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Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles:

Fish Collection and Tagging, 2019

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Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles: Fish Collection and Tagging, 2019

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Executive Summary

During late summer 2019, we collected and tagged fish as part of a multiyear research project to monitor the migrational behavior and survival of wild juvenile spring/summer Chinook salmon in the Snake River Basin. Each study year, we collect wild Chinook parr in natal tributaries, implant them with passive integrated transponder (PIT) tags, and release them near their respective collection sites.

In this report, we present data on fish collection and tagging efforts during July and August 2019. Detection data will be collected from these tagged fish as they begin migration during spring 2020. These data and the respective analyses will be presented in our 2020 *Survival and Timing* report.

- During July-August 2019, we collected a total of 11,231 wild Chinook salmon parr from 16 Idaho sample locations. Of the parr collected, 8,421 were PIT-tagged and released.

- Of all fish collected, we observed an overall average length of 64.0 mm and average weight of 3.5 g.

- We observed a mortality rate of 1.5% (173) for collected fish over all sample reaches combined. The main cause of mortality was associated with collection of fish, and we recorded only three mortalities associated with anesthetizing, tagging, and handling.

Introduction

In 1991, the National Marine Fisheries Service (NMFS) conducted a biological status review of Snake River spring/summer run Chinook salmon *Oncorhynchus tshawytscha.* This status review was conducted in response to multiple petitions to list several individual Snake River Chinook stocks as threatened or endangered under the U.S. Endangered Species Act (ESA).

Because resources were not sufficient to review the large number of individual petitions, NMFS biological review team evaluated all petitioned populations as part of its status review of the entire Snake River spring/summer run Chinook evolutionarily significant unit (ESU). Based on these evaluations, the team concluded that the Snake River spring/summer-run Chinook salmon ESU was well below the threshold for threatened status and only slightly above the threshold for endangered status under the ESA (Matthews and Waples 1991).

The Snake River spring/summer-run Chinook salmon ESU was listed as threatened under the ESA in 1992. Since that time, this ESU has been the focus of a recovery plan to restore its populations to self-sustaining levels. The plan serves as base of coordination for recovery efforts from federal, state, tribal, and municipal entities, as well as from private groups and individuals. Recovery efforts focus on both salmon populations and their habitats.

In an analysis of potential recovery strategies, Kareiva et al. (2000) found that "modest reductions in first-year mortality or estuarine mortality would reverse current population declines" for Snake River spring/summer-run Chinook salmon. Their finding supports prioritization of the juvenile stage as an efficient approach toward allocation of resources for recovery goals.

For Pacific salmon *Oncorhynchus* spp., tagging and recapture studies have been at the center of research to improve survival of juvenile downstream migrants. Tagging studies began in the mid-1950s, and advances in technology since that time have continued to improve various tagging methods. However, until the late 1980s, resource managers relied on methods that could provide only limited information on fish passage, such as freeze-branding, index counts at traps and dams, and analyses of flow patterns.

In the late 1980s, the passive integrated transponder (PIT) tag was introduced to the fisheries community. Each PIT tag contains a unique code, which allows researchers to track and record the movements of individual fish. Because it is small and biologically

inert, a PIT tag can be retained throughout the fish's life cycle. The tag allows multiple detections of an individual fish without physical recapture.

Since its introduction, use of the PIT tag has expanded from about 50,000 to more than 2 million fish tagged annually. These tagging efforts, along with automated data collection methods, have provided large data sets for a broad mixture of wild/natural and hatchery stocks, ages, and year classes. The Columbia Basin PIT Tag Information System (PTAGIS) was established as a shared repository for these data (PSMFC 1996).

Data from PIT tag detections have provided insight for decisions on programs to enhance juvenile passage at dams, such as spill and transportation. However, the need remains for data upon which to base decisions for these and other restoration and recovery efforts. Major gaps remain in understanding life history patterns and survival at different points in the life cycle of Columbia Basin stocks. Our research directly addresses these data gaps for wild Snake River spring/summer Chinook salmon at the parr-to-smolt stage.

