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

Fish Collection and Tagging, 2024

Project **1991-028-00**, Contract **83639 REL 60**
covering the period from **January to December 2024**

December 2024

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Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles: Fish Collection and Tagging, 2024

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Executive Summary

During summer 2024, we collected and tagged fish as part of a multiyear research project to assess migrational characteristics and estimate parr-to-smolt survival for wild Snake River spring/summer Chinook salmon smolts in the Snake River Basin. During each study year since 1991, we have collected wild Chinook parr in natal tributaries, implanted them with passive integrated transponder (PIT) tags, and released them near their respective collection sites.

In this report, we present data on fish collection and tagging efforts during July 2024. Detection data will be collected from these tagged fish as they begin migration during spring 2025. These data and the respective analyses will be presented in our 2025 *Survival and Timing* report.

- During July 2024, we collected a total of 3,926 wild Chinook salmon parr from two Idaho sample locations: Marsh Creek (1,616) and the South Fork Salmon River (2,310). Of the parr collected, 3,000 were PIT-tagged and released.

- For all fish collected, we observed an overall average length of 65.9 mm and average weight of 3.7 g.

- We observed a mortality rate of 1.4% (54) for collected fish over all sample reaches combined. The main cause of mortality was associated with collection of fish, and we recorded three mortalities associated with anesthetizing, tagging, and handling.

Contents

Introduction

Snake River spring/summer-run Chinook salmon *Oncorhynchus tshawytscha* was listed as threatened under the U.S. Endangered Species Act (ESA) in 1992. Since that time, this evolutionarily significant unit (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 its 2016 status review, the National Marine Fisheries Service (NMFS) concluded that the Snake River spring/summer Chinook salmon ESU remains at high overall risk, and that all but one population (Chamberlain Creek) remain at high risk (NMFS 2016). In this status review, NMFS (2016) reported that for most populations in the Snake River spring/summer Chinook salmon ESU, natural-origin abundance has increased over levels reported in the previous status review. However, these increases were inconsistent across populations and not substantial enough to change viability ratings.

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 a central component of research to improve survival of juvenile downstream migrants. When tagging studies began in the mid-1950s, researchers relied on data from methods that could only provide limited information on fish passage (ie freeze branding, index counts, etc). In the late 1980s, the passive integrated transponder (PIT) tag was introduced to the fisheries community. The PIT tag 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 “passive” capability of the tag, which does not require a battery, means a single tag can potentially produce multiple detections of an individual fish throughout the life-span of that fish.

Since its introduction, use of the PIT tag has expanded from about 50,000 to more than 2 million fish tagged annually within the Federal Columbia River Power System (FCRPS). 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).

Construction and installation of the spillway PIT detection system at Lower Granite Dam was completed in January 2020. The new spillway system allows fish (including fish from this study) to be detected as they pass through spill bay 1(PITAGIS interrogation site GRS). Prior to installation of the spillway system, a large number of PIT tagged fish passed Lower Granite without being detected. The new system has increased detection rates, and these higher numbers of detected fish allow for more precise estimates of survival and timing for the wild Snake River spring/summer Chinook tagged as part of this project.

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

The 2020 NMFS Columbia River System Biological Opinion (NMFS 2020) calls for investigations to understand the factors contributing to the expressions of life-history diversity, such as yearling vs. subyearling life-history strategies for spring/summer Chinook salmon. We need to examine factors influencing the adoption of alternative life-history patterns, and how such changes might contribute to the abundance and productivity of affected populations. This includes examining how and where potential density-dependence limitations are affecting spring/summer Chinook salmon productivity in freshwater habitats, including what is happening in the overwintering life stage. In addition, to investigate factors that contribute to the subyearling life-history pattern of spring/summer Chinook salmon and the limiting factors that determine adult returns.

