

SYSTEM OPERATIONAL REQUEST: #2020-6

WALLA WALLA DISTRICT

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FROM: Dave Swank, FPAC Chair

DATE: September 22, 2020

SUBJECT: Snake River Zero Nighttime Flow

SPECIFICATIONS: The fishery managers recommend continued application of Zero Nighttime Flow limitations and criteria, implemented since 2005, at the Snake River projects.

JUSTIFICATION: Zero nighttime flow operations at federal projects in the Lower Snake River have been the subject of much discussion since the dams were completed. Decades of discussion culminated in limiting Zero Nighttime Flow operations to periods after December 1 and through February 28 “when there are few, if any, actively migrating anadromous fish present in the Snake River” in Water Management Plan Seasonal Updates beginning in 2004. Fish managers defined “few, if any” in SOR 2005-22 and the criteria in this definition have guided and governed implementation since then. However, zero night time flow operations do not support normal ecological river functions and as such are not supported by all fish managers.

The 2020 Columbia River System Operations Biological Opinion (Page 65, Section 1.3.1.3.) and pending Water Management Plan do not include fish-based zero flow implementation criteria and extends the zero flow operation period by 45 days:

“Between October 15 and February 28, when power market conditions warrant and when river conditions make it feasible, power generation at Snake River projects may cease, and water stored, during nighttime hours, most commonly implemented between 2300 and 0500 hours when demand for power is lowest or other renewable resources are generating surplus power (or both). This operation will end no later than 2 hours before dawn between October 15 and November 30. During the operation between December 15 and February 28, daytime hours will no longer be excluded from this operation, and up to 3 hours of daytime cessation will be part of the proposed action.”

Dropping implementation criteria and implementing zero flow operations earlier would allow river flows in the Lower Snake River to be shutoff for up to 25% (6 hours) of each day (37.5% or 9 hours after December 15) for 4.5 months, even during periods of known significant adult and juvenile passage.

Zero nighttime flow is a load-following operation, often referred to as “peaking”, where water is stored during periods of low power demand and subsequently released when demand is high. Little definitive information on the impacts of peaking on anadromous fishes in the Lower Snake River exists and is largely limited to upstream migrating adults, with no analysis of the impacts on juveniles. Furthermore, it is difficult to predict the impacts of the new zero nighttime flow operation because of the flexibility afforded to the Action Agencies — it can occur every day or very seldom. No study completed to date indicates that zero flow operations benefit fish passage or protection measures.

Impacts on adults

Multiple species of anadromous fish migrate through the lower Snake River as adults during October, November, and December (Figure 1). Chinook salmon passing Lower Granite dam after August 17th are considered fall Chinook run type. Fall chinook adult run timing currently peaks in late-September and continues through late November. The 10-year average Lower Granite Dam daily passage abundance of fall Chinook on October 15th is 218 fish. Many of these adults move through the Lower Snake in ripe spawning condition, with spawning typically starting in early-October and extending into early-December. Migration of adult coho salmon through the Lower Snake River starts in mid-September, peaks in early-October, and continues through late-November. Similar to fall Chinook, coho have a minimal maturation

period between arrival to natal streams and spawning. Adult steelhead are present year-round, with peak passage at Lower Granite Dam occurring around the end of September. The 10-year average daily steelhead passage on October 15th is 1,681 fish.

Three separate studies have investigated the response of migrating adult fish to zero nighttime flow operations — McMaster et al 1977, Liscom et al. 1985, and Bjornn et al. 1998 — with variable results and limited direct applicability to the operation set to begin October 15th, 2020.

McMaster et al. 1977 used a small number of radio tags, magnetic tags, and count data to monitor Chinook salmon and steelhead movement patterns under controlled nighttime flows (10,000 or 20,000 cfs) or zero nighttime flow in 7 day blocks during July – November 1975 and on 2 day rotating blocks from July – September 1976. Radio tagged Chinook salmon had low conversion rates, which the authors attributed to handling and tagging effects. The authors did not attribute changes in steelhead behavior to the zero nighttime flow operations.

Following the results of McMaster et al. 1977, Bonneville Power Administration requested the ability to implement zero flow conditions for 9 hours at night (22:00 – 07:00) and for a continuous 35 hours on weekends from August – April (Liscom et al. 1985). Concern over this operation led NMFS and the state fishery agencies to again study adult passage under zero flow conditions by radio tagging 232 steelhead and 32 Chinook salmon and monitoring their migration rate between Lower Monumental and Little Goose Dams from July – September 1981. They used alternating 1 week blocks of the zero flow operations requested by BPA and “normal” conditions. This study found high variability in passage times under zero flow conditions potentially worsened by high water temperatures, which also reduced tagging rates. Travel times for steelhead and Chinook salmon were significantly higher between Lower Monumental and Little Goose Dams during zero flow treatment blocks.

