

SYSTEM OPERATIONAL REQUEST: #2024-1

Walla Walla District

The following State, Federal, and Tribal Salmon Managers have participated in the preparation and support this SOR: Idaho Department of Fish and Game, Nez Perce Tribe, Yakama Nation, Columbia River Inter-Tribal Fish Commission, Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife

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FROM: Jonathan Ebel (Idaho Department of Fish and Game)

DATE: May 16, 2024

SUBJECT: Cease smolt transportation at Lower Monumental Dam in 2024

SPECIFICATIONS:

Suspend barge transportation from Lower Monumental Dam for the remainder of 2024 to decrease within day variation in outflow at Lower Monumental and Ice Harbor Dams and stabilize reservoir dynamics of the Lower Monumental pool.

JUSTIFICATION:

Juvenile transport at Lower Monumental Dam (LMN) requires the barge to transit the tailrace to approach the juvenile fish facility. As a result, the USACE curtails spill for safety reasons for approximately four hours (typically 1900 to 2300h) on days when fish are being transported. Operations to the 125% TDG gas cap for 24 hours per day at present river discharge has resulted in a “minimum generation – spill the rest” situation where project outflow is rapidly changed before/after the barge transits the tailrace by reducing/increasing spill while maintaining minimum generation. LMN outflow during the evening barge transit changed more than 50% over a few hours each day from 25 Apr – 03 May (range approximately 35 - 90kcfs; Figure 1 middle panel).

Rapid changes in flow are translating to a similar outflow pattern at Ice Harbor Dam (IHR; Figure 1). Rapid changes in flow results in drastic changes in tailrace conditions because total outflow is determined by spill volume under minimum generation conditions (i.e., a 60 kcfs change in outflow over a short period corresponds to a 60 kcfs change in spill volume). Stabilizing inflow to Ice Harbor would stabilize tailrace conditions by reducing the rate of change in spill volume and provide for better adult passage conditions at Ice Harbor Dam.

The substantial changes in outflow from Lower Monumental Dam has impacts both upstream to the Little Goose Dam tailwater and downstream to the confluence of the Columbia and Snake Rivers which may negatively impact both adult Chinook salmon passage and juvenile salmon and steelhead migrants.

Impacts of flow fluctuation on adult passage:

We acknowledge that many interacting factors influence adult Chinook salmon travel time between projects in the Snake and Columbia Rivers including spill proportion, project outflow, temperature, and angling pressure. The interaction of these factors combined with ever changing operational conditions makes it difficult to identify which operations or conditions are the dominant cause of changes in adult travel time. However, we know that Chinook salmon exhibit behavioral responses to rapid changes in river conditions, whatever those may be, and those behavioral responses ultimately produce the patterns we observe in travel times but generally not conversion rates.

High within-day variation in flow may be slowing adult passage at Ice Harbor Dam (Figure 1 bottom panel). Increased arrivals of PIT-tagged adult Snake River Chinook salmon at McNary Dam in 2024 coincided with a substantial increase in variation in outflow caused by transport operations at Lower Monumental Dam. These first arriving fish exhibited slower travel times than expected, with more than 50% of tagged fish requiring greater than 4 days to pass Ice

Harbor Dam. Adult travel time, as indicated by median conversion, increased when flows stabilized with the cessation of transport at Lower Monumental in 2024. Similar increases in adult travel time occurred coincident to sequential days of high within-day flow variation from 05-13 May 2023 and 03-18 June 2022 (See CBR DART tool and hourly operation data for those periods).

The large and rapid flow changes at Ice Harbor Dam were a direct result of juvenile transportation operations at Lower Monumental Dam in 2024. In 2022 and 2023, it was caused by ponding water to maintain 30% spill/ 8h/d at Little Goose Dam. The operation for barge transportation from Lower Monumental Dam has similar effects, but over a shorter daily duration and begins occurring at lower total river discharge. The mechanism for changes in adult travel time caused by flow fluctuations is difficult to evaluate with current tools because a change in total discharge alters reservoir dynamics at a reservoir scale compared to changes in spill proportion of spill pattern which impacts tailrace dynamics. The impacts of the latter may be inferred from hourly counts whereas the former cannot. Adult travel time from McNary to Ice Harbor may be influenced by changes in attraction flow to the Snake River itself as discharge at the confluence varies within a day.

