Emigration of

Chinook Salmon and Steelhead

Nez Perce Tribe
Department of Fisheries Resources Management
Research Division

July 2022

Emigration of Natural and Hatchery Juvenile Chinook Salmon (Nacó'x in Nez Perce) and Steelhead (Héeyey in Nez Perce) During Migration Year 2021

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Prepared for:
U.S. Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

BPA Project Number: 1997-015-01
BPA 2021 Contract Number: 74017 REL 72

BPA Project Number: 1998-007-02
BPA 2021 Contract Number: 74017 REL 76

BPA Project Number: 1996-043-00
BPA 2021 Contract Number: 74017 REL 74

BPA Project Number 1983-350-003
BPA 2021 Contract Number: 86929

BPA Project Number 2010-057-00
BPA 2021 Contract Number: 74017 REL 73

and

U.S. Fish and Wildlife Service
Lower Snake River Compensation Plan
1387 Vinnell Way
Boise, Idaho 83709

Cooperative Agreement for FY 2016: F16AC00029

Acknowledgements

The Nez Perce Tribe Executive Committee authorized this report. Funding was provided by the United States Department of Energy, Bonneville Power Administration, and United States Fish and Wildlife Service, Lower Snake River Compensation Plan. The Nez Perce Tribe administers these projects, in cooperation with Federal, State, and Tribal agencies.

We recognize Carol Reuben, Mark Pishl, Brent Broncheau, Donald Anderson, David Bright, John Byrne, Anthony Capetillo, Chris Eaton, Leander Goodteacher, Frederick Haberman, Mark Maze, Joseph McCormack, Neal Meshell, Andrew Moody, Jay Oatman, Bailey Peters, Jon Rombach, and Samuel Davis, and Ezra Broncheau for their efforts in collecting data during migration year 2021.

Project leaders Bill Arnsberg, Peter Cleary, Jim Harbeck, Craig Rabe, Sherman Sprague, and Shane Vatland are recognized for their leadership and assistance in the review of this document. Jason Vogel and William Young are recognized for project management and assisting with budgeting and contract needs. Ryan Kinzer, is recognized for his leadership and organization of the Juvenile Technical Team, as well as his technical and analytical assistance in the reporting process.

We also thank the many employees of the Nez Perce Tribe Hatchery Complex, IDFG's McCall Fish Hatchery, WDFW's Lyon's Ferry Fish Hatchery, Kooskia Fish Hatchery, Dworshak National Fish Hatchery, ODFW's Lookingglass Fish Hatchery, and the USFWS Irrigon Hatchery for their dedication to rearing and raising spring/summer and fall Chinook Salmon and summer steelhead.

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Stream and release site	Release site/group acronym	Associated rear type, species, and life stage (emigrant group)
Clear Creek		
Kooskia National Fish Hatchery	KNFH*	Hatchery Chinook Salmon smolts
Clearwater River		
Nez Perce Tribe Hatchery	NPTH I	Hatchery Chinook Salmon smolts (early release)
Nez Perce Tribe Hatchery	NPTH II	Hatchery Chinook Salmon smolts (late release)
Imnaha River		
Imnaha River rotary screw trap	IMNTRP	Natural Chinook Salmon presmolts and smolts Natural summer/fall tagged steelhead emigrants Natural steelhead smolts Hatchery Chinook Salmon smolts (recaps) Hatchery steelhead smolts (recaps)
Imnaha River Acclimation Facility (IMNNAHR); Imnaha River Weir (IMNAHW)	IMNHSC*	Hatchery Chinook Salmon smolts
Little Sheep Acclimation Facility	LSHEEF	Hatchery steelhead smolts
Johnson Creek		
Johnson Creek rotary screw trap	JOHTRP	Natural Chinook Salmon parr, presmolts, and smolts Natural summer/fall tagged steelhead emigrants Natural steelhead smolts
Johnson Creek	JOHNSC	Hatchery Chinook Salmon smolts
Lolo Creek		
Lolo Creek rotary screw trap	LOLTRP	Natural Chinook Salmon presmolts and smolts Hatchery Chinook Salmon smolts (recaps from LOLOCY released presmolts) Natural summer/fall tagged steelhead emigrants Natural steelhead smolts
Yoosa Creek Acclimation Facility	LOLOCY*	Hatchery Chinook Salmon presmolts
Lostine River		
Lostine River Acclimation Pond	LOSTIP	Hatchery Chinook Salmon smolts
Secesh River		
Secesh River rotary screw trap	SECTRP	Natural Chinook Salmon parr, presmolts, and smolts Natural steelhead smolts
Selway River		
Meadow Creek	MEADOC	Hatchery Chinook Salmon parr
South Fork (SF) Clearwater River		
SF Clearwater River rotary screw trap	SFCTRP	Natural Chinook Salmon presmolts and smolts Natural steelhead smolts
Newsome Creek Acclimation Facility	NEWSAF*	Hatchery Chinook Salmon presmolts
Meadow Creek	MEAD2C	Hatchery steelhead smolts
Newsome Creek (upstream)	NEWSOC	Hatchery steelhead smolts
Red House Hole	REDHOS*	Hatchery steelhead smolts

*not an official Pacific States Marine Fisheries Commission mark/recapture/recovery acronym

Release site/group acronyms continued.

Release stream, release site, release site/group acronym, and associated rear type and life stage for fall Chinook Salmon.

Stream and release site	Release site/group acronym	Associated rear type and life stage (emigrant group)
Clearwater River		
Clearwater River beach seine	CLRWBS*	Natural Chinook Salmon subyearlings
Big Canyon Creek Acclimation Pond	BCCAP I*	Hatchery Chinook Salmon subyearlings (early release)
Big Canyon Creek Acclimation Pond	BCCAP II*	Hatchery Chinook Salmon subyearlings (late release)
Nez Perce Tribe Hatchery	NPTH	Hatchery Chinook Salmon subyearlings
Lapwai Creek		
North Lapwai Valley Acclimation Pond	NLVP	Hatchery Chinook Salmon subyearlings
Selway River		
Cedar Flats Acclimation Facility	CEFLAF	Hatchery Chinook Salmon subyearlings
South Fork Clearwater River		
Luke's Gulch Acclimation Facility	LUGUAF	Hatchery Chinook Salmon subyearlings
Snake River		
Captain John Rapids Acclimation Pond	CJRAP I*	Hatchery Chinook Salmon subyearlings (early release)
Captain John Rapids Acclimation Pond	CJRAP II*	Hatchery Chinook Salmon subyearlings (late release)
Pittsburg Landing Acclimation Pond	PLAP I*	Hatchery Chinook Salmon subyearlings (early release)
Pittsburg Landing Acclimation Pond	PLAP II*	Hatchery Chinook Salmon subyearlings (late release)

*not an official Pacific States Marine Fisheries Commission mark/recapture/recovery acronym

Introduction

The Nez Perce people historically fished throughout the Snake and Columbia rivers. Native fishes have long-standing cultural significance to the Nez Perce Tribe (hereafter referred to as the Tribe) including subsistence, ceremonial, spiritual, medicinal, economic, commercial, and intrinsic values. Sharp declines in the once robust runs of anadromous fishes (salmon, steelhead, lamprey, etc.) can largely be attributed to hydroelectric power developments, habitat degradation, poor water quality and quantity, over-harvesting, and more recently poor ocean conditions as a result of climate change. The Tribe strives to recover all species and populations of anadromous and resident fish to healthy and harvestable levels within usual and accustomed areas in manners consistent with treaty-reserved rights (Department of Fisheries Resources Management [DFRM] Strategic Plan Ad Hoc Team 2013).

The Research Division of the DFRM is tasked with monitoring anadromous fish runs held sacred by the Tribe, which include Snake River basin Chinook Salmon *Oncorhynchus tshawytscha* and summer steelhead *O. mykiss*. The juvenile life-history stage of these anadromous species provides researchers with important information regarding the status of the population and is thus closely monitored by the Tribes' various programs. In the Clearwater subbasin, the Tribe relies upon the Nez Perce Tribe Hatchery Monitoring and Evaluation (NPTH M&E) project and the Snake Basin Steelhead Assessments (SBSA) project to monitor juvenile Chinook Salmon (spring/summer and fall life-history forms) and summer steelhead, respectively. The Imnaha River Steelhead Status and Smolt Monitoring (IRSSSM) project and the Lower Snake River Compensation Plan (LSRCP) Hatchery Evaluation Project monitor juvenile spring/summer Chinook Salmon and summer steelhead in the Imnaha River subbasin, as does the Johnson Creek Artificial Propagation and Enhancement Monitoring and Evaluation (JCAPE M&E) project in Idaho's South Fork Salmon River subbasin.

The following report was prepared by the Research Division Juvenile Technical Team (JTT). The JTT is tasked with reporting standardized juvenile metrics for Chinook Salmon and steelhead stocks and/or populations and meeting contractual obligations outlined by the Bonneville Power Administration (BPA) contracts. Standardized metrics are consistent across Division projects and geographic location, and follow regional definitions outlined by the Ad-Hoc Supplementation Workgroup (Beasley et al. 2008). This report shares Division-wide results of migration year 2021 (MY2021) juvenile life stage metrics for natural- and hatchery-origin Chinook Salmon and steelhead. The data presented in this report were collected by the Tribe's fisheries offices located in Joseph, Oregon, and McCall and Orofino, Idaho. This report satisfies contract obligations to the BPA project and contract numbers: 1998-007-02, contract: 74017 REL 76 (GRSME); 1983-350-003, contract: 86929 (NPTH M&E); 2010-057-00, contract: 74017 REL 73 (SBSA); 1997-015-01, contract: 74017 REL 72 (IRSSSM); 1996-043-00, contract 74017 REL 74 (JCAPE); and, Lower Snake River Compensation Plan contract: F16AC00029

(LSRCP).

Project areas

The Clearwater River subbasin (Hydrologic Unit Code [HUC] 17060306), located in north-central Idaho, encompasses about 25,000 km^2. The basin extends from its headwaters in the Bitterroot Mountains along the Idaho-Montana border to its mouth on the Idaho-Washington border (Figure 1). The Clearwater River subbasin ranges in elevation from about 2,750 m at its headwaters to 225 m at its confluence with the Snake River. Lolo Creek drains into the Clearwater River about 13.5 km upstream from Orofino, Idaho after passing through a steep canyon with limited access. The South Fork (SF) Clearwater River starts at the confluence of the American River and Red River at an elevation of 1,189 m and flows 100 km to join the Middle Fork Clearwater River at Kooskia, Idaho at an elevation of 373 m. The Lolo Creek and SF Clearwater rotary screw traps are located at river kilometer (rkm) 21.0 and 9.0, respectively. Beach seining occurs in the lower Clearwater River downstream of Orofino, Idaho and on the lower South Fork Clearwater River downstream of Harpster, Idaho. Additionally, hook and line surveys were used on the lower Clearwater River near Lewiston, Idaho to supplement beach seining efforts.

The Imnaha River subbasin (HUC 17060102), located in northeast Oregon, encompasses an area of about 2,538 km^2. The Imnaha River flows north for 103 km from its headwaters in the Eagle Cap Wilderness Area to its confluence with the Snake River at rkm 309. Elevations in the watershed range from 3,048 m at the headwaters to about 290 m at its confluence with the Snake River. The Imnaha River rotary screw trap is located at rkm 7.0.

The South Fork Salmon River (SFSR) subbasin (HUC 17060208), located in the Boise and Payette National Forests in central Idaho, encompasses an area of about 3,400 km^2. Johnson Creek flows north for 62 rkm until it joins the East Fork South Fork Salmon River (EFSFSR) near the town of Yellow Pine, which flows west for 23 km where it joins the SFSR. The Secesh River flows 43 km to join with the SFSR less than two kilometers downstream of where the EFSFSR empties into the SFSR. Elevations in the subbasin vary from 2,841 m at the headwaters of the Secesh River to 609 m at the confluence with the Salmon River. The Johnson Creek and Secesh River rotary screw traps are located at rkm 6.0 and 7.0, respectively.

Emigrating smolts travel about 700 km from the headwaters of the Snake River basin through eight reservoirs and hydropower facilities before reaching the Pacific Ocean. Moving downstream in the Snake River, smolts from the project areas first arrive at Lower Granite Dam (LGR) then Little Goose Dam, Lower Monumental Dam, and Ice Harbor Dam, respectively. The Snake River then enters the Columbia River where the smolts encounter McNary Dam, John Day Dam, The Dalles Dam, and Bonneville Dam.

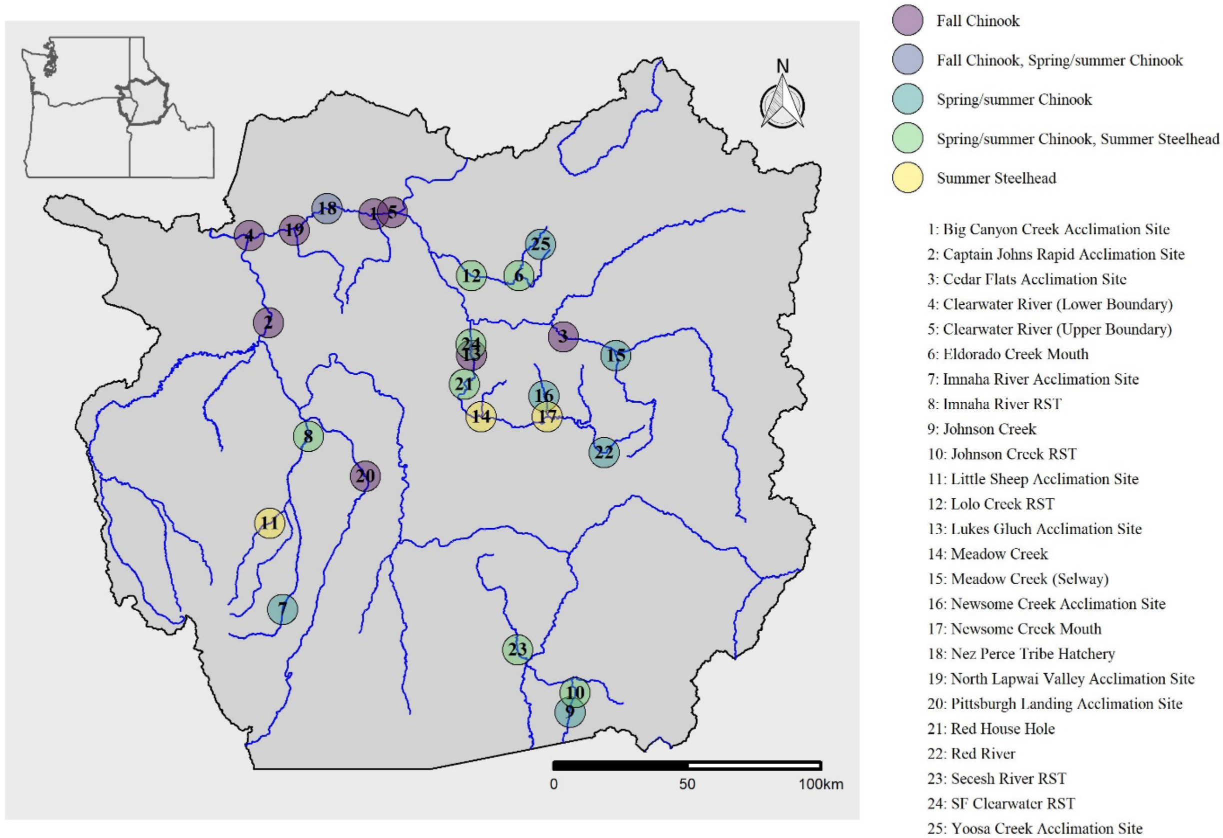

Figure 1. Map of rotary screw traps (RST), hatchery release locations, and major dams. The black line represents the perimeter of the Indian Claims Commision Boundary.

Methods

The Tribe used rotary screw traps (hereafter referred to as the trap or traps), beach seining, and hook-and-line sampling to capture and monitor MY2021 anadromous juvenile spring/summer Chinook Salmon, fall Chinook Salmon, and summer steelhead. These methods are commonly used throughout the Pacific Northwest to safely capture emigrating juvenile salmonids (Johnson et al. 2007). The migration year for the majority of juvenile spring/summer Chinook Salmon and summer steelhead captured at the trap locations was defined as starting in July 2020 and ending in June 2021. Exceptions to this occurred when traps captured early emigrating spring/summer Chinook Salmon parr in May and June and/or late emigrating spring/summer Chinook Salmon smolts and juvenile summer steelhead in early July. Trapping was partitioned into two seasons: summer/fall (July – December) and winter/spring (January – June). Beach seining and hook-and-line sampling for natural fall Chinook Salmon subyearlings occurred from mid-June through mid-August 2021.

Field sampling

Spring/summer Chinook Salmon and summer steelhead sampling

We used traps to target and capture natural spring/summer Chinook Salmon and summer steelhead emigrants at each of the five trapping locations in the Snake River basin (Table 1). We operated traps continuously unless precluded by high water, excessive water temperature, icing, equipment malfunction, hatchery releases, and/or insufficient staffing. Traps were checked and the catch was processed daily. For details regarding the basic operation and maintenance of the Tribe's traps, the equipment needed to process and record the catch, and safe fish capture, handling, tagging, and release procedures see https://www.monitoringresources.org/Document/Protocol/Details/2242. Natural- and hatchery-origin (hereafter referred to as natural or hatchery, respectively) emigrants were distinguished by the presence (natural) or absence (hatchery) of an adipose fin, or the presence of a coded-wire tag (hatchery). For details regarding life stage determination of spring/summer Chinook Salmon and seasonal partitioning of summer steelhead see https://ryankinzer.github.io/NPT_Standardized_Methods/chap-juvenile.html#sec:juvenileabundance.

Table 1. Trap site, rotary screw trap cone size (m), location in decimal degrees (DD), and elevation (m).

Trap site	Cone size (m)	Latitude (DD)	Longitude (DD)	Elevation (m)
Imnaha River[1]	1.5	45.76381	-116.74802	359
Imnaha River[2]	2.1	45.76381	-116.74802	359
Johnson Creek	1.5	44.91764	-115.48336	1,486
Lolo Creek	1.5	46.29386	-115.97494	626
Secesh River	1.5	45.05952	-115.75691	1,216
SF Clearwater River	1.5	46.06790	-115.97792	412

[1] operated from early fall to early spring
[2] operated from early spring to early summer

Staff at the Imnaha River trap implemented subsampling procedures when catch rates exceeded levels for safe handling (e.g., during hatchery smolt releases). Subsampling the catch allowed us to produce estimates of the number of fish captured in the trap by species, origin, and life stage without processing the entire catch. For details regarding subsampling protocols see https://www.monitoringresources.org/Document/Method/Details/6635.