In addition to acquiring data for the NWPPC and several other fish and wildlife programs, our research addresses "Reasonable and Prudent Alternatives" in the 2000 NMFS Biological Opinion (NMFS 2000). For example, section 9.6.5.2 of action 180 advocates a regional monitoring effort on the population status of wild fish stocks and the environmental status of their natal streams and tributaries. Section 9.6.5.5, Action 199 and Appendix H, research action 1193 call for

> ...research to produce information on the migrational characteristics of Columbia and Snake River basin salmon and steelhead. The smolt monitoring program produces information on the migrational characteristics of various salmon and steelhead stocks...and provides management information for implementing flow and spill measures designed to improve passage conditions in the mainstem lower Snake and Columbia Rivers (NMFS 2000).

More recently, in response to the remanded biological opinion, the *Final Updated Proposed Action for the FCRPS Biological Remand* proposed that researchers should

> …implement and maintain the Columbia River Basin PIT Tag Information System. Expand the system to systematically plan PIT tag efforts in the pilot study basins such that production and survival can be estimated throughout the system for wild and hatchery fish. Also, continue development and implementation of new fish detection and tagging techniques (Action Agencies 2004).

Clearly, the migratory performance of wild fish (e.g., run timing/survival) is important and should continue to be monitored. To this end, marking wild/natural parr with PIT tags in their natal streams during the summer of their first year of life provides

the opportunity to precisely track these stocks through instream PIT-tag detectors, traps, and detection systems in the hydroelectric complex during their parr/smolt migrations.

This report includes information on tagging of wild Chinook salmon parr from Idaho streams during 2019. We will monitor these fish during spring and early summer 2020 as they migrate downstream towards the Pacific Ocean. The 2020 *Survival and Timing* component of this report will provide estimates of downstream survival and timing of those fish to Lower Granite Dam, as well as interrogation data from other downstream sites throughout the Snake and Columbia River Basin.

This research continues studies that began in 1991 with funding from the Bonneville Power Administration (BPA). Results from previous study years have been reported annually (Achord et al. 1994-1995a, 1995b, 1996a, 1997-1998, 2000-2001a, 2001b, 2002-2012; Lamb et al. 2013-2019). The goals of this ongoing study are to:

1. Characterize migration timing and growth and estimate parr-to-smolt survival of different populations of wild Snake River spring/summer Chinook salmon to Lower Granite Dam
2. Determine whether consistent patterns in migration/survival are apparent
3. Determine which environmental factors may influence patterns in migration/survival
4. Characterize the migrational behavior and estimated survival of different wild juvenile fish populations as they move downstream from natal rearing areas.

This study provides critical information for recovery planning and ultimately for the restoration of these wild fish populations, all of which remain listed as threatened under the U.S. Endangered Species Act of 1973 (NMFS 2008).

Methods

During summer 2019, NOAA Fisheries personnel tagged fish in 16 Idaho streams or sample reaches (Figure 1). Fish collection followed the safe handling methods developed for this study and detailed by Matthews et al. (1990, 1997). Anesthetized fish were tagged, provided they met the 55-mm minimum fork length requirement.

In 2019, all fish were tagged using individual single-use hypodermic needles pre-loaded with 9- or 12-mm PIT tags. All fish measuring 55-60 mm were tagged with 9-mm tags, per request of Idaho state permitting officials. All fish longer than 60 mm were tagged with standard 12-mm tags. This method ensured that each fish was tagged with a sterile, sharp needle, thus minimizing stress and injury during the tagging process. All other tagging methodology remained the same as in previous years of this study (Achord et al. 1994, 1995a, 1995b, 2003, 2004, 2010, 2011; Lamb et al. 2013-2019).

