NOAA Contract Report NMFS-NWFSC-CR-2026-04

https://doi.org/10.25923/vjd7-4b57

Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles:
Survival and Timing, 2025

Project **1991-028-00**, Contract **83639 REL 68**
covering the period from **January 2024** to **December 2025**

March 2026

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northwest Fisheries Science Center

NOAA Contract Report Series NMFS-NWFSC-CR

Recommended citation:

(Lamb et al. 2026)[1]

[1] Lamb, J. J., B. P. Sandford, S. G. Smith, L. W. Stearman, R. M. Gleason, and A. L. Barenberg. 2026. Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles: Survival and Timing, 2025. U.S. Department of Commerce, NOAA Contract Report NMFS-NWFSC-CR-2026-04.

https://doi.org/10.25923/vjd7-4b57

Monitoring the Migrations of Wild Snake River Spring/Summer Chinook Salmon Juveniles: Survival and Timing, 2025

Jesse J. Lamb, Benjamin P. Sandford, Steven G. Smith, Loren W. Stearman, Ross M. Gleason, and Amber L. Barenberg

https://doi.org/10.25923/vjd7-4b57

Click author name for ORCID.

March 2026

Fish Ecology Division
Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, Washington 98112
https://ror.org/05r7z1k40

"This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the authors' and do not necessarily represent the views of BPA."

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Executive Summary

From late summer 2024 to mid-2025, we continued a multiyear research project to monitor the migration behavior and survival of wild juvenile spring/summer Chinook salmon *Oncorhynchus tshawytscha* in the Snake River Basin of Idaho. Wild parr were collected in natal tributaries, implanted with passive integrated transponder (PIT) tags, and released near their respective collection sites. In this report, we present data and analyses from detections of fish tagged in summer 2024 and monitored through spring 2025. Comprehensive detail on fish collection and tagging is described in our report of December 2024, *Monitoring the migrations of wild Snake River spring/summer Chinook salmon juveniles: Fish collection and tagging, 2024*.

Our analyses included estimates of survival from release to instream monitoring systems and from monitoring systems to Lower Granite Dam (LGD). These estimates are summarized in Table 1. For both stream populations sampled, we estimated detection and survival estimates from release to LGD as well as median date of arrival at the dam. We also recorded growth rate and fish condition factor for recaptured subsamples of these fish. Results from all work in 2024-2025 are summarized below:

- During July 2024, we PIT-tagged 3,000 wild Chinook salmon parr and released them back into the two sample locations from which they were collected (Marsh Creek and South Fork Salmon River).

- For fish from all streams combined, the average estimated rate of parr-to-smolt survival to LGD was 18.1% (range 13.4-20.3%).

- For tagged parr from the two populations combined, peak passage dates using expanded detections occurred during two periods of similarly high detection from 17 to 19 April and again from 2 to 4 May 2025. Respective dates of the 10th, 50th, and 90th passage percentiles at the dam were 11 April, 29 April, and 17 May 2025.

- During 2025, we recaptured seven study fish using the separation-by-code system at LGD. Recaptures included five fish from the South Fork Salmon River and two fish from Marsh Creek. For the recaptured fish, average growth was 31 mm in length and 6.0 g in weight over an average period of 248 d.

- We found no significant difference relating to fish size (FL at tagging) between those detected at LGD during April versus those detected later in May/June (P = 0.0228). Similarly, we found no significant difference between the size of fish detected in the juvenile bypass system compared to those detected passing the spillway (P = 0.9505). We did find that fish with larger average fork length at release were significantly more likely to be detected the following spring at LGD (68.5 v 67.1mm; P = 0.0070).

Table 1. Numbers and proportions of PIT-tagged wild spring/summer Chinook salmon released during 2024 and detected during 2024-2025 with associated estimates of survival to monitoring systems and to Lower Granite Dam. Results shown are for three tagging cohorts which migrated past instream PIT-tag monitoring systems.

		Instream monitoring systems							Estimated survival (%)		
		Detected		Detection period (%)						To Lower Granite Dam	
Study Site/Monitor	Released (n)	(n)	(%)	Late summer/ fall	Winter	Spring	Detection efficiency (%)	SE	To instream monitor	From instream monitor	From release site
S Fork Salmon R	1,500										
Krassel Creek	---	270	18.0	38.5	56.7	4.8	47.4	5.7	38.0	37.3	14.2
South Fork Guard Station	---	62	4.1	82.2	9.7	8.1	10.5	3.5	39.3	33.4	14.2
Marsh Creek	1,500	818	54.5	70.4	21.3	8.3	98.0	1.4	55.7	40.5	22.1

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 a 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 natural-origin abundance for most populations in the Snake River spring/summer Chinook salmon ESU have 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. Tagging studies began in the mid-1950s, and initially researchers relied on data from methods that could only provide limited information on fish passage (i.e., 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 to approximately 2 million fish tagged annually within the Federal Columbia River Power System (FCRPS). These tagging efforts, along with automated data collection methods, have provided mass quantities of data for a broad mixture of salmonid and non-salmonid species.

Implemented in 1991, the Columbia Basin PIT Tag Information System (PTAGIS) was established as a shared repository for these data (PSMFC 1996). In addition to being the primary repository for regional PIT tag data, PTAGIS develops tagging software so that contributors can collect quality PIT tag data. High quality data and real time accessibility are crucial to the research and management within the FCRPS.

Data from PIT tag detections continue to provide insight for decisions on programs to enhance juvenile passage at dams, such as spill and transportation. There is an ongoing need for recent data upon which to base decisions for these and other restoration and recovery efforts. Our research directly addresses data gaps surrounding life history patterns and survival 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, there is a need to investigate factors that contribute to the sub-yearling 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 wild Chinook salmon monitored from fall 2024 to spring and early summer 2025 as they moved downstream and began migration towards the Pacific Ocean. Estimates of survival and timing to LGD are reported, as well as interrogation data at several other sites throughout the Snake and Columbia River hydropower system. Results from previous study years were reported by Achord et al. (1994, 1995a,b, 1996a, 1997, 1998, 2000, 2001a,b, 2002-2012; Lamb et al. 2013-2019a,b, 2021-2024). 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 provides 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 of 1973 (NMFS 2008).

During 2024-25, we recorded water temperature and depth measured at 6 locations in the Salmon River Basin, Idaho, for the *Baseline Environmental Monitoring Program*. These environmental data can be compared with parr/smolt migration, survival, and timing data to discern patterns or characteristic relationships that may exist. Understanding these relationships will provide additional insight for recovery planning of threatened salmon populations.

Fish Collection, Tagging, and Release

This section provides a brief summary of tagging and collection effort in summer 2024. Complete details of this work are reported by Lamb et al. (2024). Briefly, National Marine Fisheries Service (NMFS) personnel tagged fish in two Idaho streams (Figure 1; Table 2). Fish collection followed the safe handling methods developed for this study by Matthews et al. (1990, 1997). Anesthetized fish were randomly selected for tagging, provided they met the minimum fork length (FL) requirement of 55-mm.

In 2024, fish were tagged using 9-mm & 12-mm advanced performance PIT tags (HPT9 & ATP12, 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 disease transmission during the tagging process. After recovery from the anesthetic, 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.

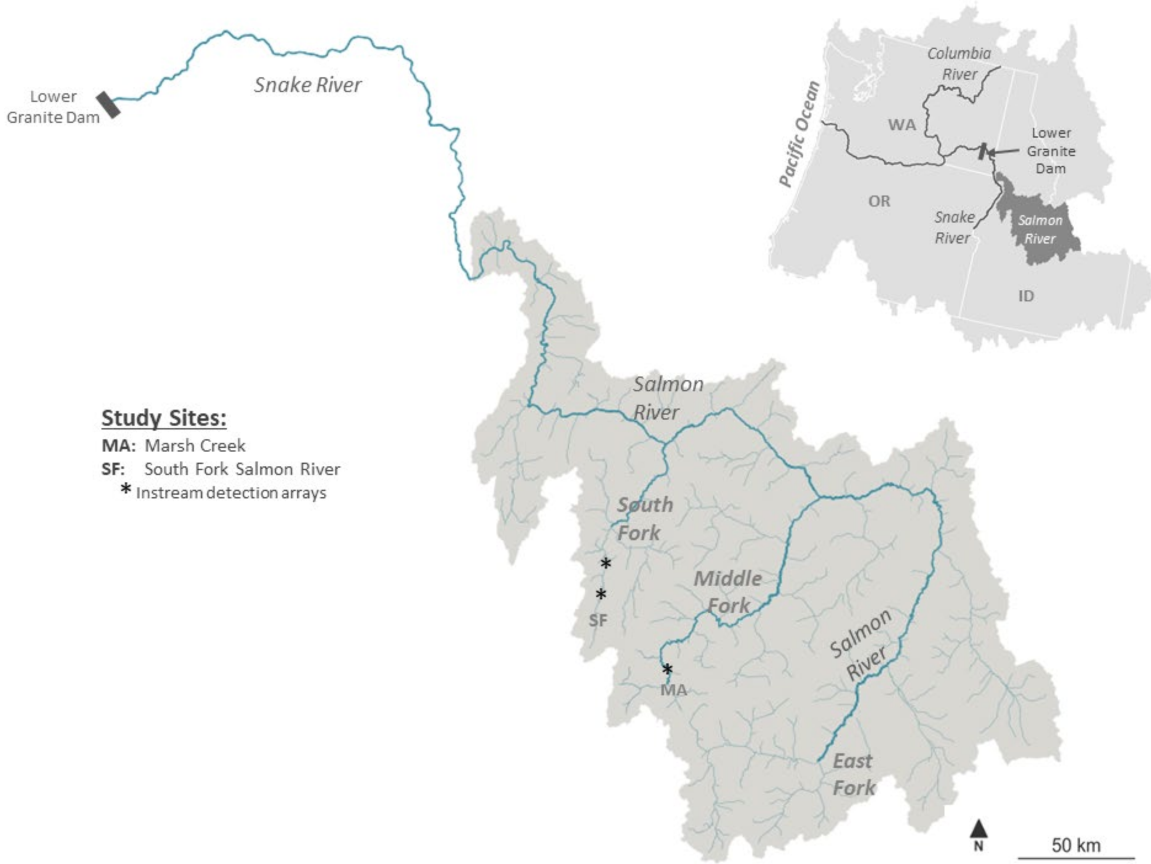


Figure 1. Map showing the streams and study sites where wild spring/summer Chinook salmon parr were PIT tagged during 2024.

Table 2. 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.

Tagging location	Number of fish		Average length (mm)		Average weight (g)		Collection area to stream mouth (km)	Est. stream area sampled (m^2)
	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**

Downstream Detection and Recapture

Detection of Tagged Fish

Instream monitoring systems

In 2002, the first instream PIT-tag monitoring systems were installed by NOAA at two sites in Valley Creek. These systems were designed to detect fish closer to their natal rearing sites. Expansion and improvement of these systems since 2002 has been detailed in previous annual reports (Achord et al. 2004-2005, 2009-2012; Lamb et al. 2013-2021).

Instream monitoring systems automatically interrogate, store, and transmit data from passing tagged fish that are detected. From late July 2024 through June 2025, we collected detection data from wild PIT-tagged Chinook salmon juveniles passing instream monitoring sites (Table 3). Detection data are uploaded to the Columbia River PIT-Tag Information System (PTAGIS), a regional shared database operated by the Pacific States Marine Fisheries Commission (PSMFC 1996).

Table 3. Details of collection, tagging, and release areas and instream monitoring sites used in studies of wild spring/summer Chinook salmon parr implanted with passive integrated transponder (PIT) tags, 2024-2025.