We summarized trap operational period(s) by the number of days operated and not operated during MY2021. Target catch (i.e., spring/summer Chinook Salmon and summer steelhead juveniles) was summarized by species, origin, and life stage (i.e., collectively referred to as an emigrant group). Incidental catch (e.g., non-target catch including Pacific lamprey *Entosphenus tridentatus*) was also summarized by species and life stage (if known).

Fall Chinook Salmon sampling

We conducted beach seining and hook-and-line sampling on the lower SF Clearwater and mainstem Clearwater rivers to capture natural subyearling fall Chinook Salmon for PIT tagging. Hook-and-line sampling was used in locations too deep to allow beach seining or when beach seine catch declined later in the sampling season. Beach seining activities commenced when the Clearwater River discharge fell below 30,000 cfs and continued to decline (U.S. Geological Survey [USGS] gauging station at Spalding, ID; Appendix A). For details regarding the Tribe's beach seining protocols see https://www.monitoringresources.org/Document/Protocol/Details/2243. Juvenile hatchery fall Chinook Salmon were identified by the absence of an adipose fin and/or the presence of a coded wire tag. We reported the number of natural fall Chinook Salmon subyearlings captured, PIT tagged, and mean CPUE (number of fish/seine haul) for each week of sampling. Additionally, we calculated mean water temperature (ºC), discharge (cfs), fork length (mm), and Fulton's condition factor for each week of sampling.

Hatchery releases

Data on hatchery-released Chinook Salmon and steelhead were provided by the hatcheries that released juveniles within the project areas or by the Tribe's projects associated with the project area. Release group information included species and life stage, release site, release type, release date(s), number of fish released, and the number of PIT-tagged fish within the release group.

State and federal co-managers and the Tribe's production staff released hatchery-reared spring/summer Chinook Salmon (brood year 2019) at locations throughout the Snake River basin (Figure 1). Acclimated releases of smolts reared at the Kooskia National Fish Hatchery and the Nez Perce Tribe Fish Hatchery were released from each hatchery into the Clearwater River. Direct and acclimated releases of smolts reared at Lookingglass Fish Hatchery occurred upstream of the Imnaha River trap at the Imnaha River Acclimation Facility and upstream of the Lostine River trap at the Lostine River Acclimation Facility. Smolts reared at McCall Fish Hatchery were directly released into Johnson Creek about 9 rkm upstream of the trap near the Moose Creek confluence. Acclimated releases of presmolts reared at the Nez Perce Tribe Hatchery occurred upstream of the Lolo Creek trap at the Yoosa Creek Acclimation Facility and upstream of the SF Clearwater River trap at the Newsome Creek Acclimation Facility. Parr reared at the Nez Perce Tribe Hatchery were direct released into Meadow Creek (Selway River) just upstream of the mouth.

State and federal co-managers and Tribal production staff released hatchery-reared summer steelhead (brood year 2020) in the Imnaha and the SF Clearwater rivers (Figure 1). An acclimated, volitional release of smolts reared at Irrigon Fish Hatchery occurred upstream of the Imnaha River trap at the Little Sheep Acclimation Facility. The SF Clearwater River received four direct releases of steelhead smolts at three different locations: the Red House Hole at rkm 31 (the first release group was reared at Clearwater Fish Hatchery and the second release group was reared at Dworshak National Fish Hatchery), Meadow Creek at rkm 53 (reared at Clearwater Fish Hatchery), and Newsome Creek at rkm 84 (reared at Clearwater Fish Hatchery). Snow blocked access to the intended release site on Lolo Creek in 2021 requiring Tribal staff to adopt an alternate release location at Red House Hole on the SF Clearwater River for steelhead smolts reared at Dworshak National Fish Hatchery.

Snake River hatchery fall Chinook Salmon subyearling releases (brood year 2020) occurred throughout the Snake River basin (Figure 1). Acclimated releases of subyearlings reared at Lyons Ferry Hatchery occurred at Captain John Rapids and Pittsburg Landing on the Snake River, and Big Canyon on the Clearwater River. Acclimated releases of subyearlings reared at the Nez Perce Tribe Hatchery occurred at North Lapwai Valley on the lower Clearwater River, Luke's Gulch on the SF Clearwater River, and Cedar Flats on the Selway River. Additionally, fall Chinook Salmon subyearlings were directly released into the lower Clearwater River from the Nez Perce Tribe Hatchery.

Environmental data

We collected temperature (ºC) data using in-stream temperature loggers installed near traps (Imnaha River, Johnson Creek), in-stream PIT tag arrays (Lolo Creek, Secesh River, SF Clearwater River), and USGS gauging stations (Clearwater River; Appendix A). Discharge data were obtained from Idaho Power (Imnaha River) and USGS gauging stations (Clearwater River, Johnson Creek, Lolo Creek, SF Clearwater River). We calculated mean daily temperature and discharge associated with each trap site. Discharge data for the Secesh River were unavailable during MY2021.

Performance measures

Data collected during the MY2021 reporting period allowed us to estimate juvenile abundance, emigration and travel timing, survival, and size and condition (i.e., performance measures). Performance measures were reported for each emigrant group captured at a release site (e.g., trap, acclimation facility, beach seining river) where sufficient data were available. In some cases, data were pooled across various collection methods and emigrant groups when they were insufficient to calculate a performance metric. For example, beach seine and hook-and-line fall Chinook Salmon subyearling data from the SF Clearwater and Clearwater rivers were combined into a single emigrant group to facilitate calculating the full suite of performance measures (excluding fork length and Fulton's condition factor).

Emigrant abundance at the release site

We estimated natural emigrant abundance at each trapping location following the methods outlined at https://ryankinzer.github.io/NPT_Standardized_Methods/chap-juvenile.html#sec:juvenileabundance. When a trap was not operating, the number of emigrants passing the trap was not estimated; therefore, MY2021 natural emigrant abundance estimates are considered minimum estimates of natural emigrant abundance during MY2021. Additionally, natural emigrant abundance estimates assume all fish captured actively emigrated within the migration year; however, information presented in Appendix B suggest the emigration habits of juvenile summer steelhead captured and tagged at the traps do not always follow this assumption. We could not estimate abundance for natural fall Chinook Salmon subyearlings sampled in the Clearwater and SF Clearwater rivers because the sampling design did not support that objective. However, we calculated mean CPUE (number of fish/seine haul/week) for beach seine samples. Pre-release census counts of hatchery-reared Chinook Salmon and steelhead were reported in place of estimated abundance.

Emigration timing at the trap sites and Lower Granite Dam

We calculated emigration timing at the trap sites following the methods outlined at https://ryankinzer.github.io/NPT_Standardized_Methods/chap-juvenile.html#sec:emigrationtime. We calculated mainstem arrival timing of emigrants at LGR following the methods outlined at https://ryankinzer.github.io/NPT_Standardized_Methods/chap-juvenile.html#sec:mainstemarrival. The proportion of emigrants passing LGR before the initiation of collections for transportation (April 23, 2021) was calculated following the methods outlined at https://ryankinzer.github.io/NPT_Standardized_Methods/chap-juvenile.html#sec:mainstemarrival.

Travel time from the release site to Lower Granite Dam

We calculated travel time as the number of days it took a PIT-tagged fish to travel from it's release site to an interrogation site at LGR. Travel time was summarized for each emigrant group at a given release site using box and whisker plots.

Survival to Lower Granite Dam

We estimated apparent survival from the release site to LGR for each emigrant group following methods outlined at https://ryankinzer.github.io/NPT_Standardized_Methods/chap-juvenile.html#sec:juvsurvival. Estimates of apparent survival do not account for individual fish that were still alive but did not emigrate past the hydrosystem during the migration year in which they were tagged. Juvenile summer steelhead have been documented delaying emigration to subsequent years post PIT tagging (Dobos et al. 2020; Appendix B). Delayed emigration of juvenile summer steelhead has the potential to negatively bias survival estimates.

Smolt equivalents at Lower Granite Dam

We estimated smolt equivalents and the precision of the estimate following methods outlined at https://ryankinzer.github.io/NPT_Standardized_Methods/chap-juvenile.html#sec:smolts. Smolt equivalents were not estimated for fall Chinook Salmon subyearlings because an abundance estimate or census count was not available.

Size and condition

The size and condition of emigrants at the time of capture were summarized for each emigrant group at a release site following methods outlined at https://ryankinzer.github.io/NPT_Standardized_Methods/chap-juvenile.html#sec:sizeemigration and https://ryankinzer.github.io/NPT_Standardized_Methods/chap-juvenile.html#sec:conditionfac.

Results and Discussion

Field sampling

Spring/summer Chinook Salmon and summer steelhead sampling

Traps were operated continuously during MY2021 unless precluded by environmental conditions, equipment damage/malfunction, or staffing shortages (Table 2). The traps operated during the migration year, with some traps collecting MY2021 juveniles slightly outside of the migration year. For example, spring/summer Chinook Salmon parr were captured in Johnson Creek in late May. Four of the five traps were removed in November or December due to unsuitable winter conditions. Johnson Creek, Lolo Creek, Secesh River, and SF Clearwater River traps were reinstalled in the spring and the Imnaha River trap was fished through the winter months when conditions allowed. Operational days outnumbered non-operational days at all trapping sites during the trapping periods with environmental conditions often the reason for non-operational days. Water temperature and discharge were reported for the trapping period at each trap site, including the winter months when trapping was discontinued at four of the five sites (Figure A-2 – Figure A-6).

Table 2. Trap site, trapping period, the number of days operated, and the number of days not operated, by trap site, within migration year 2021.

			# days not operated	
Trap site	Trapping period	# days operated	Environment	Equipment/ Staffing
Imnaha River	10/02/20 – 06/30/21	251	9	11
Johnson Creek	05/07/20 – 11/11/20*	175	13	0
	03/04/21 – 06/25/21	84	29	0
Lolo Creek	09/24/20 – 11/21/20	55	4	0
	03/18/21 – 06/26/21	99	1.5	0
Secesh River	07/04/20 – 11/07/20	117	9	0
	03/25/21 – 06/25/21	75	15	0
SF Clearwater River	09/25/20 – 12/22/20	61	28	0
	02/01/21 – 06/26/21	115	28	2

*Some emigrants assigned to migration year 2021 were captured slightly outside of the migration year (i.e., July – June).

Target catch at the trap sites included natural spring/summer Chinook Salmon and summer steelhead emigrants. Hatchery smolts were not considered target catch but were included to allow for comparison with natural smolts in each system. Target catch was highly variable among trap sites (Table 3). The majority of the catch at the Johnson Creek and Secesh River traps was comprised of natural spring/summer Chinook Salmon captured as parr and presmolts emigrating during the summer/fall trapping season. The Imnaha River trap operates during hatchery releases of spring/summer Chinook Salmon and summer steelhead because considerable numbers of natural spring/summer Chinook Salmon and summer steelhead continue to emigrate during the hatchery releases.

Table 3. Target catch (i.e., non-expanded) by trap site and emigrant group for migration year 2021. Emigrant groups with N/A indicate the emigrant group was not represented at the trap site or the trap was not operational during emigration for that emigrant group/rear type.

	Natural Chinook Salmon			Hatchery Chinook Salmon	Natural steelhead juveniles	Hatchery steelhead juveniles
Trap site	parr	presmolts	smolts	smolts		
Imnaha River*	N/A	2,533	4,270	87,526	7,238	27,954
Johnson Creek	5,105	6,149	515	85	847	N/A
Lolo Creek	N/A	1,794	308	582	2,446	N/A
Secesh River	3,010	8,428	438	N/A	215	N/A
SF Clearwater River	N/A	570	546	2,477	130	11,893

*Target catch includes estimates from subsampling: 316 natural Chinook Salmon smolts, 59,632 hatchery Chinook Salmon smolts, 497 natural steelhead smolts, 1,810 hatchery steelhead smolts.

Target species mortalities were summarized by trap site, emigrant group, and source of mortality, including handling, tagging, predation, and dead on arrival (Appendix C). Trapping was the most common source of mortality and was low among trap sites, with several trap sites reporting no mortality for many emigrant groups.

Incidental (non-target) catch captured during MY2021 included six families of freshwater fish: Catostomidae, Centrarchidae, Cottidae, Cyprinidae, Ictaluridae, and Salmonidae (Table 4). Incidental catch varied widely among trap sites. Non-native species comprised some of the incidental catch including Smallmouth Bass *Micropterus dolomieu* and Brook Trout *Salvelinus fontinalis*. Pacific Lamprey ammocoetes and macropthalmia were captured at all trap sites during MY2021 (Table 5).

Table 4. Incidental catch by family, common name, scientific name, and trap site captured during migration year 2021 sampling.

		Trap site				
Family	Common name *Scientific name*	Imnaha River	Johnson Creek	Lolo Creek	Secesh River	SF Clearwater River
Catostomidae	sucker *Catostomus sp.*	1,897	0	194	0	251
Centrarchidae	Smallmouth Bass *Micropterus dolomieu**	59	0	0	0	0
Cottidae	sculpin *Cottus sp.*	70	1	26	8	7
Cyprinidae	Chiselmouth *Acrocheilus alutaceus*	185	0	1	0	14
	dace *Rhinichthys sp.*	0	0	388	0	75
	Longnose Dace *R. cataractae*	321	20	0	107	0
	Northern Pikeminnow *Ptychocheilus oregonensis*	24	0	34	0	7
	Peamouth *Mylocheilus caurinus*	28	0	0	0	0
	Redside Shiner *Richardsonius balteatus*	13	0	1	0	25
Salmonidae	Brook Trout *Salvelinus fontinalis**	0	0	4	7	0
	Bull Trout *S. confluentus*	33	6	1	2	1
	Chinook Salmon – fall *Oncorhynchus tshawytscha*	0	0	0	0	6
	Coho Salmon *O. kisutch*	0	0	413	0	4
	Mountain Whitefish *Prosopium williamsoni*	125	85	31	44	2
	steelhead - adult *O. mykiss*	4	0	1	0	2
	Westslope Cutthroat Trout *O. clarkii lewisi*	0	53	2	21	0
Total Catch		2,759	165	1,096	189	394

* Non-native species

Table 5. Pacific Lamprey *Entosphenus tridentatus* catch by trap site and life stage for migration year 2021.

	Life stage		
Trap site	Ammocoete	Macropthalmia	Adult
Imnaha River	443	0	0
Johnson Creek	73	5	0
Lolo Creek	215	134	0
Secesh River	2	0	0
SF Clearwater River	68	18	0

Fall Chinook Salmon sampling

In 2021, crews conducted beach seining and hook-and-line sampling for natural fall Chinook Salmon subyearlings on the Clearwater River for nine weeks. The first week of beach seining was May 24th and continued through the week of June 28th (Table 6). Additionally, beach seining was conducted in the SF Clearwater River once on July 21st. Flow and increasing water temperature limited beach seining on the SF Clearwater (Figure A-6). Hook-and-line sampling was conducted from the week of July 5th through the week of August 2nd on the lower Clearwater River as subyearlings moved to deeper pools. During the sampling season, Clearwater River flows and temperatures remained within operational levels for staff to safely capture and handle fish (Figure A-1). Beach seining and hook-and-line sampling captured 5,037 fall Chinook Salmon subyearlings, of which 3,084 were PIT tagged for survival and emigration studies. Weekly catch varied from a high of 1,484 during the fourth week of sampling to a low of 71 fish captured during the second week of sampling.

Table 6. Week of sampling, mean temperature and discharge (Spalding, ID), number captured, number PIT tagged, mean FL (mm), mean K (Fulton's condition factor), and mean CPUE (number of fish/seine haul) during natural fall Chinook Salmon subyearling beach seining and hook-and-line sampling (H/L) on the lower Clearwater and SF Clearwater rivers for migration year 2021.

Week of sampling	Mean temp (ºC)	Mean discharge (cfs)	# captured	# PIT tagged	Mean FL (mm)	Mean K	Mean CPUE
24-May	13.2	24,300	118	56	55.8	1.03	79.0
31- May	11.1	29,900	71	25	45.5	1.02	36.0
7-Jun	13.1	21,933	1,445	639	61.4	1.10	459.8
14-Jun	14.6	20,000	1,484	571	62.7	1.08	247.7
21-Jun[1]	15.5	17,767	771	673	59.5	1.11	168.6
28-Jun	12.8	19,225	99	89	57.8	1.16	5.6
5-Jul	13.0	13,200	243	236	82.6	1.13	H/L
12-Jul	12.2	12,550	302	298	101.5	1.10	H/L
19-Jul	11.9	10,720	101	94	99.8	1.14	H/L
26-Jul	14.3	7,437	217	217	102.3	1.13	H/L
2-Aug	14.1	10,343	186	186	101.7	1.16	H/L
Totals			5,037	3,084			

[1] Included in total # captured were 22 fall Chinook Salmon seined and 5 PIT tagged on the lower SF Clearwater.

Hatchery releases

Hatchery releases occurred within each project area, except for the Secesh River (Table 7), in collaboration with project partners including the Idaho Department of Fish and Game, the Oregon Department of Fish and Wildlife, the Washington Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service. A portion of each hatchery release group were PIT tagged to allow comparisons between natural and hatchery emigrant group performance measures. The Yoosa Creek Acclimation Facility, Newsome Creek Acclimation Facility, and Meadow Creek (Selway River) were the only release sites with parr or presmolt spring/summer Chinook Salmon hatchery releases in the summer/fall; all other hatchery smolt releases occurred in the spring. Juvenile steelhead releases in the SF Clearwater River at Red House Hole were comprised of smolts from Clearwater Fish Hatchery released in late March and smolts from Dworshak National Fish Hatchery released in early to mid-April. Subyearling fall Chinook Salmon releases occurred in the spring (Table 8). The earliest fall Chinook Salmon release occurred on May 4th from North Lapwai Valley Acclimation Pond and the latest release occurred on June 10th from Nez Perce Tribe Hatchery on the Clearwater River.