Impacts of flow fluctuation on juvenile migration:

Impacts of daily flow fluctuation on juvenile migrants has not been specifically studied to our knowledge. Quantifying the impact of acute, short duration events at a reservoir level is difficult. Yet, we can qualitatively assess the impact by looking at reservoir dynamics and thinking about how juvenile migrants move downstream. A rapid decrease in the flow out of Lower Monumental Dam immediately altered the Little Goose Tailwater (Figure 1 bottom panel) suggesting that there are probably rapid changes in water velocities reservoir-wide, which can disorient juveniles with several potential outcomes including slower fish travel times and increased predation rates. Relationships between powerhouse passage and ponding operations have also been demonstrated (FPC 2018) like what is required for barge transportation from Lower Monumental Dam.

Potential Impacts of cessation of transport at Lower Monumental Dam on returning adults of future generations

This request will reduce the proportion of yearling Chinook, subyearling Chinook, steelhead and Sockeye salmon transported from Lower Monumental Dam to zero and reduce the total proportion transported from the three collector projects combined by approximately 30%. (Figure 8 and Figure 5).

Snake River Spring/Summer Chinook Salmon

We compared smolt-to-adult return ratios (SARs) of wild Chinook salmon collected and transported from each dam (data available in Appendix D of the Comparative Survival Study (CSS) Annual Report; McCann et al. 2023) and found little qualitative difference between dams (Figure 2). We then compared SARs of wild Chinook salmon collected and transported from Lower Monumental Dam (Appendix D of McCann et al. 2023) and compared it to SARs of fish

that were not detected at any of the three collector projects (C0 group; McCann et al. 2023) and to fish that were detected in the bypasses of one of more collector projects but returned to the river. We found little difference between the SARs of Chinook salmon transported from Lower Monumental Dam and in-river study groups included in the CSS (Figures 3 & 4).

Snake River Summer Steelhead

Like above, we compared the SARs of wild steelhead transported from Lower Monumental Dam to in-river migrants. Wild steelhead transported from Lower Monumental Dam have generally exhibited higher SARs than C0 and C1 groups, but the difference between the groups has narrowed over time as in-river survival has increased (Figures 6 & 7).

For both the Spring/ Summer Chinook Salmon and the Summer Steelhead comparisons of SARs, it is important to note three things.

- (1) The sample size of PIT tagged fish transported from Lower Monumental is much lower than the sample size of the other two groups and consequently the confidence bounds are much greater on the SAR estimate for transported fish.
- (2) Second, the C0 and C1 group SARs are from Lower Granite Dam as juveniles back to Lower Granite Dam as adults. Therefore, the C0 and C1 group estimates incorporate more juvenile mortality than the Lower Monumental Dam group because of the different starting point of these estimates (i.e., mortality between Lower Granite Dam to Lower Monumental is incorporated into the C0 and C1 estimates, but not the LMN transport SAR).
- (3) In this SOR, we show estimates of SARs of an entire migration year, but there is a seasonality component to transportation benefits such that earlier migrants perform better in the river and later migrants perform better when transported. Additionally, the degree of benefit from transportation varies among water years — past data suggests higher transport benefits in low water supply years.

Even with these three caveats, we conclude that does not appear to be a substantial survival benefit to Chinook Salmon transported at Lower Monumental Dam relative to remaining in the river over the entire migration year, but there is a benefit to transporting for wild Summer Steelhead.

Snake River Fall Chinook Salmon

The majority of hatchery-origin Snake River Fall Chinook pass Lower Granite Dam during the spring transportation period and would be placed on a barge if collected at any of the three collector projects (see cumulative passage index tool on the FPC website, which largely reflects hatchery-origin timing; FPC 2023). Smith et al. (2018) showed strong seasonality to transportation effects on hatchery Fall Chinook where earlier arriving Fall Chinook salmon had the Transport-to-Bypass SAR ratios (T:B ratio) at Lower Monumental Dam that were well below 1 and that the transport had a negative effect on SAR until between June 16th and July 1st. We predict that suspending transportation at Lower Monumental Dam will benefit Snake River Fall Chinook Salmon by improving river conditions relative to the wide fluctuations in flow and that

Fall Chinook do not appear to benefit from transport prior to the end of the spring transport season.