Fish collection, tagging, and release areas	Instream monitoring site		
	Description	River or creek (rkm)	Site code*
S.F. Salmon River	Guard Station Road Bridge	S Fork Salmon R (rkm 30)	SFG
South Fork Salmon River	Krassel Creek	S Fork Salmon R (rkm 65)	KRS
Marsh Creek	Lola Creek Campground	Marsh Creek (rkm 8)	MAR

* Site code is an abbreviation designated for monitoring systems listed in the Columbia Basin Pit Tag Information System (PTAGIS) regional database.

Monitoring systems at dams and in the estuary

During spring and summer 2025, wild Chinook smolts that had been PIT-tagged as parr in 2024 began a directed migration downstream. Of the eight dams encountered by these smolts on the lower Snake and Columbia Rivers, seven have PIT-tag interrogation systems in their juvenile bypass systems. These were Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Dams on the Snake River and McNary, John Day, and Bonneville Dams on the Columbia River.

At these seven dams, smolts guided into juvenile bypass systems were monitored for PIT tags by interrogation systems similar to those described by Prentice et al. (1990). At LGD, the spillway ogee detection system (GRS) began operation in 2020 (Axel et al. 2021) and continues to be a vital source for detection of our study fish. During 2025, the majority of wild fish from the study detected at LGD were detected on the GRS system (84; 80.0%).

Tagged fish have several possibilities for detection in the lower Columbia River estuary. A pair-trawl fitted with a PIT-tag detection antenna is operated ~150 km downstream from Bonneville Dam from Columbia River rkm 66 to 84 (Ledgerwood et al. 2004; Magie et al. 2010; Morris et al. 2015). Since 2022, multiple detection systems located downstream of Bonneville Dam have operated from April to June on pile dikes between rkm 62 and 82. These pile dike systems have proven effective in detection of migrating juvenile salmonids including two fish from our study during 2025, and are used in calculating passage and survival in the lowest river section.

For all of these monitoring systems, date and time to the nearest second were automatically recorded for each detected fish. Detection data were then transferred to the PTAGIS database at designated intervals, depending on the respective communications procedure of each monitoring system.

Recapture of Tagged Fish

Juvenile migrant traps

Some fish PIT tagged as parr in natal rearing areas were subsequently collected at migrant traps downstream of release. During summer/fall 2024 and spring 2025, juvenile migrant traps were operated at the following locations:

- South Fork Salmon River at Krassel Creek
- Marsh Creek below its confluence with Cape Horn Creek, near Lola Campground
- Salmon River at rkm 103 near Whitebird
- Snake River at Lewiston, Idaho

Traps were operated by Idaho Fish and Game and the Nez Perce Tribe. Generally, study fish recaptured at these traps were anesthetized, scanned for PIT tags, measured, and weighed. Upon recovery from the anesthetic, fish were released back to the stream or river.

Separation-by-code at Lower Granite Dam

At LGD, sampling was conducted from April through June 2025 in an effort to recapture subsamples of our study fish tagged as parr in summer 2024. Recaptures were obtained by programming the PIT-tag separation-by-code (SbyC) system, which can divert specific, predesignated tagged study fish from the population passing the dam (Downing et al. 2001). The SbyC system was programmed to divert a maximum of 100 fish from each stream at a maximum collection rate of 15 fish/d per stream.

All recaptured fish were handled using water-to-water transfers and other best handling practices. After measuring weight and length, we returned all tagged and non-tagged fish to the river via the bypass system.

In addition to recording fork length (mm) and weight (g) for these wild smolts at LGD, we calculated a Fulton-type condition factor (CF) as:

$$CF = \frac{weight\ (g)}{length\ (mm)^3} \times 10^5$$

Condition factor was calculated both at release and recapture using release data associated with the PIT tag code.

Results and Discussion

A total of 107 wild spring/summer Chinook salmon tagged in summer 2024 were recaptured at traps above LGD from summer/fall 2024 to spring 2025 (Table 4). The average number of days to recapture was 74 days for both populations. The largest number of recaptured fish were from Marsh Creek (90; Table 4) most likely due to proximity of release (3-5km upstream). Only three fish were recaptured in the Salmon River trap located near Whitebird, ID and no study fish were recaptured at the Snake River trap near Lewiston, ID.

During 2025, we attempted to recapture study fish from Idaho streams at LGD to measure growth over the entire migration season (April-June). As in past years, we set a recapture maximum of 15 fish/d from each stream. The SbyC operated without error over the entire collection period. However, we only recaptured 7 fish in the SbyC system at LGD for examination of length, weight, and condition factor (Table 4). From the South Fork Salmon we recaptured five fish and from Marsh Creek, two fish. For the recaptured study fish, overall mean growth was 0.12 mm/d during 2024-2025. Even with the small sample size this is comparable to overall growth rates measured in previous years (Achord et al. 2002-2012; Lamb et al. 2013-2024).

Dam operations and water levels at LGD in recent years (2021-present) have led to fewer fish passing via the juvenile bypass system. The lack of fish using the bypass paired with low numbers of study fish (3,000) being released during 2024 meant very few fish recaptured at LGD. Future changes in dam operations and more study fish being tagged would provide more opportunity for collection of previously PIT tagged fish in the bypass system.

Table 4. Fork length, weight, and condition factor of wild spring/summer Chinook salmon PIT-tagged in Idaho during summer 2024 and recaptured either in the separation-by-code system at Lower Granite Dam (A) or at traps (B) during summer/fall 2024 and spring/summer 2025. Precocious males were not included in the analysis.

	Recaptured fish						Weight and condition factor (CF)				
	Days to recapture			Length gain (mm)				Weight gain (g)		Mean CF	
	n	range	mean	n	range	mean	n	range	mean	release	recapture
Wild spring/summer Chinook salmon recaptured in SbyC at Lower Granite Dam											
(A) Lower Granite Dam											
Marsh Creek	2	250-257	254	2	22-37	29	1	---	3.9	---	1.07
S Fork Salmon River	5	244-248	246	5	28-37	31	5	6.1-6.8	6.4	1.28	1.06
Totals or average	**7**	**244-257**	**248**	**7**	**22-37**	**31**	**6**	**3.9-6.8**	**6.0**	**1.40**	**1.01**
(B) Trap and Origin											
Marsh Cr											
Marsh Cr-fall	85	1-93	52	85	-4-16	6	1	---	1.7	1.20	---
Marsh Cr-spring	5	246-266	254	5	15-29	21	0	---	--	1.32	---
S Fork Salmon R (Krassel)											
S. Fork Salmon R-fall	12	58-97	84	12	4-19	12	12	0.6-2.0	1.3	1.14	1.01
S. Fork Salmon R-spring	2	233-253	243	2	15-17	16	2	2.9-3.5	3.2	0.9	1.00
Salmon River-spring	3	261-272	266	3	10-46	24	0	---	---	1.16	---
Total or average	**107**	**1-272**	**74**	**107**	**-4-46**	**8**	**15**	**0.6-3.5**	**1.6**	**1.18**	**1.02**

Detection and Survival in Monitored Streams

Methods

For each release group from each stream population, we estimated detection probability at LGD. Estimates of survival from release as parr to arrival at the dam as smolts were based on these detection probability estimates. However, for fish from monitored streams, the reach was divided into two smaller segments: 1) a stream segment, which spanned from the point of release to the lower instream monitor, and 2) a river segment, which spanned from the lower instream monitor to the dam.

For estimates of parr-to-smolt survival in stream segments, we constructed a detection history for each fish that specified detection or non-detection at 1) the instream monitor and 2) any downstream dam. This produced four possible detection histories for fish in each release group: detection or non-detection at a stream monitor and detection or non-detection at a dam. Counts of fish with each detection history were fitted to a multinomial model, with cell probabilities parameterized as functions of detection and survival probability.

To estimate survival, we used the Cormack-Jolly-Seber (CJS) single-release model with multiple recapture (Cormack 1964; Jolly 1965; Seber 1965). This model is used extensively to estimate survival for PIT-tagged fish in the Columbia River Basin.

In the past we explored a method to estimate detection and survival in reaches with two instream detection sites based only on detection data from the instream monitors (Connolly et al. 2008). However, detection data from monitoring systems with two antenna arrays have shown that detection probability at an upstream antenna array was not independent of detection probability at a downstream array.

This pattern of detection violated a critical assumption required by the CJS model—that probabilities of detection (recapture) at each location are independent of one another. Assuming a survival rate of 100% between upper and lower instream monitors, we could have modeled dependency between these detection probabilities. However, it was not possible to test the assumption of 100% survival, and sample size in many cases was not sufficient to obtain useful estimates of dependency. Therefore, we used the CJS model for two separate estimates of survival: from release to the instream monitors and from the instream monitors to LGD.

Results

Marsh Creek

We collected and tagged 1,500 wild Chinook salmon parr from Marsh Creek on 25-27 July 2024. The average fork length of Marsh Creek tagged fish was 69.8 mm (Table 2). Release sites for the Marsh Creek fish were 3-5 km upstream from the instream monitoring array near Lola Creek Campground on Marsh Creek.

From July 2024 through June 2025, 818 Marsh Creek fish were detected on the Marsh Creek instream array (Figure 2). Of the 818 detections from Marsh Creek, 576 (70.4%) occurred in late summer/fall, 174 (21.3%) in winter, and 68 (8.3%) in spring (Table 1).

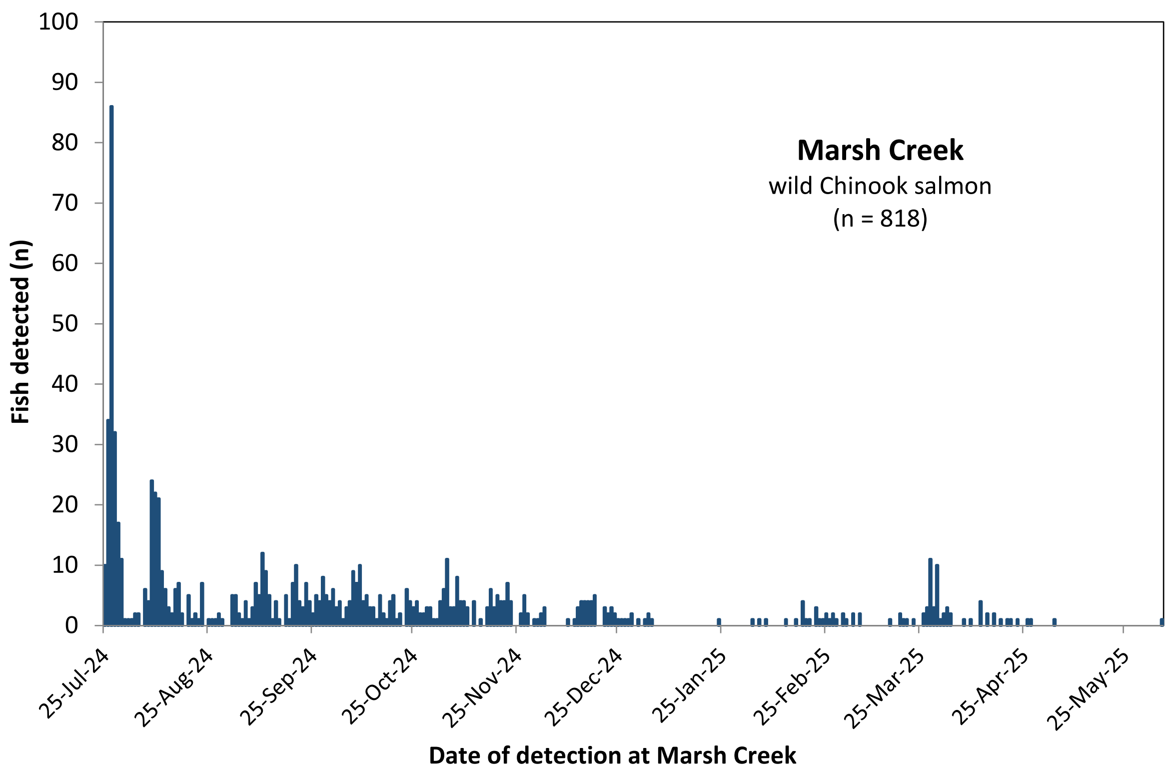


Figure 2. Detections on instream monitors at Marsh Creek from 1,500 wild spring/summer Chinook salmon PIT tagged during July 2024. All fish were released in areas 3-6 km above the Marsh Creek monitors.