Table 7. Hatchery spring/summer Chinook Salmon and summer steelhead releases by stream, emigrant group, release site, release type, release date(s), number released, and the number of fish released with a PIT tag for migration year 2021. Refer to acronym table for release site names.

Stream	Emigrant group	Release site	Release type	Release date(s)	Number released	PIT tags released
Clearwater River	Chinook Salmon smolts	KNFH	Acc	04/13/21	633,835	5,981
Clearwater River	Chinook Salmon smolts	NPTH	Acc	03/25/21	177,358	1,000
Clearwater River	Chinook Salmon smolts	NPTH	Acc	04/15/2021	222,902	1,000
Imnaha River	Chinook Salmon smolts	IMNAHR	Acc	04/17/21	298,265	11,810
Imnaha River	Chinook Salmon smolts	IMNAHW	Dir	04/15/21	212,782	8,795
Imnaha River	Steelhead juveniles	LSHEEF	Acc	04/01/21 – 4/30/21	233,555	14,978
Johnson Creek	Chinook Salmon smolts	JOHNSC	Dir	04/06/21 – 04/08/21	96,250	2,187
Lolo Creek	Chinook Salmon presmolts	LOLOCY	Acc	10/09/20	153,319	5,952
Lostine River	Chinook Salmon smolts	LOSTIP	Acc	04/05/21 – 4/20/21	240,260	5,961
Selway River	Chinook Salmon parr	MEADOC	Dir	06/30/2020	472,452	5,001
SF Clearwater River	Chinook Salmon presmolts	NEWSAF	Acc	10/12/20	79,170	2,994
SF Clearwater River	Steelhead juveniles	MEAD2C	Dir	03/26/21 – 03/30/21	538,459	10,783
SF Clearwater River	Steelhead juveniles	NEWSOC	Dir	04/05/21 – 04/06/21	123,147	5,996
SF Clearwater River	Steelhead juveniles	REDHOS	Dir	03/25/21 – 03/26/21; 04/05/21 – 04/12/21	876,489	12,286

Table 8. Hatchery fall Chinook Salmon subyearlings (brood year 2020) released by stream, release group, release type, release date, number released, and the number of fish released with a PIT tag for migration year 2021. Refer to acronym table for release group names.

Stream	Release group	Release type	Release date	Number released	PIT tags released
Clearwater River	BCCAP I	Acclimated	05/12/21	458,034	11,023
Clearwater River	BCCAP II	Acclimated	06/02/21	201,225	4,467
Clearwater River	NPTH	Acclimated	06/10/21	776,976	4,433
Lapwai Creek	NLVP	Acclimated	05/04/21	248,148	4,500
Selway River	CEFLAF	Acclimated	06/07/21	246,563	4,438
SF Clearwater River	LUGUAF*	Acclimated	06/08/21	279,245	4,390
Snake River	CJRAP I	Acclimated	05/13/21	467,332	25,788
Snake River	CJRAP II	Acclimated	06/03/21	200,429	4,450
Snake River	PLAP I	Acclimated	05/05/21	406,616	25,647
Snake River	PLAP II	Acclimated	05/26/21	199,800	4,450

*On 05/06/21 a bear broke the intake pipe to a single tank and 34,858 unmarked/untagged fish were released early.

Performance measures

Emigrant abundance at the trap site

Abundance estimates varied by trap site and emigrant group. Natural spring/summer Chinook Salmon parr and presmolt emigrants comprised the majority of the Johnson Creek and Secesh River emigrant abundance (Figure 2). Abundance estimates for Imnaha River, Johnson Creek, and Lolo Creek natural steelhead juveniles were not partitioned into seasonal catch but rather estimates for the entire migration year. The wide conficence intervals for the natural steelhead juvenile abundance estimate at Lolo Creek is likely related to the variable trap efficiency (1.3% - 17.9%) encountered throughout the trapping season. Abundance estimates for natural steelhead emigrants from the Secesh River and the SF Clearwater River were unavailable for MY2021 because environmental conditions or low trap catch precluded the efficiency trials required in the calculations.

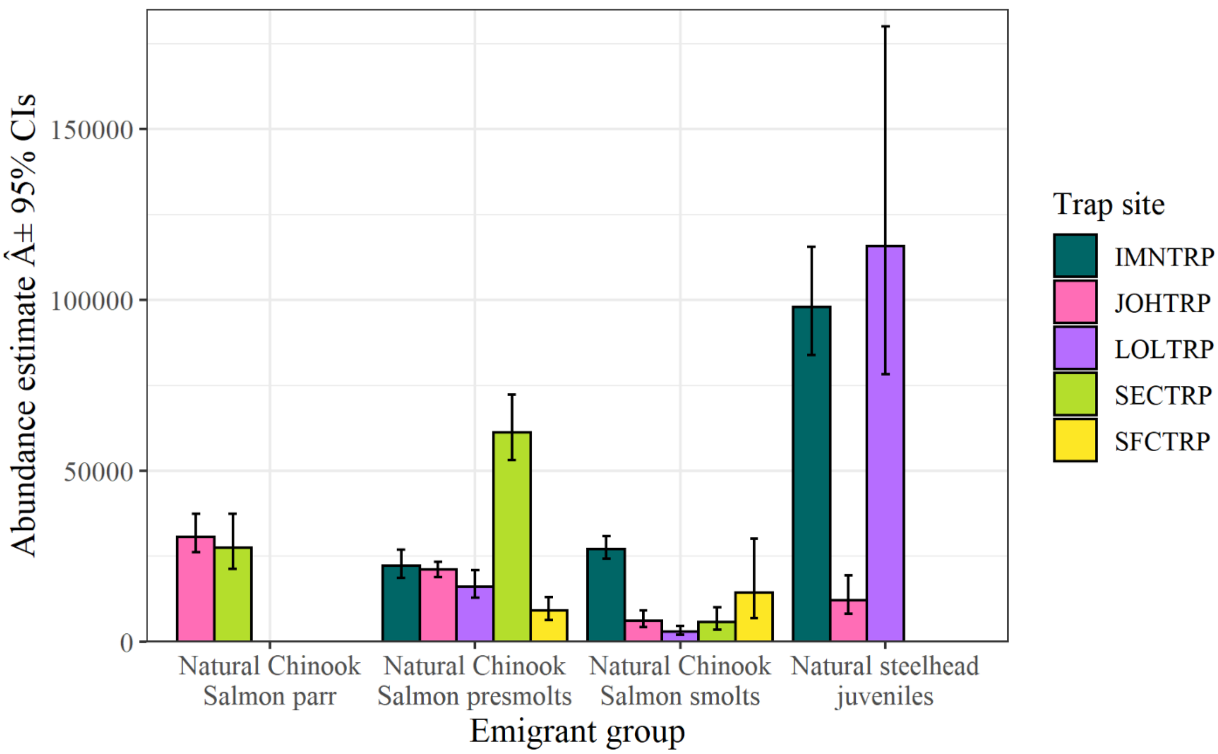

Figure 2. Natural spring/summer Chinook Salmon and summer steelhead abundance estimates and 95% confidence intervals by trap site for each emigrant group during migration year 2021. Refer to acronym table for trap site names.

Emigration timing at the trap sites

Cumulative proportion curves summarized emigrant arrival timing at the trap sites. Trapping periods likely captured the majority of emigration at the trap sites, as suggested by the rate of catch (i.e., catch/trap day) at the start and end of a trapping period. However, traps often begin capturing fish soon after the initial deployment, suggesting some emigration occurs prior to the start of trapping; therefore, it is reasonable to assume that some emigration also continued after the cessation of trapping (Table 2; Figures 3 and 4). Additionally, a decline in catch (represented by a decrease in slope of the cumulative proportion curve), can be caused by natural fluctuations in emigrant arrival at the trap or by environmental conditions or staff shortages precluding trap operation.

The juvenile life stage of salmon and steelhead available for capture at each trap was influenced by the relative location of the trap within each subbasin and/or the times during which the traps were operated. The higher elevation traps, which include Johson Creek and Secesh River, were operable throughout summer, fall, and spring months, which allowed for the capture of natural spring/summer Chinook Salmon parr, presmolt, and smolt (respectively; Figure 3). The mid- and lower-elevation traps, represented by Lolo Creek, South Fork Clearwater River, and Imnaha River, did not operate during summer months due to elevated temperatures, and were installed later in the migration year (i.e., early October) capturing presmolts and smolts. Presmolts comprised ≥0.50 of the catch at Lolo Creek and the SF Clearwater traps, while smolts comprised about 0.55 of the catch at the Imnaha River trap. The differences in emigration timing of juvenile salmonids from natal habitat may be due to food and space limitations (Chapman 1966). Additionally, Copeland (et al., 2014) discusses mechanisms affecting early migration patterns of juvenile spring/summer Chinook Salmon, including how most juveniles born in high-elevation habitats rear in downstream areas, while individuals spawned in less harsh habitats more commonly rear in their natal reach.

Natural summer steelhead emigrant arrival timing and cumulative proportion varied among traps during MY2021 (Figure 4). Natural summer steelhead emigrant catch was insufficient at the SF Clearwater River trap to develop a cumulative proportion curve for MY2021 (Table 3). Summer/fall emigrants comprised >0.50 of natural summer steelhead captured at the Johnson Creek, Lolo Creek, and Secesh River traps; conversely, the majority (>0.70) of emigrants captured at the Imnaha River and SF Clearwater River traps occurred in the winter/spring. The Imnaha River trap was the only trap operated during winter months when other traps were inoperable because of harsh winter conditions.

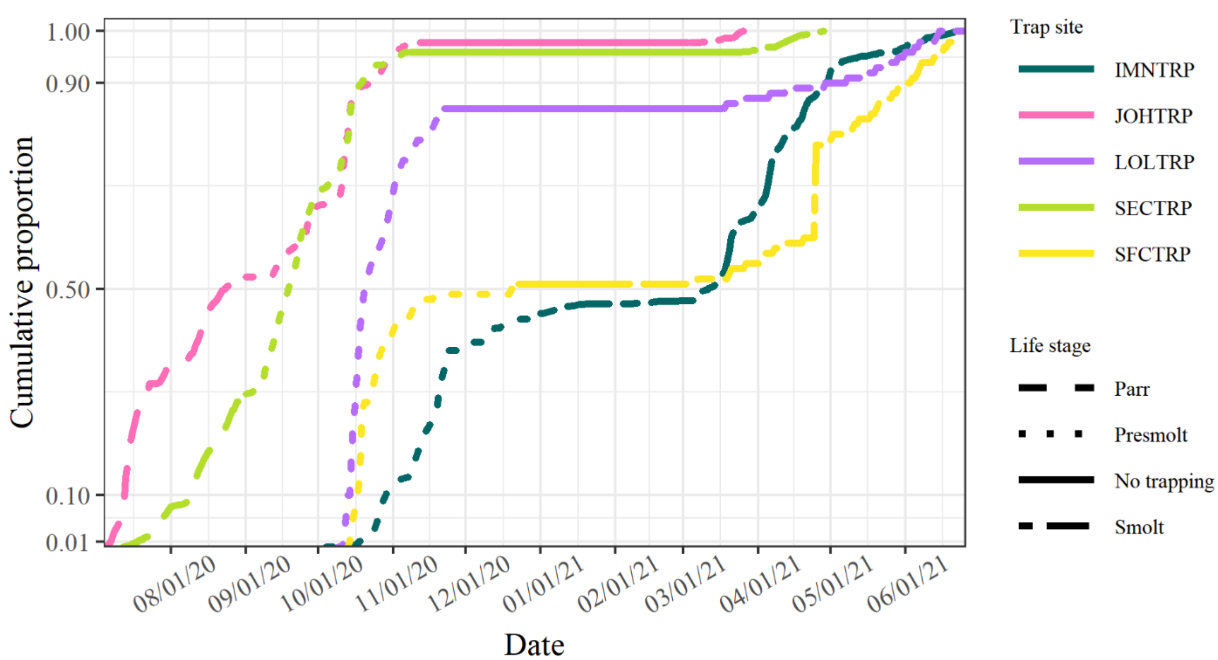

Figure 3. Cumulative proportion and arrival date at the trap site for natural spring/summer Chinook Salmon during migration year 2021. The SF Clearwater trap (SFCTRP) arrival timing data are not expanded by trap efficiency due to insufficient trap efficiency trials. Refer to acronym table for trap site names.

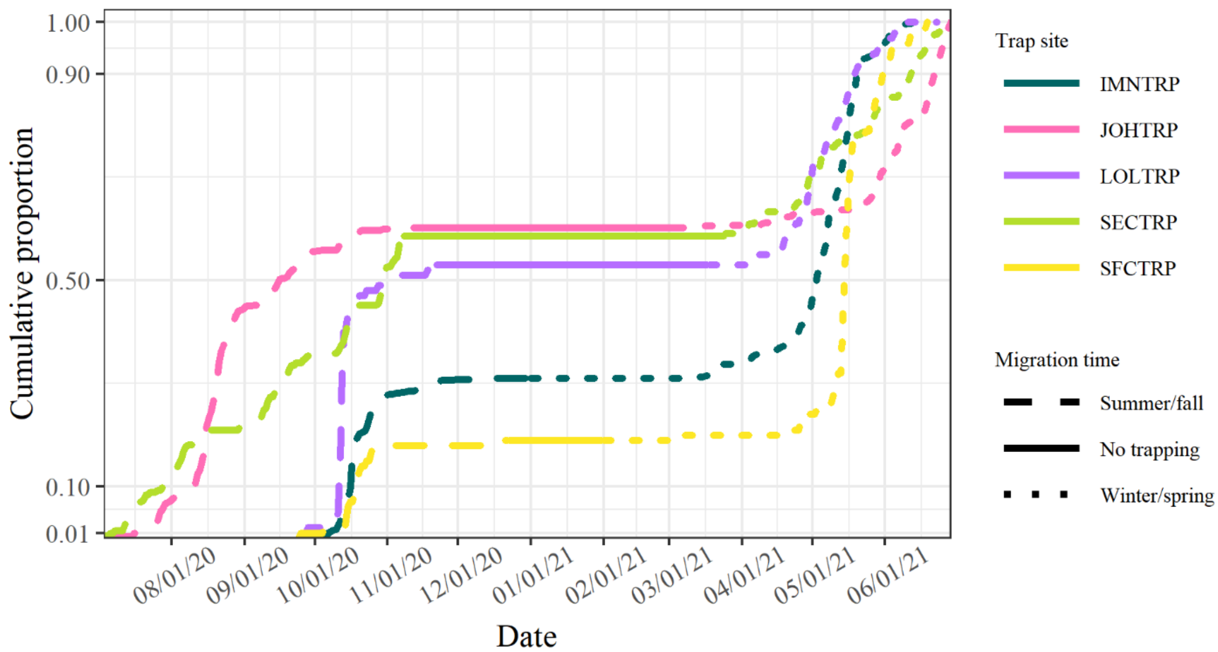

Figure 4. Cumulative proportion and arrival date at the trap site for natural summer steelhead during migration year 2021. Refer to acronym table for trap site names.

Emigration timing at Lower Granite Dam

The PIT tag antennas at LGR were fully operable starting March 1, 2021 at the juvenile bypass facilities and starting March 3, 2021 at the spillway. Spring spill began on April 3, 2021 before the majority of emigrants arrived (Figures 5–7). Natural emigrant groups tagged and released in the summer/fall generally arrived earlier and completed emigration past LGR sooner than those tagged in the winter/spring (Figures 5 and 6). Hatchery spring/summer Chinook Salmon and summer steelhead smolts arrived earlier and completed emigration past LGR sooner than natural conspecifics, with the exception of Imnaha River natural spring/summer Chinook Salmon smolts protracted emigration past LGR. Detections of natural summer steelhead smolts at LGR often included individuals tagged during past migration years because they delayed emigration one or more years post tagging. For example, during MY2021, detections at LGR included 31 Lolo Creek individuals, 17 Secesh River individuals, 14 Johnson Creek individuals, and 29 Imnaha River individuals PIT tagged in prior migration years (data excluded from Figure 6). See Appendix B for further discussion of delayed emigration of juvenile summer steelhead.

Arrival timing and cumulative proportion of fall Chinook Salmon subyearling release groups at LGR was variable and likely related to temporal and spatial differences associated with the releases (Figure 7). Arrival timing of natural fall Chinook Salmon subyearlings lagged considerably behind the hatchery release groups, possibly associated with the later emergence of natural fall Chinook Salmon in the Clearwater River and/or the advanced growth of hatchery-reared fall Chinook Salmon. The late arrival timing of the natural subyearlings occurred during the summer spill regime at LGR (June 21, 2021 – August 8, 2021); conversely, many hatchery subyearlings passed LGR during spring spill conditions.

Initiation of the juvenile transport system at LGR for juvenile emigrants started April 23, 2021. The proportion of emigrant groups passing before the initiation of collection for transportation varied (Table 9; Figures 5-7). Parr and presmolt emigrant groups generally passed LGR earlier than smolt emigrant groups, making them less available for transport (Table 9). Natural fall Chinook Salmon subyearlings began passing LGR after transportation operations commenced (Figure 7). However, emigration past LGR when transportation occurred does not guarantee an emigrant will be transported. The probability of transport depends on the route an emigrant travels through the dam (i.e., spillway, bypass, or turbine) and the collection efficiency within the bypass system.

