Late - Integrated Program (Omak Acclimation Pond Release)

Chief Joseph Hatchery Production Plan

Brood Year:	2015						**Planting Goal:**	566,000	
Species:	Summer Chinook - Late						**Pounds:**	32,600	
Stock:	Okanogan								
Origin:	Wild								
Program:	Integrated								
Egg Take Goal:	765,000						**Adult Goal:**	340	

Estimated Release Data:

Start Date:	End Date:	Num Released	fish per lb.	Wt. grams	Total weight (lb.)	Total weight (kg)	Life Stage	Release Site	Mark Type	Tagged
04/15/17	04/30/17	266,000	10	45	26,600	11,970	yearlings	Omak	Ad Clipped	CWT
05/15/16	06/01/16	300,000	50	11	6,000	3,300	sub-yearling	Omak	Ad Clipped	CWT

Notes:
Egg take goal includes 3% for culling.
Adult Goal includes 10% pre-spawn mortality
10% Green to Eyed egg mortality
Rearing mortality is 15.7% for yearlings, 16.2% for subs.

Rearing Summary:

Species	Source	Date	Number Green Eggs	Number Eyed Eggs	Number Ponded	Fed Fry	Released	Location
EA SU Chinook YR	Okanogan	April	348,764	313,887	298,193	283,283	266,000	Omak
EA SU Chinook Sub	Okanogan	June	393,287	353,958	336,260	319,447	300,000	Omak

Table B 3. Summer Chinook Late – Segregated Program (CJH Site Release)

Chief Joseph Hatchery Production Plan

Brood Year:	2015	**Planting Goal:**	450,000
Species:	Summer Chinook - Late	**Pounds:**	29,000
Stock:	Okanogan		
Origin:	Hatchery		
Program:	Segregated		
Egg Take Goal:	620,000	**Adult Goal:**	276

Estimated Release Data:

Start Date:	End Date:	Num Released	fish per lb.	Wt. grams	Total weight (lb.)	Total weight (kg)	Life Stage	Release Site	Mark Type	Tagged
04/15/17	04/30/17	250,000	10	45	25,000	11,250	yearlings	CJ hatchery	Ad Clipped	
05/15/16	06/01/16	200,000	50	11	4,000	2,200	sub-yearling	CJ hatchery	Ad Clipped	

Notes:
Egg take goal includes 5% for culling.
Adult Goal includes 10% pre-spawn mortality
10% Green to Eyed egg mortality
Rearing mortality is 14.4% for yearlings, 16.5% for subs.

Rearing Summary:

Species	Source	Date	Number Green Eggs	Number Eyed Eggs	Number Ponded	Fed Fry	Released	Location
EA SU Chinook YR	Okanogan	April	323,950	291,555	276,977	263,128	250,000	CJ Hatchery
EA SU Chinook Sub	Okanogan	June	265,050	238,545	226,618	215,287	200,000	CJ Hatchery

Table B 4. Summer Chinook Early – Integrated Program (Riverside Acclimation Pond Release)

Chief Joseph Hatchery Production Plan

Brood Year:	2015						**Planting Goal:**	266,000		
Species:	Summer Chinook - Early						**Pounds:**	26,600		
Stock:	Okanogan									
Origin:	Wild									
Program:	Integrated									
Egg Take Goal:	360,000						**Adult Goal:**	158		
Estimated Release Data:										
Start Date:	**End Date:**	**Num Released**	**fish per lb.**	**Wt. grams**	**Total weight (lb.)**	**Total weight (kg)**	**Life Stage**	**Release Site**	**Mark Type**	**Tagged**
04/15/17	04/30/17	266,000	10	45	26,600	11,970	yearlings	Riverside	Ad Clipped	CWT
Notes:	Egg take goal includes 3% for culling.									
	Adult Goal includes 10% pre-spawn mortality									
	10% Green to Eyed egg mortality									
	Rearing mortality is 16.7%									

Rearing Summary:

Species	Source	Date	Number Green Eggs	Number Eyed Eggs	Number Ponded	Fed Fry	Released	Location
EA SU Chinook YR	Okanogan	April	349,200	314,280	298,566	283,638	266,000	Riverside

Table B 5. Summer Chinook Early – Segregated Program (CJH Release Site)

Brood Year:	2015						**Planting Goal:**	450,000			
Species:	Summer Chinook - Early						**Pounds:**	29,000			
Stock:	Okanogan										
Origin:	Hatchery										
Program:	Segregated										
Egg Take Goal:	620,000						**Adult Goal:**	276			
Estimated Release Data:											
Start Date:	**End Date:**	**Num Released**	**fish per lb.**	**Wt. grams**	**Total weight (lb.)**	**Total weight (kg)**	**Life Stage**	**Release Site**	**Mark Type**	**Tagged**	
04/15/17	04/30/17	250,000	10	45	25,000	11,250	yearlings	CJ hatchery	Ad Clipped		
05/15/16	06/01/16	200,000	50	9	4,000	1,800	sub-yearling	CJ hatchery	Ad Clipped		
Notes:	Egg take goal includes 5% for culling.										
	Adult Goal includes 10% pre-spawn mortality										
	10% Green to Eyed egg mortality										
	Rearing mortality is 14.4% for yearlings, 16.5% for subs.										

Rearing Summary:

Species	Source	Date	Number Green Eggs	Number Eyed Eggs	Number Ponded	Fed fry	Released	Location
EA SU Chinook YR	Okanogan	April	323,950	291,555	276,977	263,128	250,000	CJ Hatchery
EA SU Chinook Sub	Okanogan	June	265,050	238,545	226,618	215,287	200,000	CJ Hatchery

Table B 6. Spring Chinook - Leavenworth (CJH Release)

Chief Joseph Hatchery Production Plan

Brood Year:	2015						**Planting Goal:**	700,000		
Species:	Spring Chinook						**Pounds:**	46,667		
Stock:	Leavenworth									
Origin:	Hatchery									
Egg Take Goal:	1,094,400						**Adult Goal:**	640		
Estimated Release Data:										
Start Date:	**End Date:**	**Num Released**	**fish per lb.**	**Wt. grams**	**Total weight (lb.)**	**Total weight (kg)**	**Life Stage**	**Release Site**	**Mark Type**	**Tagged**
04/15/17	04/30/17	700,000	15	30	46,667	21,000	yearlings	CJ hatchery	Ad Clipped	
Notes:	Egg take goal includes 20% for culling.									
	Adult Goal includes 10% pre-spawn mortality									
	10% Green to Eyed egg mortality									
	Rearing mortality is 15.5%									

Rearing Summary:

Species	Source	Date	Number Green Eggs	Number Eyed Eggs	Number Ponded	Fed Fry	Released	Location
Spring Chinook	Leavenworth	April	875,520	787,968	748,570	711,141	700,000	CJ Hatchery

Table B 7. Spring Chinook - Met Comp (Tonasket Acclimation Pond Release)

Chief Joseph Hatchery Production Plan

Brood Year:	2015						**Planting Goal:**	200,000		
Species:	Spring Chinook						**Pounds:**	13,333		
Stock:	Met Comp									
Origin:	Hatchery/Wild									
Egg Take Goal:	326,800						**Adult Goal:**	190		
Estimated Release Data:										
Start Date:	**End Date:**	**Num Released**	**fish per lb.**	**Wt. grams**	**Total weight (lb.)**	**Total weight (kg)**	**Life Stage**	**Release Site**	**Mark Type**	**Tagged**
04/15/17	04/30/17	200,000	15	30	13,333	6,000	yearlings	Tonasket Pond	Ad Clipped	CWT
Notes:	Egg take goal includes 20% for culling.									
	Adult Goal includes 10% pre-spawn mortality									
	10% Green to Eyed egg mortality									
	Rearing mortality is 15.8%									

Rearing Summary:

Species	Source	Date	Number Green Eggs	Number Eyed Eggs	Number Ponded	Fed Fry	Released	Location
Spring Chinook	Met Comp	April	261,440	235,296	223,531	212,355	200,000	Tonasket

APPENDIX C

DRAFT TECHNICAL MEMORANDUM

Date: 16 Oct 2014

From: Casey Baldwin and Jennifer Miller

To: Kirk Truscott and Andrea Pearl (CCT), Jeff Fryer (CRITFC)

CC: Randy Friedlander (CCT), Howie Wright (ONA)

Subject: Acoustic evaluation of sockeye passage at the lower Okanogan River weir, 2014

Background

CCT has been working on a cooperative sockeye evaluation project with CRITFC (funded by BPA) since 2009. The project has included PIT, acoustic, and temperature tagging sockeye salmon at Wells Dam and tracking them through the Columbia and Okanogan rivers. The purpose of the study was to improve escapement estimates and understand the locations and extent of pre-spawn mortality. An important component of the study was to gain knowledge about the timing of migration through the Okanogan in relation to river temperature and the thermal barrier at the mouth of the Okanogan. Acoustic receivers in the Okanogan River included locations in the lower river, such as Monse Bridge, as well as the upper river near Oroville and in the Similkameen River.

In 2014, several additional receivers were available and we decided to use them to take a closer look at behavior, primarily travel time, in proximity to the lower Okanogan weir. The management questions included:

1. Is the lower Okanogan weir causing delay of sockeye salmon in their migration?
2. If delay occurs, to what extent and is it biologically significant?

The purpose of this memo is to provide the Chief Joseph Hatchery Monitoring and Evaluation Project with the data and analysis to add to the ongoing evaluations of the lower Okanogan weir. Additionally, this memo will be provided to CRITFC as part of the deliverables for the CCT contract with CRITFC and to any other interested party, such as the ONA and the transboundary sockeye harvest negotiation workgroup.

Methods

Three acoustic receivers were deployed on 21 July 2014 approximately 600 meters apart in locations that would be a similar upstream and downstream distance from the weir (Figure C 1). Two receivers were used in the upstream position due to river width and a split channel. Fine scale acoustic receiver locations were selected by finding relatively deep (2-3 m) non-turbulent water where tag detectability would be efficient. Receivers were deployed with a single-float line attached to a 9 kg weight with the receiver approximately 0.25 m from the bottom of the river.

A two-receiver array was installed at the Monse Bridge (Okanogan river km 8) as part of the larger sockeye acoustic study. Monse Bridge is approximately 17 km downstream from the weir. This detection array has been used previously and was not installed specifically to evaluate fish movement and travel times relevant to the weir. However, to strengthen our assessment of the potential weir effects we also evaluated travel time from Monse Bridge to the downstream weir receiver to evaluate differences in travel times that were not affected by the weir. The travel time was determined by the last detection at the downstream receiver to the first detection at the upstream receiver.

The lower Okanogan weir is a metal tripod and PVC picket weir that is used to manage returning adult summer/fall Chinook salmon. The weir was installed between 4-8 August, but was not actively fished (pickets down) until river temperatures decreased below 22.5 C on 15 August. Picket spacing included five panels of 5.1, 6.4 and 7.6 cm (2.0, 2.5, 3.0 inch) that were specifically implemented to allow unabated passage of sockeye salmon. Passage data were collected at the weir trap and observations were made from shore and via snorkeling and raft surveys to evaluate fish abundance and behavior at and near the weir. Those data (and a full description of the weir configuration and operations) will not be summarized in this memo, but will be part of the CJH M&E annual report.

Temperature and flow data were taken from the USGS gage at Malott, Washington (http://nwis.waterdata.usgs.gov/wa/nwis/nwisman/?site_no=12447200&agency_cd=USGS).

A two-sample t-test (with unequal variance) was used to evaluate the differences in mean travel times before and after weir installation. Time was converted to a standard unit of measure (days) for the purpose of conducting statistical tests.