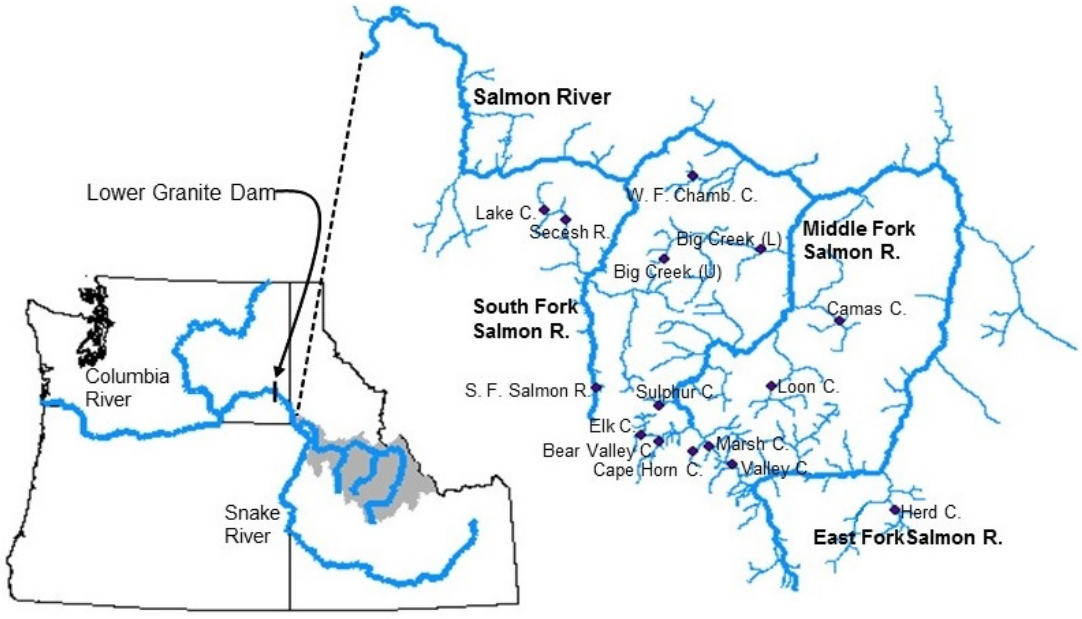

Figure 1. Map showing the streams and sample reaches where wild spring/summer Chinook salmon parr were PIT tagged during 2019.

Results

From 16 July to 25 August 2019, we collected 11,231 wild spring/summer Chinook salmon parr from 16 Idaho stream populations (Figure 1). Fish were collected over a distance of about 28.5 stream km and over an area of approximately 314,287 m^2 (Table 1; Appendix Table 1). Of the 11,231 fish collected, 8,421 were tagged with either 9-mm or standard 12-mm PIT tags.

All tagged fish were released back to their respective natal stream along with any remaining untagged live fish. Collected fish were returned to the natal stream without tagging if they had been previously tagged, were too small, injured, had matured precociously, or if sufficient numbers of fish had already been tagged. Numbers of tagged fish released per stream or sample reach ranged from 35 in Herd Creek to 1,241 in the South Fork Salmon River (Tables 1; Appendix Table 1).

In 2019, the mean fork length of all Chinook salmon parr collected was 64.0 mm and the mean weight was 3.5 g. For Chinook salmon parr that were tagged and released, mean fork length was 65.5 mm and mean weight was 3.4 g (Table 1; Appendix Table 1). Collection areas within each stream were delineated by recording the global positioning system (GPS) coordinates of each tagging site using the Universal Transverse Mercator (UTM) coordinate system (Appendix Table 3).

Other than Chinook salmon parr, sculpin (genus *Cottus*) was the most abundant fish observed during field collection operations (Table 2). However, records of non-target fish do not represent their total abundances in collection areas, as only Chinook salmon were targeted for collection, while other species were counted as incidental take.

Mortality associated with collection and tagging procedures in 2019 was low (Table 3; Appendix Table 4). The collection and handling mortality rate was 1.5%, and there were only three mortalities following tagging and 24-h holding.

Table 1. Summary of collection, PIT tagging, and release of wild Chinook salmon parr with average fork lengths and weights (includes recaptured tagged fish), approximate distances, and estimated areas sampled in Idaho streams from July through August 2019.