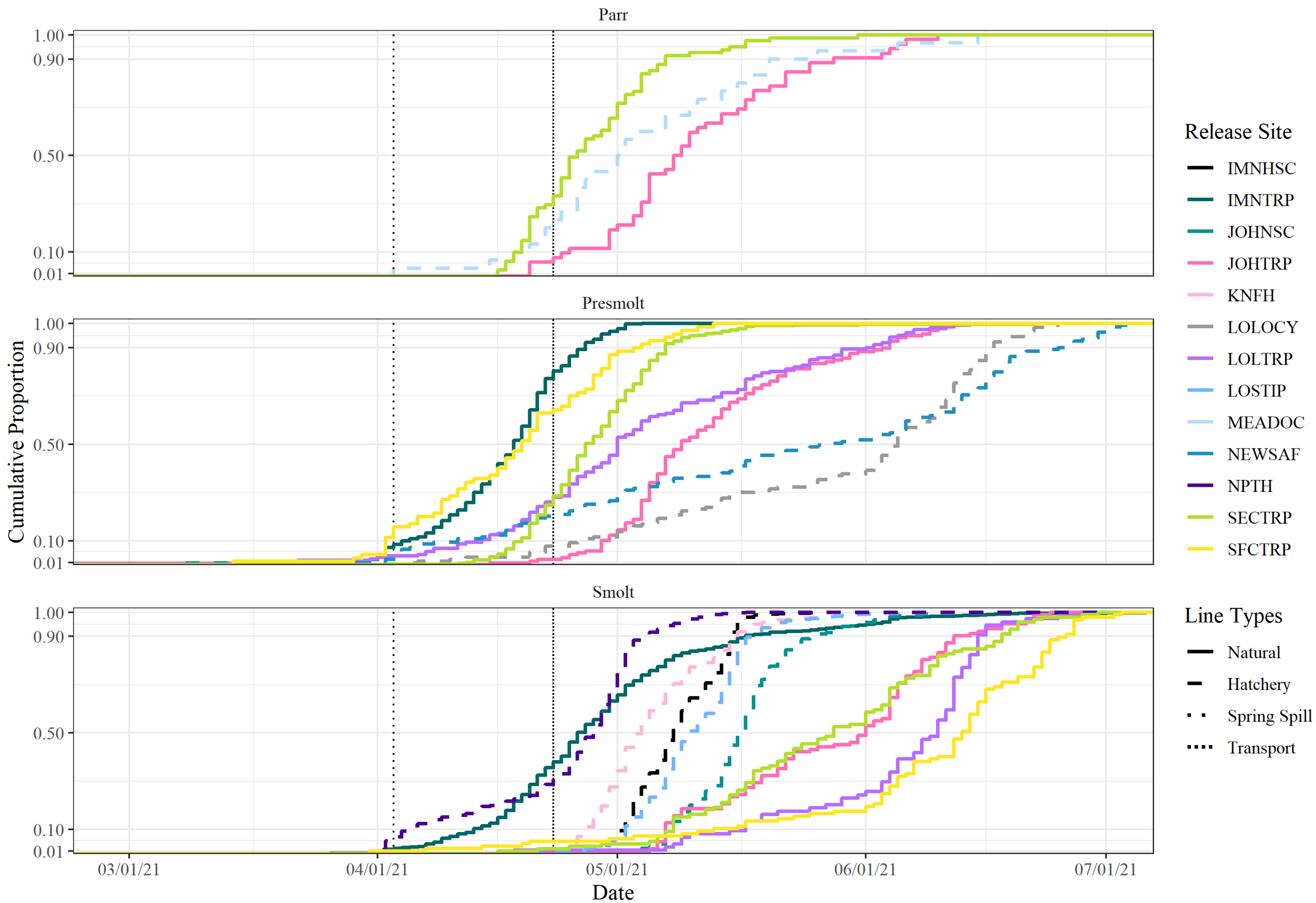

Figure 5. Cumulative proportion by arrival date at Lower Granite Dam for natural and hatchery spring/summer Chinook Salmon for each release site for migration year 2021. The sparsely dotted vertical line represents the start of spring spill and the densely dotted vertical line represents the start of transportation collections at Lower Granite Dam. Refer to acronym table for release site names.

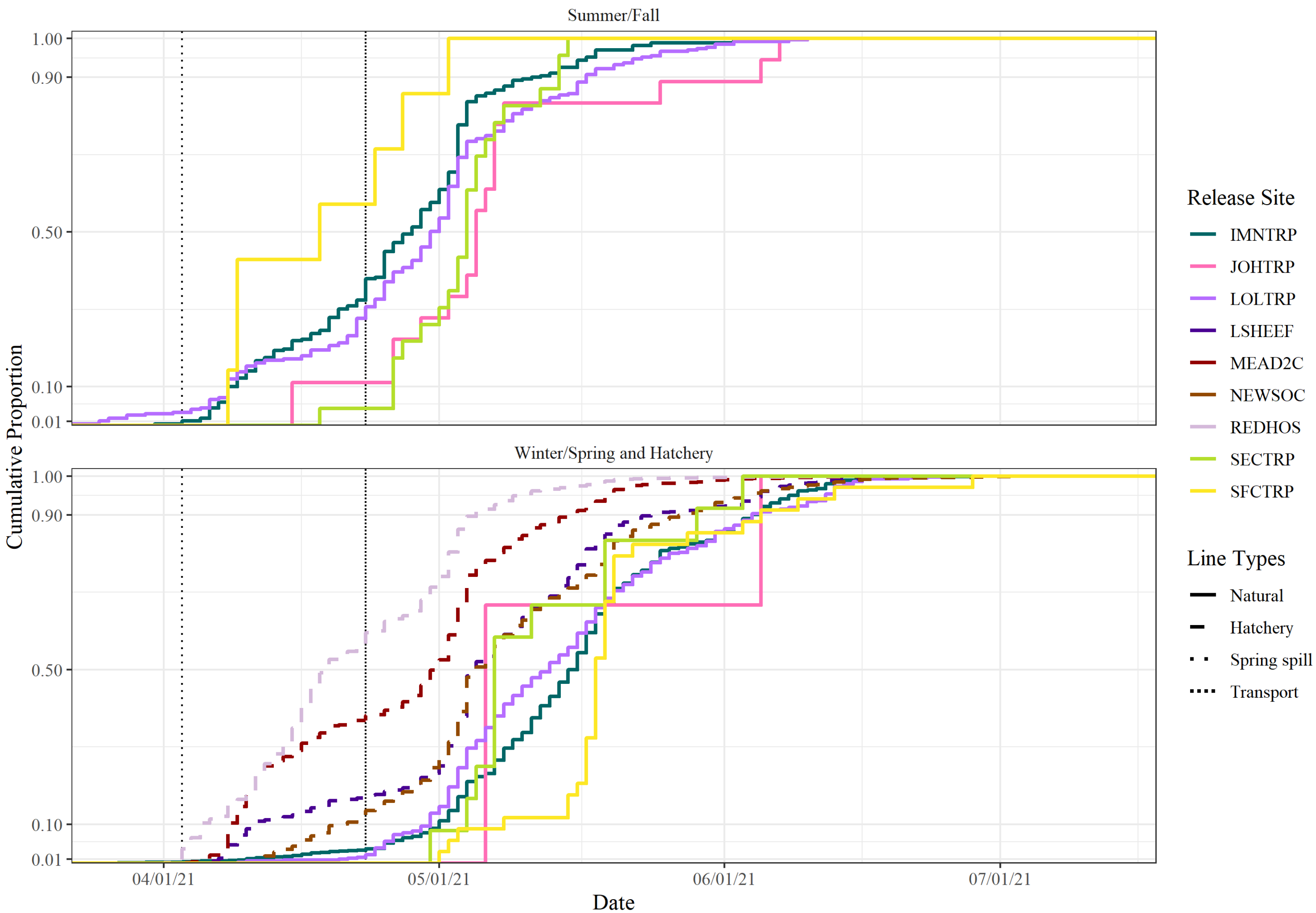

Figure 6. Cumulative proportion by arrival date at Lower Granite Dam for natural and hatchery summer steelhead for each release site for migration year 2021. The sparsely dotted vertical line represents the start of spring spill and the densely dotted vertical line represents the start of transportation collections at Lower Granite Dam. Refer to acronym table for release site names.

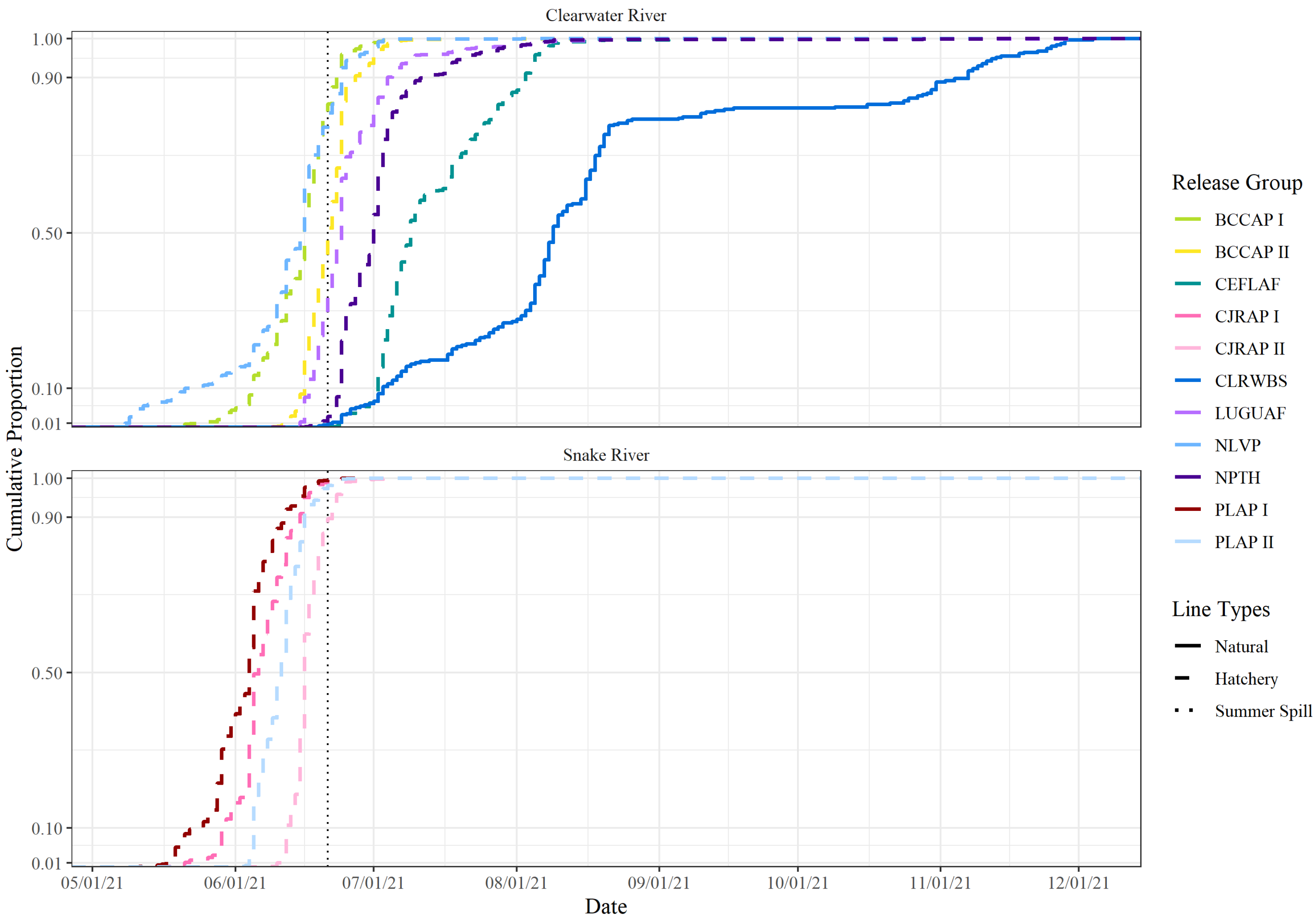

Figure 7. Cumulative proportion by arrival date at Lower Granite Dam for natural and hatchery fall Chinook Salmon for each release site for migration year 2021. The dotted vertical line represents the start of summer spill at Lower Granite Dam. Refer to acronym table for release group names.

Table 9. Proportion arrived and the number of individuals detected (in parentheses) at Lower Granite Dam before April 23, 2021 when transportation collections began for migration year 2021 spring/summer Chinook Salmon and summer steelhead emigrant groups.

	Emigrant Group								
Stream	Natural Chinook Salmon parr	Hatchery Chinook Salmon parr	Natural Chinook Salmon presmolts	Hatchery Chinook Salmon presmolts	Natural Chinook Salmon smolts	Hatchery Chinook Salmon smolts	Natural steelhead summer/fall juveniles	Natural steelhead winter/spring juveniles	Hatchery steelhead juveniles
Clear Creek	-	-	-	-	-	0.01 (9)	-	-	-
Clearwater River	-	-	-	-	-	0.29 (188)	-	-	-
Imnaha River	-	-	0.77 (332)	-	0.36 (347)	0.00 (0)	0.32 (87)	0.03 (96)	0.17 (1268)
Johnson Creek	0.06 (3)	-	0.02 (3)	-	0.00 (0)	0.00 (0)	0.11 (2)	0.00 (0)	-
Lolo Creek	-	-	0.26 (42)	0.08 (10)	0.01 (1)	-	0.28 (74)	0.01 (6)	-
Lostine River	-	-	-	-	-	<0.01 (3)	-	-	-
Meadow Creek (Selway River)	-	0.20 (6)	-	-	-	-	-	-	-
Secesh River	0.30 (24)	-	0.25 (82)	-	0.02 (2)	-	0.04 (1)	0.00 (0)	-
SF Clearwater River	-	-	0.63 (44)	0.20 (28)	0.05 (5)	-	0.57 (4)	0.00 (0)	0.39 (6047)

Travel time

Species, location of release, season of release, and/or origin appears to influence travel time between release sites and detection at LGR (Figures 8–10). Travel times for spring/summer Chinook Salmon and summer steelhead released during the summer/fall period often exceeded 120 days (Figures 8 and 9). Spring/summer Chinook Salmon presmolts over-winter below the trap site but above LGR (Raymond 1979). Spring/summer Chinook Salmon smolts and winter/spring-tagged summer steelhead often took less than 50 days to travel from the release site to LGR. In general, juvenile hatchery summer steelhead took longer to travel from the release site to LGR compared to natural conspecifics released at a trap in the same basin (Figure 9). Conversely, beach seined natural fall Chinook Salmon subyearlings from Clearwater River basin had a more protracted travel time to LGR than hatchery subyearlings released into the Clearwater River (Figure 10). Spring and summer spill regimes at LGR were intended to decrease emigrant travel time through the pool behind LGR and decrease the likelihood that an individual will travel past the dam via the powerhouse, both outcomes have been associated with increased juvenile survival in the hydrosystem (McCann et al. 2018).

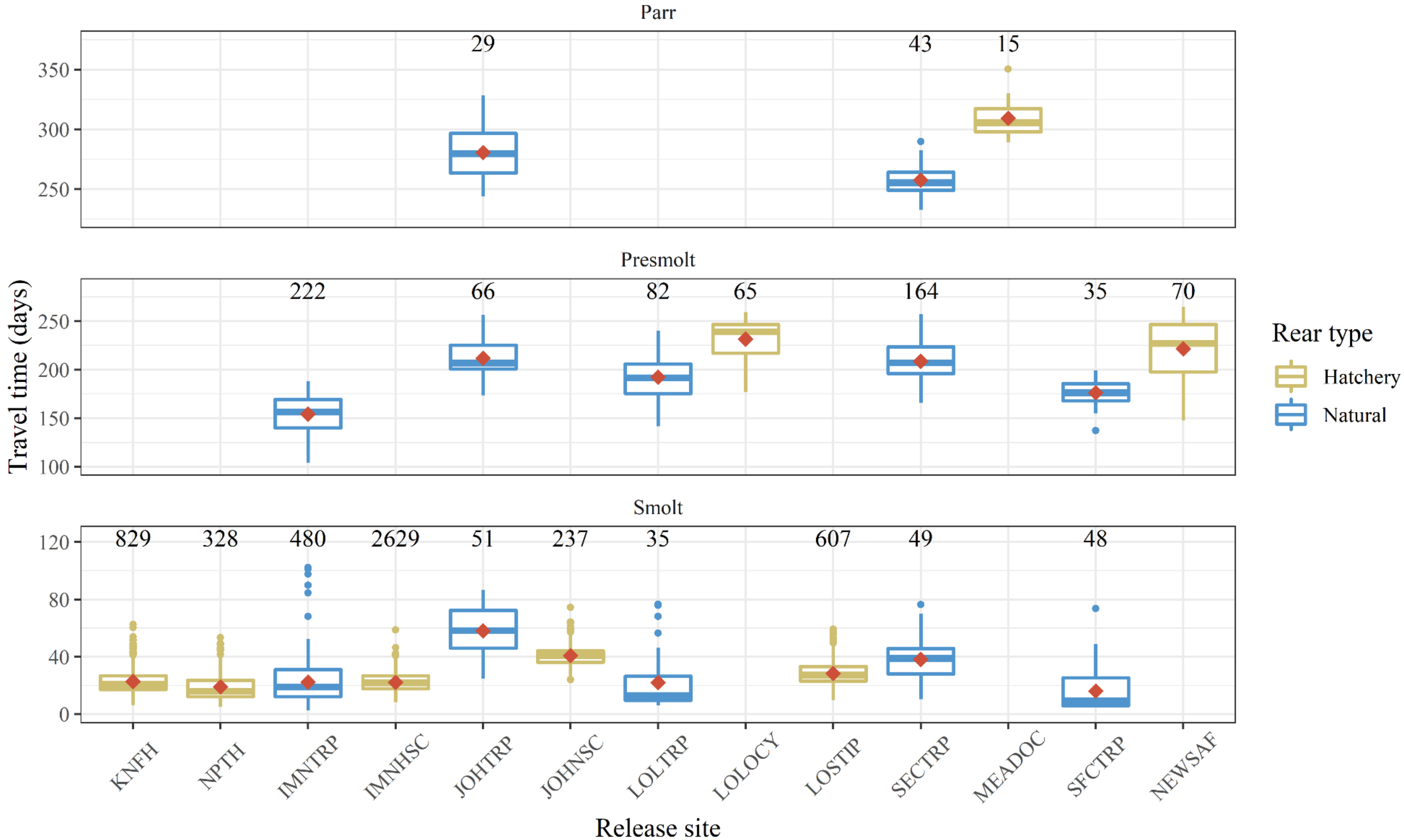

Figure 8. Travel time from release site to Lower Granite Dam for spring/summer Chinook Salmon parr, presmolts, and smolts during migration year 2021. Mean travel time (red diamond) and box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box. Refer to acronym table for release site names.