Snake River Sockeye

Of the four listed species of anadromous fishes in the Snake River, Snake River Sockeye Salmon transported by barge perform the worst relative to their in-river counterparts. Transport-to-In-River SAR ratios (TIR) is consistently below 1 (McCann et al. 2023 in Table A.67 on pdf page 409), meaning in-river sockeye perform better than transported sockeye. Additionally, Snake River sockeye pass through the Snake River projects during a much shorter window than the other species, such that short duration operational changes may have exaggerated effects if it aligns with the sockeye passage window. Suspending transportation at Lower Monumental Dam may benefit Snake River sockeye because the species does not benefit from being barged and it may improve in-river conditions relative to reducing spill and total outflow for barge safety.

Current progress of juvenile migration

Migration year 2024 yearling Chinook and steelhead juvenile migration has probably reached its peak and the percentage of populations that could benefit, or at least not be harmed by transportation is very low. Meanwhile, subyearling Chinook Salmon have begun arriving at Lower Granite Dam in the thousands and Snake River Sockeye are also about to increase in numbers in the Lower Snake River. Subyearling Chinook Salmon and Snake River Sockeye exhibit negative responses to barge transport. Resuming transport at Lower Monumental at this point in 2024 will probably have little benefit to wild steelhead because of the small percentage that may be transported and a potentially higher cost to subyearling Chinook and Sockeye Salmon. For current status of migration timing, please see the Two Week Passage Index Report from the Smolt Monitoring Program (<https://www.fpc.org/currentdaily/passindx.pdf>)

Summary

In summary, operations associated with barge transportation from Lower Monumental Dam cause dramatic changes in the river environment from the Little Goose Dam tailwater to the confluence of the Columbia and Snake Rivers. Meanwhile, we expect to transport between 7-20% and 4-30% of juvenile Chinook salmon and steelhead, respectively (Figure 8). Of the total number of juveniles transported, approximately 30% would be transported from Lower Monumental Dam (Figure 5). Scaling up, juveniles transported from Lower Monumental Dam comprise 2-7% and 1-10% of the *entire* juvenile Chinook salmon and steelhead run in a given recent year, respectively. This means that any benefits of barge transportation would be experienced by less than 10% of the total run, while over 70% of the total juvenile run that migrates in the river may be negatively impacted by the operation that permits barge transportation from that facility.

In terms of the current migration year, the majority of steelhead have passed Lower Monumental Dam, or will pass in the next few days. Subyearling Chinook and sockeye are beginning to increase in numbers such that resuming transport will benefit a very small portion of wild steelhead and impact a higher proportion of the two species that exhibit a negative response to

barging. Furthermore, there is increasing anecdotal evidence of a relationship between within-day flow variation and adult travel times between Ice Harbor Dam and McNary Dam and that stabilizing flows improves adult travel times.

The requested operation — suspending juvenile transportation at Lower Monumental Day— will stabilize flows to benefit in-river juveniles and upstream migrating adults until we can arrive at another solution to the flow variability and ponding caused by transport operations.

References:

McCann, J., B. Chockley, E. Cooper, G. Scheer, R. Tessier, S. Haeseker, B. Lessard, T. Copeland, J. Ebel, A. Storch, and D. Rawding. 2023. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye: 2023 Annual Report. BPA Contract #19960200.

Fish Passage Center. 2023. Snake River fall Chinook migration characteristics. Memorandum 39-23. October 25th, 2023.

Fish Passage Center. 2018. Review of special operation at LGS to improve adult passage. Memorandum 30-18. June 01, 2018.

Smith, S. G., T. M. Marsh, and W. P. Connor. 2018. Responses of Snake River Fall Chinook Salmon to dam-passage strategies and experiences. Report to Walla Walla District USACE by Northwest Fisheries Science Center, NOAA and Idaho Fish and Wildlife Conservation Office, USFWS. November 2018

Widener et al. 2023. Survival Estimates for the passage of spring-migrating juvenile salmonids through Snake and Columbia River Dams and Reservoirs, 2022. Northwest Fisheries Science Center, NOAA. October 2023.