Based on detections at downstream dams, overall detection efficiency of the instream monitoring system at Marsh Creek was 98.0% for parr from Marsh Creek (SE 1.4%; Table 1). Based on these detection efficiencies, we estimated survival to the Marsh Creek instream monitoring system at 55.7% (SE 1.5%). We did not find a significant relationship between fork length at tagging and timing of detection for these fish ($R^2 = 0.00$, $P = 0.668$; Figure 3).

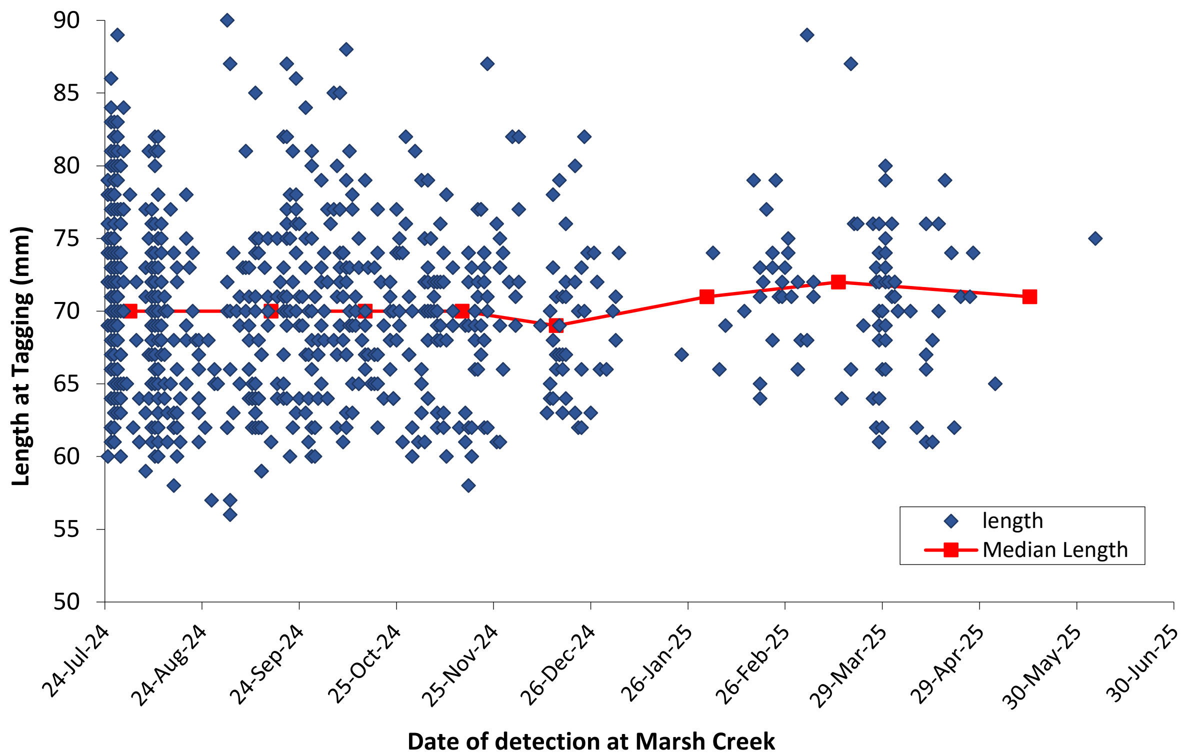


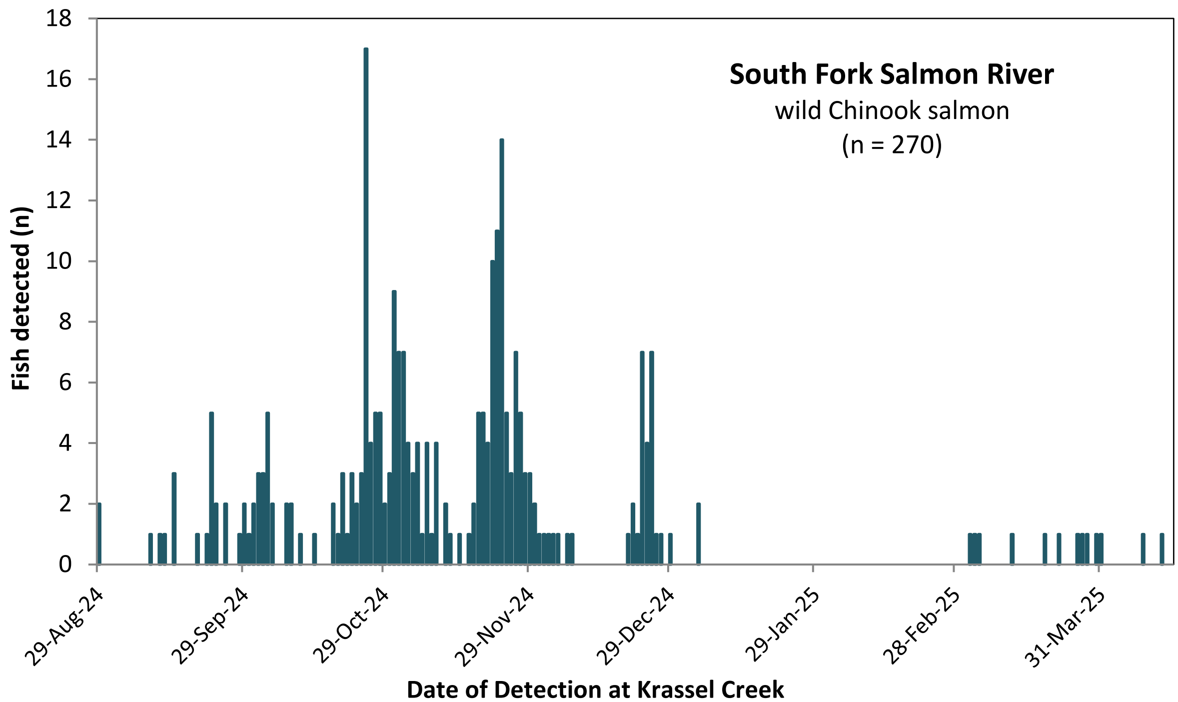
Figure 3. Length at tagging vs. date of detection for fish collected and tagged at Marsh Creek. A total of 818 fish from Marsh were detected at the instream monitoring site in Marsh Creek.

South Fork Salmon River

We tagged and released 1,500 wild Chinook salmon parr to the South Fork Salmon River during 29-31 July 2024. Tagged fish had an average fork length of 64.5 mm (Table 2). All fish were released to natal rearing areas 50-55 km upstream from the monitoring system near Krassel Creek (KRS) at rkm 65 and 80-85 km upstream of the South Fork Guard (SFG) monitoring system located at rkm 30.

Of fish tagged and released to the South Fork Salmon River, 270 were detected at Krassel Creek and 62 were detected at the South Fork Guard monitoring system from August 2024 through June 2025. Of the 270 detections at Krassel Creek, 104 (38.5%) occurred during late summer/fall, 153 (56.7%) during winter, and 13 (4.8%) during the following spring (Table 1; Figure 4). Of the 62 detections at South Fork Guard, 51 (82.2%) occurred during late summer/fall, 6 (9.7%) during winter, and 5 (8.1%) during the following spring (Table 1; Figure 4).

Based on detections at downstream dams, overall detection efficiencies of the instream monitoring systems were 47.4% (SE = 5.7%) and 10.5% (SE = 3.5%) for Krassel Creek and South Fork Guard Station, respectively. Using these detection efficiency rates, we found no significant difference between the estimated survival to the Krassel Creek monitoring system (38.0%; SE = 4.5%) or the South Fork Guard Station (39.3%: SE = 12.3%). We found no significant relationship between fork length at tagging and timing of detection for fish at Krassel Creek ($R^2 = 0.61$, $P = 0.201$) or South Fork Guard Station ($R^2 = 0.05$, $P = 0.857$).



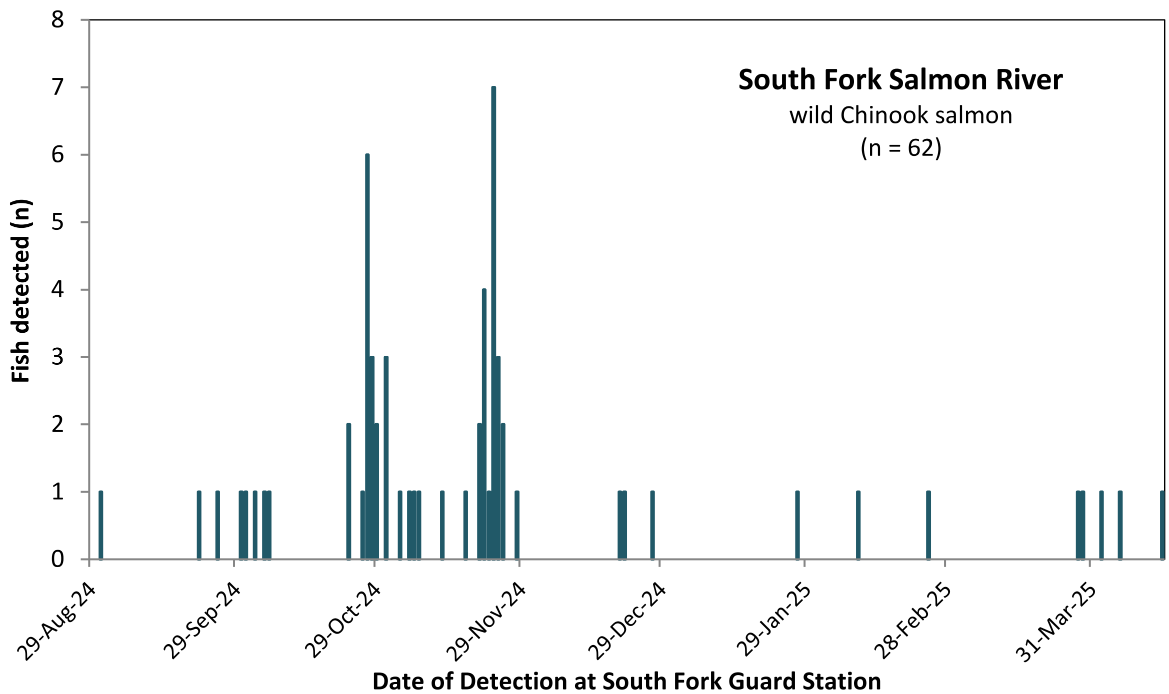
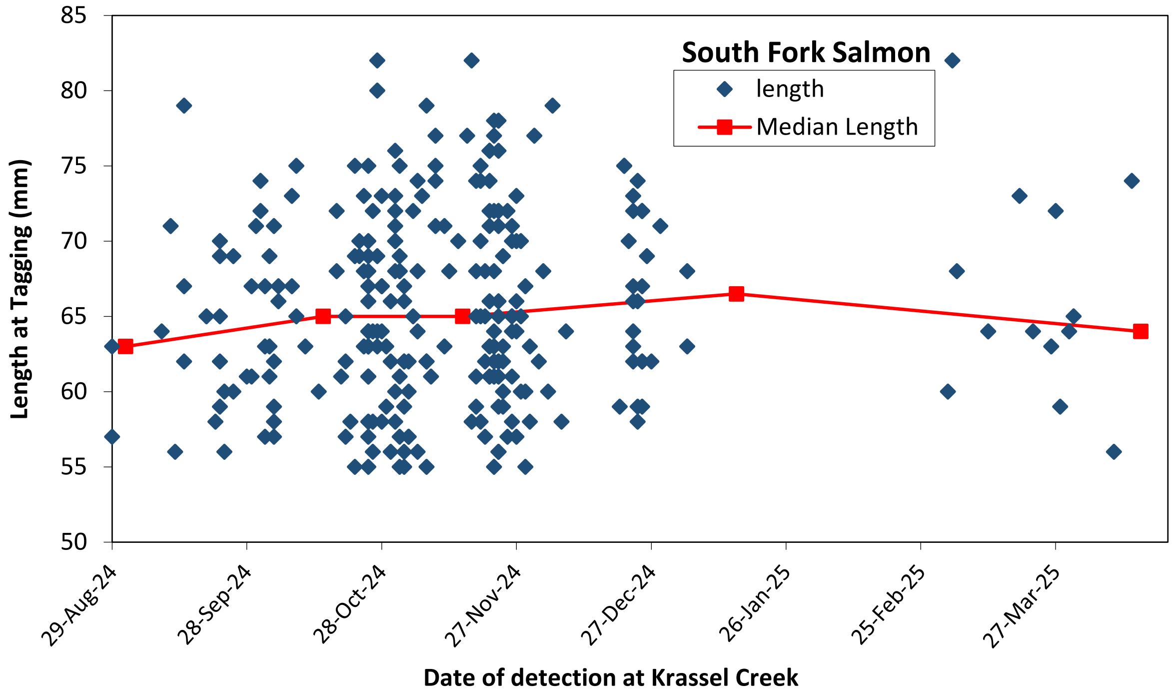