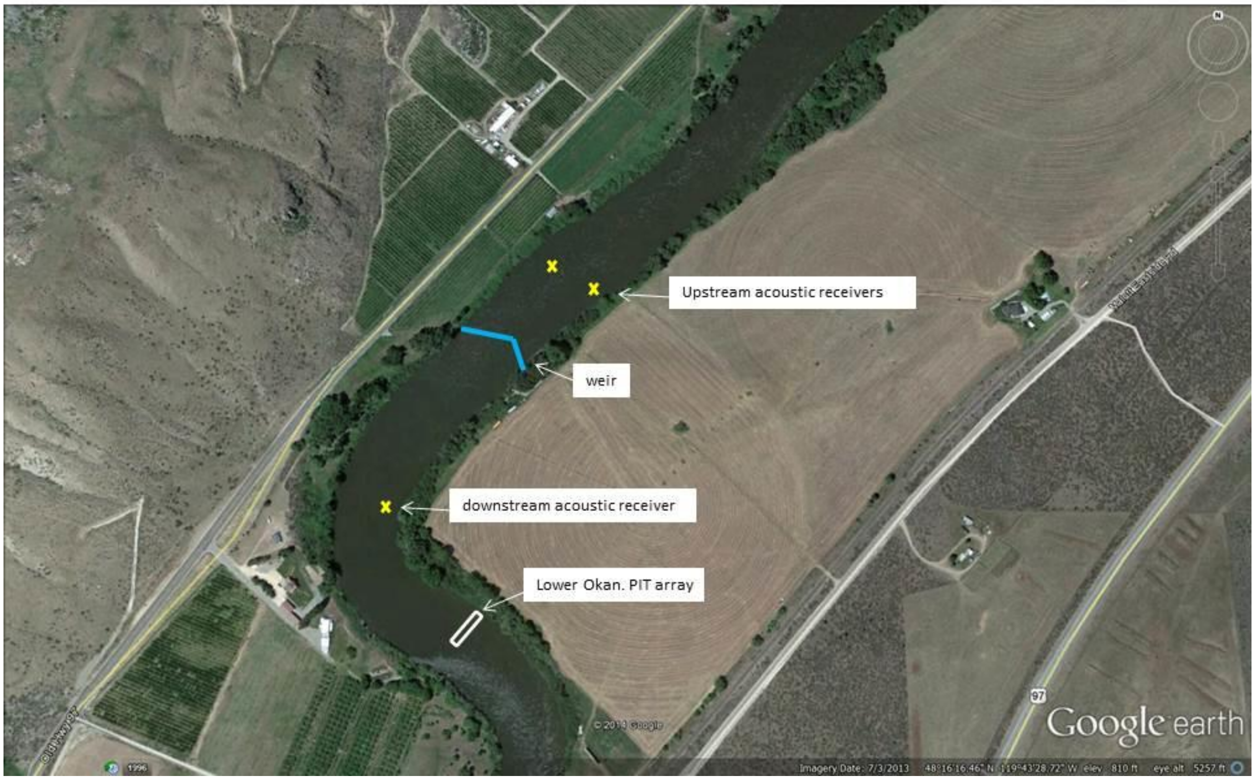


Figure C 1. Aerial image of the approximate locations of the lower Okanogan weir, acoustic receivers, and the lower Okanogan PIT tag detection array. The area shown is at river km 26, approximately 1.5 km downstream of the town of Malott, Washington.

Results

Sixty-seven acoustic tagged sockeye passed the receivers at the lower Okanogan weir site between 21 July and 7 September 2014. Survival was 100% from the downstream to upstream receivers at the weir. Additionally, there was 100% survival from the Monse Bridge acoustic receivers to the upstream weir receivers.

Fifty-two (84%) sockeye passed between 21 July and 3 August, and therefore did not encounter the weir (Figure C 2). The average travel time from the downstream to upstream receivers was 00:09:01 (hours:minutes:seconds) with a range of 00:03:58 to 00:16:15 and a standard deviation of 00:02:40. During these dates, flow steadily decreased from about 2500-1500 cfs whereas the temperature was very dynamic during this period, starting at about 22 C dropping to 19 C then returning back up to and over 22 C again (

Figure C **3**).

Once temperatures exceeded 22 ^{0}C, no acoustic tagged sockeye were encountered until 16 August and subsequently 15 acoustic tagged sockeye passed between 16 August and 9 September (Figure C 2). The average travel time post-weir was 00:38:48 with a range of 00:11:55 to 01:21:23 and a standard deviation of 00:22:04.

During the post-weir passage events flow was between 1500-800 cfs and temperatures were generally decreasing from 21.5 to 19 ^{0}C (

Figure C **3**).

The mean travel time was significantly faster pre-weir than post-weir (df=14, p<0.001)(Figure C 4). Sockeye passing the weir site did so 330% slower during the post weir time period.

The pre-weir mean travel time from Monse Bridge to the downstream weir receiver was 06:17:47 with a range from 05:04:14 to 08:27:24 and a standard deviation of 00:43:01. The post-weir mean travel time was 09:11:17 with a range from 06:15:21 to 16:57:33 and a standard deviation of 03:13:46.

The mean travel time was significantly faster pre-weir than post-weir (df=14, p<0.004)(Figure C 5). Sockeye traveling from Monse Bridge to the downstream acoustic receiver did so 46% slower during the post weir time period.

Multiple passage events were detected for four fish during the study period. Three fish that passed the weir site during the pre-weir period had their last detection at the downstream receiver. One of these fish (transmitter # A69-1601-18377) descended on the same day whereas the other two descended eight (transmitter # A69-1601-18399) and 10 (transmitter # A69-1601-18378) days later (but still during the pre-weir period). One fish (transmitter # A69-1601-18423) detected during the post-weir time period re-ascended on the same day as the initial ascent. The second ascent was approximately six minutes slower than the initial ascent. In all cases the initial ascent was included in the analysis.

Discussion and Management Implications

The effects on the physical habitat and non-target taxa are an important consideration in the configuration and operation of the weir. This study was conducted to provide additional insight and analysis to the ongoing investigation of the weir and its effects and effectiveness as a fish management tool for the summer Chinook salmon population. This study did not have a true control for time, and therefore was not adequate to prove that the weir itself caused a delay of sockeye salmon in their migration through the lower Okanogan River. Temperature, flow, fish migration behavior, fish condition and holding effects and other factors were all different between the pre- and post-weir migration observations. The fish that swam past the weir in August may have migrated into the Columbia River later (therefore getting tagged later and not having a chance to enter the Okanogan during the first thermal barrier break). Even if the 15 fish that migrated in mid-late August were just as fit as those that migrated in late July at initial tagging, they held in the Columbia River for 3-4 weeks longer and could have experienced additional stress such as predator avoidance, angling, or just simple energy expenditure associated with pre-spawn holding in marginal temperatures of the Columbia River. To partially evaluate that, we compared the travel times through a portion of the lower Okanogan River before getting to the weir site (Monse Bridge to the downstream weir receiver). This evaluation did show that sockeye were moving through the Lower Okanogan River at a slower pace during the post-weir timeframe than sockeye passing during the pre-weir timeframe (Figure C 5). However, sockeye traveling through the lower Okanogan River (downstream of the weir site) were only 46% slower whereas they were 330% slower traveling through the weir site. To thoroughly control for location and time effects, we would need to compare travel times during the same day and week with the weir in the water and out of the water. Much greater sample sizes of acoustically tagged sockeye (and likely other species) would likely need to be part of the study to justify such a labor-intensive effort. More importantly, evidence that biologically significant delay is occurring would likely be needed to justify an expansion of the existing study. If the 15 sockeye traveling past the weir with acoustic transmitters were representative of the population, then we suggest that fish managers need to decide if an average travel time through the weir of approximately 40 minutes, with a potential average delay of approximately 30 minutes, is biologically significant.

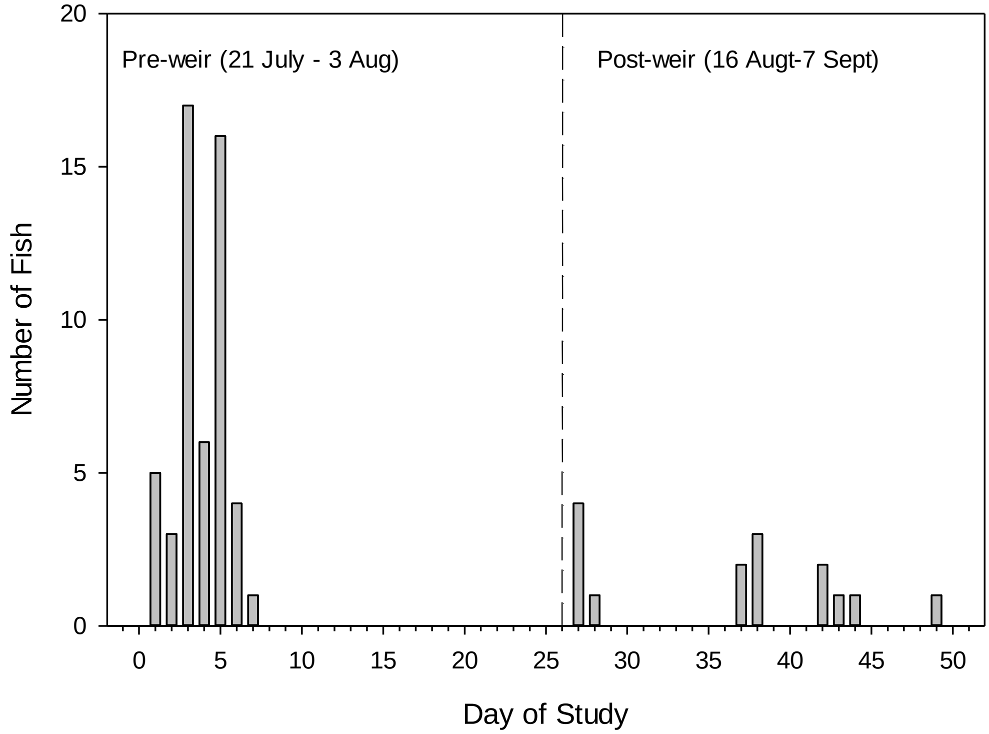
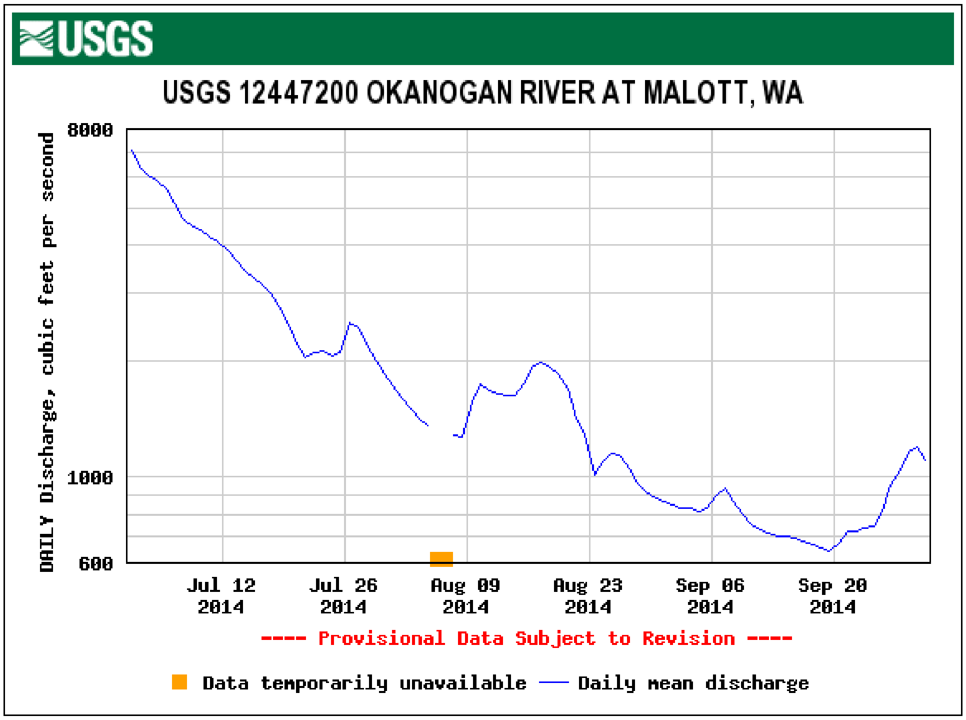


Figure C 2. Sample size of acoustic tagged sockeye passing through the lower Okanogan River between 21 July and 7 September 2014.