Section 1.3.2.5.5 of the 2020 BiOp states that

> *The Action Agencies will continue to: monitor habitat status and trends (including stream temperature and flow); conduct compliance and implementation monitoring (to ensure that habitat improvement actions are implemented as planned); monitor effectiveness of their habitat mitigation efforts at a range of scales; fund fish and habitat monitoring; and, support research projects with regional partners as funding and priorities allow.*

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 natal rearing streams, unimpounded

sections of the Salmon and Snake Rivers, and the hydroelectric complex during their parr/smolt migrations.

This report includes information on tagging of wild Chinook salmon parr from Idaho streams during 2024. We will monitor these fish during spring and early summer 2025 as they migrate downstream towards the Pacific Ocean. Estimates of survival and timing of study fish to Lower Granite Dam, will be provided in the *Survival and Timing* component of this report, along with interrogation data at several other sites throughout the Snake and Columbia River hydropower system in 2025.

This research continues studies that began in 1991 with funding from the Bonneville Power Administration (BPA). Results from previous study years were reported by Achord et al. (1994, 1995a,b, 1996, 1997, 1998, 2000, 2001a,b, 2002, 2003a, 2004-2007a,b, 2008-2012; Lamb et al. 2013-2019a,b; 2021; 2023a,b,c; 2024). The goals of this ongoing study are to:

1. Characterize migration timing and growth and estimate parr-to-smolt survival to Lower Granite Dam for individual stream populations of wild Snake River spring/summer Chinook salmon.
2. Determine whether consistent patterns in migration timing and 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 Chinook populations as they migrate from natal rearing areas.

This study continues to provide critical information for recovery planning and restoration efforts for these wild Chinook salmon populations, all of which remain listed as threatened under the U.S. Endangered Species Act (NMFS 2008).

Methods

During summer 2024, we tagged fish in sample reaches of two Idaho streams (Figure 1). Fish collection followed the safe handling methods developed for this study and detailed by Achord et al. (1994; 2007b) and Matthews et al. (1997). During 2024, we continued to use the electrofishing methods described by Meyer et al. (2021) as the "100-Watt method." This technique results in fewer delayed effects for collected fish while increasing catch per unit effort. Anesthetized fish were tagged only if they met the 55-mm minimum fork length requirement and had no observable pre-existing injuries.

In 2024, fish that measured 55-60 mm fork length (FL) were tagged using a 9-mm (HPT9) tag, while those larger than 60 mm FL were tagged with a 12-mm (ATP12) advanced performance PIT tag (Biomark, Inc. Boise, Idaho).[1] All fish were implanted with tags using pre-loaded, individual single-use hypodermic needles. This method ensured that each fish was tagged with a sterile, sharp needle, thus minimizing stress, injury, and potential disease transmission during the tagging process. A portion of tagged fish were held for 24 hours to observe any potential delayed mortality associated with tagging and handling. After recovery from the anesthetic or the 24-h hold, fish were released back to the streams where they had been originally captured.