Figure 4. Detections on instream monitors at Krassel Creek (A) and South Fork Guard Station (B) from 1,500 wild spring/summer Chinook salmon PIT tagged during July 2024. All fish were released in areas 50-85 km above the monitors.



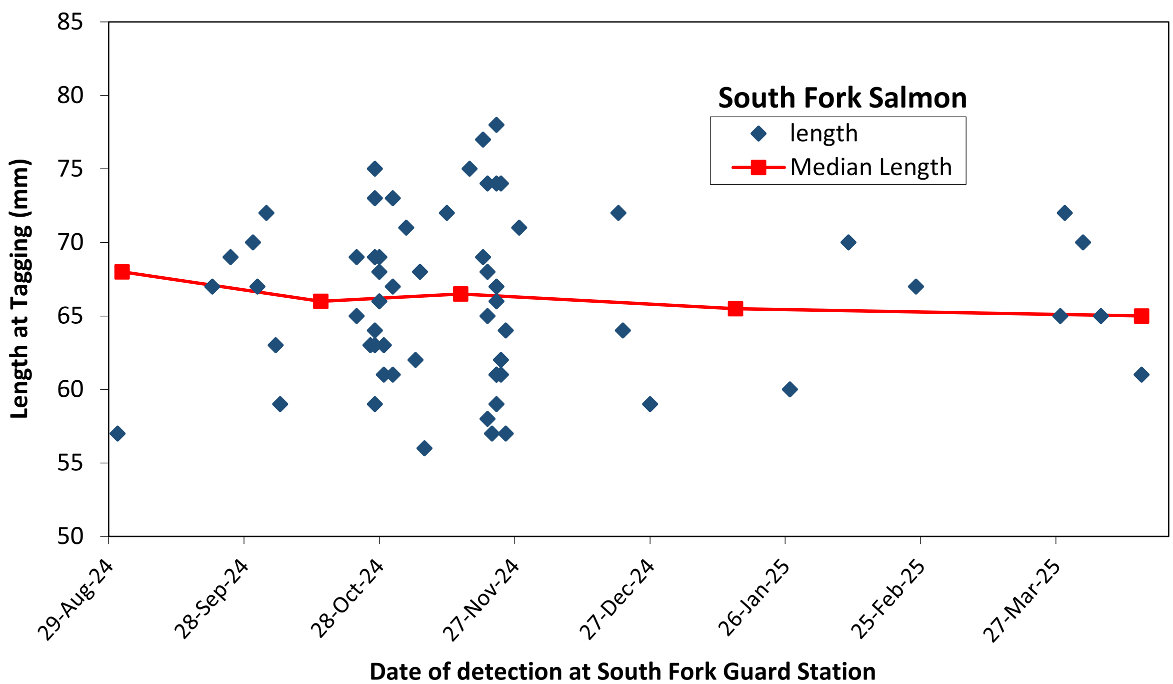


Figure 5. Fork length at tagging vs. date of detection for wild spring/summer Chinook salmon tagged in the South Fork Salmon River and detected at the instream PIT-tag monitoring sites. Detections were for 270 fish and 62 fish at Krassel Creek (A) and South Fork Guard Station (B) monitors, respectively.

Discussion

During 2024-2025, the instream PIT-tag monitoring system on Marsh Creek performed exceptionally well. Based on numbers of fish detected at Marsh Creek and subsequently detected at downstream dams, we estimated detection efficiency of the system at 98.0%. The Marsh Creek system has been the best performing instream site within our study area since installation in late 2019 and continues to provide valuable information about study fish tagged and released upstream.

For fish from the South Fork River, detection efficiencies at Krassel Creek (rkm 65) during 2024-2025 were estimated to be 47.4%, which is similar to 2023-2024 (50.0%) and continues to benefit from technological improvements made during 2020. At the South Fork Guard Station site improvements (September 2023) have also led to more detections and better estimated efficiency (39.3%). Distance from release (54-85kms), as well as, environmental conditions when fish arrive during late fall/winter are not optimal for detection at SFG. However, the combination of these two instream sites within the South Fork Salmon River provide the opportunity to examine seasonal migration through transects of the drainage and produce critical data not found elsewhere within our study area.

During 2025, a new instream detection site was installed within Bear Valley Creek at rkm 6, near Fir Creek Campground. The Bear Valley site may mean additional data if tagging upstream of the site is to occur in the future (no tagging was permitted in Bear Valley or Elk Creek during 2025 due to low adult escapement). The Bear Valley site means the potential for instream detection at 11 of our 16 historic study sites. We are optimistic that continued advances in PIT technology should help to enhance and boost instream detection in years to come.

Survival to Lower Granite Dam and Overall Parr-to-Smolt Survival

Methods

In this section, we present methods for estimating detection probability and parr-to-smolt survival at LGD. For fish from the seven streams with monitoring systems, we also estimated survival from instream monitors to LGD. For fish from streams without monitoring systems, we estimated detection and survival probability from respective release points to the dam.

Estimated survival from streams to Lower Granite Dam

We estimated separate probabilities of survival to LGD for fish from each stream overall and for each of three detection periods: late summer/fall (August-October), winter (November-February), and spring (March-June). For fish from monitored streams with two arrays, we estimated survival from the lowermost array to the dam.

First, we grouped detected fish by seasonal period of detection on instream monitors. For each seasonal group, we then compiled a temporal distribution of daily detections at LGD by stream cohort.

For fish from each stream, each daily count at the dam was divided by the estimate of detection probability for LGD on that day to obtain an *expanded* daily estimate (methods for expanded estimates are explained below in *Estimates of parr to smolt survival*). Daily passage estimates were then summed to estimate the total number of fish from each stream that survived to LGD. This total was divided by the total number of fish released from that stream to derive the estimate of survival to LGD.

For the three sampling sites with monitoring systems, we used the above process for the number of fish that survived to LGD *and* had previously been detected on an instream monitoring system during each seasonal period. To derive estimates of survival to the dam by season, the pertinent totals of expanded daily passage numbers at the dam were divided by the total number of fish detected on instream monitors during each seasonal period, regardless of whether they were detected at LGD. For fish from these monitored streams, we estimated overall parr-to-smolt survival by calculating the weighted mean of the three seasonal survival estimates calculated above. Means for each season were weighted according to the proportion of total detections from that season.

Estimates of parr-to-smolt survival

To estimate parr-to-smolt survival, we used daily detection probabilities at LGD to *expand* daily observed detections. Detection probability estimates for this expansion were based on detections of our tagged study fish pooled with detections of fish tagged for other studies, or "auxiliary" detection data. These auxiliary data included any wild Snake River Chinook salmon PIT-tagged and released upstream from the dam, regardless of source. Pooled detections of study and auxiliary fish at LGD were used for all estimates of parr-to-smolt survival and travel time.

To estimate expanded detection probabilities from pooled detections, we followed the methods of Schaefer (1951) as modified by Sandford and Smith (2002). For each day of the migration season, we estimated numbers of tagged fish detected at LGD as well as numbers of tagged fish *not* detected that day, but known to have passed because they were subsequently detected downstream. We developed a series of daily detection probabilities as follows:

1) Fish detected on day *i* at Little Goose Dam that had previously been detected at Lower Granite were tabulated according to day of passage at Lower Granite Dam.
2) Fish detected on day *i* at Little Goose but ***not*** previously detected at Lower Granite were assigned an estimated day of passage at Lower Granite, assuming that passage distribution for these fish was proportionate to passage distribution of fish detected at Lower Granite.
3) This process was repeated for all days with detections at Little Goose Dam.
4) Detected and non-detected fish known to have passed Lower Granite Dam on day *i* were summed.
5) Detection probability on day *i* was estimated by dividing the number of fish detected at Lower Granite on day *i* by the sum of fish both detected and not detected, but known to have passed Lower Granite (because of detection at Little Goose) and estimated to have passed on day *i*.

We slightly modified the method of Sandford and Smith (2002) for parr-to-smolt survival estimates of fish that passed LGD during the early and late periods of each season, or "tails" of the passage distribution curve. This modification was necessary because for fish passing during these periods, there were often no detections at Little Goose Dam; thus, no passage date at LGD could be inferred. For this modification, bootstrap methods were used to derive standard errors for the estimated probability of survival to LGD.

Auxiliary data were used to derive bootstrap distributions of estimated daily detection probability at the dam. Standard errors were derived for estimates of survival to the dam from both release sites and instream monitors (Achord et al. 2007b). For fish from each stream release or instream monitor detection group, we used detections at LGD for bootstrap distributions of dam passage.

Results

Survival of fish from all Idaho streams

For fish from both Idaho streams combined, we estimated average parr-to-smolt survival probability at 18.1% (SE 2.2%; Table 5). This estimate was based on expanded detections at LGD from 31 March to 16 June 2025 (n = 544). An additional 69 first-time detections were recorded at Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, Bonneville Dam, the PIT Trawl, and lower Columbia Pile Dike sites (Appendix Tables 3-5).

Table 5. Summary of observed vs. expanded detections of wild spring/summer Chinook smolts at Lower Granite Dam in 2024-2025. Proportions of detected fish from the expanded numbers were used for parr-to-smolt survival estimates and are shown with the SE of each estimate.

		Lower Granite Dam detections, **2024-2025**				
	Tagged and	Observed		Expanded (parr-to-smolt survival)		
Stream	released (n)	(n)	(%)	(n)*	(%)	SE (%)
Marsh Creek	1,500	60	4.0	332	22.1	3.5
S Fork Salmon River	1,500	45	3.0	213	14.2	2.4
Totals or averages	**3,000**	**105**	**3.5**	**544**	**18.1**	**2.2**

* Due to rounding, expanded detection numbers may vary slightly from those in Appendix Tables 3-5.