As part of a large multi-part study on adult salmon and steelhead migration, Bjornn et al. (1998) employed spaghetti loop tags and radio transmitters to steelhead in two week blocks of zero versus minimum flows from September – mid November 1991-1993 where zero flow was implemented between 23:00 and 05:00. These authors found changes in steelhead travel time, but differences were not statistically significant and attributed the observed changes in passage to differences in temperature among treatment blocks. More specifically, slow travel times were documented at the beginning (early September) and end (late October) of the study period.

The combined results of these three studies suggest that the impacts of zero nighttime flow may be small for steelhead, but larger for Chinook. However, all three studies discuss temperature as a confounding factor and the difficulty of drawing conclusions from this type of blocked design. No study investigated coho, or tagged Chinook later than mid-September. It is, however, important to note that zero nighttime flow operations may directly impact steelhead passing the dams at night, which was estimated to be 5.4 – 8.7% of adult steelhead passing Lower Granite Dam during non-window count hours (20:00 – 04:00) (FPC 2015).

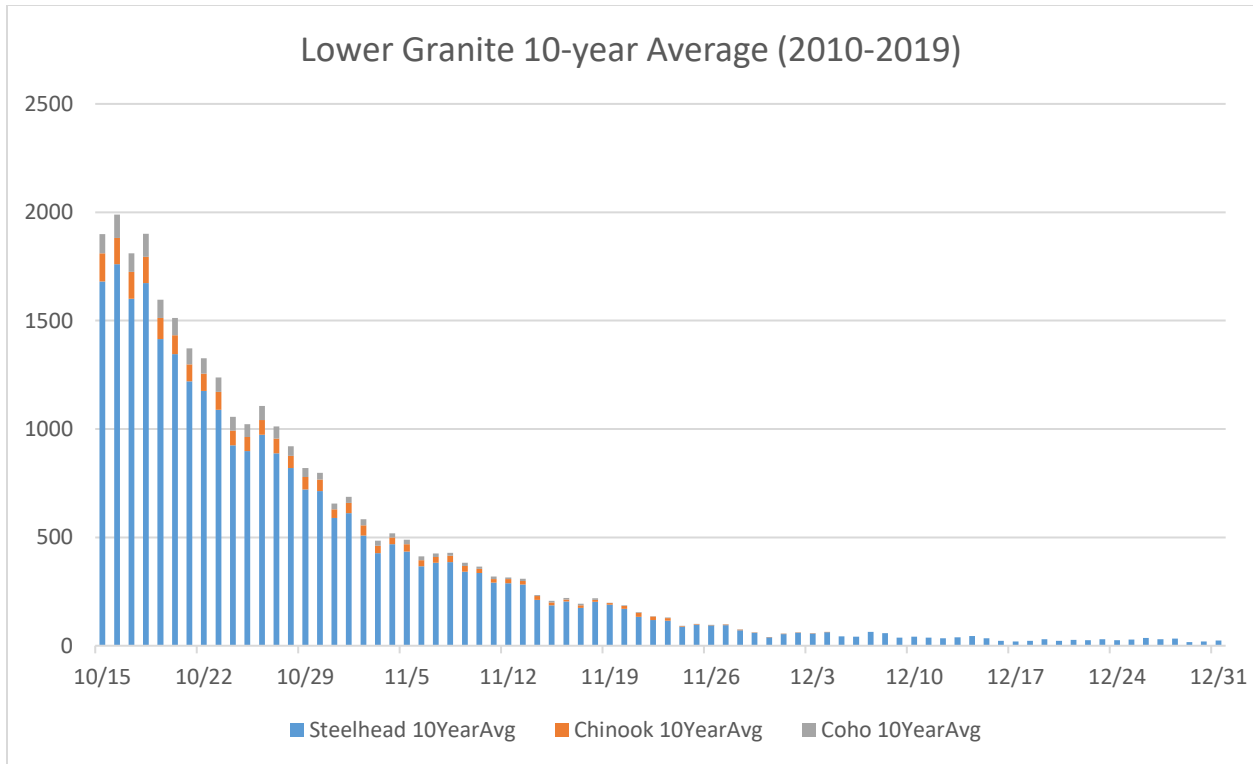


Figure 1. Daily adult passage at Lower Granite Dam (10-year average) for steelhead, fall Chinook, and coho. Data generated by U.S. Army Corps of Engineers, downloaded from DART (http://www.cbr.washington.edu/dart/query/adult_daily) on September 14, 2020.

Impacts on juveniles

Assessment of zero nighttime flow operations on juvenile fall Chinook behavior has not occurred and effects are unknown.