[1] Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

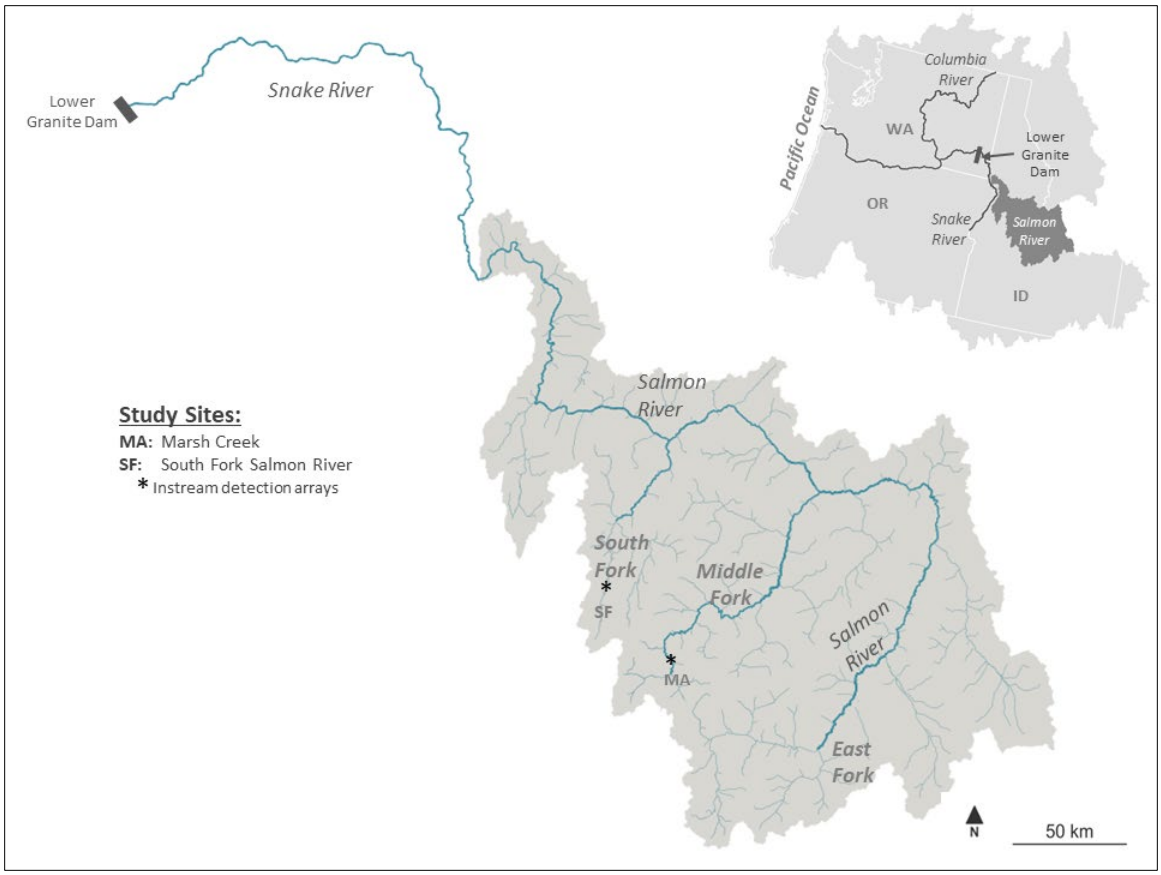

Figure 1. Map showing the streams and sample reaches where wild spring/summer Chinook salmon parr were PIT tagged during 2024.

Results

From 25-31 July 2024, we collected 3,699 wild spring/summer Chinook salmon parr from two Idaho stream populations (Figure 1). Fish were collected over a distance of about 6.5 stream km and over an area of approximately 83,012 m^2 (Table 1). Of the 3,699 fish collected, 3,000 were injected with PIT tags.

All tagged fish were released back to their respective natal streams 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. Number of tagged fish was equal (1,500) in both locations (Table 1; Appendix Table 1).

In 2024, the mean fork length of all Chinook salmon parr collected was 65.9 mm and the mean weight was 3.7 g. For Chinook salmon parr that were tagged and released, mean fork length was 67.2 mm and mean weight was 3.7 g (Table 1; Appendix Table 1). Collection areas within each stream were delineated by recording the global positioning system (GPS) coordinates of each 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). Brook trout *S. fontinalis* were found in high numbers at both locations. However, records of non-target species did not represent their total abundances in collection areas, as only Chinook salmon were targeted for collection. Non-target species were counted as incidental take.

Mortality associated with collection and tagging procedures in 2024 was low and consistent with what we have observed in previous years (Table 3; Appendix Table 4). The overall collection, handling, and tagging mortality rate was 1.4% (collection and handling accounted for 1.3%) across both sampling locations, which included a 24-h hold for a portion (10% or more) of the tagged fish to evaluate post-tagging mortality and tag retention.