Survival of Fish from Monitored Streams

Marsh —For wild juvenile Chinook from Marsh Creek detected on Marsh Creek monitors, we estimated overall survival to LGD at 40.5% and overall parr-to-smolt survival at 22.1% (Table 6).

South Fork Salmon River—For wild juvenile Chinook from the South Fork Salmon River detected on the instream array near Krassel Creek, overall survival to LGD was estimated at 37.3% (SE 9.3%). For those detected on the South Fork Guard Station, overall survival to LGD was estimated at 39.3% (SE 12.3%). Overall, the estimated parr-to-smolt survival to LGD from the South Fork River was 12.5% (Table 6).

Table 6. Estimated survival to Lower Granite Dam for fish detected on instream monitors with overall estimated parr-to-smolt survival for study populations passing instream PIT-tag monitoring arrays, 2024-2025.

		Estimated survival to Lower Granite Dam (%)			Estimated parr-to-smolt survival (%)		
Stream population	Instream monitor	Overall mean	SE	95% CI	Overall mean	SE	95% CI
Marsh Creek	Marsh Creek	40.5	6.3	26.3-50.7	22.1	3.5	14.2-28.4
S Fork Salmon R	Krassel Creek	37.3	9.3	21.6-57.2	14.2	2.4	9.5-19.0
	South Fork Guard	39.3	12.3	14.6-63.9	14.2	2.4	9.5-19.0

Relationship between Length at Tagging and Detection at Dams

For tagged fish from all streams combined, average fork length at release was 67.2 mm (Table 2; Appendix Table 1). Comparison of mean tagging length of fish detected at LGD during different months (April v May/June) showed no significant difference ($P = 0.9204$) and there was no difference between size of fish detected within the spillway (GRS) v the juvenile bypass ($P = 0.9505$). However, fish with larger average fork length at release were significantly more likely to be detected the following spring at LGD (68.5 v 67.1mm; $Z = 2.70$; $P = 0.0070$; Figure 6).

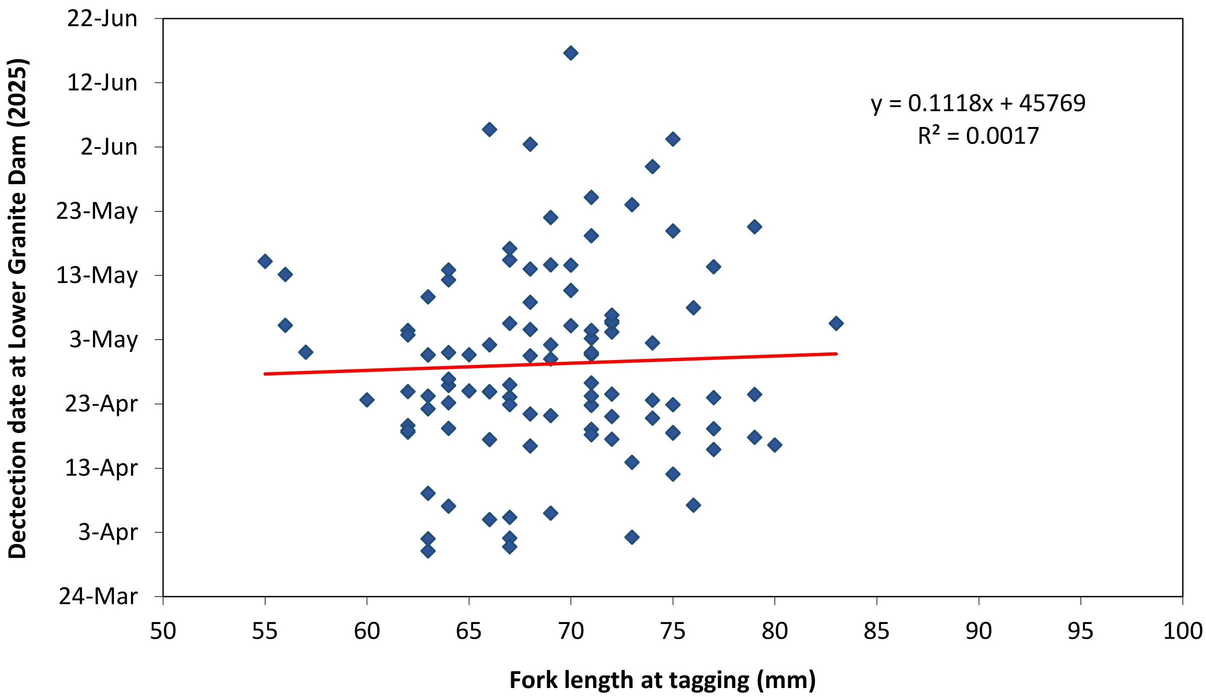


Figure 6. Relationship between fork length of wild Chinook salmon parr at tagging (2024) and detection date at Lower Granite Dam in 2025 (n = 173).

To examine this relationship further, we grouped all released fish into 5-mm length bins and compared length distributions at release vs. detection using a series of *Z*- tests. Length distribution of non-detected fish was compared to that of fish detected at dams in spring by comparing the two percentages in each bin. Percentages were relative to the total released for each bin (detected or not). We saw a significant difference between fish detected versus not detected for the <=59mm group ($P = 0.00$; Figure 7). All other length bins showed no significant difference.

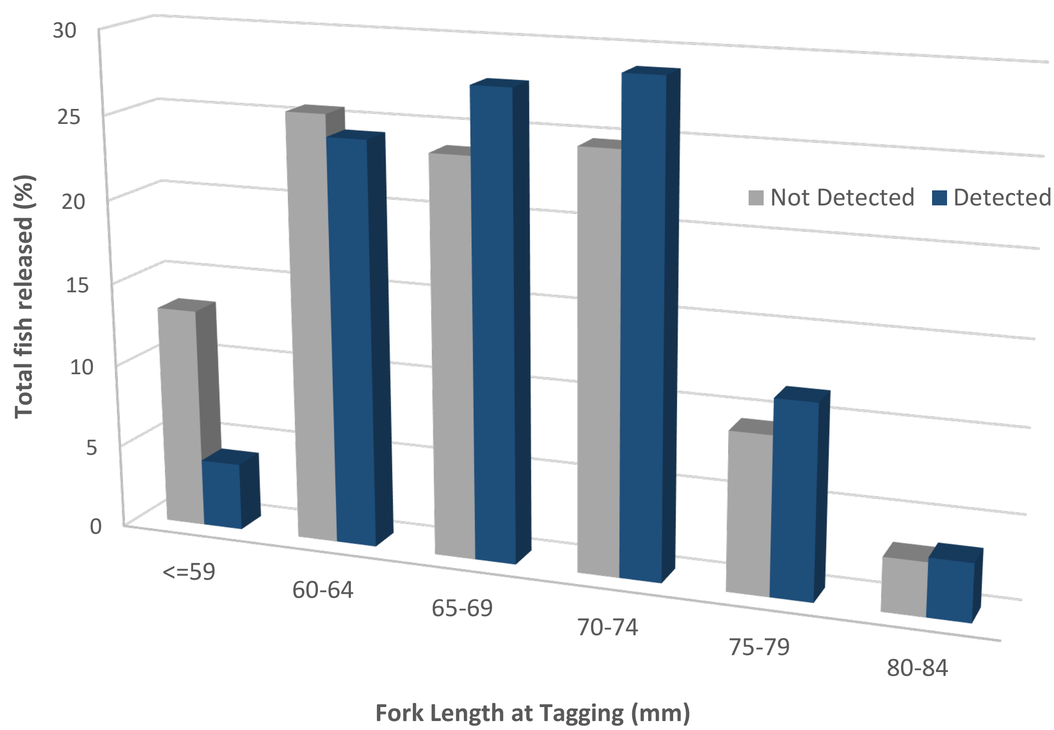


Figure 7. Distributions of fork length by 5-mm length bin for wild spring/summer Chinook salmon parr PIT-tagged and released in Idaho streams, 2024. Gray bars represent percentages not detected (n = 2,818) and blue bars represent percentages detected at Lower Granite Dam in spring/summer 2025 (n = 173).

Discussion

During 2024, we estimated an overall survival of 18.1%, which is higher than the long-term average, but only represents fish from two sampling locations (compared to potentially 16 locations in past years). Annual parr-to-smolt survival estimates have ranged 7.9-25.4% for Idaho stream populations studied over the past 32 years. Fish from all streams combined had an overall parr-to-smolt survival rate of 15.3% averaged over all years (Figure 8). Similar to past years, fish that were detected on instream monitors had considerably higher survival to LGD than that of fish never seen on the instream monitors (Table 6), this could indicate that a certain amount of “culling” or mortality occurs prior to fish arriving at the instream detection sites.

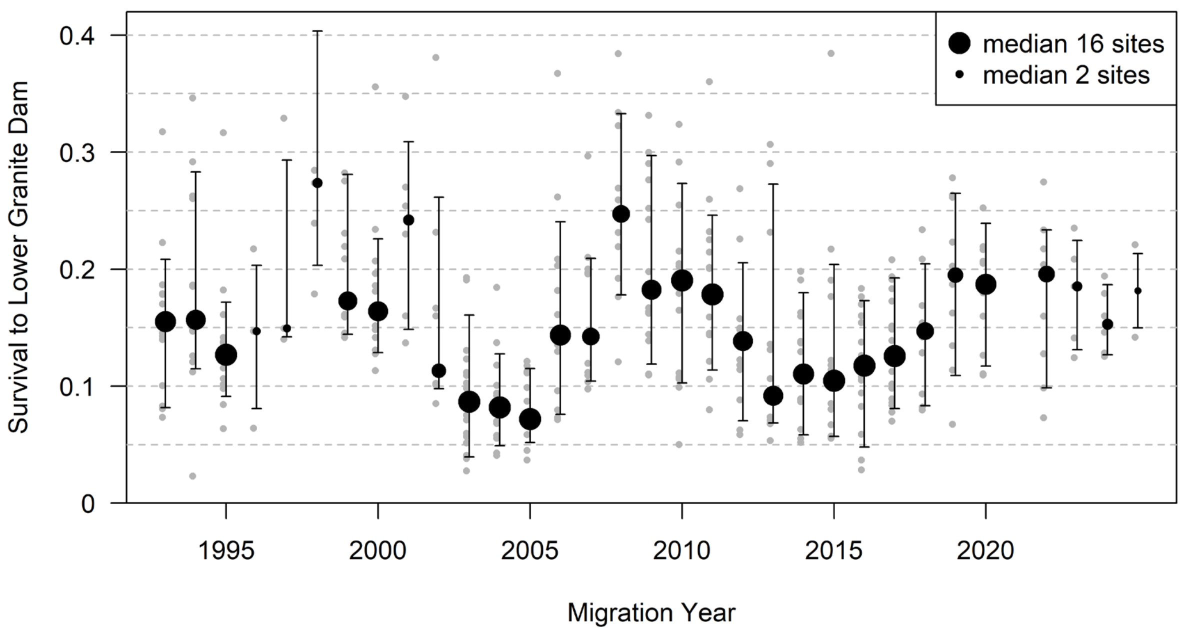


Figure 8. Estimated survival of wild juvenile Snake River spring/summer Chinook salmon from natal tributaries where they were tagged to Lower Granite Dam in the Snake River across study years. Black circles are medians, sized to the number of streams sampled, whiskers are medians of the 10th and 90th percentiles across sampled populations, and gray dots are individual sites.