	Number of fish		Average length (mm)		Average weight (g)		Collection area to stream mouth (km)	Est. stream area sampled (m^2)
Tagging location	Collected	Tagged & released	Collected	Tagged	Collected	Tagged		
Herd Creek	37	35	66.2	64.6	4.0	3.2	2.0-3.3	8,531
Camas Creek	308	177	57.2	61.1	2.7	2.9	21-23	11,684
Loon Creek	596	255	54.3	60.7	2.5	2.7	28-30	13,271
Marsh Creek	824	515	59.8	62.8	2.8	3.1	11-12.8	22,559
Cape Horn Creek	546	128	55.9	58.7	3.3	2.4	0.5-1.6	13,364
Valley Creek	1,219	1,144	64	64.0	3.2	3.1	3.5-5.0 & 7.0-8.3	35,262
Big Creek (upper)	995	565	59.8	62.4	3	3.1	56.5-59	28,520
Bear Valley Creek	1,041	1,000	68.4	68.4	4.2	4.2	8-9.75 & 12.3-13.3	34,147
Elk Creek	634	619	71.2	71.2	4.5	4.6	0.2-1.8	14,888
Sulphur Creek	564	535	64.4	64.5	3.2	3.1	5-6.4	15,861
S Fork Salmon R	1,875	1,241	62.1	64.8	2.9	3.1	117-119	28,595
Secesh River	527	450	61.8	63.1	2.9	2.8	24.2-26	16,662
Lake Creek	566	327	62.1	64.8	3.2	3.2	2-3	20,254
W Fork Chamberlain Cr	534	500	70.2	70.4	3.9	3.9	1-2	14,554
Chamberlain Creek	764	737	67.1	66.9	3.5	3.4	23.6-25	18,394
Big Creek (lower)	201	193	80.2	80.2	6.2	6.2	9-11	17,741
Totals/averages	11,231	8,421	64.0	65.5	3.5	3.4	28.5	314,287

Table 2. Summary of species other than Chinook salmon parr observed during collection operations in Idaho from July through August 2019. Steelhead greater than 80 mm in length were PIT tagged in Big Creek for the Idaho Department of Fish and Game.

Streams	Steelhead	Tagged steelhead	Unidentified fry	Brook trout	Cutthroat trout	Bull trout	Sculpin	Dace	Sucker	Whitefish	Northern Pike-minnow	Pacific lamprey (ammocoete)
Herd Creek	23	0	19	0	0	3	141	0	0	3	0	0
Camas Creek	32	0	16	0	0	1	0	0	0	1	0	0
Loon Creek	59	0	32	0	3	3	206	0	0	1	0	0
Marsh Creek	30	0	10	97	0	0	583	0	0	5	0	0
Cape Horn Creek	27	0	6	44	0	9	378	0	0	0	0	0
Valley Creek	27	0	63	334	0	3	1,265	238	332	66	2	0
Big Creek (upper)	80	62	18	267	0	10	1,211	0	0	0	0	0
Bear Valley Creek	48	0	311	778	0	0	695	60	511	2	0	0
Elk Creek	18	0	16	390	0	0	453	110	839	641	0	0
Sulphur Creek	29	0	81	0	0	2	462	0	4	0	0	0
S Fork Salmon R	82	0	159	40	0	0	237	157	0	0	0	0
Secesh River	26	0	55	21	0	2	190	25	0	0	0	260
Lake Creek	32	0	24	59	0	8	1,076	17	0	1	0	75
W Fork Chamberlain Cr	92	0	3	0	0	22	1,570	0	0	0	0	0
Chamberlain Creek	107	0	0	0	0	5	1,120	0	0	0	0	0
Big Creek (lower)	67	48	505	0	5	0	1,46	176	44	0	0	0
Totals	**779**	**110**	**1,318**	**2,030**	**8**	**68**	**9,733**	**783**	**1,730**	**720**	**2**	**335**

Table 3. Mortality percentages for wild Chinook salmon parr collected and PIT-tagged in Idaho from July through August 2019.

	Mortality (%)		
Tagging Location	Collection	Tagging/24 h	Overall
Herd Creek	0.0	0.0	0.0
Camas Creek	1.6	0.0	1.6
Loon Creek	0.5	0.0	0.5
Marsh Creek	0.7	0.0	0.7
Cape Horn Creek	0.4	0.0	0.4
Valley Creek	2.7	0.0	2.7
Upper Big Creek	2.0	0.0	2.0
Bear Valley Creek	2.8	0.0	2.8
Elk Creek	1.6	0.0	1.6
Sulphur Creek	2.8	0.0	2.8
S. Fork Salmon	0.6	0.2	0.7
Secesh River	0.6	0.0	0.6
Lake Creek	1.2	0.0	1.2
WF Chamberlain Creek	2.2	0.0	2.2
Chamberlain Creek	0.9	0.0	0.9
Lower Big Creek	3.0	0.0	3.0
Averages	**1.5**	**0.0**	**1.5**

Discussion

During July and August 2019, the number of wild Chinook salmon parr tagged was smaller than the annual average number tagged over the past 10 years (8,421 vs. 13,623). However, we were able to sample all 16 historic sites. Low collection and tagging numbers at multiple sites were most likely the result of low parr densities, which were expected due to low redd counts observed during 2018. Conditions during collection periods were good all season, with low-to-average flows and high water clarity.