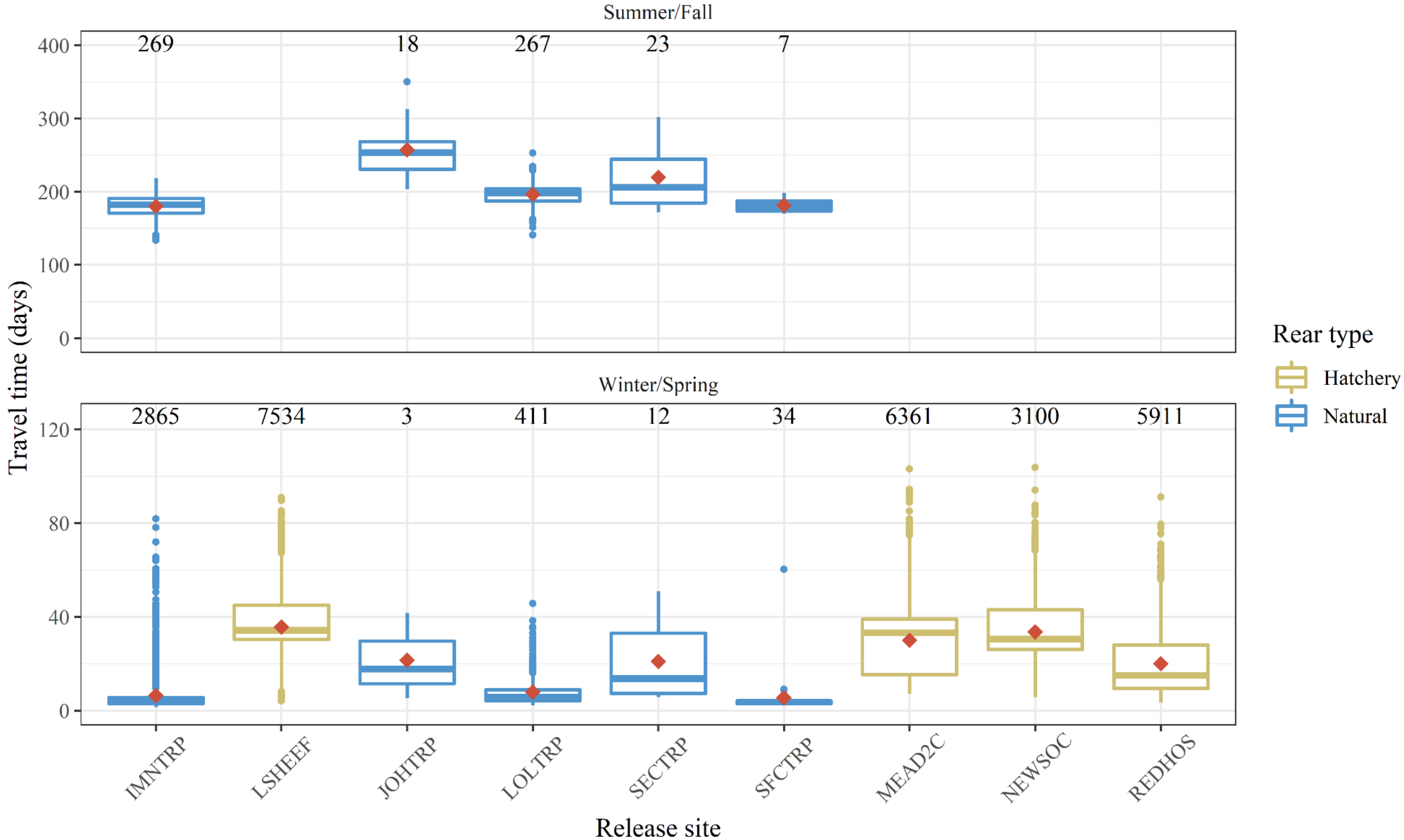

Figure 9. Travel time from release site to Lower Granite Dam for summer steelhead tagged in the summer/fall and winter/spring during migration year 2021. Mean travel time (red diamond) and box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box. Refer to acronym table for release site names.

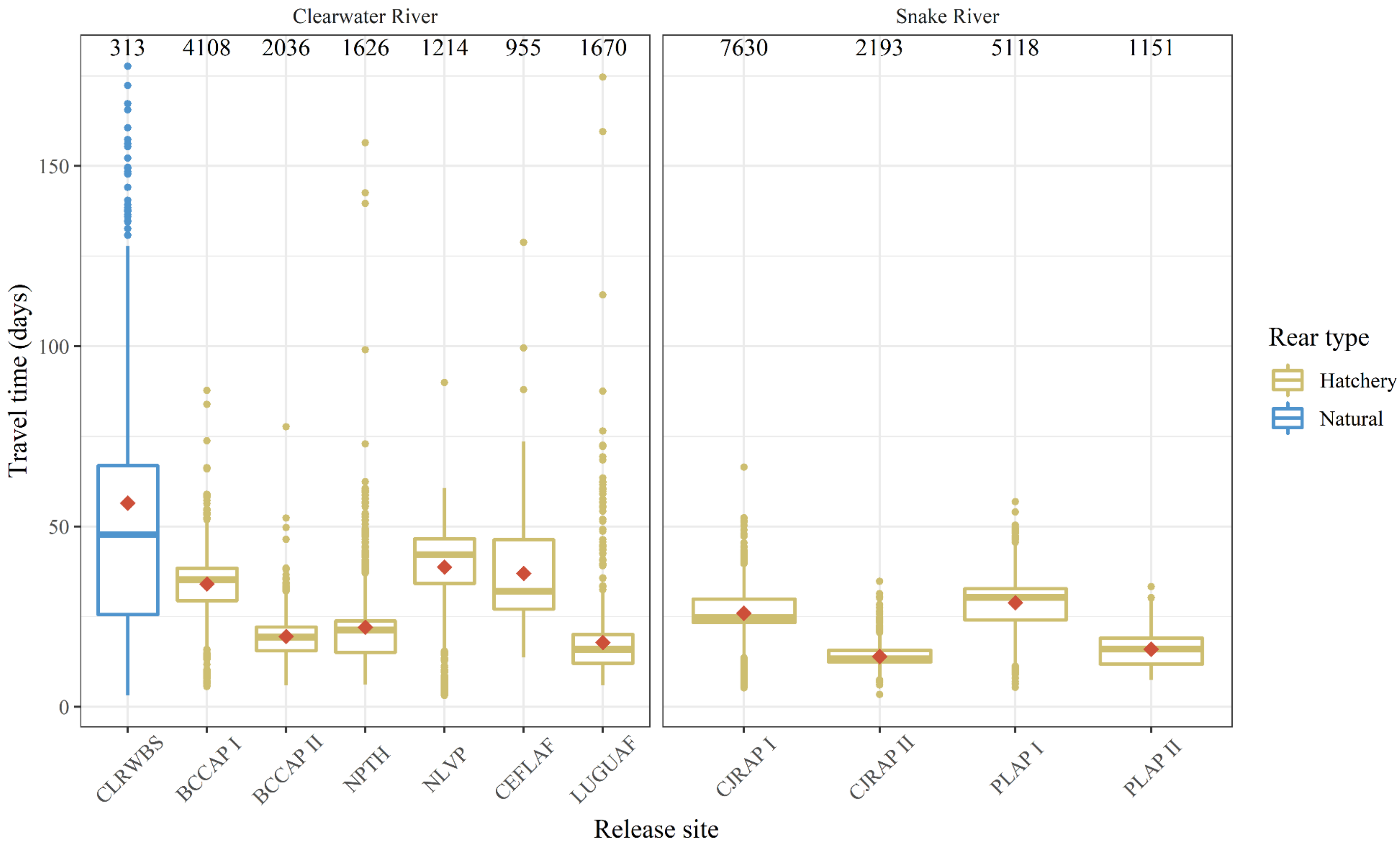

Figure 10. Travel time from release site to Lower Granite Dam for fall Chinook Salmon subyearlings during migration year 2021. Mean travel time (red diamond) and box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box. Refer to acronym table for release site names.

Survival and smolt equivalents

Apparent survival and smolt equivalents were reported for each emigrant group at a given release with a sufficient sample size of tagged and detected emigrants (used for survival estimation) and an abundance estimate or census count (used for smolt equivalents). Some release sites did not meet one or both of these criteria for survival and smolt equivalent estimates for MY2021 (Table 10). Natural summer steelhead smolt survival and smolt equivalents from the Imnaha River trap represent winter/spring emigrant estimates, and survival estimates for natural steelhead smolts at the Johnson Creek and Lolo Creek traps use emigrants captured in the winter/spring between 120 mm and 300 mm. Alternatively, natural summer steelhead smolt survival from the Secesh River trap use all fish captured during MY2021. Survival estimates for spring/summer Chinook Salmon parr and presmolts and summer steelhead juveniles tagged in the summer/fall inherently include over-winter mortality of the emigrant group and are often much lower than smolt survival. The hatchery spring/summer Chinook Salmon smolts at Lolo Creek were released as presmolts in the fall above the trap site from the Yoosa Creek Acclimation Facility. Emigrants in this group that were captured, tagged, and released at the Lolo Creek trap site the following spring were used to estimate abundance, survival, and smolt equivalents.

Table 10. Estimated survival and 95% confidence intervals (95% CI) for natural and hatchery spring/summer Chinook Salmon and summer steelhead emigrants from release site to Lower Granite Dam (LGR) and the estimated number of smolt equivalents and 95% CI arriving at LGR in migration year 2020. Refer to acronym table for release site name.

Stream and release site	Emigrant group	Survival (95% CI) to LGR	Smolt equivalents (95% CI) at LGR
Clear Creek			
KNFH	Hatchery Chinook Salmon smolts	0.80 (0.72 – 0.88)	507,702 (458,630 – 556,733)
Clearwater River			
NPTH I	Hatchery Chinook Salmon smolts[1]	0.88 (0.68 – 1.09)	156,607 (120,767 – 192,447)
NPTH II	Hatchery Chinook Salmon smolts[2]	0.78 (0.64 – 0.92)	173,641 (142,447 – 204,834)
Imnaha River			
IMNTRP	Natural Chinook Salmon presmolts	0.44 (0.38 – 0.53)	9,873 (7,452 – 12,295)
IMNTRP	Natural Chinook Salmon smolts	0.80 (0.72 – 0.89)	21,627 (17,909 – 25,434)
IMNTRP	Hatchery Chinook Salmon smolts	0.75 (0.66 – 0.86)	-
IMNHSC	Hatchery Chinook Salmon smolts	0.71 (0.67 – 0.75)	360,799 (337,260 – 384,338)
IMNTRP	Natural steelhead juveniles[4]	0.80 (0.76 – 0.85)	64,182 (52,949 – 75,416)
IMNTRP	Hatchery steelhead juveniles	0.85 (0.80 – 0.92)	-
LSHEEF	Hatchery steelhead juveniles	0.76 (0.74 – 0.78)	178,436 (173,446 – 183,426)
Johnson Creek			
JOHTRP	Natural Chinook Salmon parr	0.23 (0.19 – 0.24)	7,027 (3,118 – 10,935)
JOHTRP	Natural Chinook Salmon presmolts	0.30 (0.24 – 0.33)	6,269 (4,257 – 8,281)
JOHTRP	Natural Chinook Salmon smolts	0.49 (0.41 – 0.51)	2,965 (1,365 – 4,565)
JOHNSC	Hatchery Chinook Salmon smolts	0.55 (0.48 – 0.62)	52,553 (43,045 – 62,060)
JOHTRP	Natural steelhead juveniles[4, 6]	0.07 (0.04 – 0.11)	802 (94 – 1,509)
Lolo Creek			
LOLTRP	Natural Chinook Salmon presmolts	0.20 (0.16 – 0.24)	3,199 (2,083 – 4,315)
LOLTRP	Natural Chinook Salmon smolts	0.54 (0.40 – 0.81)	1,660 (735 – 2,585)
LOLOCY	Hatchery Chinook Salmon presmolts	0.04 (0.03 – 0.05)	5,519 (3,927 – 7,112)
LOLTRP	Natural steelhead juveniles [4, 6]	0.75 (0.65 – 0.90)	87,096 (42,269 – 131,924)
LOLTRP	Natural steelhead juveniles [5]	0.42 (0.35 – 0.50)	
Lostine River			
LOSTIP	Hatchery Chinook Salmon smolts[1]	0.49 (0.43 – 0.57)	58,037 (49,733 – 66,342)
LOSTIP	Hatchery Chinook Salmon smolts[2]	0.48 (0.42 – 0.56)	58,599 (50,378 – 66,820)
LOSTIP	Hatchery Chinook Salmon smolts[3]	0.49 (0.44 – 0.54)	-
Secesh River			
SECTRP	Natural Chinook Salmon parr	0.29 (0.26 – 0.33)	7,962 (4,261 – 11,663)
SECTRP	Natural Chinook Salmon presmolts	0.39 (0.36 – 0.42)	24,074 (18,647 – 29,501)
SECTRP	Natural Chinook Salmon smolts	0.63 (0.47 – 0.71)	3,654 (993 – 6,314)
SECTRP	Natural steelhead juveniles	0.50 (0.35 – 0.61)	-
Selway River			
MEADOC	Hatchery Chinook Salmon parr	0.02 (0.00 – 0.03)	8,977 (2,217 – 15,736)
SF Clearwater River			
SFCTRP	Natural Chinook Salmon presmolts	0.46 (0.35 – 0.65)	4,207 (2,142 – 6,272)
SFCTRP	Natural Chinook Salmon smolts	0.51 (0.39 – 0.73)	7,287 (729 – 13,844)
SFCTRP	Natural steelhead juveniles	-	-
NEWSOC	Hatchery Chinook Salmon presmolts	0.10 (0.08 – 0.12)	8,075 (6,368 – 9,782)
MEAD2C	Hatchery steelhead juveniles	0.80 (0.78 – 0.82)	431,306 (421,613 – 441,536)
NEWSOC	Hatchery steelhead juveniles	0.77 (0.74 – 0.80)	94,207 (90,513 – 98,148)
REDHOS	Hatchery steelhead juveniles[7]	0.69 (0.66 – 0.72)	441,556 (423,690 – 461,337)
REDHOS	Hatchery steelhead juveniles[8]	0.73 (0.71 – 0.76)	174,987 (168,789 – 181,662)

[1] Early release estimate.
[2] Late release estimate.
[3] Combined release estimate.
[4] Winter/spring tagged fish.
[5] Summer/fall tagged fish.
[6] Estimate for fish 120mm – 300mm fork length.
[7] Dworshak National Fish Hatchery stock.
[8] Clearwater Fish Hatchery stock.

Apparent survival estimates for natural and hatchery fall Chinook Salmon subyearlings, from release site to Lower Granite Dam, were variable for MY2021 (Table 11). Natural subyearlings tagged during beach seining activities had the lowest survival at 0.23 (0.20 – 0.28). Hatchery subyearling survival estimates from release site to Lower Granite Dam ranged from a low of 0.41 (0.37 – 0.44) from the Cedar Flats Acclimation Facility on the Selway River to a high of 0.76 (0.72 – 0.81) from the Captain John Rapids late release. However, the emigration habits of some fall Chinook Salmon subyearlings could bias estimates of survival to LGR because subyearlings have been documented overwintering in the Snake River reservoirs prior to emigration the following spring (Arnsberg and Wickard 2020).

Table 11. Estimated survival and 95% confidence intervals (95% CI) for natural and hatchery fall Chinook Salmon from beach seining and hatchery releases to Lower Granite Dam (LGR) and the estimated number of smolt equivalents and 95% CI at LGR in migration year 2021 (brood year 2020). Refer to acronym table for release group name.

Stream and release group	Emigrant group	Survival (95% CI) to LGR	Smolt equivalents (95% CI) at LGR
Clearwater River			
CLRWBS	Natural Chinook Salmon subyearlings[1]	0.23 (0.20 – 0.28)	-
BCCAP I	Hatchery Chinook Salmon subyearlings	0.62 (0.60 – 0.65)	285,355 (272,787 – 297,924)
BCCAP II	Hatchery Chinook Salmon subyearlings	0.67 (0.63 – 0.71)	134,418 (126,491 – 142,346)
NPTH	Hatchery Chinook Salmon subyearlings	0.54 (0.51 – 0.58)	421,121 (395,384 – 446,858)
Lapwai Creek			
NLVP	Hatchery Chinook Salmon subyearlings	0.55 (0.50 – 0.60)	136,978 (124,770 – 149,186)
Selway River			
CEFLAF	Hatchery Chinook Salmon subyearlings	0.41 (0.37 – 0.44)	99,858 (91,014 – 108,702)
SF Clearwater River			
LUGUAF	Hatchery Chinook Salmon subyearlings	0.60 (0.56 – 0.64)	166,989 (156,316 – 177,661)
Snake River			
CJRAP I	Hatchery Chinook Salmon subyearlings	0.63 (0.61 – 0.66)	295,354 (283,263 – 307,445)
CJRAP II	Hatchery Chinook Salmon subyearlings	0.76 (0.72 – 0.81)	153,128 (143,346 – 162,909)
PLAP I	Hatchery Chinook Salmon subyearlings	0.45 (0.43 – 0.47)	182,571 (173,565 – 191,576)
PLAP II	Hatchery Chinook Salmon subyearlings	0.48 (0.43 – 0.52)	95,105 (86,607 – 103,603)

[1] Smolt equivalents for natural fall Chinook Salmon not possible due to lack of an abundance estimate.

Size and condition

Spring/summer Chinook Salmon and summer steelhead fork length at the time of capture varied within emigrant group among release sites (Figure 11). Natural steelhead juveniles captured at the Johnson Creek trap were smaller than those captured at other screw traps; however, median Fulton's condition factor was slightly higher than other trap sites (Figure 12). The majority of natural fall Chinook Salmon subyearlings were sampled from the Clearwater River in MY21 (Figure 13). Fork length and condition of hatchery spring Chinook Salmon reared at Kooskia National Fish Hatchery and the Nez Perce Tribe Hatchery varied by emigrant group, and had different medians within emigrant groups, but there was much overlap in the range of data (Figures 14 and 15). Pre-release sampling of hatchery fall Chinook Salmon subyearlings suggest slightly smaller fork lengths for the North Lapwai Valley Acclimation Pond release group but a higher Fulton's condition factor when compared to the other release groups (Figures 16 and 17).