Annual average data continues to indicate a potential inverse relationship between parr-to-smolt survival and parr density (Figure 9; r = -0.66). Achord et. al. (2003b) hypothesized that observed density dependence may stem from a shortage of marine derived nutrients, which is directly related to the number of returning adults to each stream. In years with low numbers of returning adults, the carrying capacity for juvenile rearing is limited, affecting the parr-to-smolt survival.

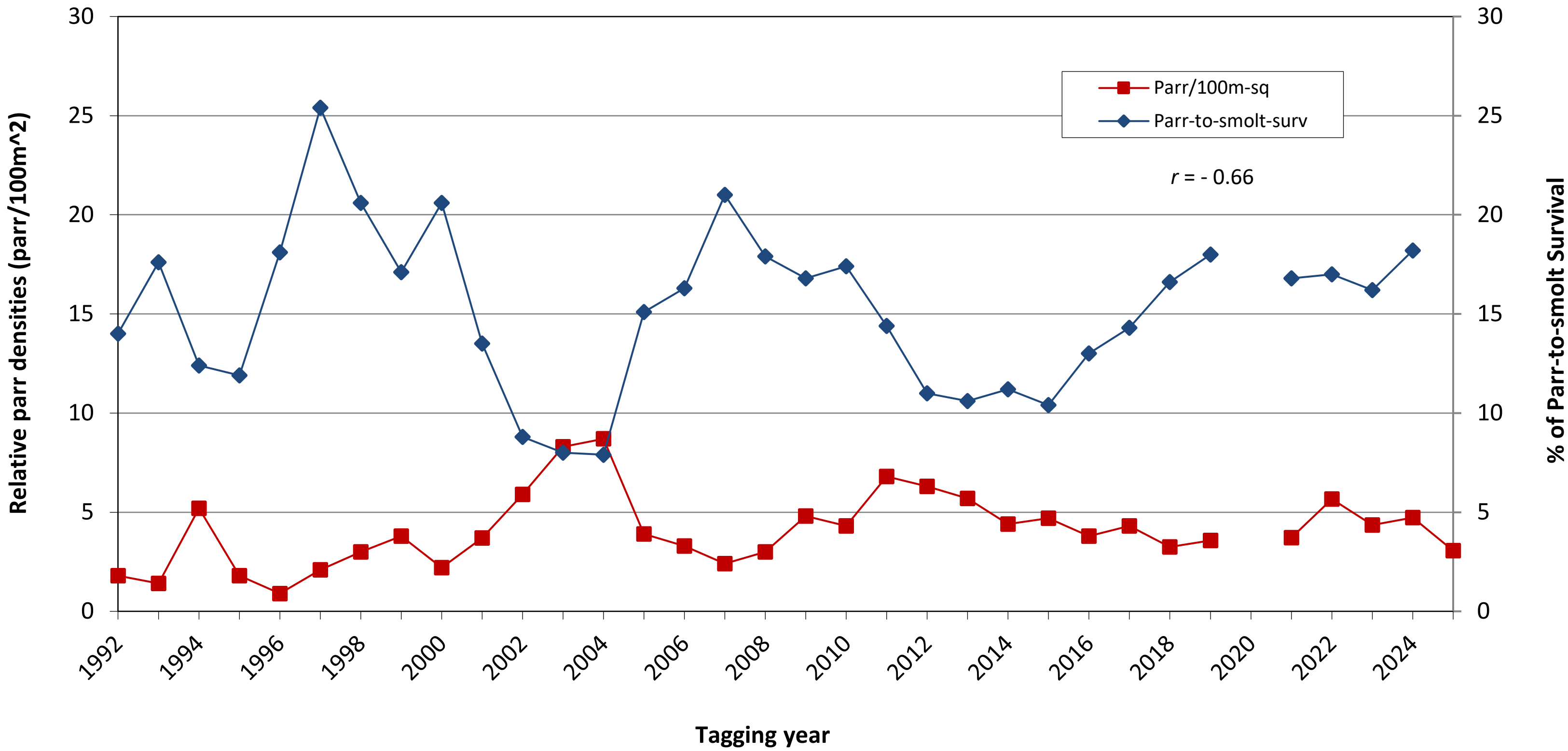


Figure 9. Annual average density of Chinook salmon parr (parr/100 m^2) in Idaho streams vs. annual estimated survival of smolts from these streams to Lower Granite Dam the following year, 1992 to 2025 (excluding 2020, when no fish were collected).

Arrival Timing at Lower Granite Dam

Methods

For each stream population, we estimated arrival timing at LGD based on detections of tagged study fish at the dam. Variation in arrival timing was expected because stream populations vary in size and streams vary in temperature, elevation, and mean flow.

To estimate arrival time, we used expanded detection data as described in the previous methods section, *Estimates of parr-to-smolt survival*. We pooled daily detections at LGD and divided each daily detection total by its corresponding daily detection probability estimate. Arrival timing at the dam was then calculated based on dates from the expanded detections, with passage dates of the 10th, median, and 90th percentile calculated for each stream population.

We compared arrival timing at LGD among individual populations and among years to determine trends and similarities or differences between years and populations. Comparisons of the 10th, 50th, and 90th percentile passage dates were made among streams using a two-factor analysis of variance (ANOVA), where year was considered a random factor and stream a fixed factor. Residuals were visually examined to assess normality. Treatment means were compared using Fisher's least significant difference procedure (Peterson 1985) with $\alpha = 0.05$.

Results

Dates of arrival at Lower Granite Dam

In 2025, arrival timing of tagged fish at LGD varied between the Marsh Creek and South Fork Salmon River populations (Figure 10). Marsh Creek fish arrived slightly later than fish from the South Fork Salmon, but had a shorter duration between the 10^{th} and 90^{th} percentiles (33 days v 41 days). The median passage date for both populations varied by seven days occurring in late April for South Fork Salmon fish and early May for Marsh Creek fish (Figure 10).

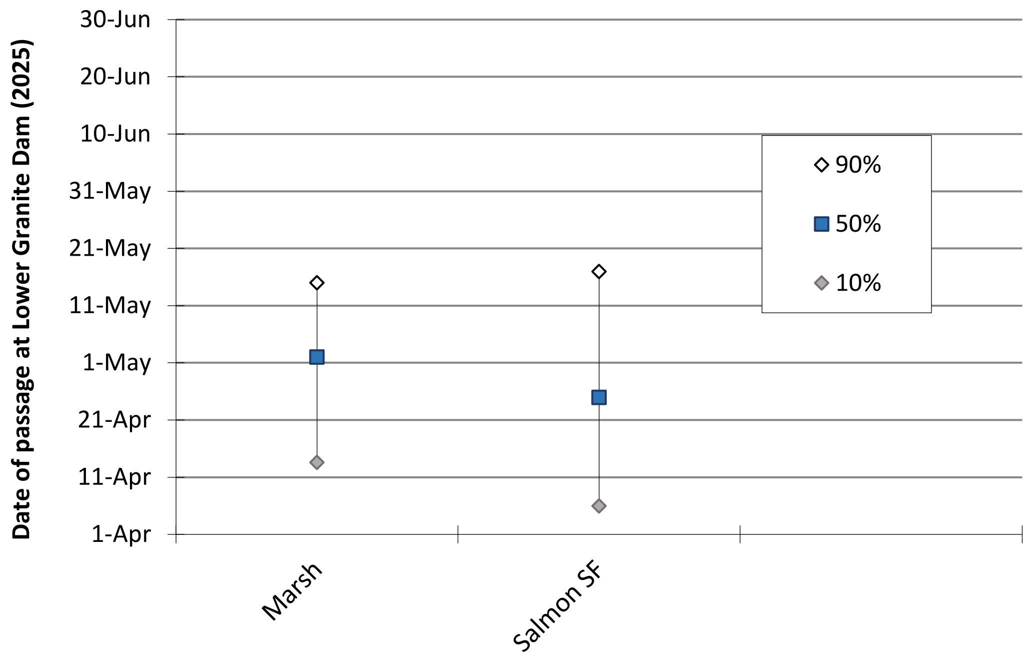


Figure 10. Estimated passage distribution dates at Lower Granite Dam from earliest to latest in 2025 for wild spring/summer Chinook salmon smolts tagged in Idaho streams. See Appendix Tables 3-5 for daily estimated passage numbers.

For fish from the 16 study sites with 15 years or more data, detection at LGD has shown clear patterns among stream populations in timing of the 10th, 50th, and 90th passage percentiles (Table 7). Timing of the 10th passage percentile at LGD has been significantly earlier for fish from the Secesh River than for fish from all other streams, with the exception of Lake Creek.

Dates of the 50th passage percentile at LGD have been significantly later for fish from Upper Big Creek than for fish from all other streams. Over all study years, the Upper Big Creek population has also been one of the latest arriving groups in comparisons of the 90th passage percentile; only the Valley Creek and South Fork Salmon River populations have been comparable.

Table 7. Percentile passage dates at Lower Granite Dam by stream population of wild spring/summer Chinook salmon smolts tagged as parr in Idaho streams the previous summer. Statistics for each stream are constructed using only migration years that stream was sampled from 1989 to 2024 (streams sampled during 2024 are highlighted in gray). For each stream population, 95% confidence intervals (CIs) for each passage percentile are included with standard errors (SEs).

	Dates of passage at Lower Granite Dam by population percentile									
	10th			50th			90th			Study
Stream	Mean date	95% CI	SE (d)	Mean date	95% CI	SE (d)	Mean date	95% CI	SE (d)	years
S Fork Salmon River	18 Apr	15-21 Apr	1	5 May	2-8 May	2	28 May	23 May-1 Jun	2	33
Secesh River	14 Apr	11-16 Apr	1	25 Apr	23-28 Apr	1	24 May	18-30 May	3	32
Bear Valley Creek	20 Apr	18-23 Apr	1	5 May	2-8 May	1	27 May	23 May-31 May	2	32
Elk Creek	19 Apr	16-22 Apr	1	3 May	30 Apr-5 May	1	25 May	21-29 May	2	31
Valley Creek	23 Apr	19-26 Apr	2	9 May	6-12 May	2	31 May	27 May-4 Jun	2	30
Lake Creek	15 Apr	13-17 Apr	1	28 Apr	25 Apr-1 May	1	25 May	20 May-31 May	3	29
Marsh Creek	20 Apr	17-22 Apr	1	2 May	30 Apr-5 May	1	20 May	18-23 May	1	28
Big Creek (upper)	28 Apr	25 Apr-1 May	1	16 May	12-19 May	2	2 Jun	27 May-7 Jun	3	27
Loon Creek	25 Apr	22-28 Apr	2	6 May	2-9 May	2	18 May	14-21 May	2	22
Cape Horn Creek	22 Apr	19-26 Apr	2	8 May	4-12 May	2	25 May	20-30 May	2	22
Chamberlain Creek	20 Apr	17-24 Apr	2	30 Apr	26 Apr-3 May	2	21 May	14-27 May	3	16

Table 8. Mean annual passage dates at Lower Granite Dam for the past 10 years (2016-2025) for combined stream populations of wild spring/summer Chinook salmon smolts PIT tagged the previous summers as parr. For all study years (1989-2025), average dates for the 10th, 50th, and 90th passage percentiles were 20 April, 3 May, and 25 May, respectively.