Our overall collection effort in 2019 included all 16 possible sample reaches, which led to a larger sample area than in several of the years prior, at 314,287 m^2. Over the entirety of the sample area we estimated an annual density of 3.57 parr/100 m^2. Parr densities varied over sampling sites, with the highest observed in the South Fork Salmon River (6.56 parr/100 m^2) and the lowest in Herd Creek (0.43 parr/100 m^2). Past data has indicated an inverse relationship between parr density and parr-to-smolt survival (Figure 2).

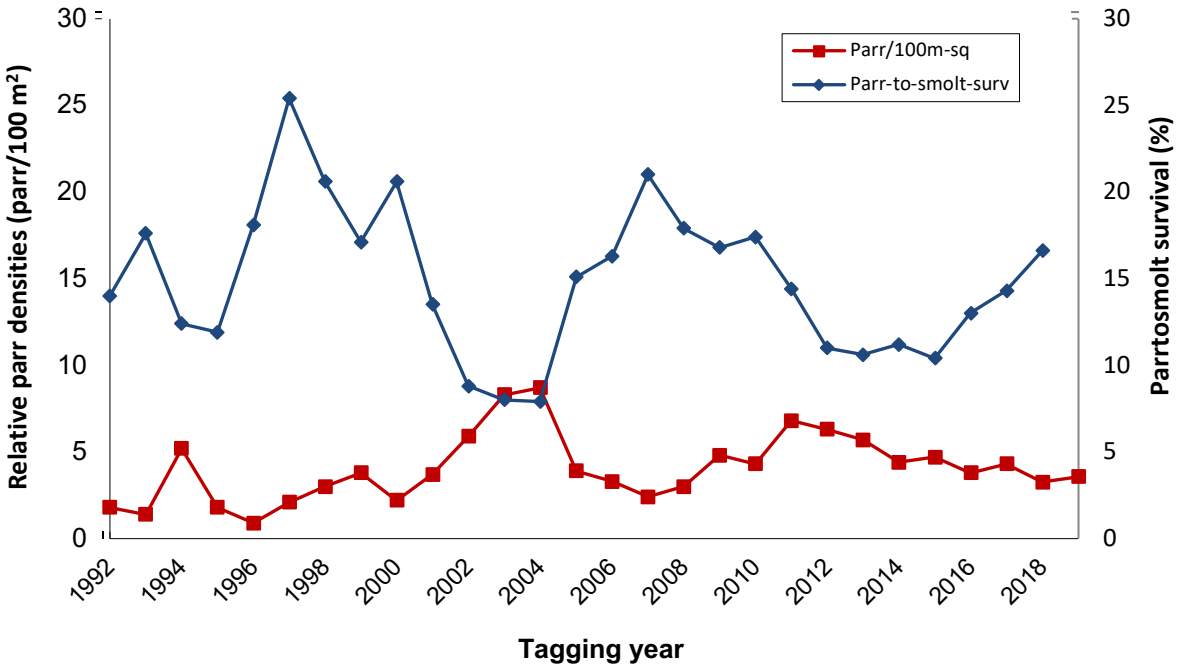

Figure 2. Annual average density of Chinook salmon parr (parr/100 m^2) in Idaho streams vs. annual estimated survival of smolts from these streams to Lower Granite Dam the following year, 1992 to 2019.

During 2020, we will collect downstream migration data from the wild spring/summer Chinook parr collected and tagged during field operations in July and August 2019. Analyses from these data will include estimates of parr-to-smolt survival, arrival and migration timing to and from streams with instream detection capabilities, and smolt passage timing at Lower Granite Dam. These analyses are included in our annual reports, along with environmental data collected from each tagging location and growth data on migrants recaptured at Lower Granite Dam.