Table 1. Summary of collection, PIT tagging, and release of wild Chinook salmon parr with average fork lengths and weights, approximate distances, and estimated areas sampled in Idaho streams during July 2024.

	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		
Marsh Creek	1,616	1,500	70.2	69.8	4.4	4.2	13-16	44,712
S Fork Salmon River	2,310	1,500	61.5	64.5	3.0	3.1	115-118.5	38,300
Totals/averages	**3,926**	**3,000**	**65.9**	**67.2**	**3.7**	**3.7**	**6.5**	**83,012**

Table 2. Summary of species other than Chinook salmon observed during collection operations in Idaho July 2024.

Sample Site	Steelhead	Unidentified Fry	Brook Trout	Bull trout	Sculpin	Dace	Sucker	Whitefish	Redsided Shiner	Pacific Giant Salamander	Cutthroat Trout
Marsh Creek	111	138	314	3	2223	0	0	7	0	0	2
S.F.Salmon River	137	261	441	0	7	355	0	5	13	3	0
Totals	**248**	**399**	**755**	**3**	**2230**	**355**	**0**	**12**	**13**	**3**	**2**

Table 3. Mortality percentages for wild Chinook salmon parr collected and PIT-tagged in Idaho during July 2024.

	Mortality (%)		
Tagging Location	Collection	Tagging/24 h	Overall
Marsh Creek	2.5	0.0	2.5
S Fork Salmon River	0.5	0.2	0.6
Averages	**1.3**	**0.1**	**1.4**

Discussion

During 2024, the number of wild Chinook salmon parr tagged was far lower than the annual average number tagged over the past 10 years (3,000 vs. 11,260). This low number was due to the fact that we sampled at only two locations in 2024, while up to 16 locations have been sampled in previous years. Pre-season analysis of redd counts provided by Idaho Department of Fish and Game (IDFG 2017) showed that parr densities would be low at many locations in 2024 and that many locations (including 14 of our traditional sampling locations) would fall below the IDFG "critical abundance threshold." At streams with parr densities below this threshold, sampling in Idaho was prohibited. Nevertheless, during all collection periods in 2024, stream conditions were good, with low-to-average flows, low-to-average temperatures, and high water clarity.

Our overall collection effort in 2024 included sample reaches with a combined sample area of 83,012 m^2. Over the entirety of the sample area, we estimated an annual density of 4.73 parr/100 m^2, which is very similar to the five-year average of these same sample sites (Marsh Creek and South Fork Salmon) of 4.84 parr/100 m^2 from 2019 to 2024 (excluding 2020, when no fish were collected). Past data has indicated an inverse relationship between parr density and parr-to-smolt survival (Achord et al. 2003b; Figure 2). Parr densities vary among sampling sites and can be biased high when using seine nets in deeper pools where parr tend to congregate. During 2024, we used seine nets only to collect parr (62) over a short distance on the South Fork Salmon River, where the nets were used as part of a live demonstration to new personnel on the seining technique.

In addition to collection and tagging of wild Chinook parr in Marsh Creek and the South Fork Salmon River, we collected genetic samples from Chinook and steelhead (*O. mykiss*) at both locations. These samples were collected from fish already captured for tagging. The samples will be used as part of BPA project (1989-096-00) *Monitor and Evaluate the Genetic Characteristics of Supplemented Salmon and Steelhead in the Snake River Basin* and parentage-based tagging (PBT) studies being conducted by IDFG.

During 2025, we will collect downstream migration data from the wild spring/summer Chinook parr collected and tagged during field operations in 2024. Analyses from these data will include estimates of parr-to-smolt survival, arrival and migration timing to Lower Granite Dam from streams with instream detection capabilities, and smolt passage timing at Lower Granite. These analyses will be included in our annual report, along with environmental data collected from each tagging location and growth data on migrants recaptured at Lower Granite Dam.