	Timing of passage percentiles at Lower Granite Dam			
Year	10th	50th	90th	Range
2016	13 Apr	24 Apr	12 May	24 Mar-9 Jun
2017	12 Apr	23 Apr	15 May	23 Mar-6 Jun
2018	14 Apr	29 Apr	14 May	1 Apr-8 Jun
2019	13 Apr	29 Apr	17 May	28 Mar-24 Jun
2020	25 Apr	5 May	26 May	4 Apr-5 Jul
2021	---	---	---	---
2022	29 Apr	10 May	28 May	7 Apr-5 Jul
2023	27 Apr	6 May	24 May	12 Apr-5 Jul
2024	11 Apr	19 Apr	9 May	3 Apr – 19 Jun
2025	11 Apr	29 Apr	17 May	31 Mar – 16 Jun
10-year average	**17 Apr**	**29 Apr**	**18 May**	**23 Mar-5 Jul**
All-year average	**20 Apr**	**3 May**	**25 May**	**23 Mar-22 Sept**

Flow Volume vs. Arrival Timing at Lower Granite Dam

To examine potential relationships between flow levels and arrival timing at LGD, we used first-time detections at LGD for tagged fish from all streams combined. First detections at LGD were expanded using the same methods described previously in *Estimates of parr-to-smolt survival*.

We then visually compared the temporal distribution of expanded detections with river flows during the same period (Figure 11; Appendix Table 8). Overall, the passage distribution of first detections ranged from early April to mid-June 2025, with the middle 80th percentile occurring during the 36-d period from 11 April to 17 May (Table 7). Peak passage dates were estimated using expanded detections. During 2025, we observed two periods of similarly high detection from 17 to 19 April and again from 2 to 4 May as flows increased (Figure 11; Appendix Table 5).

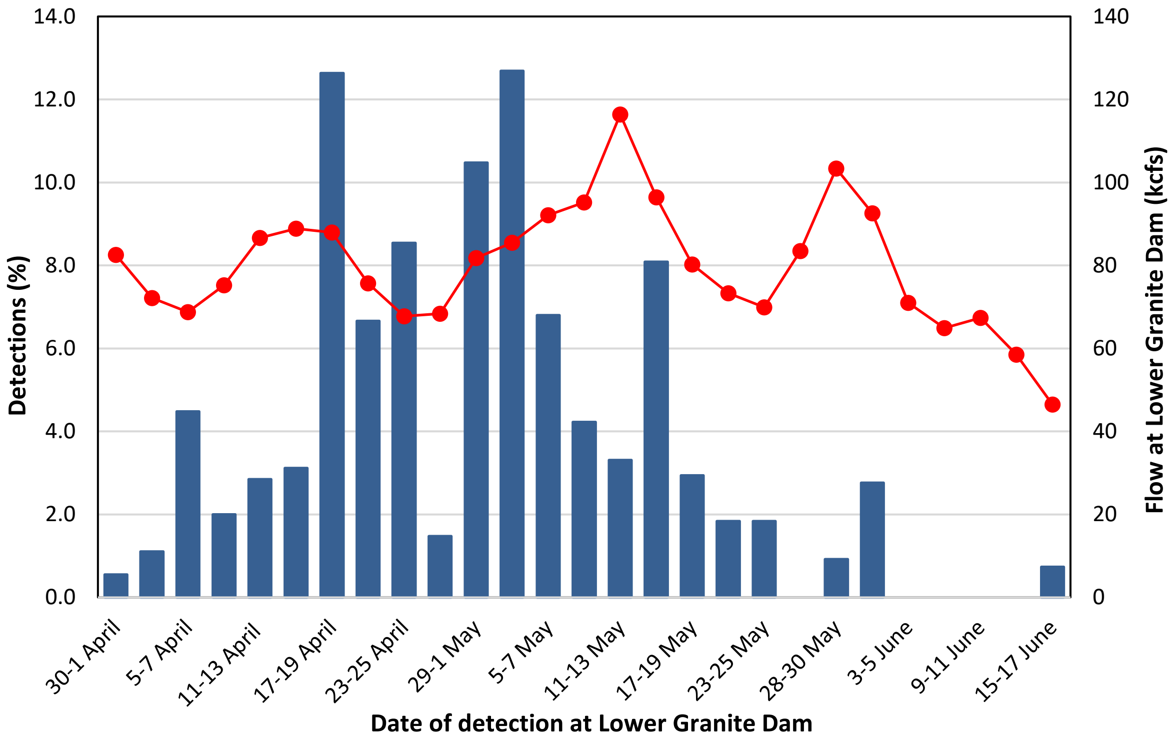


Figure 11. Overall migration timing of PIT-tagged wild spring/summer Chinook salmon smolts with associated river flows at Lower Granite Dam, 2025. Daily detections from all streams were expanded based on daily detection probability and pooled in 3-d intervals. Daily river flows at the dam were averaged over the same intervals.

Discussion

During 2025, for the second year in a row we did not witness a significant difference in arrival timing by the larger fish (measured at time of tagging), which has been a rare occurrence throughout the study (1992 to present). Results over all study years have shown that initiation of movement from natal rearing streams to larger rivers by parr, pre-smolts, and smolts is variable and probably not related to parr size at tagging (Achord et al. 2010-2012; Lamb et al. 2013-2024). However, in most study years larger tagged fish generally arrive at LGD earlier, likely due to the transition to the smolt stage earlier in spring than their smaller tagged cohorts.

Arrival timing of wild juvenile Chinook at LGD has continued to vary, but shows some indication of a geographical component (distance from LGD) linked to early arriving populations. With only two populations monitored during 2025, we did not witness one arriving significantly earlier than the other, both had similar arrival timing. Interestingly, we witnessed two periods of high passage from 17 to 19 April and 2 to 4 May. The April passage lines up with peak passage from 2024 (16 to 18 April) and the early May peak aligns with passage from 2022 and 2023 (7 to 9 and 3 to 5 May, respectively). Rising and elevated flow at LGD was witnessed during the second high passage event during early May.

Dates encompassing the middle 80th percentile passage period for all streams combined has varied from year to year (average of 35 days). During 2025, the middle 80th percentile was more compounded for Marsh Creek fish, which passed in only 33 days compared to South Fork Salmon fish which passed over 41 days.

Environmental Information

In 2007, Northwest Fisheries Science Center personnel published the *Water Quality Baseline Environmental Monitoring* website for storage and dissemination of water quality data collected during this study since 1993 (NWFSC 2007). This website was updated in January 2020 and converted to a web application (https://www.webapps.nwfsc.noaa.gov/apex/f?p=124:1::::::), which is currently (March 2026) undergoing updates.

During 2024, we were able to collect hourly water quality measurements from 6 of our 14 environmental sampling sites: CapeHorn Creek, Valley Creek, Bear Valley Creek, Chamberlain Creek, West Fork Chamberlain Creek, and the South Fork Salmon River (Knox Bridge). Mapped over time, this information, along with weather and climate data, can provide tools to predict movement of fish from individual wild fish populations. Such tools and information are vital to recovery planning for threatened and endangered populations of Pacific salmon.

Acknowledgments

We thank the Bonneville Power Administration for their support and continued funding for this project. Thanks to, Beth Sanderson, Kara Jaenecke, Joe Vinarcsik, Allison Atondo, Alexia Garcia, and Kris Snyder of the National Marine Fisheries Service for excellent assistance in the collection and tagging of fish for this study. Also, Mike Ackerman, Craig Rabe, Doug Nelson, Laura Tennant, Travis Hodsdon, Nico Higheagle, and Neal Espinosa of the Nez Perce Tribe for collaboration and assistance in the collection of fish for the study. We would also like to thank the Idaho Department of Fish and Game for their help and collaboration that makes this project possible. For troubleshooting and maintaining of PIT-tag detection arrays associated with the project, we thank the staff from Biomark, Inc. and the Nez Perce Tribe.

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Appendix

Links to Data

PIT Tag related Data:

https://www.ptagis.org/Data/AdvancedReporting

Report Filter: ({Mark Data Project} = GAA-Gordon Axel Projects) and ({Mark Site Subbasin} = 17060205:Upper Middle Fork Salmon, 17060208:South Fork Salmon) And ({Mark Year} = 2024)

Lower Granite Dam Environmental Data:

https://www.cbr.washington.edu/dart/wrapper?type=php&fname=riverdaily_1771877242_303.php

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. Cumulative passage dates at Lower Granite Dam for tagged wild spring/summer Chinook salmon smolts from Marsh Creek and South Fork Salmon River over the past ten years.

Year	Percentile passage dates at Lower Granite Dam			
	10th	50th	90th	Range
Marsh Creek				
2015	19 April	25 April	19 May	19 April-19 May
2016	14 April	27 April	9 May	10 April-18 May
2017	10 April	22 April	10 May	3 April-28 May
2018	14 April	29 April	11 May	10 April-21 May
2019[a]	---	---	---	---
2020	23 April	30 April	15 May	7 April-15 May
2021[a]	---	---	---	---
2022	5 May	12 May	26 May	27 April-13 June
2023	1 May	6 May	23 May	20 April-July 5
2024	14 April	24 April	18 May	9 April -19 June
2025	**13 April**	**2 May**	**15 May**	**2 April -16 June**
South Fork Salmon River				
2015	4 April	23 April	11 May	4 April-11 May
2016	11 April	15 April	26 April	5 April-25 May
2017	11 April	21 April	9 May	1 April-26 May
2018	14 April	4 May	13 May	4 April-24 May
2019	15 April	5 May	1 June	2 April-6 June
2020	24 April	3 May	23 May	19 April-1 June
2021[a]	---	---	---	---
2022	29 April	9 May	27 May	14 April-1 June
2023	1 May	11 May	24 May	18 April-22 June
2024	10 April	17 April	12 May	3 April-23 May
2025	**6 April**	**25 April**	**17 May**	**31 March -4 June**

[a] No parr were tagged the summer prior to this migration year.

Appendix Table 3. Detections during 2025 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,500 wild Chinook salmon from South Fork Salmon River released 29 - 31 July, 2024. Release sites were 467-469 km above Lower Granite Dam. One fish was also detected on the lower Columbia River Pile Dike (PD5) 11 May 2025.

South Fork Salmon River									
Detection	Lower Granite			First detections					
date (2025)	Spill	Bypass	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
31 Mar		2	3						
2 Apr	1	1	4						
5 Apr	1	1	10						
6 Apr		1	5						
12 Apr	1		5						
15 Apr	1		6						
16 Apr	1		5						
18 Apr	3		19						
19 Apr	1	1	10						
21 Apr				1					
22 Apr	2	1	12	1		1			
23 Apr	1	1	10	1					
24 Apr	3		9			1			
25 Apr	3		9						
26 Apr	1	1	8				1		
27 Apr							1		
29 Apr					1				
30 Apr	2		10	1		1	1		
1 May	2		15						1
2 May	1		8				1		
3 May	1		5					1	1
4 May				1			1		
5 May	1		4				1		
6 May	1		5						
7 May							1		
9 May	1		7						1
11 May				1					
13 May		1	6	1					
14 May								1	2
15 May	1		9	1		1			
16 May						1			
17 May	1		10						
19 May	1		3				1		
20 May				1					
22 May	1		5						
25 May	1		5						
4 Jun	1		5						
Total	**35**	**10**	**213**	**9**	**1**	**5**	**8**	**2**	**5**

Appendix Table 4. Detections during 2025 of PIT-tagged smolts by date at four Snake River dams and three Columbia River dams for 1,500 wild Chinook salmon from Marsh Creek released 25-27 July 2025. The release sites were 632-634 km above Lower Granite Dam. One fish was also detected on a lower Columbia River Pile Dike (PDW) 8 June, 2025.