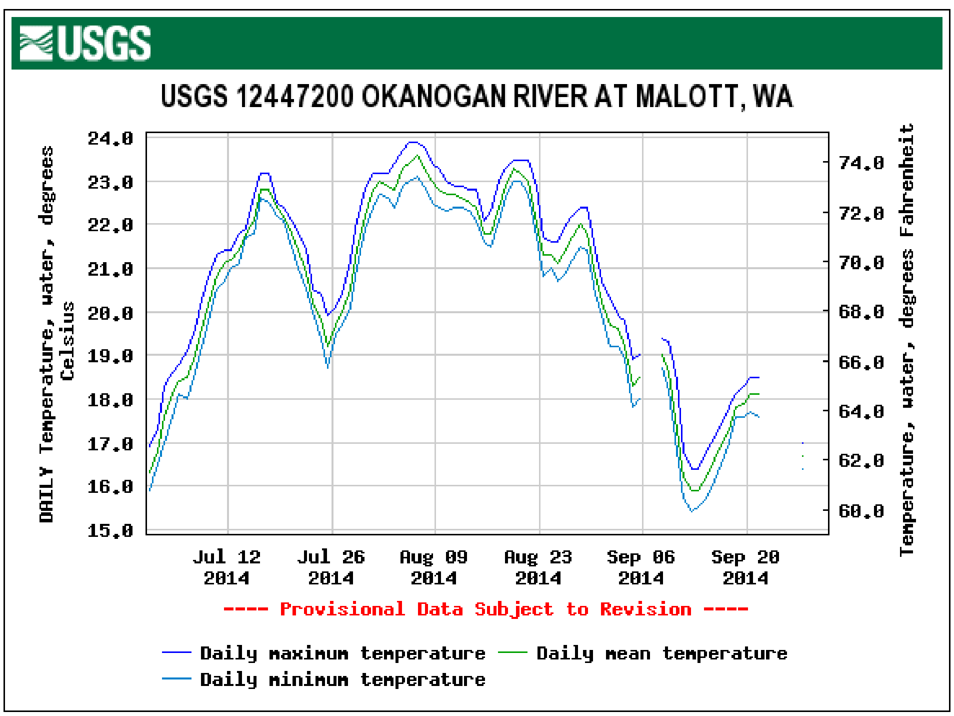


Figure C 3. Discharge and temperature in the vicinity of the lower Okanogan River weir.

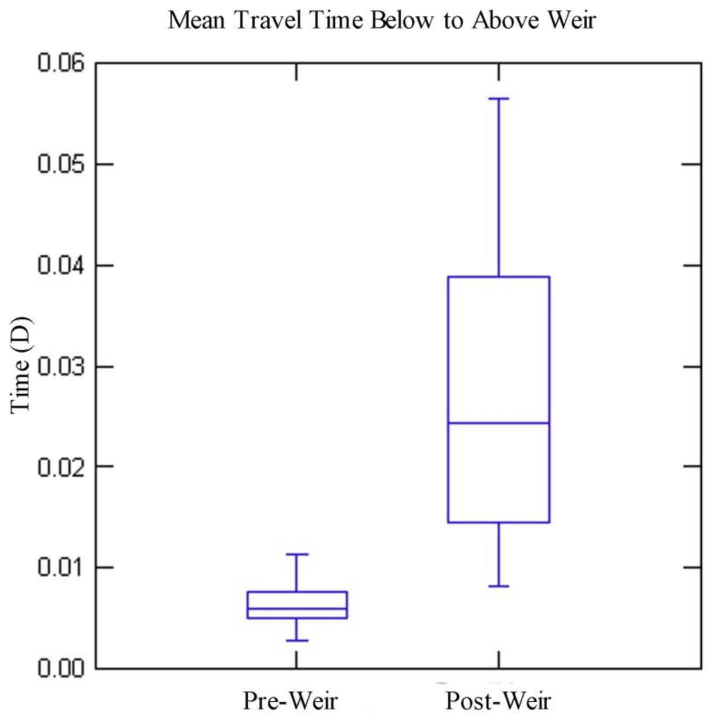


Figure C 4. A comparison of travel time (measure = fraction of a day) whereas the pre-weir mean was 0.006 days or 9 minutes 01 seconds and the post-weir mean was 0.027 days or 38 minutes 48 seconds.

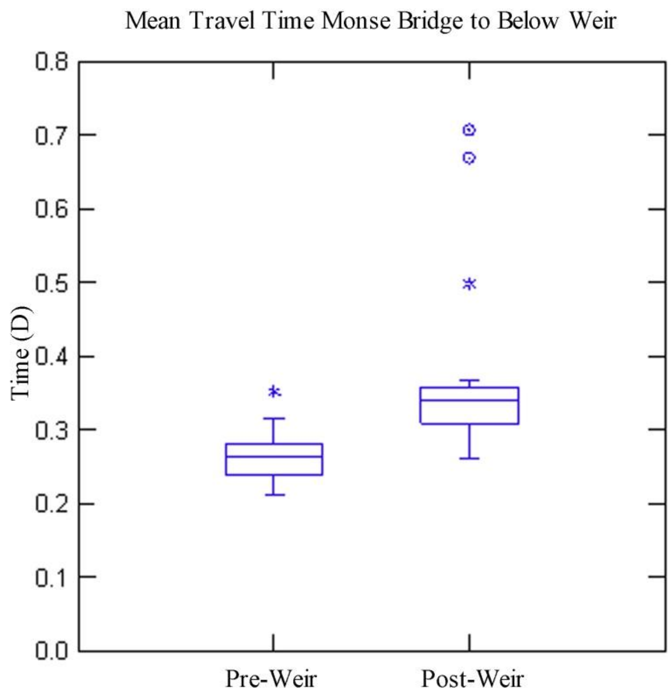


Figure C 5. Average travel time between the Monse Bridge 17 km downstream of the weir to the receiver below the weir was 0.262 d or 6:17:47 hh:mm:ss before the weir was installed and 0.383 d or 9:11:17 hh:mm:ss after the weir was installed.

APPENDIX D

Environmental DNA

Table D 1. eDNA analysis of Chinook presence at n = 24 sites throughout the U.S. and Canadian Okanogan Basin in 2012-2014.

Site	2012	2013	2014
Loup Loup Creek	NS[a]	-[b]	+[c]
Omak Creek (above falls)	-	NS	NS
Omak Creek (near mouth)	+	NS	+
Salmon Creek	+	NS	+
North Fork Salmon Creek	-	NS	-
West Fork Salmon Creek	-	NS	-
Wanacut Creek	NS	-	NS
Tunk Creek	NS	-	NS
Aeneas Creek	NS	-	-
Bonaparte Creek	+	NS	-
Siwash Creek	NS	+	NS
Tonasket Creek	NS	+	NS
Antoine Creek	NS	-	+
Similkameen River	NS	+	+
Nine Mile Creek	-	NS	-
Inkaneep Creek	+	NS	-
Vaseux Creek	+	NS	+
Shuttleworth Creek	-	NS	-
Shingle Creek	+	NS	+
Okanogan River (near mouth)	+	NS	+
Okanogan River (above Salmon cr.)	+	NS	+
Okanogan River (above Siwash cr.)	+	NS	+
Okanogan River (above Inkaneep cr.)	+	NS	+
Okanogan River (above Shuttleworth cr.)	-	NS	+
Sites positive/sites sampled	***10/16***	***2/8***	***12/19***

[a] *'NS' indicates sites that were not sampled during that specific year.*

[b] *'-' indicates sites where no Chinook eDNA was detected.*

[c] *'+' indicates sites where Chinook eDNA was detected, indicating presence of Chinook.*

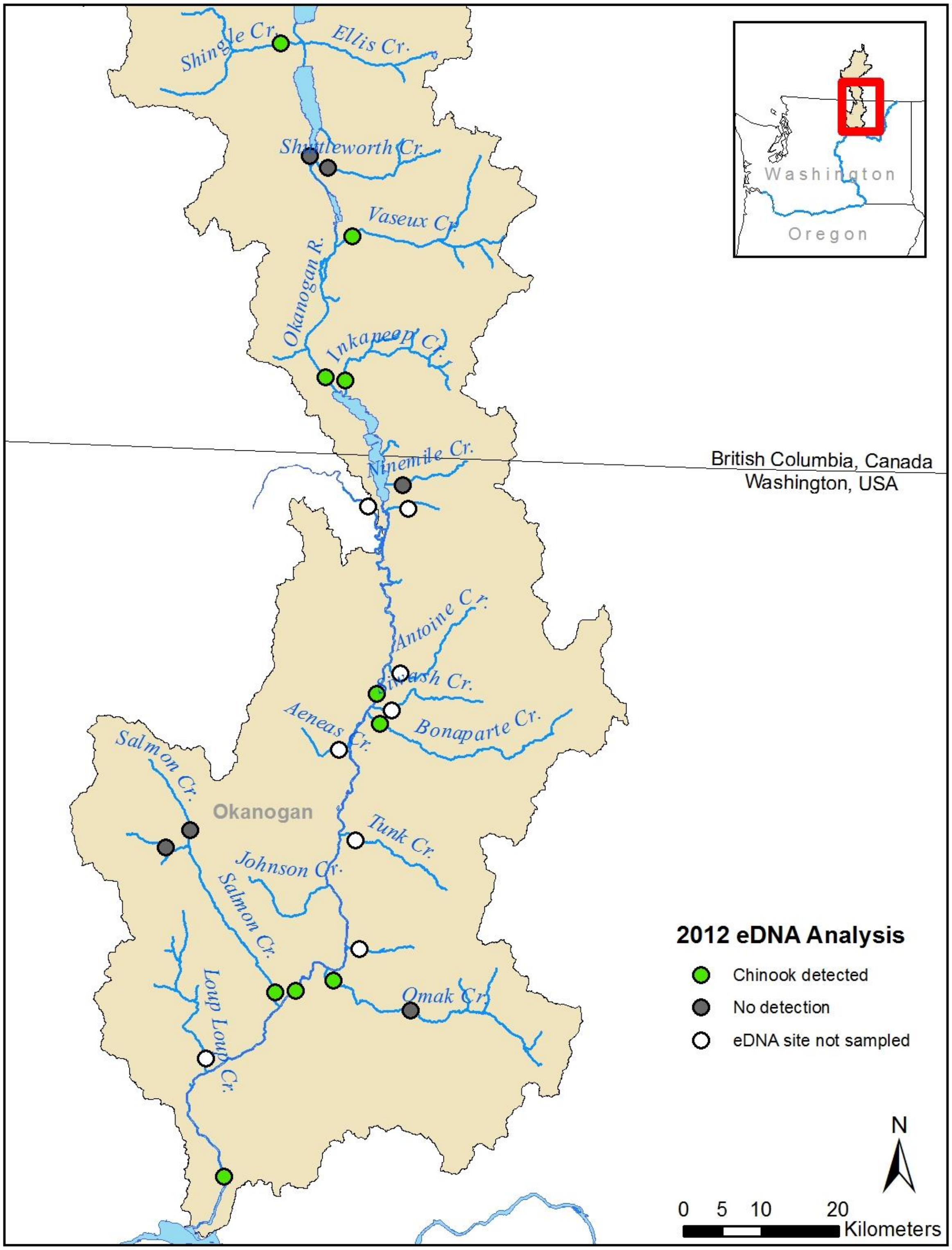


Figure D 1. Map of Okanogan Basin sites where Chinook eDNA was detected in 2012. Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