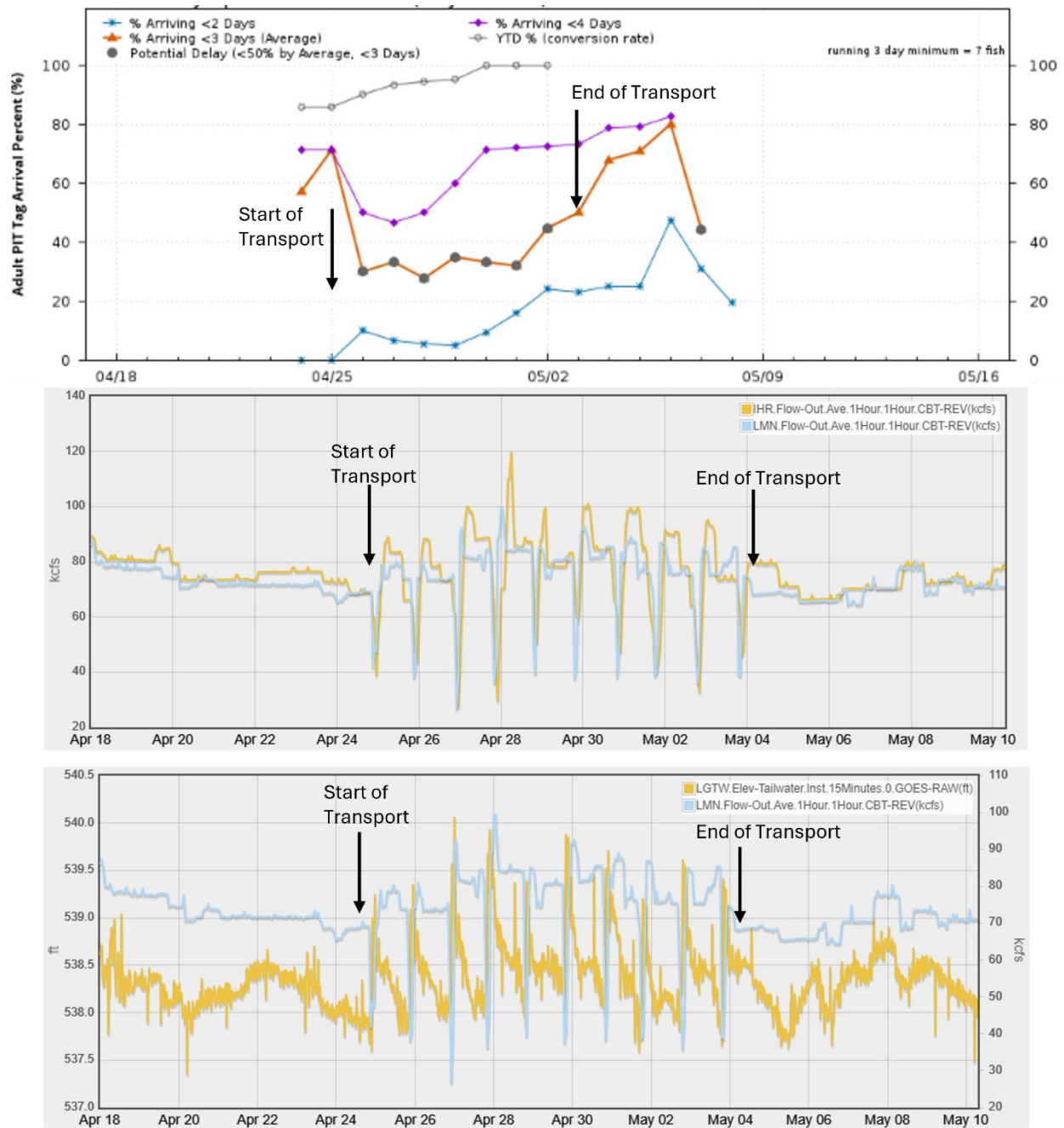


Figure 1. (Top) CBR DART adult passage tool for the McNary to Ice Harbor reach showing the median conversion rate greater than three days during the period of transport operation at Lower Monumental Dam; (Middle) Total outflow at Lower Monumental Dam and Ice Harbor Dam before, during, and after juvenile transportation; (Bottom) Lower Monumental Dam outflow variation and consequent dynamics of the Little Goose Tailwater.