	Marsh Creek								
Detection	Lower Granite			First detections					
date (2025)	Spill	Bypass	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
2 Apr		1	2						
7 Apr	2		10						
9 Apr		1	11						
13 Apr		1	10						
16 Apr		1	5						
17 Apr	1	2	17						
18 Apr	1	1	13						
19 Apr	2		10						
20 Apr	1		5						
21 Apr	3		12	1					
22 Apr	2		8	1					
23 Apr		1	3						
24 Apr	5		15						
25 Apr				1			1		
27 Apr				1					
28 Apr				1			2		
29 Apr				1			1	1	
30 Apr	5		25						
1 May		1	7						
2 May	2		16				1		
3 May	1		5				1		
4 May	4		35	1					
5 May	5		22						
6 May									1
7 May	1		6						
8 May	1		7				1		
9 May							1		3
10 May	1		8	1					
11 May				1					
12 May	1		6	2			1		
13 May		1	6						1
14 May	4		26						
15 May	1		9				1		
16 May					1				1
17 May									1
18 May				1			2		
19 May	1		3	1					
20 May	1		5						
24 May	1		5						
28 May				1					
29 May		1	5						
30 May							1		

Appendix Table 4. Continued.

	Marsh Creek								
Detection	Lower Granite			First detections					
date (2025)	Spill	Bypass	Expanded	Little Goose	Lower Monumental	Ice Harbor	McNary	John Day	Bonneville
2 June	1		5						
3 June	1		5						
16 June	1		4						
Total	**49**	**11**	**332**	**15**	**1**	**0**	**13**	**1**	**7**

Appendix Table 5. Daily detections and expanded detection numbers (i.e., estimated detection efficiency) of PIT-tagged wild spring/summer Chinook salmon smolts at Lower Granite Dam during 2025 with associated river conditions at the dam.

Lower Granite Dam							
Date (2025)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Spill Detections LGS (n)	Bypass Detections LGB (n)	Detections (n)	Expanded detections (n)
30-Mar	90.32	6.93	8.28	0	0	0	0
31-Mar	79.38	7.04	8.05	0	2	2	3
1-Apr	77.97	6.35	7.8	0	0	0	0
2-Apr	73.58	6.63	7.93	1	2	3	6
3-Apr	71.44	58.73	7.87	0	0	0	0
4-Apr	71.45	58.88	8.04	0	0	0	0
5-Apr	69.57	57.14	8.03	1	1	2	10
6-Apr	68.47	55.87	8.23	0	1	1	5
7-Apr	68.34	55.74	8.57	2	0	2	10
8-Apr	70.31	57.62	9	0	0	0	0
9-Apr	77.46	64.86	9.54	0	1	1	11
10-Apr	77.98	65.44	9.9	0	0	0	0
11-Apr	80.98	68.48	9.95	0	0	0	0
12-Apr	88.62	75.62	10.11	1	0	1	5
13-Apr	90.4	77.8	10.3	0	1	1	10
14-Apr	91.02	78.34	10.03	0	0	0	0
15-Apr	86.21	73.48	9.68	1	0	1	6
16-Apr	89.42	76.59	9.69	1	1	2	11
17-Apr	89.79	76.98	9.87	1	2	3	17
18-Apr	89.05	76.08	10.08	4	1	5	32
19-Apr	85.09	72.43	10.02	3	1	4	21
20-Apr	80.97	68.28	9.84	1	0	1	5
21-Apr	75.3	62.69	9.72	3	0	3	12
22-Apr	70.86	57.89	9.6	4	1	5	20
23-Apr	73.12	60.36	9.75	2	2	4	14
24-Apr	67.78	55.06	9.89	8	0	8	24
25-Apr	62.33	49.57	10.16	3	0	3	9
26-Apr	67.26	54.72	10.43	1	1	2	8
27-Apr	65.81	53.42	10.76	0	0	0	0
28-Apr	72.13	59.51	11.33	0	0	0	0
29-Apr	82.14	69.76	11.84	0	0	0	0
30-Apr	83.34	70.67	12.26	7	0	7	35
1-May	79.77	67.19	12.14	2	1	3	22
2-May	80.46	67.81	11.66	3	0	3	24
3-May	84.19	71.48	11.55	2	0	2	10
4-May	91.71	79.14	11.85	4	0	4	35
5-May	98.89	83.88	12.04	6	0	6	26
6-May	89.39	76.71	11.95	1	0	1	5
7-May	88.06	75.43	11.28	1	0	1	6

Appendix Table 5. Continued.

Lower Granite Dam (continued)							
Date (2025)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Spill Detections LGS (n)	Bypass Detections LGB (n)	Detections (n)	Expanded detections (n)
8-May	86.88	74.14	11.15	1	0	1	7
9-May	95.36	82.43	11.67	1	0	1	7
10-May	103.41	83.91	12.51	1	0	1	8
11-May	115.38	84.23	12.86	0	0	0	0
12-May	120.21	83.03	12.56	1	0	1	6
13-May	113.65	80.13	11.98	0	2	2	12
14-May	109.74	77.76	11.66	4	0	4	26
15-May	94.48	78.71	11.31	2	0	2	18
16-May	84.98	71.87	10.96	0	0	0	0
17-May	86.04	73.32	10.77	1	0	1	10
18-May	74.45	61.86	11.12	0	0	0	0
19-May	80.23	67.43	11.5	2	0	2	6
20-May	77.77	64.94	12.04	1	0	1	5
21-May	72.5	59.81	11.93	0	0	0	0
22-May	69.63	56.96	11.98	1	0	1	5
23-May	70.44	57.82	12.28	0	0	0	0
24-May	70.19	57.41	13	1	0	1	5
25-May	69.21	56.67	13.45	1	0	1	5
26-May	75.65	62.95	13.68	0	0	0	0
27-May	82.43	69.7	14.24	0	0	0	0
28-May	92.3	79.53	14.8	0	0	0	0
29-May	100.41	80.19	14.81	0	1	1	5
30-May	105.82	80.31	15.13	0	0	0	0
31-May	103.94	79.82	15.27	0	0	0	0
1-Jun	101.74	79.74	15.22	0	0	0	0
2-Jun	90.94	77.12	15.21	1	0	1	5
3-Jun	85.06	72.38	15.22	1	0	1	5
4-Jun	76.97	64.01	15.02	1	0	1	5
5-Jun	70.03	56.94	14.65	0	0	0	0
16-Jun	50.07	37.32	17.11	1	0	1	4
Avg/Total	**83.05**	**64.83**	**11.36**	**84**	**21**	**105**	**544**

Appendix Table 6. Daily detections at Little Goose Dam in 2025 of wild spring/summer Chinook salmon smolts with river conditions at the dam. Fish were PIT-tagged and released in streams during summer 2024.

Little Goose Dam				
Date (2025)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
21-Apr	71.60	43.74	10.42	2
22-Apr	65.81	39.98	10.39	2
23-Apr	70.73	43.27	10.34	1
24-Apr	64.92	42.71	10.38	0
25-Apr	59.21	34.66	10.48	1
26-Apr	63.74	45.97	10.58	0
27-Apr	61.67	37.03	10.56	1
28-Apr	70.63	44.13	10.76	1
29-Apr	80.46	51.46	11.04	2
30-Apr	79.65	50.79	11.42	1
1-May	78.28	47.41	12.07	0
2-May	78.38	48.66	12.6	0
3-May	81.34	51.01	12.68	0
4-May	86.56	53.97	12.63	2
10-May	99.65	64.57	11.98	1
11-May	112.08	65.57	12.05	2
12-May	113.83	65.17	12.74	2
13-May	109.87	65.42	13.1	1
14-May	102.95	65.42	12.94	0
15-May	90.68	59.74	12.5	1
16-May	81.92	49.37	12.25	0
17-May	82.14	53.37	12.02	0
18-May	70.03	43.07	11.72	1
19-May	78.86	48.33	11.46	1
20-May	75.40	46.64	11.35	1
28-May	87.99	59.58	14.3	1
Avg/Total	**81.48**	**50.81**	**11.7**	**24**

Appendix Table 7. Daily detections at Lower Monumental Dam in 2025 of wild spring/summer Chinook salmon smolts with river conditions at the dam. Fish were PIT-tagged and released in streams during summer 2024.

Lower Monumental Dam				
Date (2025)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
29-Apr	79.41	63.31	11.16	1
16-May	79.94	64.08	13.06	1

Appendix Table 8. Daily detections at Ice Harbor Dam in 2025 of wild spring/summer Chinook salmon smolts with river conditions at the dam. Fish were PIT-tagged and released in streams during summer 2024.

Ice Harbor Dam				
Date (2025)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
22-Apr	68.83	55.05	11.09	1
24-Apr	63.53	49.98	11.17	1
30-Apr	82.49	68.62	11.76	1
15-May	94.3	80.67	13.08	1
16-May	84.72	71.04	13.48	1

Appendix Table 9. Daily detections at McNary Dam in 2025 of wild spring/summer Chinook salmon smolts with river conditions at the dam. Fish were PIT-tagged and released in streams during summer 2024.

McNary Dam				
Date (2025)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
25-Apr	200.37	139.79	10.5	1
26-Apr	181.66	121.05	10.8	1
27-Apr	185.21	124.91	10.7	1
28-Apr	171.87	111.12	10.9	2
29-Apr	189.61	128.98	11.2	1
30-Apr	211.82	149.83	11.6	1
1-May	211.58	150.10	11.9	0
2-May	218.61	157.03	12.1	2
3-May	198.83	136.43	11.9	1
4-May	198.24	137.23	11.7	1
5-May	219.69	159.09	12.0	1
6-May	226.75	165.53	12.4	0
7-May	209.28	148.48	12.7	1
8-May	219.77	157.97	13.0	1
9-May	239.23	177.11	13.3	1
10-May	230.49	168.53	13.2	0
11-May	239.34	178.52	13.0	0
12-May	273.49	211.51	13.0	1
13-May	246.12	183.53	12.9	0
14-May	217.75	156.51	13.0	0
15-May	198.00	137.19	12.8	1
16-May	203.38	142.27	12.8	0
17-May	211.98	151.54	13.1	0
18-May	185.72	125.33	13.2	2
19-May	166.08	105.22	13.2	1
30-May	220.26	159.50	15.5	1
Avg/Total	**210.58**	**149.40**	**12.4**	**21**

Appendix Table 10. Daily detections at John Day Dam in 2025 of wild spring/summer Chinook salmon smolts with river conditions at the dam. Fish were PIT-tagged and released in streams during summer 2024.

John Day Dam				
Date (2025)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
29-Apr	189.03	82.91	11.75	1
3-May	194.56	85.87	12.11	1
14-May	223.07	97.76	13.74	1

Appendix Table 11. Daily detections at Bonneville Dam in 2025 of wild spring/summer Chinook salmon smolts with river conditions at the dam. Fish were PIT-tagged and released in streams during summer 2024.

Bonneville Dam				
Date (2025)	Average flow (kcfs)	Average spill (kcfs)	Water temperature (°C)	Numbers detected (n)
1-May	224.97	150.81	12.3	1
2-May	226.94	151.55	12.6	0
3-May	207.24	149.52	12.7	1
4-May	209.47	148.79	12.6	0
5-May	232.79	149.17	12.5	0
6-May	251.38	148.83	12.8	1
7-May	223.62	148.63	13.2	0
8-May	225.76	148.56	13.3	0
9-May	230.73	149.61	13.5	4
10-May	237.59	149.45	13.3	0
11-May	241.34	150.24	13.4	0
12-May	276.63	150.42	13.39	0
13-May	266.50	150.13	13.34	1
14-May	214.74	149.85	13.5	2
15-May	213.41	150.36	13.6	0
16-May	212.69	149.96	13.7	1
17-May	215.09	151.11	13.9	1
Avg/Total	**230.05**	**149.82**	**13.2**	**12**

U.S. Secretary of Commerce
Howard Lutnick

Under Secretary of Commerce
for Oceans and Atmosphere
Dr. Neil Jacobs

Assistant Administrator for Fisheries
Eugenio Piñeiro Soler

March 2026

fisheries.noaa.gov

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National Marine
Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, Washington 98112