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Appendix: Data Tables

Appendix Table 1. Summary of numbers collected, tagged, released (with tags), and minimum, maximum, and mean lengths and weights of wild Chinook salmon parr, collected and PIT tagged in various Idaho streams, 2019.Some length-weight data includes recaptured tagged fish.

				Collection				Tagging and release			
	Fish (n)			Length (mm)		Weight (g)		Length (mm)		Weight (g)	
	Collected	Tagged	Released	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Herd Creek	37	35	35	54-133	66.2	1.5-33.8	4.0	56-76	64.6	2.0-5.1	3.2
Camas Creek	308	177	177	45-73	57.2	1.2-4.7	2.7	55-73	61.1	1.7-4.7	2.9
Loon Creek	596	255	255	40-103	54.3	0.8-13.3	2.5	55-72	60.7	1.1-4.3	2.7
Marsh Creek	824	515	515	44-135	59.8	0.7-33.3	2.8	55-84	62.8	1.2-6.9	3.1
Cape Horn Creek	546	128	128	41-118	55.9	1.1-22.8	3.3	55-76	58.7	1.5-5.7	2.4
Valley Creek	1219	1144	1144	48-133	64	0.9-34.4	3.2	55-87	64.0	1.4-8.1	3.1
Big Creek (upper)	995	565	565	44-116	59.8	0.9-22.1	3	53-84	62.4	1.2-6.9	3.1
Bear Valley Creek	1041	1000	1000	54-91	68.4	2.0-9.0	4.2	54-91	68.4	2.0-9.0	4.2
Elk Creek	634	619	619	54-87	71.2	2.1-8.5	4.5	56-87	71.2	2.2-8.5	4.6
Sulphur Creek	564	535	535	50-125	64.4	1.1-24.8	3.2	55-83	64.5	1.5-6.1	3.1
S Fork Salmon River	1875	1244	1241	41-120	62.1	0.5-21.5	2.9	55-85	64.8	1.5-7.3	3.1
Secesh River	527	450	450	47-115	61.8	0.9-19.2	2.9	55-85	63.1	1.7-7.8	2.8
Lake Creek	566	327	327	49-114	62.1	1.0-18.3	3.2	55-83	64.8	1.6-8.2	3.2
W Fork Chamberlain Cr	534	500	500	52-93	70.2	1.3-8.5	3.9	55-93	70.4	1.6-8.5	3.9
Chamberlain Creek	764	737	737	48-120	67.1	0.8-19.4	3.5	55-90	66.9	1.5-8.6	3.4
Big Creek (lower)	201	193	193	60-93	80.2	2.2-9.7	6.2	60-93	80.2	2.2-9.7	6.2
Total or mean	**11,231**	**8,424**	**8,421**	**40-133**	**64.0**	**0.5-34.4**	**3.5**	**53-93**	**65.5**	**1.1-9.7**	**3.4**

Appendix Table 2. Summary of tagging dates, times, and temperatures at capture and release with capture method, distance (rkm) from stream mouth to release point, and number of tagged fish released in 2019. Except where noted, all capture methods were electrofishing.