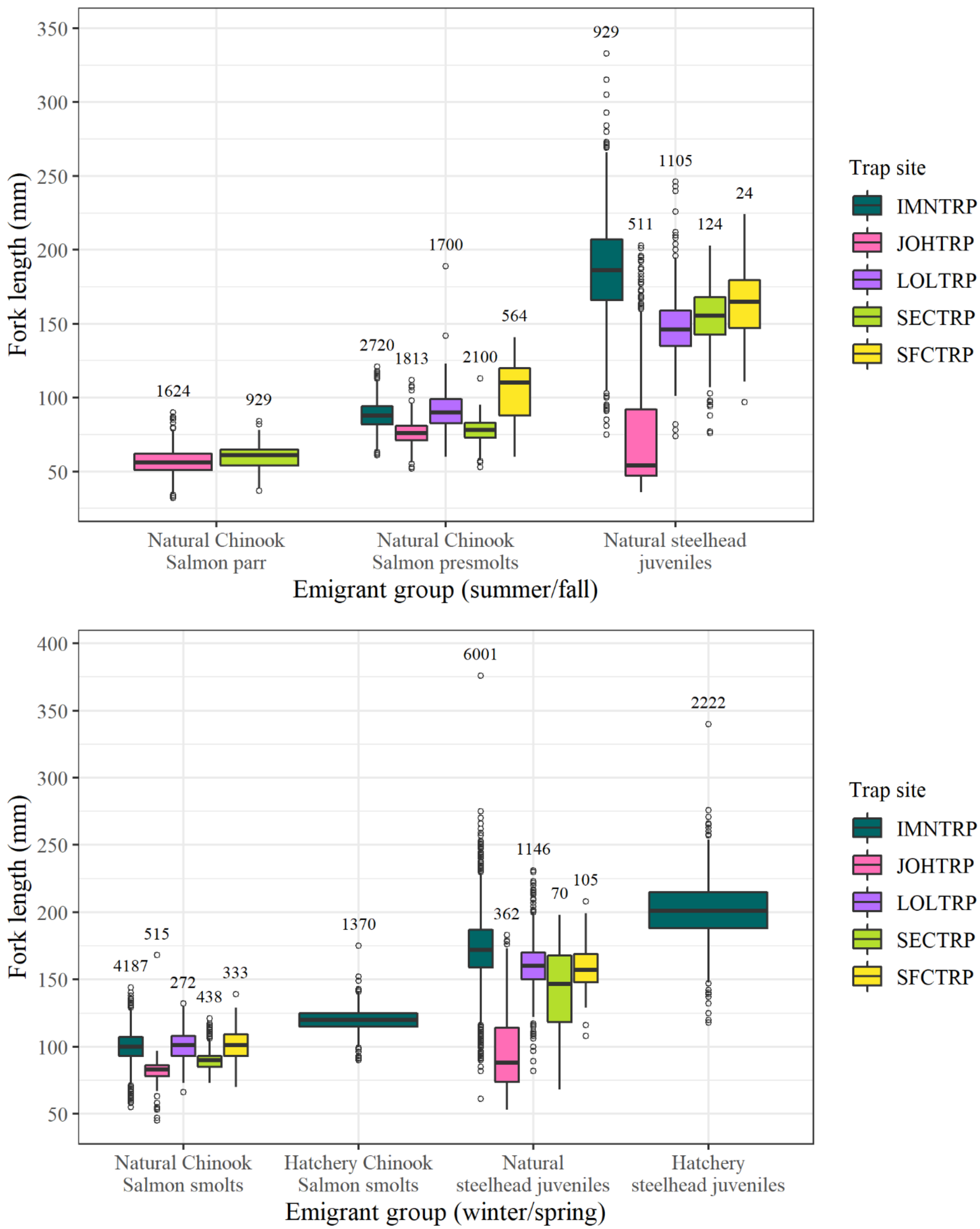

Figure 11. Fork length (mm) by emigrant group and trap site for summer/fall (top) and winter/spring (bottom) trapping seasons during migration year 2021. Box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box. Refer to acronym table for release site names.

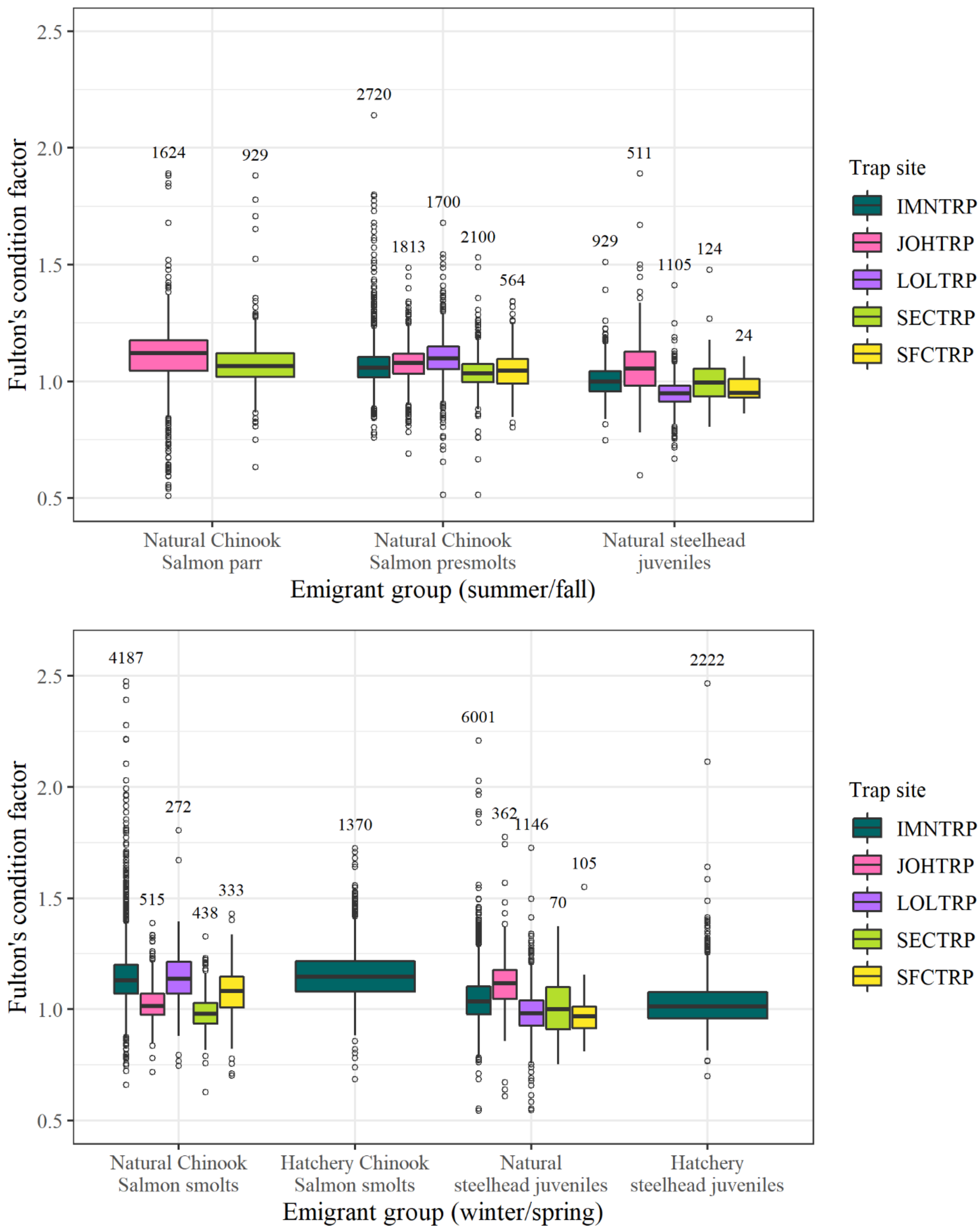

Figure 12. Fulton’s condition factor by emigrant group and trap site for summer/fall (top) and winter/spring (bottom) trapping seasons during migration year 2021. Box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box. Refer to acronym table for release site names.

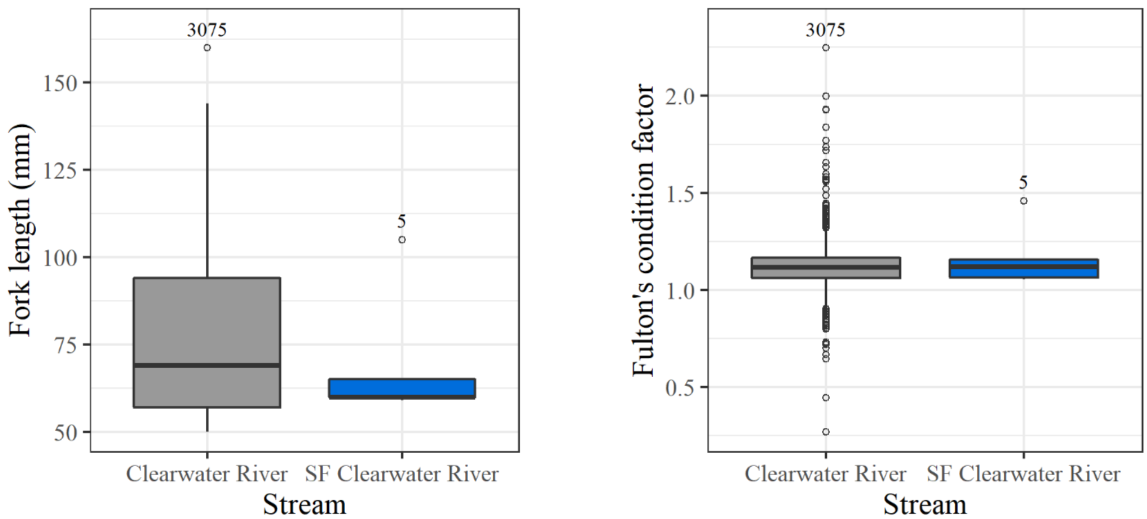

Figure 13. Fork length (mm) and Fulton's condition factor by beach seine location for natural fall Chinook Salmon subyearlings during migration year 2021. Box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box.

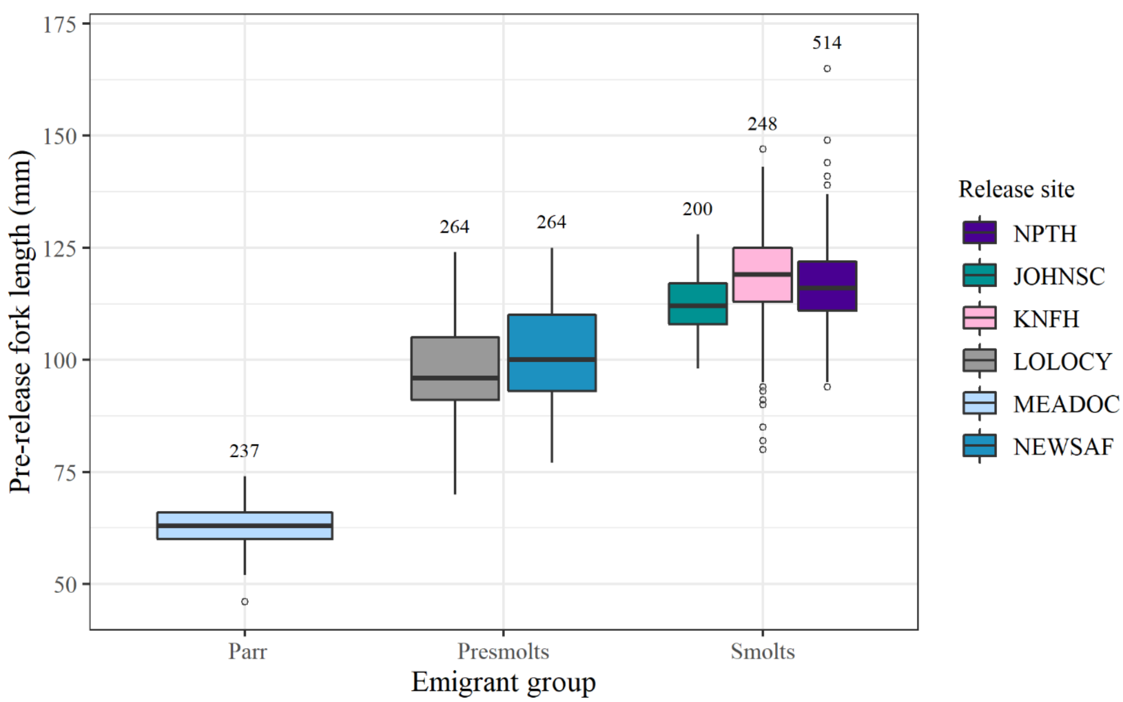

Figure 14. Pre-release fork length (mm) by release site and emigrant group for hatchery spring Chinook Salmon released during migration year 2021. Box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box. Refer to acronym table for release site names.

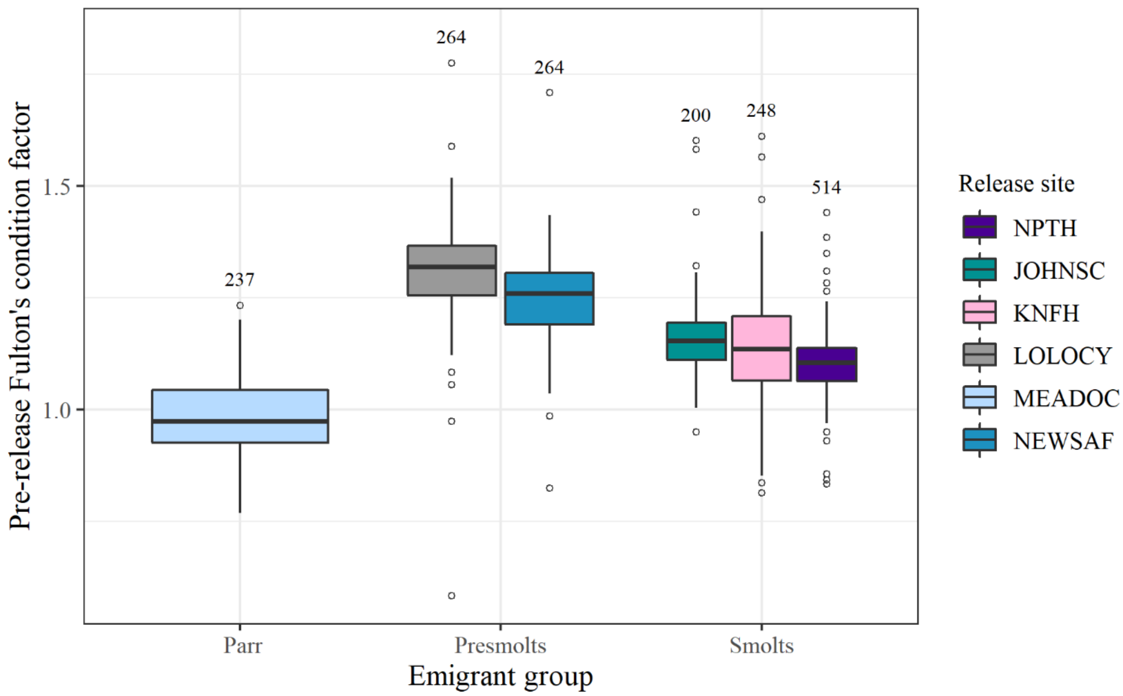

Figure 15. Pre-release Fulton’s condition factor by emigrant group and release site for hatchery spring Chinook Salmon released during migration year 2021. Box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box. Refer to acronym table for release site names.

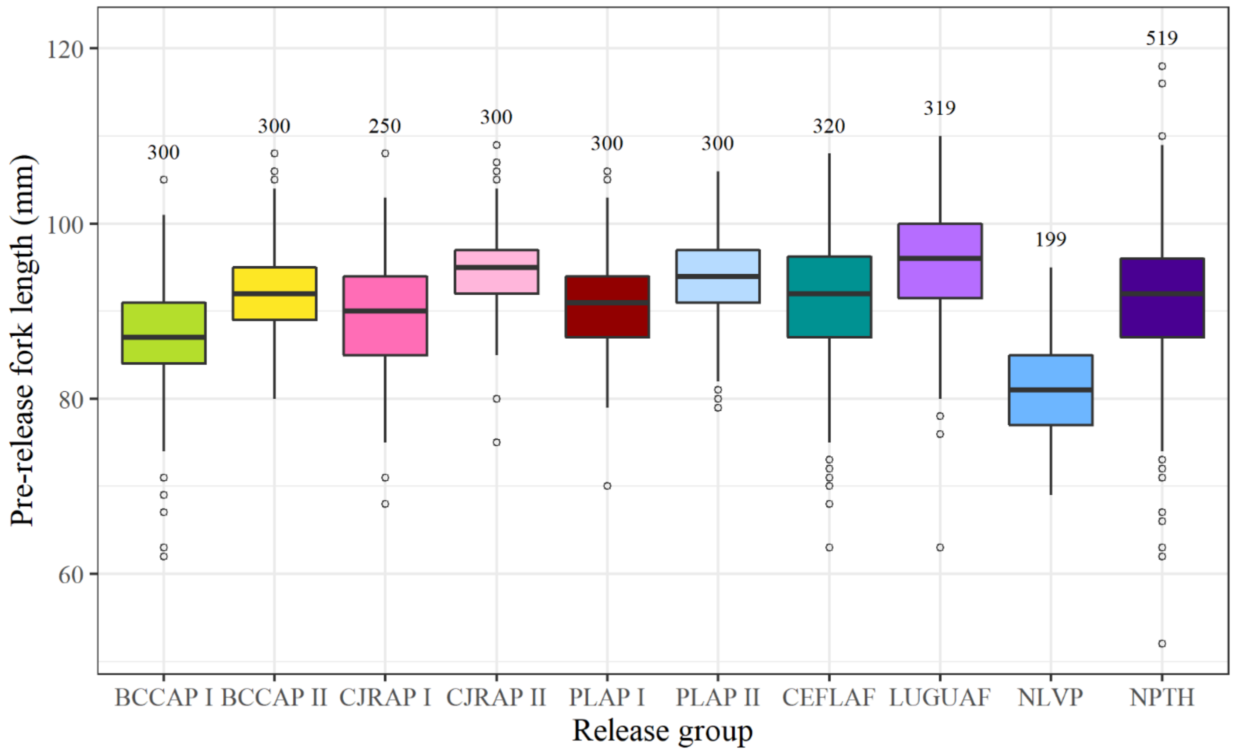

Figure 16. Pre-release fork length (mm) for hatchery fall Chinook Salmon subyearling release groups during migration year 2021. Box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box. Refer to acronym table for release site names.