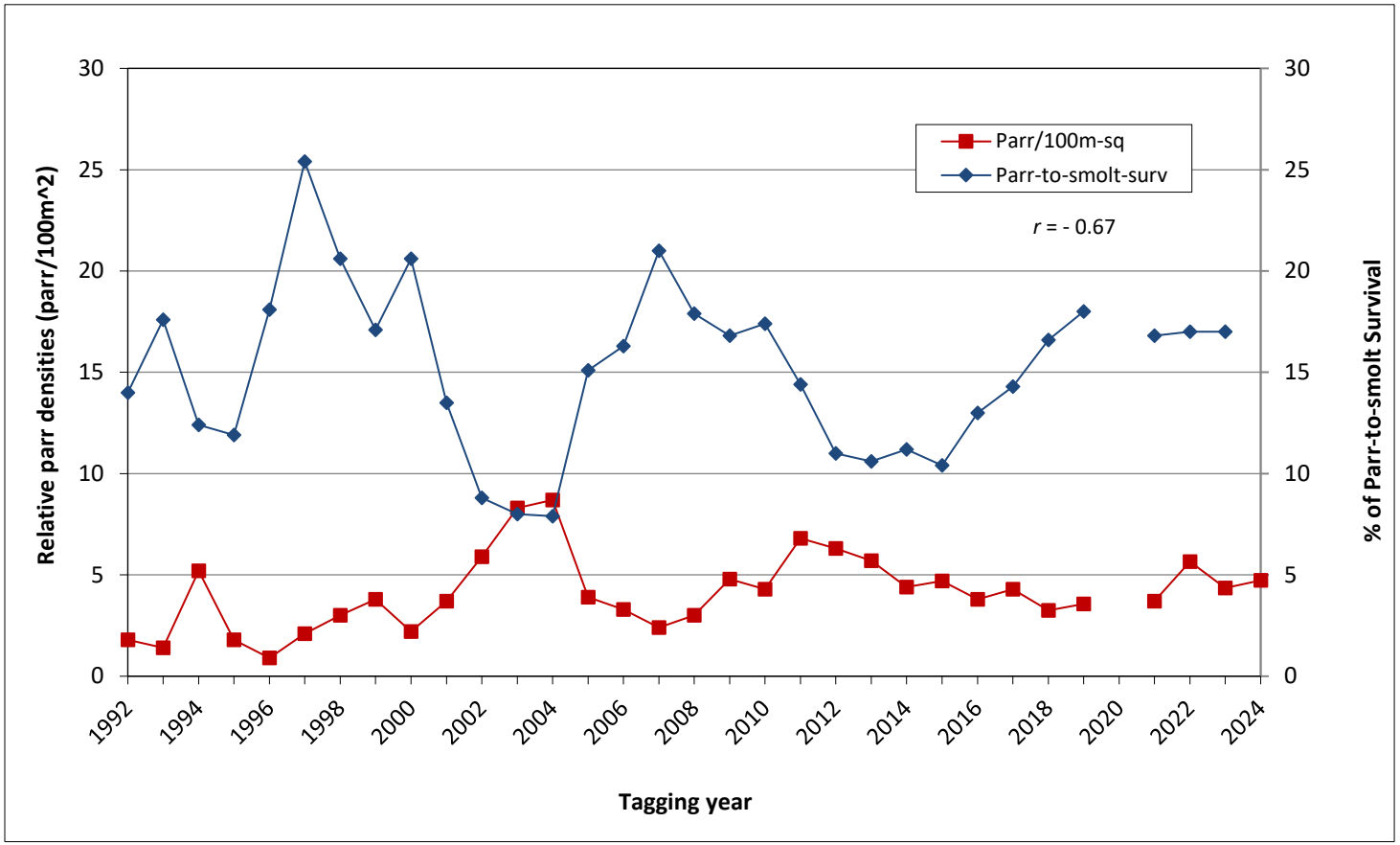

Figure 2. Annual average density of Chinook salmon parr (parr/100 m^2) in Idaho streams vs. annual estimated survival of smolts from these streams to Lower Granite Dam the following year, 1992 to 2024 (excluding 2020, when no fish were collected).