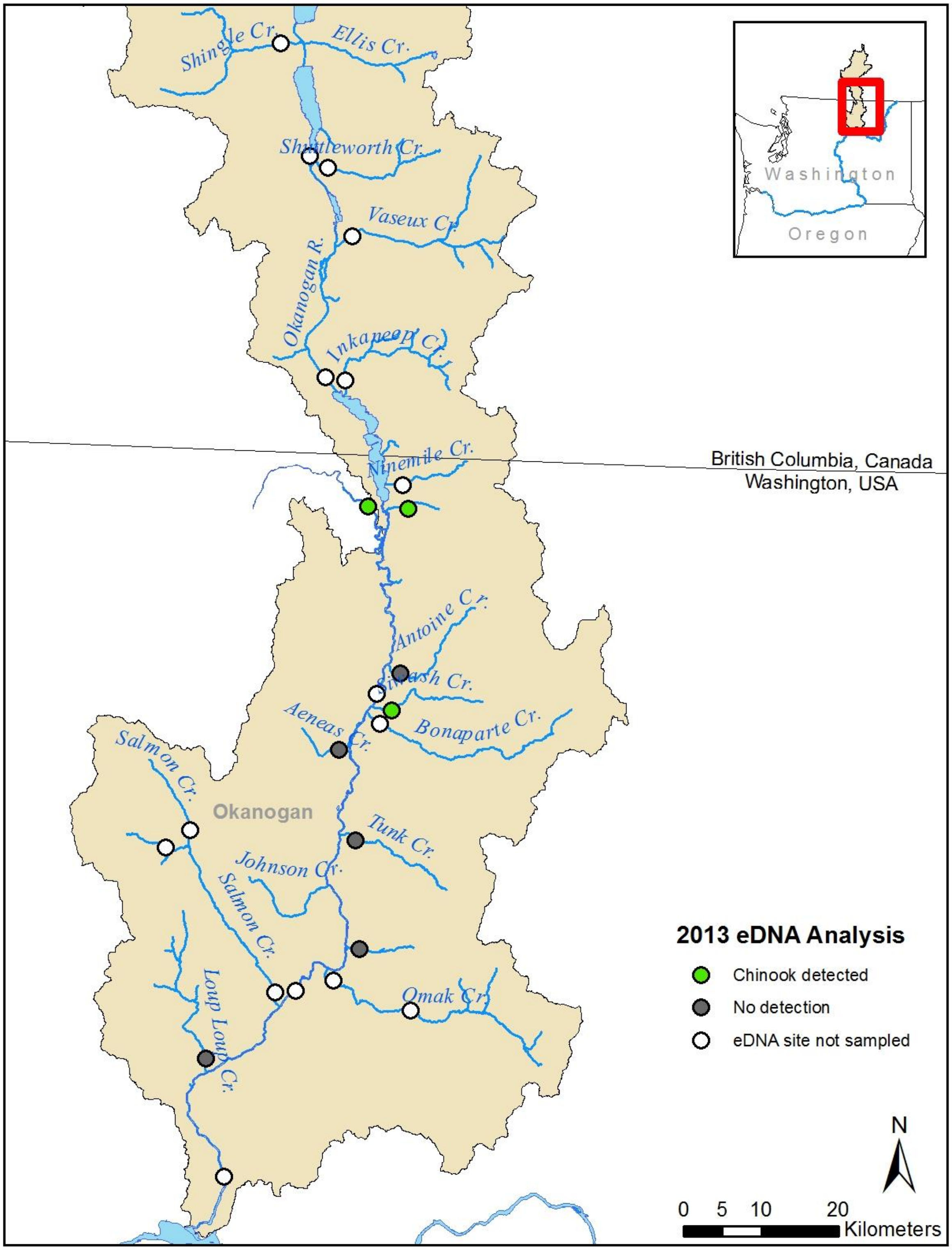


Figure D 2. Map of Okanogan Basin sites where Chinook eDNA was detected in 2013. Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

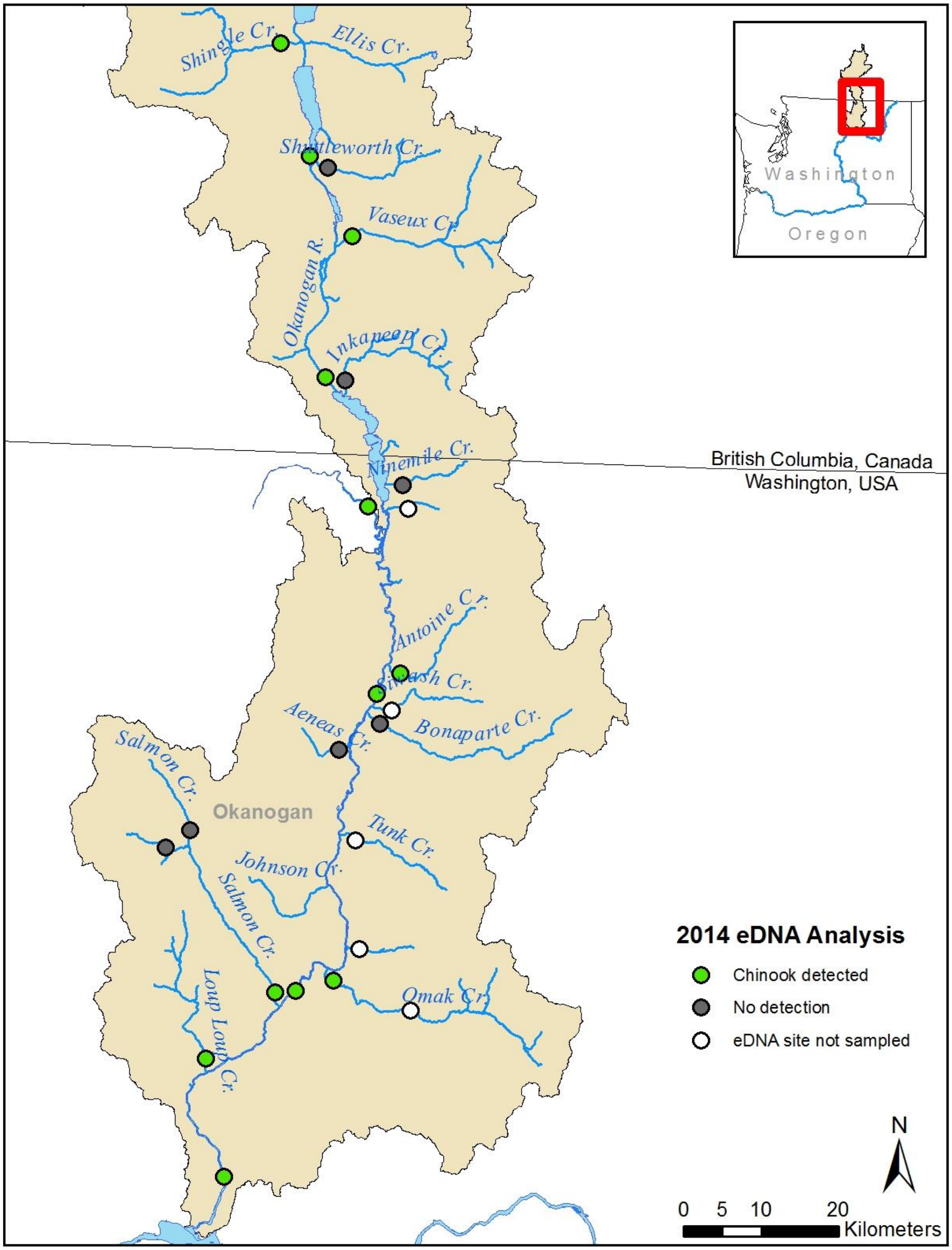


Figure D 3. Map of Okanogan Basin sites where Chinook eDNA was detected in 2014. Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Appendix E

Reach Weighted Effective pHOS

Table E 1. pHOS information for adjustments based on hatchery fish effectiveness (relative reproductive success assumption) and the reach weighting based on the proportion of redds in each reach in the Okanogan River from 2006 to 2014.

Brood Year		Number of Summer Chinook Carcasses								Total	Effective Reach Weighted pHOS[1]
		Okanogan						Similkameen			
		O-1	O-2	O-3	O-4	O-5	O-6	S-1	S-2		
2006	NOS	2	2	22	10	105	247	370	73	831	18.0%
	HOS	2	1	9	6	15	44	138	33	248	
	Effective pHOS[2]	44.4%	28.6%	24.7%	32.4%	10.3%	12.5%	23.0%	26.6%		
	% Redds	0.2%	1.3%	4.1%	3.4%	19.7%	32.0%	29.9%	9.5%	100%	
2007	NOS	1	0	30	1	284	322	405	20	1063	31.7%
	HOS	1	0	25	0	169	197	253	9	654	
	Effective pHOS[2]	44.4%	0.0%	40.0%	0.0%	32.3%	32.9%	33.3%	26.5%		
	% Redds	0.2%	0.8%	5.8%	3.1%	27.3%	27.6%	31.0%	4.3%	100%	
2008	NOS	2	1	14	11	107	324	347	41	847	54.3%
	HOS	2	9	26	25	141	341	512	116	1172	
	Effective pHOS[2]	44.4%	87.8%	59.8%	64.5%	51.3%	45.7%	54.1%	69.4%		
	% Redds	0.2%	2.4%	2.8%	4.5%	17.4%	26.2%	37.3%	9.3%	100%	
2009	NOS	2	3	13	14	189	347	330	75	973	40.4%

	HOS	0	4	18	18	159	153	373	75	800	
	Effective pHOS[2]	0.0%	51.6%	52.6%	50.7%	40.2%	26.1%	47.5%	44.4%		
	% Redds	0.1%	1.1%	3.1%	4.7%	20.9%	26.5%	36.8%	7.0%	100%	
2010	NOS	1	5	19	18	154	180	329	69	775	41.2%
	HOS	2	5	11	24	87	172	296	79	676	
	Effective pHOS[2]	61.5%	44.4%	31.7%	51.6%	31.1%	43.3%	41.9%	47.8%		
	% Redds	0.4%	2.7%	3.2%	4.2%	16.9%	20.3%	42.3%	10.0%	100%	
2011	NOS	0	0	21	4	201	362	216	19	823	47.4%
	HOS	0	0	34	10	160	116	537	95	952	
	Effective pHOS[2]	0.0%	0.0%	56.4%	66.7%	38.9%	20.4%	66.5%	80.0%		
	% Redds	0.1%	0.6%	3.2%	1.8%	19.0%	30.2%	39.0%	6.1%	100%	
2012	NOS	0	0	18	9	133	427	206	23	816	39.7%
	HOS	1	0	38	6	123	110	288	31	597	
	Effective pHOS[2]	100.0%	0.0%	62.8%	34.8%	42.5%	17.1%	52.8%	51.9%		
	% Redds	0.4%	2.0%	5.9%	2.5%	20.7%	28.6%	34.1%	5.7%	100%	
2013	NOS	0	0	22	7	37	352	191	4	613	27.1%
	HOS	0	0	8	2	15	80	188	4	297	
	Effective pHOS[2]	0.0%	0.0%	21.6%	21.6%	24.5%	15.4%	44.1%	44.1%		
	% Redds	0.1%	0.1%	4.5%	1.3%	11.2%	46.8%	35.4%	0.7%	100%	
2014	NOS	0	1	60	47	233	716	641	425	2123	12.0%
	HOS	1	0	19	7	42	67	129	64	329	

	Effective pHOS[2]	100.0%	0.0%	20.2%	10.6%	12.6%	7.0%	13.9%	10.8%		
	% Redds	0.3%	1.3%	4.5%	2.6%	20.0%	23.7%	40.8%	6.7%	100%	
Average % Redds		***0.2%***	***1.3%***	***4.0%***	***3.1%***	***18.7%***	***30.9%***	***35.3%***	***6.5%***		
Average Effective pHOS		***47.4%***	***55.9%***	***40.6%***	***39.5%***	***33.6%***	***23.8%***	***41.7%***	***35.1%***		
Average Reach Weighted Effective pHOS =											***33.1%***

Table E 2. Number of hatchery- and natural-origin (wild) summer Chinook carcasses collected in each reach of the Okanogan (O1-O6) and Similkameen rivers from 1993 to 2014.