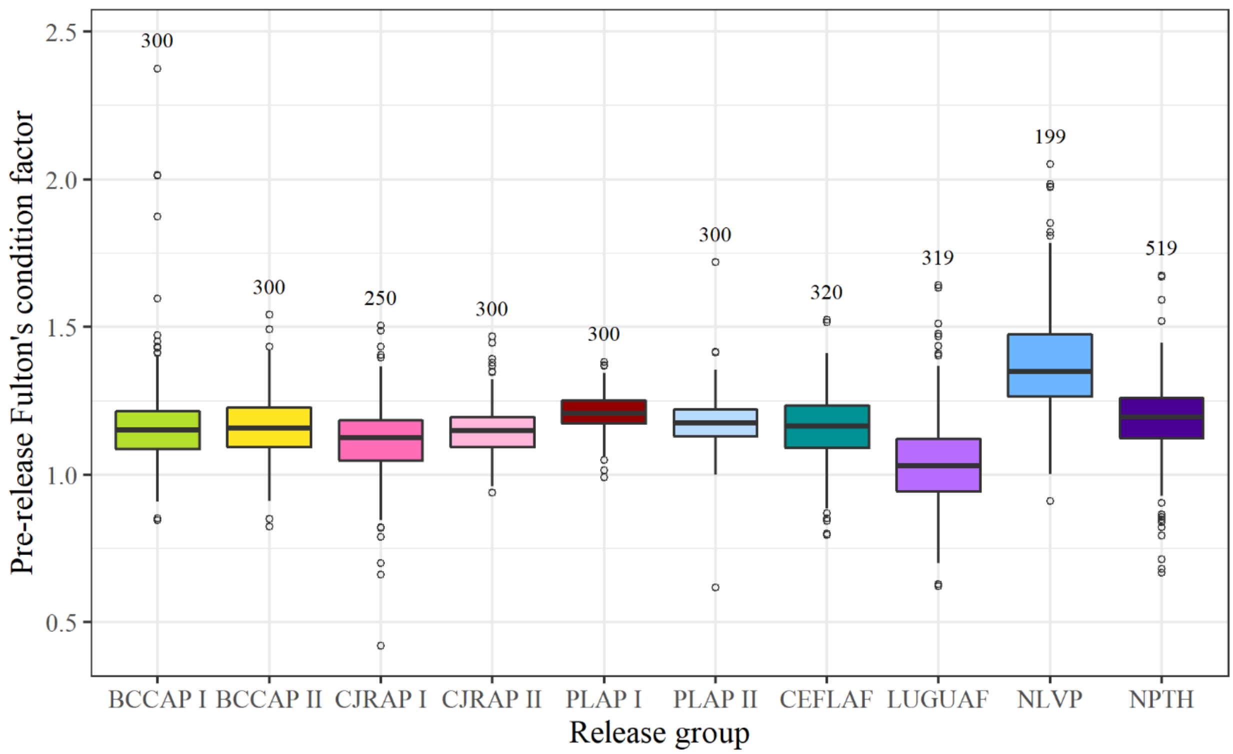

Figure 17. Pre-release Fulton's condition factor for hatchery fall Chinook Salmon subyearling release groups during migration year 2021. Box (25% quantile, median, 75% quantile) and whisker (hinge ± 1.5 * the interquartile range; and outliers represented by circles) plots by emigrant group at each release site. Sample size is above each box. Refer to acronym table for release site names.

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Appendices

Appendix A. Temperature recorder and gauging station ID and location information by trap site.

Table A-1. Temperature data source, PTAGIS (PIT Tag Information System) array ID, and location (DD; decimal degrees) by trap site.

Trap site	Temperature source	PTAGIS Array ID	Latitude (DD)	Longitude (DD)
Clearwater River	USGS Spaulding, ID	N/A	46.44833	-116.82750
Imnaha River	Onset® logger	N/A	45.76224	-116.74918
Johnson Creek	Onset® logger	N/A	44.91764	-115.48340
Lolo Creek	PIT array	LOLOC	46.29435	-115.97602
Secesh River	PIT array	ZEN	44.03338	-115.73291
SF Clearwater River	PIT array	SC1, SC2	46.12723	-115.97774

Table A-2. Gauging station location, gauge ID, and location (DD; decimal degrees) by trap site.

Trap site	Location	Gauge ID	Latitude (DD)	Longitude (DD)
Clearwater River	Spalding, ID	13342500	46.44833	-116.82750
Imnaha River	Imnaha, Oregon	13292000	45.56202	-116.83402
Johnson Creek	Yellow Pine, Idaho	13313000	44.96167	-115.50000
Lolo Creek	Greer, Idaho	13339500	46.37167	-116.16250
Secesh River	no gauge available	-	-	-
SF Clearwater River	Stites, Idaho	13338500	46.08667	-115.97556

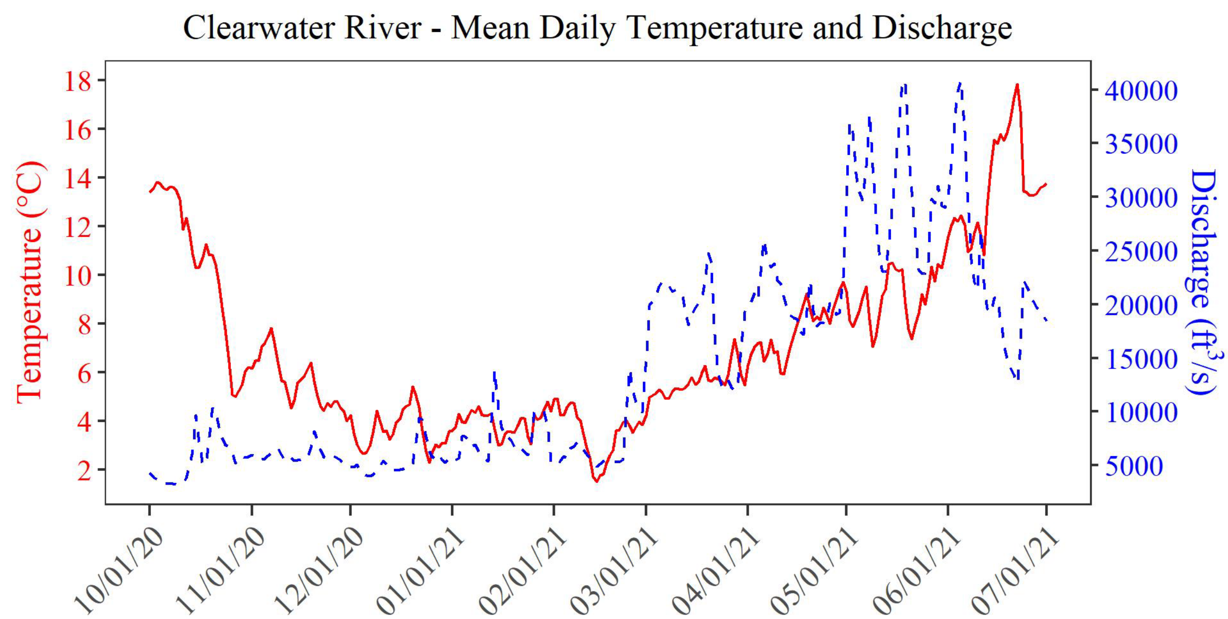

Figure A-1. Mean daily temperature (°C, red solid) and discharge (ft^3/sec, blue dash) for the Clearwater River at Spalding, ID during migration year 2021 fall Chinook Salmon beach seining operations.

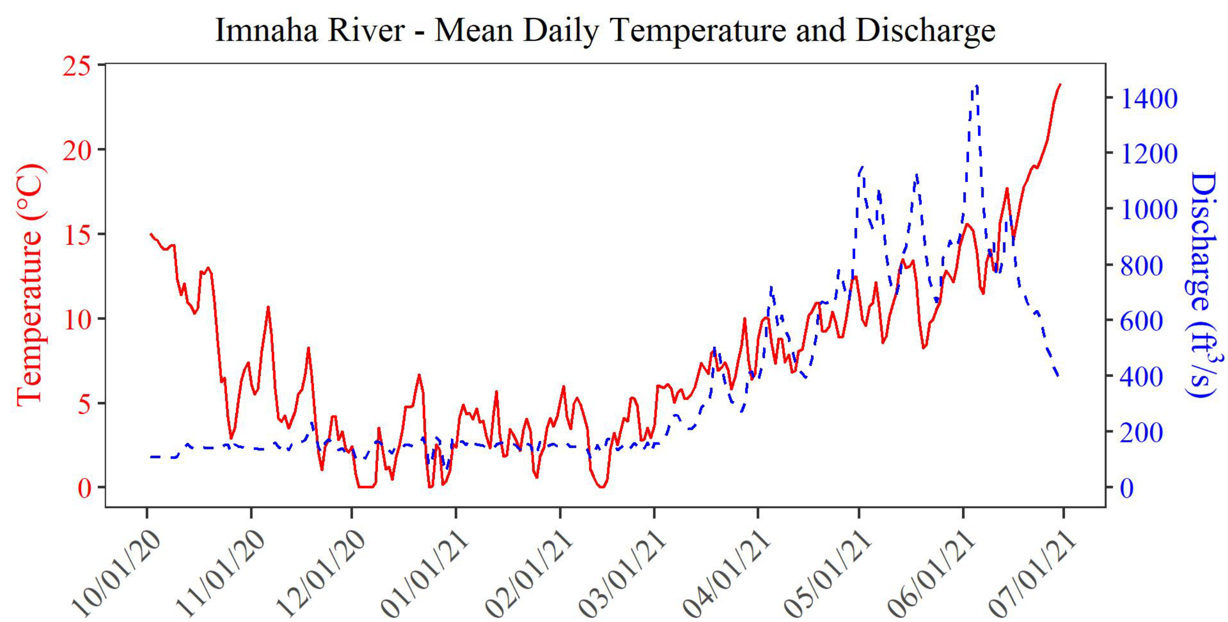

Figure A-2. Mean daily temperature (°C, red solid) and discharge (ft^3/sec, blue dash) for the Imnaha River during migration year 2021 spring/summer Chinook Salmon and steelhead rotary screw trapping.

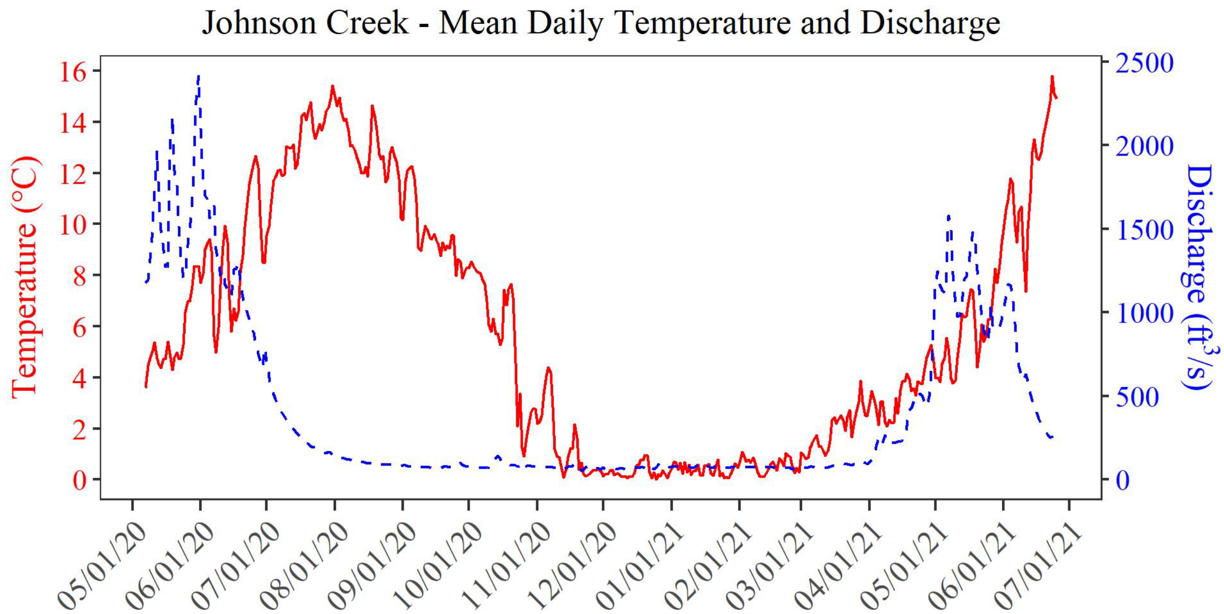

Figure A-3. Mean daily temperature (°C, red solid) and discharge (ft^3/sec, blue dash) for Johnson Creek during migration year 2021 spring/summer Chinook Salmon and steelhead rotary screw trapping.

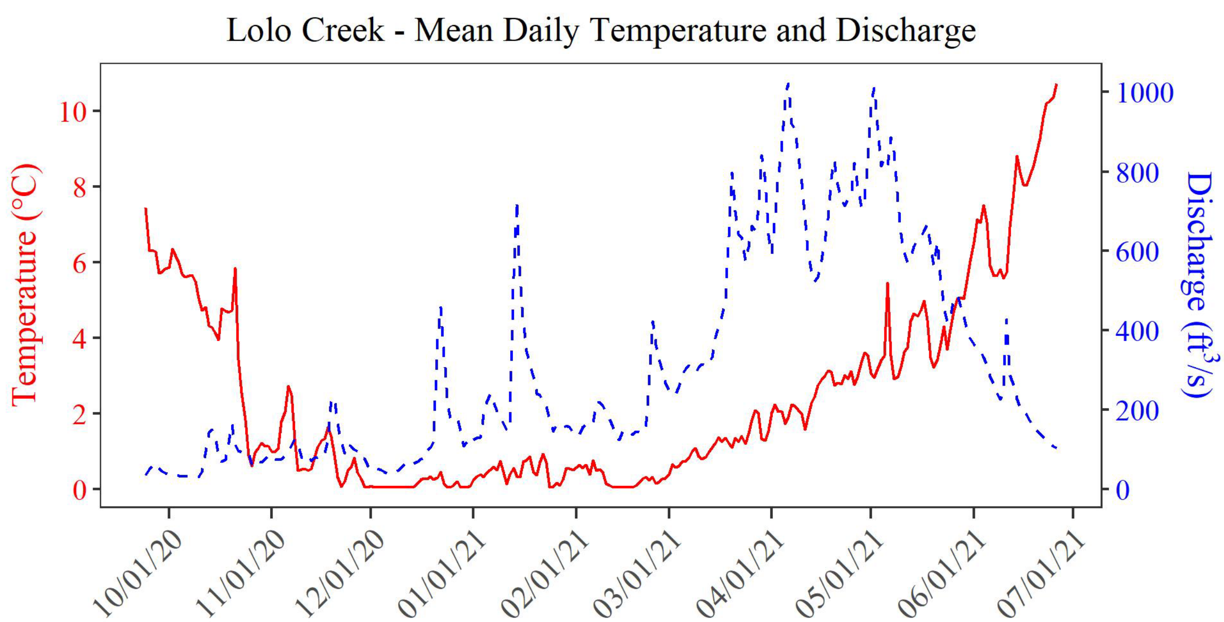

Figure A-4. Mean daily temperature (°C, red solid) and discharge (ft^3/sec, blue dash) for Lolo Creek during migration year 2021 spring/summer Chinook Salmon and steelhead rotary screw trapping.

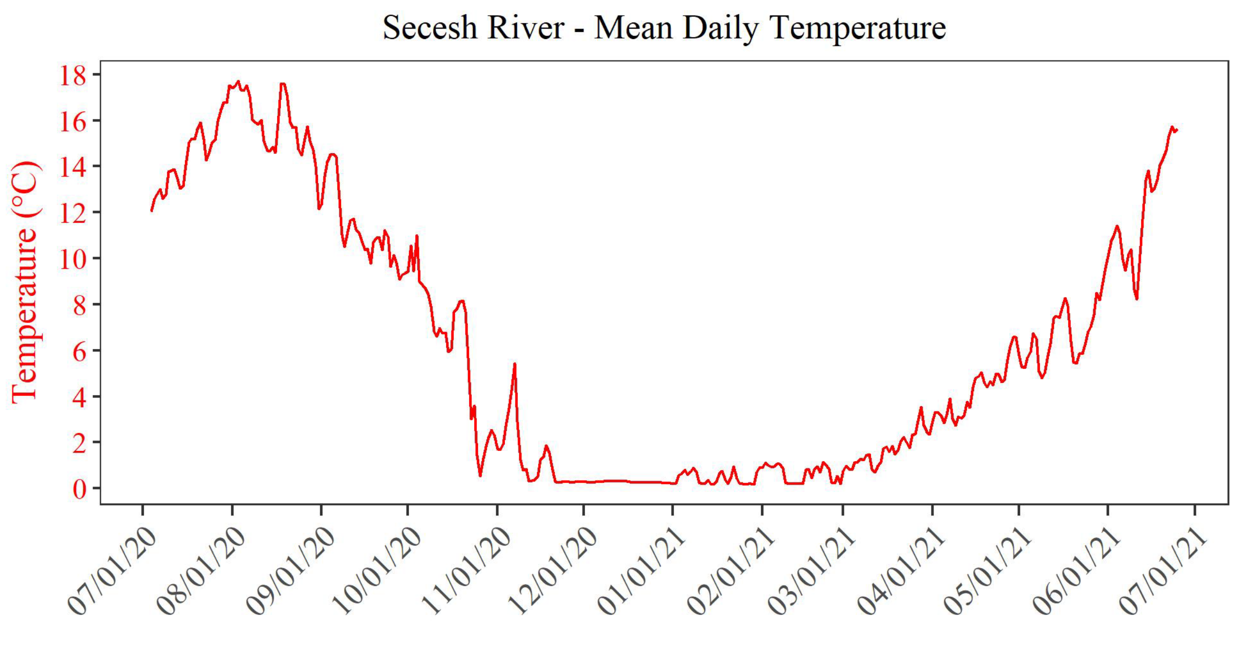

Figure A-5. Mean daily temperature (°C, red solid) for Secesh River during migration year 2021.