	Tagging			Release				
Group	Date (2019)	Time (PST)	Temp (°C)	Date (2019)	Time (PST)	Temp (°C)	Location (rkm)	n
Herd Creek								
GAA-2019-197-001	16 Jul	0700	9.0	16 Jul	0948	10.0	3	35
Camas Creek								
GAA-2019-198-001	17 Jul	0700	8.5	17 Jul	1040	11.0	23	177
Loon Creek								
GAA-2019-200-001	19 Jul	0700	8.0	20 Jul	0725	8.0	30	255
Marsh Creek								
GAA-2019-202-001	21 Jul	0700	5.0	22 Jul	0635	7.5	12	100
GAA-2019-202-002	21 Jul	0800	5.0	21 Jul	1150	11.5	12	415
Cape Horn Creek								
GAA-2019-203-001	22 Jul	0700	7.5	22 Jul	1140	10.0	2	175
Valley Creek								
GAA-2019-204-001	23 Jul	0530	12.0	24 Jul	0530	12.0	5	101
GAA-2019-204-002	23 Jul	0830	12.0	23 Jul	1230	14.5	5	256
GAA-2019-204-003*	23 Jul	1100	12.0	23 Jul	1230	14.5	5	299
GAA-2019-205-001	24 Jul	0530	12.0	24 Jul	0945	15.0	7	488
Big Creek (upper)								
GAA-2019-212-001	31 Jul	0700	9.5	1 Aug	0800	9.0	59	206
GAA-2019-212-002	31 Jul	0700	9.5	1 Aug	0800	9.0	59	187
GAA-2019-213-001	1 Aug	0700	9.0	1 Aug	0800	9.0	59	174
Bear Valley Cr								
GAA-2019-214-001	2 Aug	0700	12.0	3 Aug	0605	11.5	9	100
GAA-2019-214-002	2 Aug	0700	12.0	2 Aug	1215	16.0	9	419
GAA-2019-215-001	3 Aug	0700	11.5	3 Aug	1200	14.0	13	481
Elk Creek								
GAA-2019-216-001*	4 Aug	0700	13.0	5 Aug	0600	13.0	1	106
GAA-2019-216-002*	4 Aug	0700	13.0	5 Aug	0600	13.0	1	256
GAA-2018-213-001	4 Aug	0700	13.0	4 Aug	1110	16.0	1	260
Sulphur Creek								
GAA-2019-218-001	6 Aug	0700	12.0	6 Aug	1340	14.0	6	535
South Fork Salmon R								
GAA-2019-224-001	12 Aug	0500	8.5	13 Aug	0945	10.0	118	110
GAA-2019-224-002	12 Aug	0500	8.5	13 Aug	0945	10.0	118	369
GAA-2019-225-001	13 Aug	0500	9.0	13 Aug	1110	16.0	118	763

Appendix Table 2. Continued.

Group	Tagging Date (2019)	Tagging Time (PST)	Tagging Temp (°C)	Release Date (2019)	Release Time (PST)	Release Temp (°C)	Release Location (rkm)	n
Secesh River								
GAA-2019-226-001	14 Aug	0700	9.0	14 Aug	1300	14.0	26	450
Lake Creek								
GAA-2019-227-001	15 Aug	0700	9.5	15 Aug	1430	14.0	3	328
W Fork Chamberlain Cr								
GAA-2019-234-001	22 Aug	0700	10.0	22 Aug	1100	11.5	25	500
Chamberlain Creek								
GAA-2019-235-001	23 Aug	0700	8.5	24 Aug	0800	8.0	25	100
GAA-2019-235-002	23 Aug	0700	8.5	23 Aug	1215	12.0	25	637
Big Creek (lower)								
GAA-2019-237-001	25 Aug	0700	12.0	26 Aug	0600	12.0	10	78
GAA-2019-237-002	25 Aug	0700	12.0	25 Aug	1215	15.0	11	117

***** Fish were captured using a beach or purse seine

Appendix Table 3. Universal Transverse Mercator grid coordinates of Global Positioning System that identifies sampling areas at the beginning and end of daily collections in streams for each collection crew in 2019.