Survey year	Origin	Survey reach								Total
		O-1	O-2	O-3	O-4	O-5	O-6	S-1	S-2	
1993[a]	Wild	0	0	3	0	13	4	48	1	69
	Hatchery	0	2	0	0	10	9	25	0	46
1994[b]	Wild	0	0	1	0	7	1	113	22	144
	Hatchery	0	4	3	0	20	4	205	38	274
1995	Wild	0	0	1	0	10	0	66	4	81
	Hatchery	0	0	1	0	20	0	173	11	205
1996	Wild	0	0	0	1	3	1	53	0	58
	Hatchery	0	0	0	1	2	1	173	0	177
1997	Wild	0	0	1	0	0	3	83	0	87
	Hatchery	0	0	1	0	9	0	142	1	153
1998	Wild	0	1	3	1	6	5	162	4	182
	Hatchery	0	0	5	0	1	2	178	0	186
1999	Wild	0	0	0	0	9	23	293	9	334
	Hatchery	0	0	3	2	14	30	473	39	561
2000	Wild	0	0	8	8	24	11	189	4	244
	Hatchery	0	2	12	7	23	5	538	37	624
2001	Wild	0	10	23	5	67	42	390	54	591
	Hatchery	0	16	52	5	60	70	751	51	1,005
2002	Wild	6	14	20	10	81	212	340	72	755
	Hatchery	4	18	63	25	123	360	925	187	1,705
2003[c]	Wild	0	0	13	0	12	152	231	124	532
	Hatchery	0	0	15	0	5	91	365	257	733

2004	Wild	0	2	19	19	108	225	1,125	260	1,758
	Hatchery	0	2	12	5	38	58	267	38	420
2005	Wild	0	5	51	21	256	364	531	176	1,404
	Hatchery	0	3	42	16	115	70	200	100	546
2006	Wild	2	2	22	10	105	247	370	73	831
	Hatchery	2	1	9	6	15	44	138	33	248
2007	Wild	1	0	30	1	284	322	405	20	1,063
	Hatchery	1	0	25	0	169	197	253	9	654
2008	Wild	2	1	14	11	107	324	347	41	847
	Hatchery	2	9	26	25	141	341	512	116	1,172
2009	Wild	2	3	13	14	189	347	330	75	973
	Hatchery	0	4	18	18	159	153	373	75	800
2010	Wild	1	5	19	18	154	180	329	69	775
	Hatchery	2	5	11	24	87	172	296	79	676
2011	Wild	0	0	21	4	201	362	216	19	823
	Hatchery	0	0	34	10	160	116	537	95	952
2012	Wild	0	0	18	9	133	427	206	23	816
	Hatchery	1	0	38	6	123	110	288	31	597
2013[d,e]	Wild	0	0	22	7	37	352	191	4	613
	Hatchery	0	0	8	2	15	80	188	4	297
2014	Wild	0	1	60	47	233	716	641	425	2123
	Hatchery	1	0	19	7	42	67	129	64	329
Average	***Wild***	***1***	***2***	***17***	***9***	***97***	***206***	***314***	***70***	***715***
	Hatchery	***1***	***3***	***19***	***8***	***63***	***94***	***331***	***60***	***579***

[a] 25 additional carcasses were sampled on the Similkameen and 46 on the Okanogan without any reach designation.

[b] One additional carcass was sampled on the Similkameen without any reach designation.

[c] 793 carcasses were sampled on the Similkameen before initiation of spawning (pre-spawn mortality) and an additional 40 carcasses were sampled on the Okanogan. The cause of the high mortality (*Ichthyophthirius multifilis* and *Flavobacterium columnarae*) was exacerbated by high river temperatures.
[d] In 2013, carcass recoveries were combined in reaches O-3 and O-4, and S-1 and S-2. Then re-apportioned based on redd counts within each reach.
[e] 2013 data have been updated to reflect age and origin data acquired from scale reading since the publication of the 2013 annual report

Table E 3. Estimated number (and percent of annual total) of hatchery-origin spawners from different hatcheries recovered on the Okanogan/Similkameen spawning grounds, based on CWT recoveries and expansions, for return years 2006-2014.

Return Year	**Rearing Hatchery**															**Total**
	Homing Fish		**Within ESU Stray**										**Out of ESU Stray**			
	Okanogan River Basin		**Methow**	**Wenatchee**	**Entiat**	**Chelan River**			**Columbia River Summer Chinook**				**Fall Chinook**			
	Bonaparte Pond	**Similkameen Pond**	**Carlton Pond**	**Dryden Pond**	**Entiat NFH**	**Chelan River NP**	**Chelan PUD Hatchery**	**Chelan Hatchery**	**Wells Hatchery**	**Turtle Rock Hatchery**	**Eastbank Hatchery**	**Grant County PUD Hatchery**	**Priest Rapids Hatchery**	**Glenwood Springs Hatchery**	**Oxbow Hatchery**	
2006	0 (0%)	709 (87%)	12 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	12 (2%)	56 (7%)	12 (2%)	12 (2%)	0 (0%)	0 (0%)	0 (0%)	814
2007	0 (0%)	1121 (95%)	17 (1%)	3 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (0%)	37 (3%)	2 (0%)	3 (0%)	0 (0%)	0 (0%)	0 (0%)	1,186
2008[a]	0 (0%)	3224 (95%)	11 (0%)	24 (1%)	0 (0%)	0 (0%)	4 (0%)	0 (0%)	75 (2%)	59 (2%)	0 (0%)	0 (0%)	3 (0%)	0 (0%)	0 (0%)	3,404
2009	0 (0%)	2733 (95%)	14 (0%)	4 (0%)	0 (0%)	0 (0%)	9 (0%)	0 (0%)	76 (3%)	23 (1%)	9 (0%)	0 (0%)	0 (0%)	4 (0%)	5 (0%)	2,869
2010	4 (0%)	2165 (89%)	44 (2%)	4 (0%)	0 (0%)	0 (0%)	75 (3%)	35 (1%)	75 (3%)	0 (0%)	31 (1%)	0 (0%)	0 (0%)	0 (0%)	4 (0%)	2,434
2011	219 (5%)	4196 (93%)	44 (1%)	0 (0%)	0 (0%)	0 (0%)	6 (0%)	28 (1%)	17 (0%)	5 (0%)	5 (0%)	0 (0%)	0 (0%)	0 (0%)	6 (0%)	4,520
2012	379 (13%)	2397 (83%)	29 (1%)	23 (1%)	0 (0%)	6 (0%)	6 (0%)	6 (0%)	29 (1%)	23 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2,897
2013	254 (14%)	1437 (81%)	10 (1%)	54 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	10 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,763
2014	55 (5%)	1023 (90%)	16 (1%)	0 (0%)	6 (1%)	0 (0%)	0 (0%)	12 (1%)	17 (2%)	12 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,139
Average	**101 (4%)**	**2112 (90%)**	**22 (1%)**	**12 (1%)**	**1 (0%)**	**1 (0%)**	**11 (0%)**	**9 (0%)**	**34 (1%)**	**25 (2%)**	**7 (0%)**	**2 (0%)**	**0 (0%)**	**0 (0%)**	**2 (0%)**	**2,486**

[a] Three spring Chinook recovered in 2008 were excluded from analysis. They were reared at Entiat NFH and released from Omak Creek in 2005.

APPENDIX F

Annual Program Planning Tool Spreadsheet

Table F 1. Annual tasks, subtasks, milestones for the CJHP.

Task-->	**1.1 Manage information and support the adaptive management process**				
Subtasks-->	**1.1.1 Ensure quality, timeliness and access all information needed to support decision making (maintenance/update of ISIT/AHA)**				
Milestone	**Activity/Description**	**Begin Date**	**Due Date**	**WE Deliverable**	**Lead**
Budget, schedule, scope and assignments for RM&E program completed	Plan for, administer and coordinate CJHP RM&E Program activities.	May 1, 2014	October 1, 2014	Updated APR data set	Keith Wolf
Data entered correctly to the OBMEP database	Data for ISIT that comes from OBMEP is entered into the OBMEP database prior to updating ISIT	1-Apr-14	Feb. 2015 (tentative ; as available)	Updated APR data set	John Arterburn/ Lars Mobrand/ ICFI & Keith Wolf for Spring CK
Track and report progress toward biological goals	HARVEST (OK): In coordination with the harvest program, evaluate data on Colville Tribal C&S fisheries (Chief Joseph Dam Tailrace, platform and Okanogan River) to determine annual total effort, catch per unit of effort, and harvest of CJHP and other stocks (compilation of last season and previous year)	1-Apr-14	Nov. 1 2014	Updated APR data set	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Ensure that information is disseminated to fisheries managers and field crews as needed	Compile, analyze, and disseminate Project information, data, and findings via APR.	Nov. 2014	1-Mar-15	Updated APR data set	Keith Wolf
Task-->	**1.2 RM&E Activities required to: make annual production adjustments (in-season run-size prediction and updating)**				
Subtasks-->	**1.2.1 Update run-size projections**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Report TAC fish counts and run timing at Bonneville, Priest Rapids, and passing Wells Dams	Report TAC fish counts and run timing at mainstem hydro projects	Dec. 1 2014	Jul 31 2015	Annual Report on forecasting and disposition of returning adults	Mike Rayton