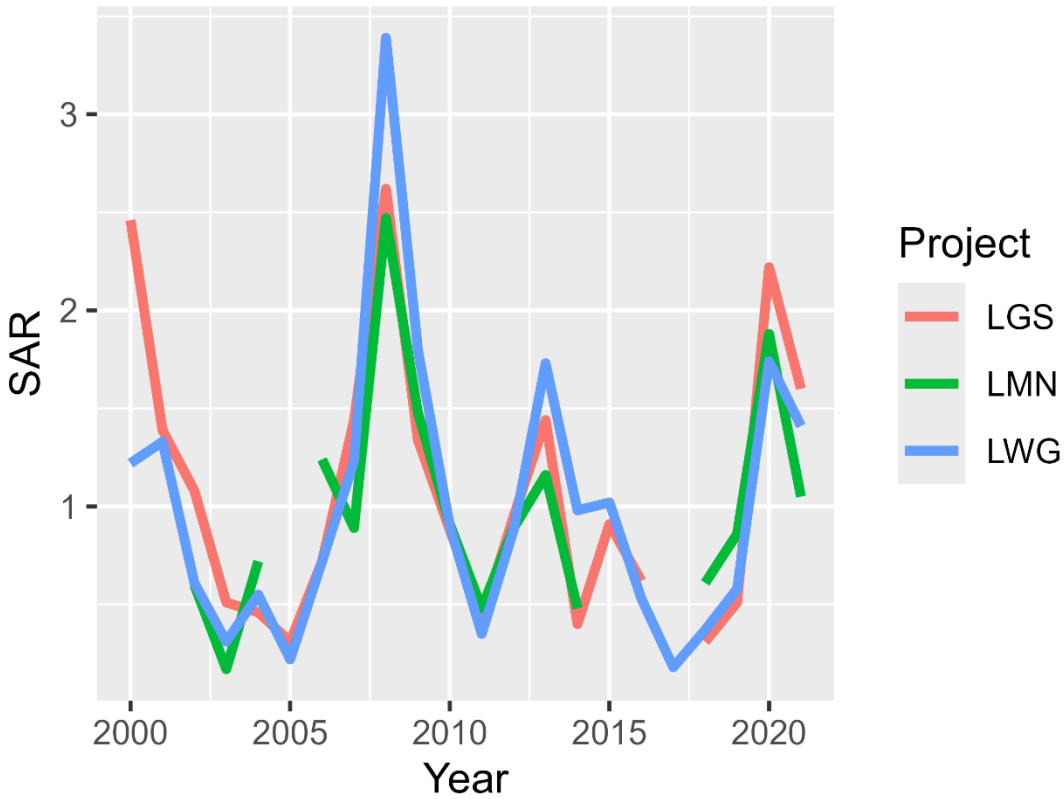


Figure 2. Smolt to Adult Return ratio (SAR) of PIT tagged wild Snake River Sp/Su Chinook salmon by dam of collection. Gaps in the time series are the result of zero returning PIT tagged adults transported at a given dam. Annual point estimates without confidence intervals. Data from Appendix D of the 2023 CSS Annual Report (McCann et al. 2023).