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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, 2024. Some length-weight data includes precocious Chinook.

				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
Marsh Creek	1616	1500	1500	51-127	70.2	1.6-27.2	4.4	56-95	69.8	1.9-10.3	4.2
S Fork Salmon River	2310	1500	1500	42-127	61.5	1.0-29.8	3.0	55-87	64.5	1.5-7.4	3.1
Total or mean	**3,926**	**3,000**	**3,000**	**42-127**	**65.9**	**1.0-29.8**	**3.7**	**55-95**	**67.1**	**1.5-10.3**	**3.7**

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 2024. Except where noted, all capture methods were electrofishing.

	Tagging			Release				
Group	Date (2024)	Time (PST)	Temp (°C)	Date (2024)	Time (PST)	Temp (°C)	Location (rkm)	n
Marsh Creek								
GAA-2024-207-001	25 Jul	0800	9.0	26 Jul	0700	8.0	13	143
GAA-2024-207-002	25 Jul	0800	9.0	25 Jul	1330	13.5	14	375
GAA-2024-208-001	26 Jul	0800	7.0	26 Jul	1400	13.5	15	482
GAA-2024-209-001	27 Jul	0800	7.0	27 Jul	1030	10.0	16	500
S Fork Salmon River								
GAA-2024-211-001	29 Jul	0800	11.0	30 Jul	0650	12.0	116	139
GAA-2024-211-002	29 Jul	0800	11.0	30 Jul	0800	10.0	117	435
GAA-2024-212-001	30 Jul	0800	12.0	30 Jul	1000	14.0	118	585
GAA-2024-213-001*	31 Jul	0800	9.0	31 Jul	1045	12.0	118	37
GAA-2024-213-002	31 Jul	0800	9.0	31 Jul	1045	12.0	118	304

***** Fish were captured using a seine net

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 2024.

Streams & Dates	Section covered	UTM start		UTM end	
		Northing	Easting	Northing	Easting
Marsh Creek					
7/25/2024	left bank	4917435	11T0645821	4916748	11T0646569
7/25/2024	right bank	4917430	11T0645798	4916852	11T0646377
7/26/2024	left bank	4915898	11T0647250	4915898	11T0647250
7/26/2024	right bank	4916848	11T0646381	4915864	11T0647217
7/27/2024	left bank	4915793	11T0647210	4915418	11T0647688
7/27/2024	right bank	4915864	11T0647217	4915400	11T0647616
South Fork Salmon River					
7/29/2024	left bank	4946796	11T0602890	4946563	11T0602933
7/29/2024	right bank	4946755	11T0602844	4946563	11T0602933
7/30/2024	left bank	4946563	11T0602933	4946142	11T0603108
7/30/2024	right bank	4946535	11T0602987	4946128	11T0603077
7/30/2024	seine	4945471	11T0602982	4945450	11T0603002
7/31/2024	left bank	4945450	11T0603002	4945497	11T0602933
7/31/2024	right bank	4945450	11T0603002	4945290	11T0602852

Appendix Table 4. Summary of observed total mortality for PIT-tagged wild Chinook salmon parr collected from Idaho streams in July 2024. Number rejected includes; fish too small to tag, precocious males, injured fish, and in some cases extra collected fish. Numbers of precocious males rejected for tagging are shown in parentheses.

Stream	Fish collected (n)	Fish tagged (n)	Fish rejected for tagging		Observed mortality			
			(n)	(%)	Collection and handling	Tagging and delayed	Total (n)	Total (%)
Marsh Creek	1,616	1,500	76 (16)	13.1	40	0	40	2.5
S Fork Salmon R	2,310	1,500	796 (12)	44.9	11	3	14	0.6
Totals/averages	**3,926**	**3,000**	**872 (28)**	**45.0**	**51**	**3**	**54**	**1.4**

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