Update forecast in ISIT based on TAC 50% run size, timing and composition (NOR v HOR) at Bonneville in June	Estimate fraction of Okanogan-origin fish arriving at mainstem hydro projects. ISIT and AHA input. Regression.	Dec. 1 2014	Jul 15 2015	Annual Report on forecasting and disposition of returning adults	Andrea Pearl
Analyze accuracy/precision and future alternatives.	Regression analysis for prediction of NORs in the Okanogan from escapement at Wells	June 1 2014	Feb. 28 2015	Annual Report on forecasting and disposition of returning adults	Casey Baldwin
Query CJH PIT tag data and report preliminary results	Upload and data management for SAR Analysis	Jan. 1 2014	Feb. 28 2015	Annual Report on forecasting and disposition of returning adults	Andrea Pearl, Casey Baldwin
Subtasks-->	**1.2.2 Reporting/recording (how is information brought into ISIT/AHA)**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Update and document Key Assumptions	Active step to populate CJHP database. QA/QC in CJHP registered database and begin analysis	Nov. 1 2014	Mar. 31 2015	Annual Report on forecasting and disposition of returning adults	Andrea Pearl, Keith Wolf
Update estimates of SAR based on PIT tagging and Juvenile sampling	Upload and data management. Analysis	Nov. 1 2014	Mar. 31 2015	Annual Report on forecasting and disposition of returning adults	Andrea Pearl, Casey Baldwin
Update EDT	Upload and data management. Analysis	Jan. 31, 2015	Mar. 31 2015	Annual Report on forecasting and disposition of returning adults	John Arterburn, Keith Wolf (EDT), Andrea (ISIT)
Update and report in-hatchery survival parameters	Upload and data management. Analysis	Mar. 1 2014	Feb. 28 2015	Annual Report on forecasting and disposition of returning adults	Pat Phillips, Andrea Pearl
Update Status and Trend Information—both analytical results and documentation	Upload and data management. Analysis	Dec. 1 2014	Feb. 28 2015	Annual Report on forecasting and disposition of returning adults	Andrea Pearl, John Rohrback, Matt Laramie
Run CJH database queries	Maintain and manage the CHJP Database. SQL or other regional standards (Juvenile trapping, weir operations, redd and carcass survey database queries, Hatchery, Harvest, Spawning Escapement)	Nov. 1 2014	Feb. 28 2015	Annual Report on forecasting and disposition of returning adults	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Development of CJH database reports	Maintain and manage the CHJP Database. SQL or other regional standards	May 1 2014	Nov. 1 2014	Annual Report on forecasting and disposition of returning adults	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Move reports into ISIT/AHA	Maintain and manage the CHJP Database. SQL or other regional standards	Dec. 1 2014	Feb. 28 2015	Annual Report on forecasting and disposition of returning adults	Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Task-->	**1.3 RM&E activities required to: effectively implement the Program in terms of adult fish management: harvest, weir operations, broodstock collection**				

Subtasks-->	1.3.1 Set Adult Management Targets				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Establish Biological Targets and report to Mike and Pat	Upload and data management. Analysis	Mar. 1 2014	15-Jul-14	Annual Report on forecasting and disposition of returning adults	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Review pre-season forecast from TAC then apply US v. OR and WDFW agreements to obtain a harvest allocation for Chinook.	data used for WE to estimate harvest allocation	Dec. 1 2014	Dec. 15 2014	Annual Report on forecasting and disposition of returning adults	Mike Rayton
Reconcile biological targets with harvest allocation; communications with co-managers	coordinated process with co-managers to disseminate information regarding harvest and biological targets	Mar. 15, 2014	Oct. 31, 2014	Annual Report on forecasting and disposition of returning adults	Kirk Truscott
Subtasks-->	**1.3.2 Deploy Selective Gear**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Establish efficiency parameters and effect monitoring	Conduct test of Weir	15-Jul-14	Oct. 31, 2014	Summary at APR/Final Report in 2015	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Establish efficiency parameters and effect monitoring	Conduct test of Tangle net	1-Jul-14	Sept. 30, 2014	Summary at APR	Mike Rayton
Establish efficiency parameters and effect monitoring	Conduct test of floating trap	NA 2014	NA 2014	0	NA 2014
Establish efficiency parameters and effect monitoring	Conduct test of beach seines	1-Jul-14	31-Oct-14	Summary at APR	Keith, Mike
Establish efficiency parameters and effect monitoring	Conduct test of scaffold	TBD	TBD	Summary at APR	TBD
Establish efficiency parameters and effect monitoring	Conduct test of hoop and dip net	TBD	TBD	Summary at APR	TBD
Establish efficiency parameters and effect monitoring	Conduct test of purse seine	11-Jun-14	Oct. 15, 2014	Summary at APR	Mike Rayton
Subtasks-->	**1.3.3 Fishing gear effect and effectiveness**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Interrogate NOR Chinook on purse and beach seine for PIT tags	Data will be uploaded to PTAGIS frequently enough during tagging/release operations that the PIT tag data will be in the database before the tagged fish are likely to be detected [specify appropriate intervals, perhaps by season if variable].	15-Oct-14	30-Nov-14	Annual Report on forecasting and disposition of returning adults	Andrea Pearl

Interrogate NOR Chinook at weir for PIT tags	Data will be uploaded to PTAGIS frequently enough during tagging/release operations that the PIT tag data will be in the database before the tagged fish are likely to be detected [specify appropriate intervals, perhaps by season if variable].	15-Jul-14	30-Nov-14	Annual Report on forecasting and disposition of returning adults	Andrea Pearl
Examine feasibility and outline study design to assess delayed mortality	Develop a study to analyze delayed mortality.	1-Apr-14	Aug. 31, 2014	Annual Report on forecasting and disposition of returning adults	Casey Baldwin
Estimate harvest rate based on catch data (Mike, July-Oct), CPUE, Feasibility/Cost Effectiveness	Data analysis to determine an estimated harvest rate. Calculate annual cost of program operations and compare to sum of ex-vessel value of commercial catches and monetary value of recreational fisheries for Chinook	TBD	TBD	Annual Report on forecasting and disposition of returning adults	TBD
Address jacks	Compile age composition for various gear types; summarize similarities and differences	15-Jul-14	Mar. 1, 2015	Annual Report on forecasting and disposition of returning adults	Casey Baldwin
Subtasks-->	**1.3.4 Monitor and record catch information-update status and trends**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Summarize and report Tribal harvest data, and recreational catch data received from WDFW to Andrea	Coordinated process with CCT staff to disseminate and share information for decision making	15-Oct-14	31-Jan-15	Annual Report on forecasting and disposition of returning adults	Mike Rayton
Tribal Creel surveys and upload of data into harvest database	Data collection on Tribal Creel fishing.	1-Jul-14	15-Nov-14	Annual Report on forecasting and disposition of returning adults	Mike Rayton
Subtasks-->	**1.3.5 Access catch information-update status and trends**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Retrieve CWT data (RMIS and DART)	query database for analysis	1-Jan-15	28-Feb-15	Annual Report on forecasting and disposition of returning adults	Casey Baldwin, Mike Rayton
Estimate number of Okanogan-origin HOR and NOR fish harvested in selective and non-selective fisheries state and tribal fisheries	Data analysis to determine an estimate of Okanogan HOR and NOR harvested by fishery	1-Nov-14	28-Feb-15	Annual Report on forecasting and disposition of returning adults	Mike Rayton, Casey Baldwin
Estimate contribution rate of Okanogan HORs to out-of-basin populations	data analysis to determine an estimate of hatchery returns to out-of-basin populations	1-Jul-14	15-Dec-14	Annual Report on forecasting and disposition of returning adults	Mike Rayton, Casey Baldwin
Estimate stray rate of Okanogan released HORs into Okanogan	data analysis to determine Okanogan releases to spawner composition	1-Jul-14	15-Dec-14	Annual Report on forecasting and disposition of returning adults	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff and Casey

					Baldwin
Subtasks-->	**1.3.6 Mark & tag recovery activities and/or development of future use of tags & marks**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Collect snouts and submit to WDFW for analysis	Collect snouts and submit to WDFW for analysis	1-Jul-14	28-Nov-14	Annual Report on forecasting and disposition of returning adults; study plans where applicable	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff, Pat Phillips, Mike Rayton
Analysis of tag recoveries	Query regional mark information system (RMIS) to determine # of recoveries of Okanogan-origin fish: in fisheries; at weir; on the spawning grounds; hatchery broodstock, hatchery ladder	15-Dec-14	28-Feb-15	Annual Report on forecasting and disposition of returning adults; study plans where applicable	Casey Baldwin, Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Analysis of tag recoveries	PIT tag activities and summary	15-Dec-14	28-Feb-15	Annual Report on forecasting and disposition of returning adults; study plans where applicable	Andrea Pearl
Future analysis of tag recoveries	Development of key management questions to be addressed through genetic analysis, and study design for use of genetic tags for CJH analysis. Continue archiving PBT information at CJH	April 1 2014	Feb. 28, 2015	Annual Report on forecasting and disposition of returning adults; study plans where applicable	Matt Laramie, Casey Baldwin, Kirk Truscott
Analysis of tag recoveries	Where available, access data. 1) Development of key management questions to be addressed through radio tag analysis, and 2) study design for use of radio tags for CJH analysis.	April 1 2014	Feb. 28, 2015	Annual Report on forecasting and disposition of returning adults; study plans where applicable	Matt Laramie, Casey Baldwin, Kirk Truscott, Jennifer Miller
Analysis of tag recoveries	where available, access data. 1) Development of key management questions to be addressed through acoustic tag analysis, and 2) study design for use of acoustic tags for CJH analysis.	April 1 2014	Feb. 28, 2015	Annual Report on forecasting and disposition of returning adults; study plans where applicable	Keith Wolf, Andrea Pearl, Casey Baldwin
Analysis of tag recoveries	Regional Coordination	1-Apr-14	15-Dec-14	Annual Report on forecasting and disposition of returning adults; study plans where applicable	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff, Pat Phillips, Casey Baldwin
Subtasks-->	**1.3.7 Plan and conduct Annual Project Review (APR)**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**

Planning and Logistics: three APR workgroups (policy, technical, logistics)	Plan, prepare for, coordinate and communicate with CCT and support staff for implementing the Annual Program Review.	Nov. 1 2014	30-Apr-15	Conduct APR and produce Annual Plans and Report	Keith Wolf, Kirk Truscott
Task-->	**1.4 Activities required to: effectively implement hatchery operations to meet production targets and contribution to CJHP RM&E**				
Subtasks-->	**1.4.1 Brood Collection**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Collect BY 14 Summer/Fall Chinook Broodstock	Off-Site Brood Collection: Purse Seine and Transport/Weir	15-Jul-14	Oct. 31, 2014	Production Report and weekly collection schedule	Pat Phillips, Tony Cleveland, Mike Rayton
Develop Broodstock collection quota	Update collection quota based on APR Biological Targets	15-Mar-14	1-Apr-14	Production Report and weekly collection schedule	Kirk Truscott
Collect BY 14 Spring Chinook Broodstock	Collect and transport Leavenworth broodstock to CJH	1-Jun-14	30-Jun-14	Production Report and weekly collection schedule	Pat Phillips
BY 14 Summer/Fall Chinook Adult Management	On-Site Fish Ladder Operation, Brood Collection and Surplus Fish Handling	1-Jul-14	30-Nov-14	Production Report and weekly collection schedule	Pat Phillips
Broodstock composition NOR, HOR for Spring Chinook	Summarize Leavenworth and Winthrop NFH transfer information (Critical Data and information)	1-Jun-14	31-Dec-14	Production Report and weekly collection schedule	Pat Phillips
Broodstock composition NOR, HOR for S/Fall Chinook	Collect data at spawn and surplussing (length, sex, CWT, PBT, PIT tag, etc.)	1-Oct-14	30-Nov-14	Production Report and weekly collection schedule	Pat Phillips, Matt Laramie
Surplussed Fish for Spring Chinook	Surplus fish as needed	NA 2014	NA 2014	Production Report and weekly collection schedule	NA 2014
Surplussed Fish for S/Fall Chinook	Remove hatchery fish from the ladder.	1-Jul-14	30-Nov-14	Production Report and weekly collection schedule	Pat Phillips
Subtasks-->	**1.4.2 On-Site Brood Holding and Egg-Take**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Within hatchery life-stage survival	Data collection of hatchery pre-spawn mortality (Spring and S/F Chinook)	1-Jun-14	30-Nov-14	Hatchery Production Report	Pat Phillips
Within hatchery life-stage survival	Data collection of spawned broodstock which includes M/F, jack and estimated green egg take (SP/Su/F)	1-Aug-14	30-Nov-14	Hatchery Production Report	Pat Phillips
Within hatchery life-stage survival	Data collection of fecundity (Spring and S/F Chinook)	1-Nov-14	31-Jan-15	Hatchery Production Report	Pat Phillips
Subtasks-->	**1.4.3 Incubation and Ponding**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Within hatchery life-stage survival	Data collection of green egg to eyed egg survival (Spring and S/F Chinook)	1-Nov-14	31-Jan-15	Hatchery Production Report	Pat Phillips