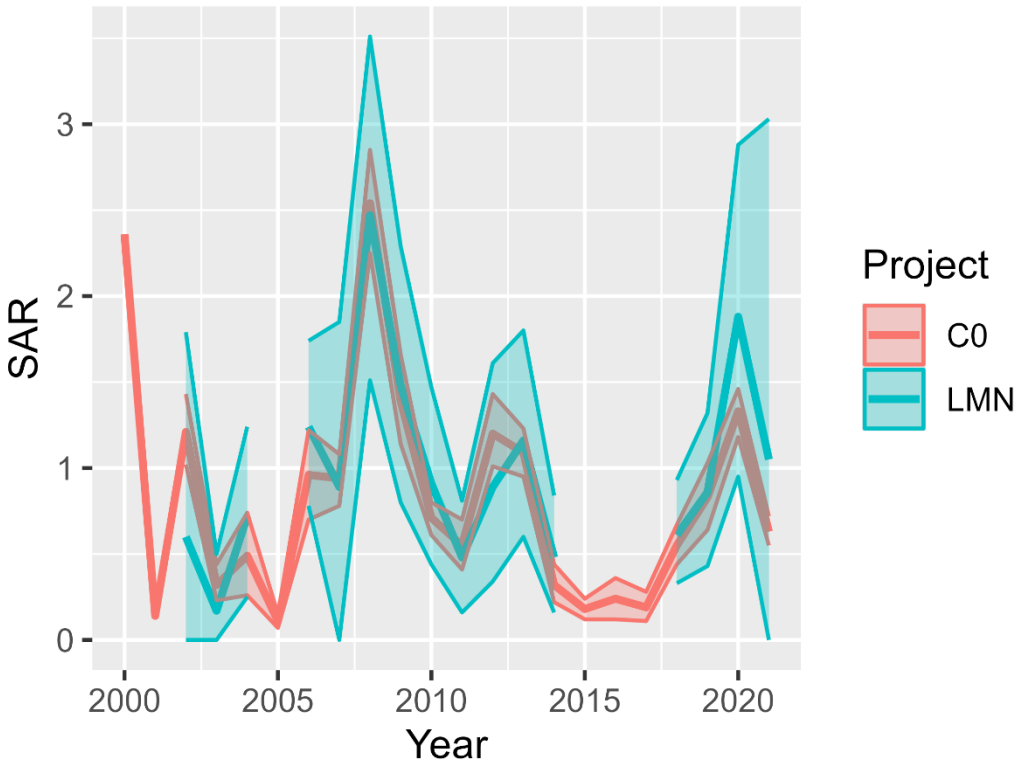


Figure 3. SAR of wild Snake River Sp/Su Chinook salmon that **were not detected at one of the three collector projects** for smolt migration year 1999-2021 (C0 Group; red line +/- 90% CI) and the SAR of wild Snake River Sp/SU Chinook salmon transported from Lower Monumental Dam (blue line +/- 90% CI). **Note:** C0-group SARs are estimated from LGR – LGR and include in-river juvenile mortality **not included** in the LMN – LGR SAR. Years without points indicate zero PIT tag returns, except for 2016. Data for LMN transported SAR is from Appendix D of the 2023 CSS Annual Report (McCann et al. 2023) and the data for the C0 group was queried from the FPC website.

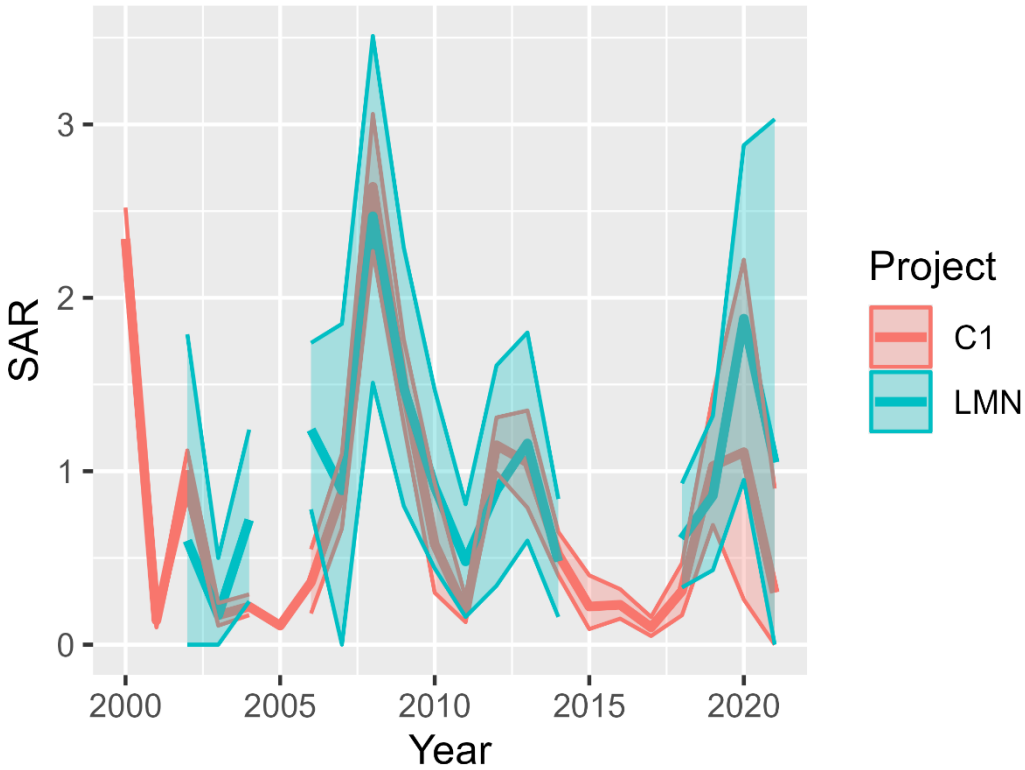


Figure 4. SAR of wild Snake River Sp/Su Chinook salmon **that were detected at one of the three collector projects** for smolt migration year 1999-2021(C1 Group; red line +/- 90% CI) and the SAR of wild Snake River Sp/SU Chinook salmon transported from Lower Monumental Dam (blue line +/- 90%CI). **Note:** C1-group SARs are estimated from LGR – LGR and include in-river juvenile mortality **not included** in the LMN – LGR SAR. Years without points indicate zero PIT tag return. Data for LMN transported SAR is from Appendix D of the 2023 CSS Annual Report (McCann et al. 2023) and the data for the C1 group was queried from the FPC website.