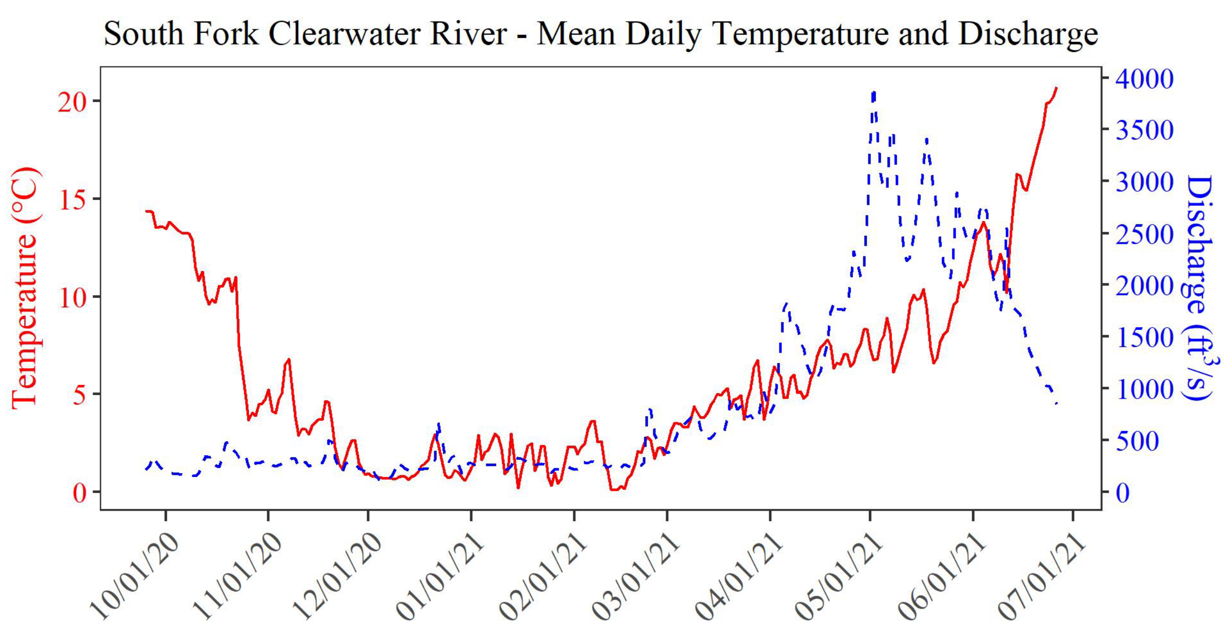

Figure A-6. Mean daily temperature (°C, red solid) and discharge (ft^3/sec, blue dash) for the South Fork Clearwater River trap site for migration year 2021.

Appendix B. Notes on juvenile summer steelhead emigration.

Introduction

During the preparation of juvenile summer steelhead survival and abundance estimates for the 2020 annual report (Tennant et al. 2021), we noticed not all steelhead tagged at Tribal rotary screw traps (hereafter referred to as trap or traps) actively emigrated to the ocean during the migration year in which they were tagged. It is well documented that steelhead have a variable and flexible freshwater life history and may spend 1 – 5 years in freshwater before downstream migration to the ocean (Scott and Crossman 1973; Quinn 2005). Additionally, juvenile steelhead captured and tagged at Fish Creek in the Clearwater River basin were younger and smaller in length and were less likely to emigrate the same migration year they were tagged compared to larger and older counterparts (Dobos et al. 2020). Therefore, delayed emigration occurring ≥1 year after tagging has the potential to bias estimates of emigrant abundance and survival if not accounted for during the estimation process. The Tribe operated traps do not currently account for delayed emigration in our estimates of steelhead emigrant abundance and survival for a migration year. Within this appendix, we continue the process of acknowledging and investigating the extent of juvenile steelhead delayed emigration at Tribal operated traps for migration years 2009 through 2020.

Methods

The Nez Perce Tribe operated emigrant traps on the Imnaha River, Johnson Creek, and the Secesh River collectively since 2009, and at Lolo Creek since 2012. In general, juvenile steelhead were PIT tagged with a 9 mm tag for fish with a fork length between ≥55 mm to < 80 mm, and a 12 mm tag for fish ≥ 80 mm. All tagged steelhead were used for estimating emigrant abundance and survival for a migration year. Exceptions to these specifications included: 1) the Imnaha River trap only tagged juvenile steelhead ≥ 80 mm in fork length that displayed smolting characteristics before 2018, and 2) Lolo Creek only estimated emigrant survival using juvenile steelhead with a fork length ≥120 mm. Scales were collected for age analysis from a subset of juvenile steelhead at the Johnson Creek, Lolo Creek, and Secesh River traps.

The Columbia Basin PIT Tag Information System (PTAGIS) database was queried for a list of juvenile steelhead PIT tagged at Tribal traps from January 1 through June 30 during the years 2009 through 2020 and detected the same migration year or a subsequent migration year at juvenile fish facilities at Lower Granite Dam or Little Goose Dam. Detections were then grouped by trap site, the migration year they were tagged, and the migration year detected at the dam(s). The mean fork length (mm) at tagging was calculated for same–year and delayed (≥1 year) emigrants by trap site. Freshwater age was determined from scales aged at the Idaho Department of Fish and Game lab in Nampa, Idaho.

Results

Detection of delayed emigrants from the Imnaha River trap represent ≤1.5% of the juvenile steelhead tagged from January 1 through June 30 (Table B-1). Juvenile steelhead detected 1+ migration year(s) after tagging comprised 13.1% – 69.2% of the Johnson Creek detections, 1.7% – 58.8% of Lolo Creek detections, and 4.2% – 70.7% of Secesh River detections for the years presented (Tables B-2– B-4). Delayed emigration occurred 1 – 3 migration years after initial tagging at the trap sites (Tables B-1– B-4). Mean fork length at the time of tagging was greater for same year emigrants than delayed emigrants at all trap sites (Figure B-1).

Scale pattern analysis ageing demonstrated that steelhead cohorts tagged and detected at the dam(s) within the same migration year comprised three to five brood years at the Lolo Creek Johnson Creek and Secesh River traps, with the majority of same year emigrants having a freshwater age between two and four years (Tennant et al. 2021). Juvenile steelhead with delayed emigration ≥1 migration years after tagging comprised two or three brood years (Tennant et al. 2021). At the time of this report, the only additional (previously unreported) scale age data were from Lolo Creek collected in 2018 and 2019, of these fish, same year migrants emigrated primarily at age-2 (80.2%; n = 77) and delayed migrants emigrated one year post-tagging at age-2, n = 5 and n = 1 in 2019 and 2020, respectively.

Discussion

Data analysis suggests that relatively few juvenile steelhead tagged at the Imnaha River trap delay emigration; conversely, the remaining NPT operated traps tag considerable numbers of juvenile steelhead that delay emigration for ≥1 migration year(s). The propensity of emigrants to delay emigration post-PIT tagging might be associated with multiple interrelated factors such as the location of capture within the respective subbasins (e.g., headwaters, lower mainstem), age of the juvenile, availability of habitat and food, or numerous other abiotic and biotic factors that influence early life-history strategy. Using our current methodology of estimating emigrant abundance and survival (see the methods in the 2021 annual report for details), delayed emigration would contribute to an overestimate of emigrant abundance, an underestimate of emigrant survival for a given migration year, and an overestimate of smolt-to-adult return. Additionally, we also use these estimates to calculate smolt equivalents at Lower Granite Dam for a migration year. The extent of bias influencing the estimate is directly related to the extent of delayed emigration associated with a trap site.

We continue to consider several changes to our methods in an effort to remedy our biased emigrant estimates. Some ideas we discussed include: 1) using a software developed by the University of Washington called Basin TribPit to estimate emigrant survival; 2) developing our own machine learning models using previously collected data to inform predictions on whether an individual will emigrate the same year as tagged or delay emigration, then using these predictions to estimate emigrant abundance and survival for the current migration year; and, 3) begin collecting scales from a subset of juvenile steelhead to better understand age-at-emigration from the Imnaha River. We are in the very early stages of vetting the previously mentioned ideas and plan to continue investigating our options and to make changes in our analyses and/or data collection where appropriate.

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Table B-1. Number of juvenile steelhead tagged at the Imnaha River trap detected the same migration year (MY) or later at juvenile facilities at Lower Granite (GRS and GRJ) or Little Goose (GOJ) dams and the percent delayed emigrants per migration year.

	Number detected per migration year														
MY Tagged	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total detected	Percent delayed emigrants
2009	2,942	2												2,944	0.1%
2010		2,253	17											2,270	0.7%
2011			1,328	4										1,332	0.3%
2012				2,896	7									2,903	0.2%
2013					3,081	7								3,088	0.2%
2014						3,727	2							3,729	0.1%
2015							1,141	6						1,147	0.5%
2016								2,315	6					2,321	0.3%
2017									1,009	5				1,014	0.5%
2018*										3,053	46			3,099	1.5%
2019											1,458	12		1,470	0.8%
2020												2,066	29	2,095	1.4%

* The Imnaha River trap started tagging all juvenile steelhead ≥65 mm in fork length in 2018.

Table B-1. Number of juvenile steelhead tagged at the Johnson Creek trap detected the same migration year (MY) or later at juvenile facilities at Lower Granite (GRS and GRJ) or Little Goose (GOJ) dams and the percent delayed emigrants per migration year.

	Number detected per migration year														
MY Tagged	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total detected	Delayed emigrants
2009	155	25	33											213	27.2%
2010		94	48	59	2									203	53.7%
2011			360	94	24	6								484	25.6%
2012				456	48	21								525	13.1%
2013					169	42	10	5						226	25.2%
2014						153	10	42	2					207	26.1%
2015							24	35	15	4				78	69.2%
2016								198	23	62	12			295	32.9%
2017									61	48	37			146	58.2%
2018										114	28	12	1	155	26.5%
2019											82	15	2	99	17.2%
2020												25	11	36	30.6%

Table B-3. Number of juvenile steelhead tagged at the Lolo Creek trap detected the same migration year (MY) or later at juvenile facilities at Lower Granite (GRS and GRJ) or Little Goose (GOJ) dams and the percent delayed emigrants per migration year.

	Number detected per migration year											
MY Tagged	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total detected	Delayed emigrants
2012	21	21	9								51	58.8%
2013		130	27	3							160	18.8%
2014			68	2							70	2.9%
2015				30	12	2					44	31.8%
2016					36	11	4				51	29.4%
2017						241	30				271	11.1%
2018							166	9			175	5.1%
2019								394	6	1	401	1.7%
2020									107	30	137	21.9%

Table B-2. Number of juvenile steelhead tagged at the Secesh River trap detected the same migration year (MY) or later at juvenile facilities at Lower Granite (GRS and GRJ) or Little Goose (GOJ) dams and the percent delayed emigrants per migration year.

	Number detected per migration year														
MY Tagged	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total detected	Delayed emigrants
2009	184	6	2											192	4.2%
2010		65	9	6	3									83	21.7%
2011			87	7	4									98	11.2%
2012				174	10	6								190	8.4%
2013					61	18	2							81	24.7%
2014						95	6	6						107	11.2%
2015							24	31	26	1				82	70.7%
2016								218	17	6	1			242	9.9%
2017									102	19	7			128	20.3%
2018										163	37	7		207	21.3%
2019											119	21	8	148	19.6%
2020												37	9	46	19.6%

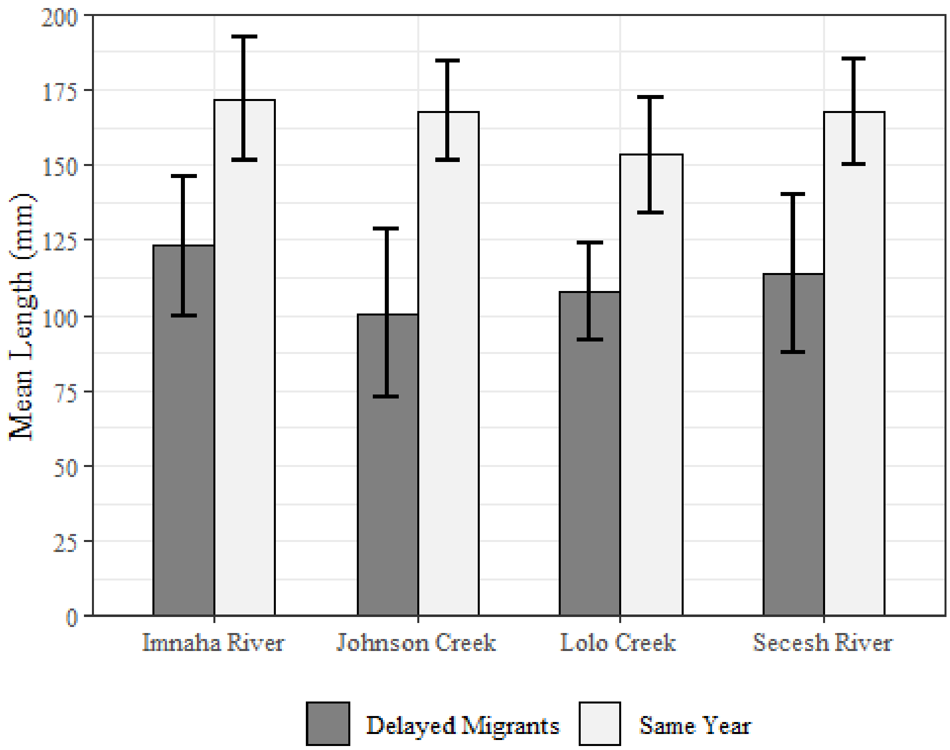

Figure B-1. Mean fork length of juvenile steelhead tagged at Nez Perce Tribe operated traps during migration years 2009 – 2020 detected the same migration year or ≥ 1 migration year later (i.e., delayed migrants) at juvenile facilities at Lower Granite or Little Goose dams. Data from Lolo Creek are from migration years 2012 – 2020.

Appendix B. Mortality of spring/summer Chinook Salmon and summer steelhead emigrants attributed to trapping, handling, tagging, predation, and dead on arrival (DOA) at the trap sites during migration year 2021.

Imnaha River screw trap

Summer/Fall 2020

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	1	0.04	0	0.00	1	0.11	0	0.00
Handling	11	0.44	0	0.00	0	0.00	0	0.00
Tagging	0	0.00	0	0.00	0	0.00	0	0.00
Predation	1	0.04	0	0.00	0	0.00	0	0.00
DOA	6	0.24	0	0.00	0	0.00	0	0.00
Total	19	0.75	0	0.00	1	0.11	0	0.00

Winter/Spring 2021

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	3	0.08	10	0.04	1	0.02	0	0.00
Handling	1	0.03	1	0.00	26	0.45	0	0.00
Tagging	2	0.05	2	0.01	1	0.02	0	0.00
Predation	0	0.00	0	0.00	0	0.00	1	<0.01
DOA	1	0.03	1	<0.01	0	0.00	0	0.00
Total	7	0.18	14	0.05	28	0.48	1	<0.01

Johnson Creek screw trap

Summer/Fall 2020

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	8	<0.01	42	<0.01	0	0.00	0	0.00
Handling	0	0.00	0	0.00	0	0.00	0	0.00
Tagging	0	0.00	0	0.00	0	0.00	0	0.00
Predation	12	<0.01	0	0.00	0	0.00	0	0.00
DOA	0	0.00	0	0.00	0	0.00	0	0.00
Total	20	<0.01	42	<0.01	0	0.00	0	0.00

Winter/Spring 2021

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	35	<0.01	0	0.00	0	0.00	0	0.00
Handling	0	0.00	0	0.00	0	0.00	0	0.00
Tagging	0	0.00	0	0.00	0	0.00	0	0.00
Predation	0	0.00	0	0.00	0	0.00	0	0.00
DOA	0	0.00	0	0.00	0	0.00	0	0.00
Total	35	<0.01	0	0.00	0	0.00	0	0.00

Lolo Creek screw trap

Summer/Fall 2020

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	57	3.32	0	0.00	11	0.85	0	0.00
Handling	0	0.00	0	0.00	0	0.00	0	0.00
Tagging	0	0.00	0	0.00	2	0.15	0	0.00
Predation	0	0.00	0	0.00	0	0.00	0	0.00
DOA	0	0.00	0	0.00	0	0.00	0	0.00
Total	57	3.32	0	0.00	13	1.01	0	0.00

Winter/Spring 2021

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	1	0.35	0	0.00	2	0.00	0	0.00
Handling	0	0.00	0	0.00	0	0.00	0	0.00
Tagging	0	0.00	0	0.00	0	0.00	0	0.00
Predation	0	0.00	0	0.00	0	0.00	0	0.00
DOA	0	0.00	0	0.00	0	0.00	0	0.00
Total	1	0.35	0	0.00	2	0.00	0	0.00

Secesh River screw trap

Summer/Fall 2019

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	2	<0.01	0	0.00	0	0.00	0	0.00
Handling	3	<0.01	0	0.00	0	0.00	0	0.00
Tagging	0	0.00	0	0.00	0	0.00	0	0.00
Predation	0	0.00	0	0.00	0	0.00	0	0.00
DOA	0	0.00	0	0.00	0	0.00	0	0.00
Total	5	<0.01	0	0.00	0	0.00	0	0.00

Winter/Spring 2020

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	0	0.00	0	0.00	0	0.00	0	0.00
Handling	0	0.00	0	0.00	0	0.00	0	0.00
Tagging	0	0.00	0	0.00	0	0.00	0	0.00
Predation	0	0.00	0	0.00	0	0.00	0	0.00
DOA	0	0.00	0	0.00	0	0.00	0	0.00
Total	0	0.00	0	0.00	0	0.00	0	0.00

South Fork Clearwater River screw trap

Summer/Fall 2020

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	0	0.00	0	0.00	0	0.00	0	0.00
Handling	0	0.00	0	0.00	0	0.00	0	0.00
Tagging	0	0.00	0	0.00	0	0.00	0	0.00
Predation	0	0.00	0	0.00	0	0.00	0	0.00
DOA	0	0.00	0	0.00	0	0.00	0	0.00
Total	0	0.00	0	0.00	0	0.00	0	0.00

Winter/Spring 2021

	Chinook Salmon				Steelhead			
	Natural		Hatchery		Natural		Hatchery	
Source of mortality	N	% trapped	N	% trapped	N	% trapped	N	% trapped
Trapping	5	1.53	0	0.00	2	0.17	0	0.00
Handling	0	0.00	0	0.00	0	0.00	0	0.00
Tagging	0	0.00	0	0.00	0	0.00	0	0.00
Predation	0	0.00	0	0.00	0	0.00	0	0.00
DOA	0	0.00	0	0.00	0	0.00	0	0.00
Total	5	1.53	0	0.00	2	0.17	0	0.00