Within hatchery life-stage survival	Data collection of eyed egg to emergence survival (Spring and S/F Chinook)	1-Dec-14	30-Apr-14	Hatchery Production Report	Pat Phillips
Within hatchery life-stage survival	Data collection of number of fry ponded to indoor rearing (Spring and S/F Chinook)	1-Dec-14	30-Apr-14	Hatchery Production Report	Pat Phillips
Subtasks-->	**1.4.4 Chinook Start-up Indoor Rearing at the Hatchery**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Within hatchery life-stage survival	Short term rearing (Spring and S/F Chinook)	1-Jan-14	31-May-14	Hatchery Production Report	Pat Phillips
Within hatchery life-stage survival	Number of fry transferred to outdoor raceways (Spring and S/F Chinook)	1-Feb-14	31-May-14	Hatchery Production Report	Pat Phillips
Subtasks-->	**1.4.5 Juvenile Fish Marking and Tagging**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Uniquely mark individual production groups	Mark reintroduction 10j Spring Chinook with 100% CWT-Ad (USFWS) and 5,000 PIT tag (CCT) --Spring Chinook	1-Jun-14	31-Aug-14	Hatchery Production Report	Pat Phillips
Uniquely mark individual production groups	Mark integrated Summer Chinook with 100% CWT-Ad and 10,000 PIT tag (CCT) -Sum/Fall Chinook	1-Jul-14	30-Apr-15	Hatchery Production Report	Pat Phillips
Uniquely mark individual production groups	Mark segregated Spring Chinook with 200k CWT and 100% Ad-Clip --Spring Chinook	1-Jul-14	31-Aug-14	Hatchery Production Report	Pat Phillips
Uniquely mark individual production groups	Mark segregated Summer Chinook with 200k CWT and 100% Ad-Clip and 10,000 PIT tag (CCT) --Sum/Fall Chinook	1-Jul-14	30-Apr-15	Hatchery Production Report	Pat Phillips
Uniquely mark individual production groups	Perform pre-release tag retention evaluation of CWT's and PIT tags. Captures mark efficiency-proportion of fish released that were successfully marked. --Spring Chinook	15-Mar-14	15-Apr-14	Hatchery Production Report	Pat Phillips, Tony Cleveland, Andrea Pearl
Uniquely mark individual production groups	Perform pre-release tag retention evaluation of CWT's and PIT tags. Captures mark efficiency-proportion of fish released that were successfully marked. --S/Fall Chinook	15-Mar-14	15-Jun-14	Hatchery Production Report	Pat Phillips, Tony Cleveland, Andrea Pearl
Subtasks-->	**1.4.6 Chinook Outdoor Rearing in Raceways and Ponds at the Hatchery**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Within hatchery life-stage survival	Outdoor rearing and release of segregated fish at the hatchery --Spring Chinook	1-May-14	30-Apr-15	Report sections for Production and Annual Report	Pat Phillips

Within hatchery life-stage survival	Outdoor rearing and release of segregated fish at the hatchery --S/Fall Chinook	1-Feb-14	30-Apr-15	Report sections for Production and Annual Report	Pat Phillips
Within hatchery life-stage survival	Outdoor rearing and release of10j reintroduction fish at the hatchery --Spring Chinook	1-May-14	31-Oct-14	Report sections for Production and Annual Report	Pat Phillips
Within hatchery life-stage survival	Outdoor rearing and release of integrated fish at the hatchery --S/Fall Chinook	1-Feb-14	30-Apr-15	Report sections for Production and Annual Report	Pat Phillips
Subtasks-->	**1.4.7 Chinook Outdoor Rearing in Ponds at the Hatchery**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
	No of segregated fish released at the hatchery --Spring Chinook	1-Feb-14	30-Apr-15	Report sections for Production and Annual Report	Pat Phillips
	No of segregated fish released at the hatchery --S/Fall Chinook	1-Feb-14	30-Apr-15	Report sections for Production and Annual Report	Pat Phillips
Subtasks-->	**1.4.8 Chinook Transport to Acclimation Ponds**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Juvenile transfers	200k 10j reintroduction juvenile fish transferred to Acclimation ponds --Spring Chinook	15-Oct-14	15-Nov-14	Hatchery Production Report	Pat Phillips, Tony Cleveland
Juvenile transfers	660k Integrated fish transferred to Acclimation ponds --S/Fall Chinook	15-Apr-14	15-Nov-14	Hatchery Production Report	Pat Phillips, Tony Cleveland
Subtasks-->	**1.4.9 Chinook Rearing at Acclimation Ponds**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Within hatchery life stage survival	Outdoor rearing and release of 10j reintroduction fish at the acclimation pond --Spring Chinook	1-Nov-14	30-Apr-15	Hatchery Production Report	Pat Phillips, Tony Cleveland
Within hatchery life stage survival	Outdoor rearing and release of integrated fish at the acclimation pond --S/Fall Chinook	15-Apr-14	30-Apr-15	Hatchery Production Report	Pat Phillips, Tony Cleveland
Task-->	**1.5 RM&E activities required to: test key program assumptions related to habitat and natural production**				
Subtasks-->	**1.5.1 Spawning habitat survey**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Empirical measurements at spawning locations	data collection and upload into database. Data analysis as needed	NA 2014	NA 2014	NA 2014	NA 2014
Subtasks-->	**1.5.2 Habitat status and trend monitoring**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Habitat surveys	Update habitat data	1-Jan-14	31-Dec-14	Updated productivity and capacity at defined intervals	John Arterburn

				(four years)	
Subtasks-->	**1.5.3 Redd/carcass surveys**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Map redd locations	Data collection and entry on where redds are located into ArcGIS for Okanogan and Similkameen rivers	1-Oct-14	28-Feb-15	APR Presentation and Annual Report	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Conduct spawning ground and carcass surveys in Okanogan and Similkameen rivers	data collection and entry for spawning ground, carcass recoveries, and egg retention in the Okanogan and Similkameen rivers	1-Oct-14	15-Nov-14	APR Presentation and Annual Report	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Inclusion of Zosel video and Redd surveys	Obtain Zosel video, pit and spawning ground data in Canada to integrate into CJHP databases	15-Nov-14	31-Jan-15		Casey Baldwin, Andrea Pearl, ONA
Upload existing data into CJH database	Uploading data from data collections	1-Oct-14	30-Nov-14	#REF!	Andrea Pearl, Keith Wolf
Analysis to meet objectives above	QA/QC on the dashboard, run query reports and data summaries. Analyze data in ArcGIS. Input data into ISIT	20-Nov-14	28-Feb-15		Andrea Pearl, Matt Laramie
Subtasks-->	**1.5.4 juvenile emigration monitoring**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Beach seining and tagging up to 25k NOR CK	Pit Tag subyearling juvenile Chinook fish >65mm	15-Jun-14	30-Jul-14	APR Presentation and Annual Report	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Screw trapping on the Okanogan River	Operate Rotary Screw Trap to conduct Juvenile abundance estimates, tagging, trap efficiency, and run timing	1-Apr-14	31-Jul-14	APR Presentation and Annual Report	Keith Wolf, Andrea Pearl
Review protocols in MM.org.	Adopt, modify or create CJH protocols	1-May-14	30-Apr-15	APR Presentation and Annual Report	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Analysis to meet objectives above	QA/QC on the dashboard, run query reports and data summaries. Analyze data in ArcGIS. Input data into ISIT	20-Nov-14	February 28th	APR Presentation and Annual Report	Keith Wolf, Andrea Pearl
Subtasks-->	**1.5.5 monitoring at wells dam**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**

Retrieve data from stock monitoring at Wells Dam east and west ladders (WDFW)	Coordinate with WDFW to obtain data into existing CJHP database	1-Dec-14	31-Jan-15	ISIT Status and Trends	Andrea Pearl
Retrieve data from ladder counts at Wells (DCPUD)	Coordinate with DCPUD to obtain data into existing CJHP database	1-Jul-14	30-Nov-14	ISIT Status and Trends	Andrea Pearl
Tagging and Marking at Wells	Tagging activities to include radio, acoustic and pit tags	NA 2014	NA 2014	ISIT Status and Trends	Keith Wolf, Casey Baldwin, Matt Laramie and John Rohrback
Subtasks-->	**1.5.6 Habitat restoration planning and implementation**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Provide implementation schedule and project description	Implement habitat restoration projects	15-Mar-14	14-Mar-15	APR Presentation and Annual Report	Chris Fisher
Subtasks-->	**1.5.7 Monitor and record annual variables and events affecting summer/fall Chinook**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Review last year's events and summarize	Document environmental anomalies	1-May-14	30-Apr-15	ISIT/AHA input, APR and Annual Report	Keith Wolf
Subtasks-->	**1.5.8 Implementation**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Were assumptions met? Review last year's events and summarize	Summarize all collection efforts at APR and adapt plans as necessary	1-Nov-14	30-Apr-15	ISIT/AHA input, APR and Annual Report	Keith Wolf
Subtasks-->	**1.5.9 All-H integration**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
		1-Nov-14	30-Apr-15	ISIT/AHA input, APR and Annual Report	Keith Wolf, Kirk Truscott
Task-->	**1.6 Activities required for RM&E-logistics and tool development**				
Subtasks-->	**1.6.1 Planning, scheduling and coordination of field work**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Work with Keith to integrate Action Plan into M&E Plan	Summarize all data collection and analysis and adapt plans as necessary.	1-Nov-14	30-Apr-15	ISIT/AHA input, APR and Annual Report	Keith, DJW
Subtasks-->	**1.6.2 Tool Development**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Set of models and other tools for use in analysis and planning. Includes other statistical and qualitative/qualitative analysis for use in annual process.	AHA/ISIT/APPT etc. data and database management	1-May-14	30-Apr-15	ISIT/AHA input, APR and Annual Report	Keith Wolf