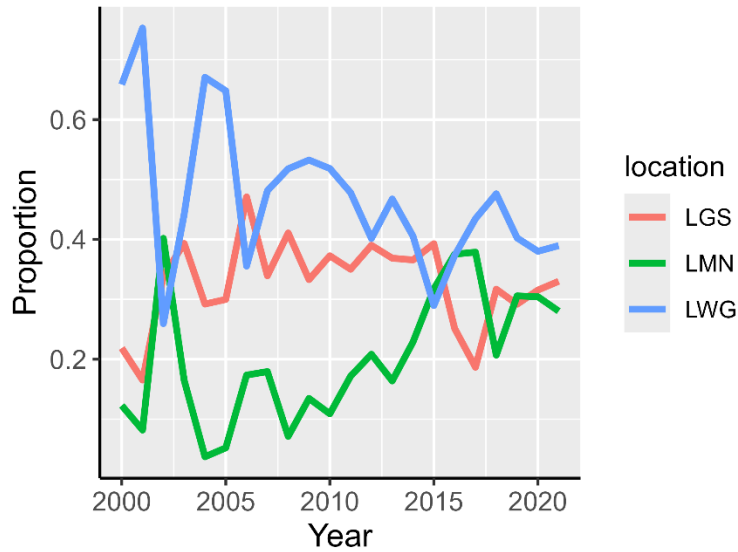


Figure 5. Proportion of total juvenile steelhead and Chinook salmon collected and transported at each dam.

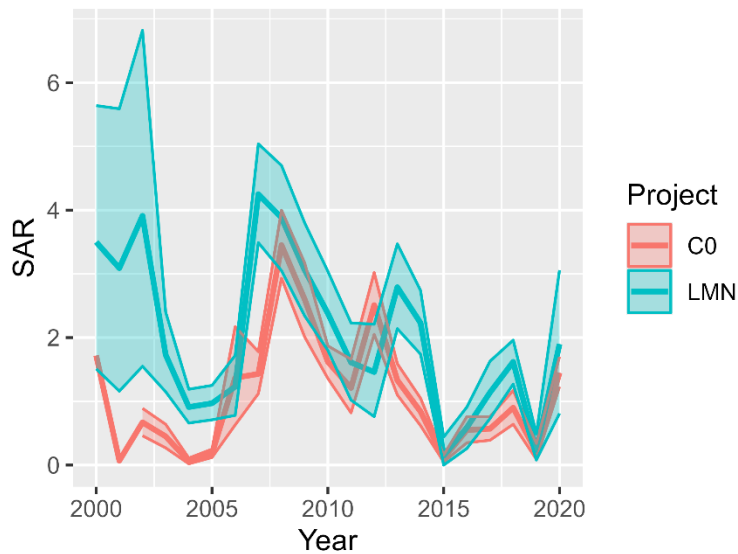


Figure 6. SAR of wild Snake River summer steelhead that **were not detected at one of the three collector projects** for smolt migration year 1999-2021 (C0 Group; red line +/- 90% CI) and the SAR of wild summer steelhead transported from Lower Monumental Dam (blue line +/- 90% CI). **Note:** C0-group SARs are estimated from LGR – LGR and include in-river juvenile mortality **not included** in the LMN – LGR SAR. Years without points indicate zero PIT tag returns, except for 2016. Data for LMN transported SAR is from Appendix D of the 2023 CSS Annual Report (McCann et al. 2023) and the data for the C0 group was queried from the FPC website.