Streams & Dates	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Herd Creek					
7/16/2019	left bank	4892072	11T0716255	4891619	11T0716747
7/16/2019	right bank	4892072	11T0716255	4891619	11T0716747
Camas Creek					
7/17/2019	left bank	4968457	11T0696389	4967309	11T0697190
7/17/2019	right bank	4968464	11T0697360	4967190	11T0697360
Loon Creek					
7/19/2019	left bank	4942261	11T0675164	4941005	11T0674051
7/19/2019	right bank	4942249	11T0675158	4941097	11T0674079
Marsh Creek					
7/21/2019	left bank	4917503	11T0645804	4916891	11T0646713
7/21/2019	right bank	4917502	11T0645791	4916520	11T0646644
Cape Horn Creek					
7/22/2019	left bank	4917269	11T0645734	4916239	11T0645252
7/22/2019	right bank	4917267	11T0645722	4916240	11T0645243
Valley Creek					
7/23/2019	right bank	4899466	11T0661396	4899864	11T0660533
7/23/2019	left bank	4899454	11T0661279	4898717	11T0660732
7/23/2019	both banks	4898717	11T0660732	4899864	11T0660533
7/24/2019	left bank	4900602	11T0659721	4900780	11T0659489
7/24/2019	right bank	4901804	11T0659324	4901804	11T0659184
Big Creek (upper)					
7/31/2019	left bank	4997280	11T0632217	4996060	11T0631504
7/31/2019	right bank	4997281	11T0632210	4996064	11T0631495
8/1/2019	right bank	4996060	11T0631504	4995559	11T0631364
8/1/2019	left bank	4996046	11T0631495	4995573	11T0631371
Bear Valley Creek					
8/2/2019	right bank	4920744	11T0633390	4920739	11T0632099
8/2/2019	left bank	4920735	11T0633231	4920849	11T0632488
8/3/2019	right bank	4919145	11T0630277	4918812	11T0629582
8/3/2019	left bank	4919110	11T0630266	4918705	11T0629669
Elk Creek					
8/3/2019	both banks	4918799	11T0629504	4918793	11T0629467
8/4/2019	left bank	4918801	11T0629501	4918956	11T0628820
8/4/2019	right bank	4918956	11T0628820	4918956	11T0628820
Sulphur Creek					
8/6/2019	left bank	4933161	11T0631023	4932402	11T0629849
8/6/2019	right bank	4933161	11T0631023	4932414	11T0629866
South Fork Salmon River					
8/12/2019	left bank	4946564	11T0602924	4945845	11T0602861
8/12/2019	right bank	4946564	11T0602924	4945845	11T0602861
8/13/2019	left bank	4945510	11T0602850	4945142	11T0602974
8/13/2019	right bank	4945757	11T0602804	4945193	11T0602771
Secesh River					
8/14/2019	left bank	5005860	11T0592940	5007197	11T0593515
8/14/2019	right bank	5005853	11T0592945	5007034	11T0593526

Appendix Table 3. Continued.

Streams & Dates	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Lake Creek					
8/15/2019	left bank	5012701	11T0585996	5013152	11T0585571
8/15/2019	right bank	5012684	11T0585992	5013257	11T0585584
W. Fork Chamberlain Creek					
8/22/2019	left bank	5027429	11T0642057	5027767	11T0641527
8/22/2019	right bank	5027426	11T0642037	5027767	11T0641527
Chamberlain Creek					
8/23/2019	left bank	5026762	11T0642563	5025993	11T0641914
8/23/2019	right bank	5026760	11T0642542	5025993	11T0641914
Big Creek (lower)					
8/25/2019	right bank	4996682	11T0669562	4996804	11T0667910
8/25/2019	left bank	4996626	11T0669562	4996791	11T0667801

Appendix Table 4. Summary of observed total mortality for PIT-tagged wild Chinook salmon parr collected from Idaho streams from July through August 2019. Number rejected includes; fish too small to tag, precocious males, injured fish, fish collected for genetic evaluation, previously tagged fish, and in some cases extra collected fish. The portion of rejects that are precocious males are in parentheses.

			Fish rejected for tagging		Observed mortality			
							Total	
Stream	Fish collected (n)	Fish tagged (n)	(n)	(%)	Collection and handling	Tagging and delayed	(n)	(%)
Herd Creek	37	35	2	5.4	0	0	0	0.0
Camas Creek	308	177	126	40.9	5	0	5	1.6
Loon Creek	596	255	328	55.0	3	0	3	0.5
Marsh Creek	824	515	303	36.8	6	0	6	0.7
Cape Horn Creek	546	128	416	76.2	2	0	2	0.4
Valley Creek	1,219	1,144	19	1.6	33	0	33	2.7
Big Creek (upper)	995	565	401	40.3	20	0	20	2.0
Bear Valley Creek	1,041	1,000	1	0.1	29	0	29	2.8
Elk Creek	634	619	5	0.8	10	0	10	1.6
Sulphur Creek	564	535	14	2.5	16	0	16	2.8
S Fork Salmon River	1,875	1,241	242	12.9	11	3	14	0.7
Secesh River	527	450	72	13.7	3	0	3	0.6
Lake Creek	566	327	232	41.0	7	0	7	1.2
W Fork Chamberlain Cr	534	500	8	1.5	12	0	12	2.2
Chamberlain Creek	764	737	12	1.6	7	0	7	0.9
Big Creek (lower)	201	193	2	1.0	6	0	6	3.0
Totals/averages	**11,231**	**8,421**	**2,183**	**19.4**	**170**	**3**	**173**	**1.5**

U.S. Secretary of Commerce
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