Regression and other analyses for reporting and the APR process	ISIT/AHA data analysis, data and database management	1-May-14	30-Apr-15	ISIT/AHA input, APR and Annual Report	Andrea Pearl
	APPT Planning Tool	1-May-14	30-Apr-15	ISIT/AHA input, APR and Annual Report	Keith Wolf, Andrea Pearl, Matt Laramie, Casey Baldwin
The CJH database includes coordinating and integrating multiple data sets from different locations (WDFW, DCPUD, EDT, PNAMP, OBMEP, ISIT, AHA)	CJH Database	1-May-14	30-Apr-15	ISIT/AHA input, APR and Annual Report	Keith Wolf, Andrea Pearl, John Rohrback
	Website development and management	1-May-14	30-Apr-15	ISIT/AHA input, APR and Annual Report	Andrea Pearl, Brenda Schmidt, Keith Wolf, Pat Phillips
Task-->	**1.7 Activities required to: manage and administer RM&E program**				
Subtasks-->	**1.7.1 Manage and Administer RM&E Activities**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Provide accrual reporting for FY 2014	Provide BPA with an estimate of contract work that will occur prior to April 30 but will not be billed until April 30 or later. Data must be input in to Pisces by March.	1-Jan-15	1-Mar-15	Record of communications	Keith Wolf
Provide development of FY 2015 budget and SOW	develop out year budget and SOW for 2015 for all CJHP activities and provide in Pisces format to BPA on time and with all required attachments	1-Jul-14	30-Sep-14	Record of communications	Keith Wolf
Provide requested budget modifications and information	Monitor budgets (not development as outlined in Manage and Administer Projects)	1-May-14	30-Apr-15	Record of communications	Keith Wolf
Subtasks-->	**1.7.2 Address Policy Issues**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Participate in meetings, communications, workshops, APR etc.	Identify key stakeholders and policy makers. Identify potential decisions and/or influence that stakeholder(s) could impose that could affect the CJHP. Provide information to Colville Tribal decision-makers	1-May-14	30-Apr-15	Record of communications	DJW and Kirk Truscott will collaborate on this list w/ Chuck Brushwood
Subtasks-->	**1.7.3 Prepare budgets**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
FY Budget Approval	Develop Budgets in BPA and Tribal Formats. Process though federal and CCT administrative steps. Incorporate into PISCES	1-Jul-14	1-Feb-15	Contract "offer"	Keith Wolf
Subtasks-->	**1.7.4 Administer agreements with contractors, PUDs, etc.**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**

Development of Cost Share Agreements and annual review	Coordinate with BPA and the Cost Share Agreement Partners. Financial review each month to approve/correct charges and approve for submission to BPA.	1-May-14	30-Apr-15	Review and approval for Cost Share Agreements	Keith Wolf
Subtasks-->	**1.7.5 Monthly reviews of all accounting, purchasing and invoicing**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Monthly review and corrections if necessary to CCT accounting reports. Approval of subsequent invoices prior to submittal to BPA	Coordinate with BPA and the Cost Share Agreement Partners. Financial review each month to approve/correct charges and approve for submission to BPA.	1-May-14	30-Apr-15	Monthly invoices	Keith Wolf
Subtasks-->	**1.7.6 Procurement and inventory control**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Approved purchases consistent with budgets	Coordination with CCT A/P, vendor communications Preparation of applicable documents	1-May-14	30-Apr-15	Receipt of purchased items	Andrea Pearl, Brenda Schmidt with approvals from Keith Wolf, Pat Phillips
Subtasks-->	**1.7.7 Publications and conferences**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
As deemed contributory to progression of program, reduction is error, improvement data collection, analysis, data management and overall science rigor.	Project Manager to assess opportunities and or requirements for attendance, presentation, training.	1-May-14	30-Apr-15	Attendance reports	Keith Wolf & Pat Phillips
Subtasks-->	**1.7.8 Training**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Completion of employee and or program development plans	Development of employee and or program development plans	May 1, 2014	April 30, 2014	Documentation of attendance, APR presentation.	Keith Wolf
Task-->	**1.8 Activities required to: produce Project Status Reports**				
Subtasks-->	**1.8.1 Prepare Project Status Report 1**				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Oct-Dec 2013 (10/1/2013 - 12/31/2013)	Status reports entered on time and correctly	1-May-14	1-Jul-14	Pisces Status Reports	Keith Wolf & Pat Phillips
Jan-Mar 2014 (1/1/2014 - 3/31/2014)	Status reports entered on time and correctly	1-Aug-14	1-Oct-14	Pisces Status Reports	Keith Wolf & Pat Phillips
Apr-Jun 2014 (4/1/2014 - 6/30/2014)	Status reports entered on time and correctly	Nov. 1 2014	1-Jan-15	Pisces Status Reports	Keith Wolf & Pat Phillips
Jul-Sep 2014 (7/1/2014 - 9/30/2014)	Status reports entered on time and correctly	1-Feb-15	30-Apr-15	Pisces Status Reports	Keith Wolf & Pat Phillips
Task-->	**1.9 Annual Program Report**				

Subtasks-->	1.9.1 Draft and finalize Annual Program Report				
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Reporting Period	entered on time and correctly with appropriate attachments	1-Nov-14	30-Apr-15	Annual Progress Report	Keith Wolf, Pat Phillips
Category-->	**2.0 Environmental Compliance**				
Task-->	**2.1 Permitting activities for RM&E activities**				
Subtasks-->					
Milestone	**Activity**	**Begin Date**	**Due Date**	**Deliverable**	**Lead**
Obtain all environmental compliance permits	On-the-ground work associated with this work element cannot proceed until this milestone is complete. Milestone is complete when final documentation is received from BPA environmental compliance staff (completion can be based on pre-existing environmental documentation from BPA).	1-May-14	30-Apr-15	Environmental compliance documents and Agreements	Keith Wolf, Andrea Pearl
Obtain all environmental compliance permits	Perform data collections and analysis for use in environmental review and permit applications.	1-May-14	30-Apr-15	Environmental compliance documents and Agreements	Keith Wolf with Andrea Pearl, John Rohrback, Matt Laramie and CJHP staff
Obtain all environmental compliance permits from NOAA	Perform data collections and analysis for use in environmental review and permit application	1-May-14	30-Apr-15	Environmental compliance documents and Agreements	Charles Brushwood, Casey Baldwin, Keith Wolf
Obtain all environmental compliance permits	Perform data collections and analysis for use in environmental review and permit application	1-May-14	30-Apr-15	Environmental compliance documents and Agreements	Charles Brushwood, Casey Baldwin, Keith Wolf
Obtain all environmental compliance permits	Perform data collections and analysis for use in environmental review and permit application	1-May-14	30-Apr-15	Environmental compliance documents and Agreements	Casey Baldwin
Obtain all environmental compliance permits and agreements	Perform data collections and analysis for use in environmental review and permit application	1-May-14	30-Apr-15	Environmental compliance documents and Agreements	Charles Brushwood, Casey Baldwin

APPENDIX G

Glossary of Terms, Acronyms, and Abbreviations

The following is a list of key terms and variables used in the Chief Joseph Hatchery Program and in this Annual Report. This is not a complete list, but provides many of the main terms used in this report or that will likely be used in future CJHP Annual Report.

Accord/MOA = A ten-year agreement (2008 – 2018) between BPA and the CCT whereas BPA agreed to fund pre-determined fish and wildlife projects and CCT agreed not to sue the Action Agencies regarding the BiOp for the FCRPS.

CJHP Master Plan = A three-step development and review process required for all new hatcheries funded by BPA in the Columbia Basin.

eDNA = environmental DNA; dissolved or cell-bound DNA that persists in the environment.

Escapement Target = Number of fish of all origins targeted to pass upstream of the Okanogan Adult Fish weir

HOB = the number of hatchery-origin fish used as hatchery broodstock.

HOR = hatchery-origin recruit. The number of HORs equals the sum of HOS + HOB + hatchery-origin fish intercepted in fisheries.

HOR Terminal Run Size = Number of Chief Joseph Hatchery HORs returning to Wells Dam

HOS = the number of hatchery-origin fish spawning naturally.

Juvenile Abundance = annual abundance of out-migrant juveniles estimated by expanding data from juveniles captured at the rotary screw trap.

Met Comp = Methow composite Spring Chinook. These fish are part of the Winthrop NFH program and are intended to be used for the Okanogan reintroduction pending approval under section 10(j) of the ESA.

NOB = the number of natural-origin fish used as hatchery broodstock.

NOR = natural-origin recruit. The number of NOR's equals the sum of NOB, + NOS + natural-origin fish intercepted in fisheries.

NOR Terminal Run Size = Number of Okanogan (and Similkameen, combined) NOR's returning to Wells Dam.

NOS = the number of natural-origin fish spawning naturally.

pHOS = proportion of natural spawners composed of HORs. Equals HOS/ (NOS + HOS).

PNI = proportion of natural influence on a composite hatchery-/natural-origin population. Can also be thought of as the percentage of time the genes of a composite population spend in the natural environment. Equals 1 - pNOB/ (pNOB + pHOS).

pNOB = proportion of hatchery broodstock composed of NORs. Equals NOB/ (HOB + NOB).

SAR = smolt to adult return.

Recovery Plans = Federally-required plans under the Endangered Species Act that describe species status, recovery criteria and expected restoration actions.

Relative Reproductive Success = The probability that an HOR produce adult offspring and summer/fall expressed as a fraction of the same probability for a NOR

Spatial Distribution = Geographic spawning distribution of adult salmon.

Spawner Abundance = Total number of adult spawners each year**.**

Subbasin Plans = Plans developed in the early 2000s for the NPCC project funding process describing “limiting factors” used for development of regional recovery and protection strategies.

Total NOR Recruitment = Annual number of adult recruits (catch plus escapement)

AHA = All H Analyzer

APPT = Annual Program Planning Tool

APR = Annual Program Review

BiOp = Biological Opinion

BKD = Bacterial Kidney Disease

BPA = Bonneville Power Administration

CA = Coordinated Assessments

CBFWA = Columbia Basin Fish and Wildlife Authority

CCT = Confederated Tribes of the Colville Indian Reservation

cfs = Cubic feet per second

CJH = Chief Joseph Hatchery

CJHP = Chief Joseph Hatchery Program

Colville Tribes = Confederated Tribes of the Colville Reservation

CTFWP = Colville Tribes Fish &Wildlife Program

CRITFC = Columbia River Inter-Tribal Fish Commission

CWT = Coded Wire Tag

DI = Density Index

DPS = Distinct Population Segment

EDT = Ecosystem Diagnostic & Treatment

ELISA = Enzyme-Linked Immunosorbent Assay

ESA = Endangered Species Act

ESU = Evolutionarily Significant Unit

FCRPS = Federal Columbia River Power System

FI = Flow Index

FPP = Fish per pound

FWS = U.S. Fish and Wildlife Service

GIS = Geographic Information System

gpm = gallons per minute

GPS = Global Positioning System

HCP = Habitat Conservation Plan(s)

HGMP = Hatchery Genetic Management Plan(s)

HSRG = Hatchery Science Review Group

ISIT = In-season Implementation Tool

ISRP = Independent Scientific Review Panel

KMQ = Key Management Questions

LNFH = Leavenworth National Fish Hatchery

NEPA = National Environmental Policy Act

NMFS = National Marine Fisheries Service

NOAA = National Oceanic and Atmospheric Administration

NPCC = Northwest Power and Conservation Council

OBMEP = Okanogan Basin Monitoring and Evaluation Program

ODFW = Oregon Department of Fish and Wildlife

ONA = Okanagan Nation Alliance

PBT = Parental Based Tagging

PIT = Passive Integrated Transponder

PNAMP = Pacific Northwest Aquatic Monitoring Partnership

PSMFC = Pacific States Marine Fisheries Commission

PTAGIS = PIT Tag Information System

PUD = Public Utility District

RKM= River Kilometer

RM = River Mile

RMIS = Regional Mark Information System

RM&E = Research, Monitoring, and Evaluation

RST = Rotary Screw Trap

SNP = Single Nucleotide Polymorphism

TAC = Technical Advisory Committee

TRMP = Tribal Resources Management Plan

TU = Temperature Unit

UCSRB = Upper Columbia Salmon Recovery Board

USGS = U.S. Geological Survey

WDFW = Washington Department of Fish and Wildlife

WNFH = Winthrop National Fish Hatchery