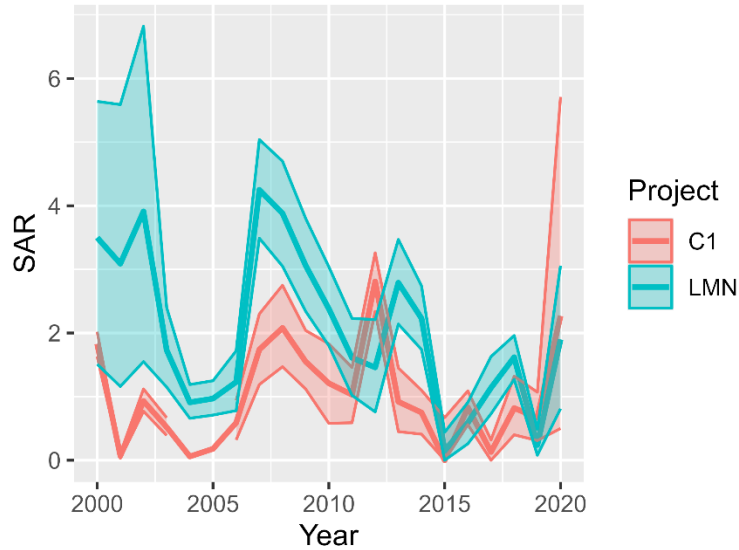


Figure 7. SAR of wild Snake River summer steelhead **that were detected at one of the three collector projects** for smolt migration year 1999-2021(C1 Group; red line +/- 90% CI) and the SAR of wild summer steelhead transported from Lower Monumental Dam (blue line +/- 90%CI). **Note:** C1-group SARs are estimated from LGR – LGR and include in-river juvenile mortality **not included** in the LMN – LGR SAR. Years without points indicate zero PIT tag return. Data for LMN transported SAR is from Appendix D of the 2023 CSS Annual Report (McCann et al. 2023) and the data for the C1 group was queried from the FPC website.

Table 21. Annual estimated percentages of Snake River yearling Chinook and juvenile steelhead arriving at Lower Granite Dam that were transported from a collector dam and released downstream of Bonneville Dam. Estimates are for hatchery and wild groups and the mean of the two, 1993-2022. Simple arithmetic means are given across all years and for periods with similar transportation schedules (1993-2006 and 2007-2022).

Year	Estimated percentages of fish transported, 1993-2022 (%)					
	Yearling Chinook salmon			Juvenile steelhead		
	Hatchery	Wild	Mean	Hatchery	Wild	Mean
1993	88.1	88.5	88.3	94.7	93.2	94.0
1994	84.0	87.7	85.9	82.2	91.3	86.8
1995	79.6	86.4	83.0	94.3	91.8	93.0
1996	68.7	71.0	69.9	82.9	79.8	81.4
1997	71.5	71.1	71.3	84.5	87.5	86.0
1998	81.5	82.5	82.0	87.3	88.1	87.7
1999	77.3	85.9	81.6	88.5	87.6	88.1
2000	63.0	70.5	66.8	81.5	84.0	82.8
2001	97.3	99.0	98.2	96.7	99.3	98.0
2002	64.3	72.1	68.2	70.6	75.2	72.9
2003	51.7	70.4	61.1	68.6	72.9	70.8
2004	90.5	92.0	91.3	97.3	96.3	96.8
2005	93.9	95.3	94.6	98.2	98.6	98.4
2006	62.3	59.9	61.1	76.7	68.4	72.6
2007	25.4	24.8	25.1	41.3	41.9	41.6
2008	45.3	54.3	49.8	46.9	57.7	52.3
2009	38.3	40.4	39.4	43.7	49.0	46.4
2010	22.6	38.2	30.4	35.0	36.6	35.8
2011	40.7	35.2	38.0	36.1	43.3	39.7
2012	24.7	22.7	23.7	26.2	31.4	28.8
2013	31.0	36.1	33.6	33.6	51.4	42.5
2014	38.3	30.9	34.6	33.3	47.4	40.4
2015	13.6	11.4	12.5	13.2	18.7	16.0
2016	21.0	19.3	20.2	22.6	27.7	25.2
2017	21.4	17.8	19.6	19.0	40.2	29.6
2018	45.4	44.1	44.8	44.5	63.3	53.9
2019	33.6	41.6	37.6	35.5	44.1	39.8
2020	12.5	18.8	15.7	11.7	20.5	16.1
2021	5.9	9.8	7.9	4.3	11.1	7.7
2022	23.9	30.6	27.3	24.0	38.7	31.4
Mean						
1993-2022	50.6	53.6	52.1	55.8	61.2	58.5
1993-2006	76.7	80.9	78.8	86.0	86.7	86.4
2007-2022	27.7	29.8	28.7	29.4	38.9	34.2

Figure 8. Table from Widener et al. 2023. Survival Estimates for the passage of spring-migrating juvenile salmonids through Snake and Columbia River Dams and Reservoirs, 2022. Northwest Fisheries Science Center. October 2023.