Juvenile migrants passing Lower Granite Dam October through December are primarily natural-origin fall Chinook salmon originating from Clearwater basin spawning aggregates (Figure 2). Index median passage timing of natural-origin juveniles tagged in the Clearwater River is October 25 (Figure 3). Juvenile fall Chinook emigration timing is diverse, with a majority passing May through July as sub-yearling smolts. Abundance gradually decreases through September as the juveniles that remain transition to a lower Snake River reservoir rearing yearling life-history, then increases after the beginning of October, with spikes of movement into lower Snake River critical habitats - likely associated with environmental cues. The Lower Granite Dam juvenile bypass system (JBS) is typically shutdown in late November, limiting data on juvenile movement (Connor et al 2011). Radio tag data generated by USGS (Tiffan et al 2012) shows juvenile fall Chinook passage continues after shutdown of the JBS. Radio tag data also shows passage is normally distributed between nighttime and daytime periods (i.e. juvenile fish do not stop migrating at night) (Figures 4 and 5).

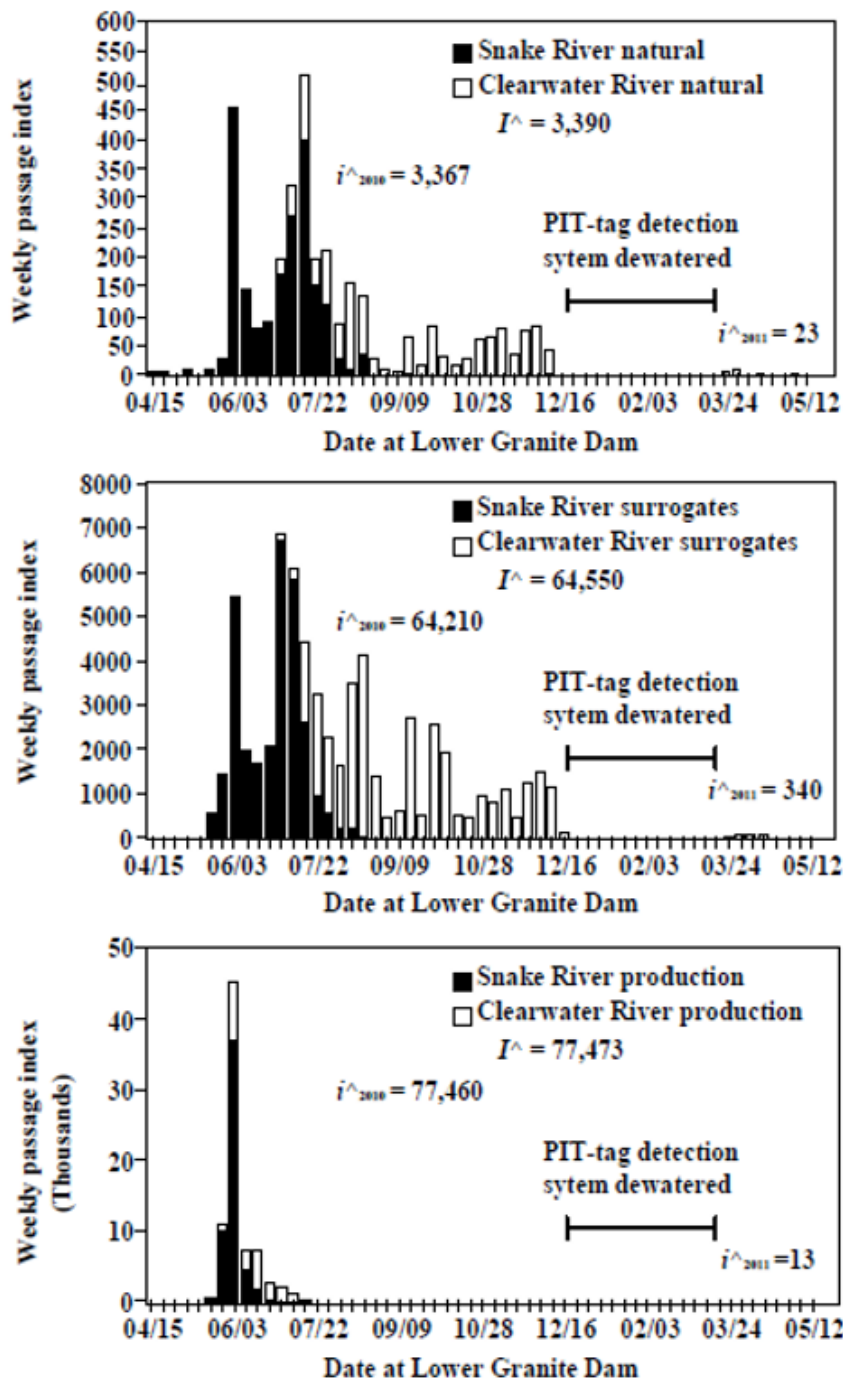
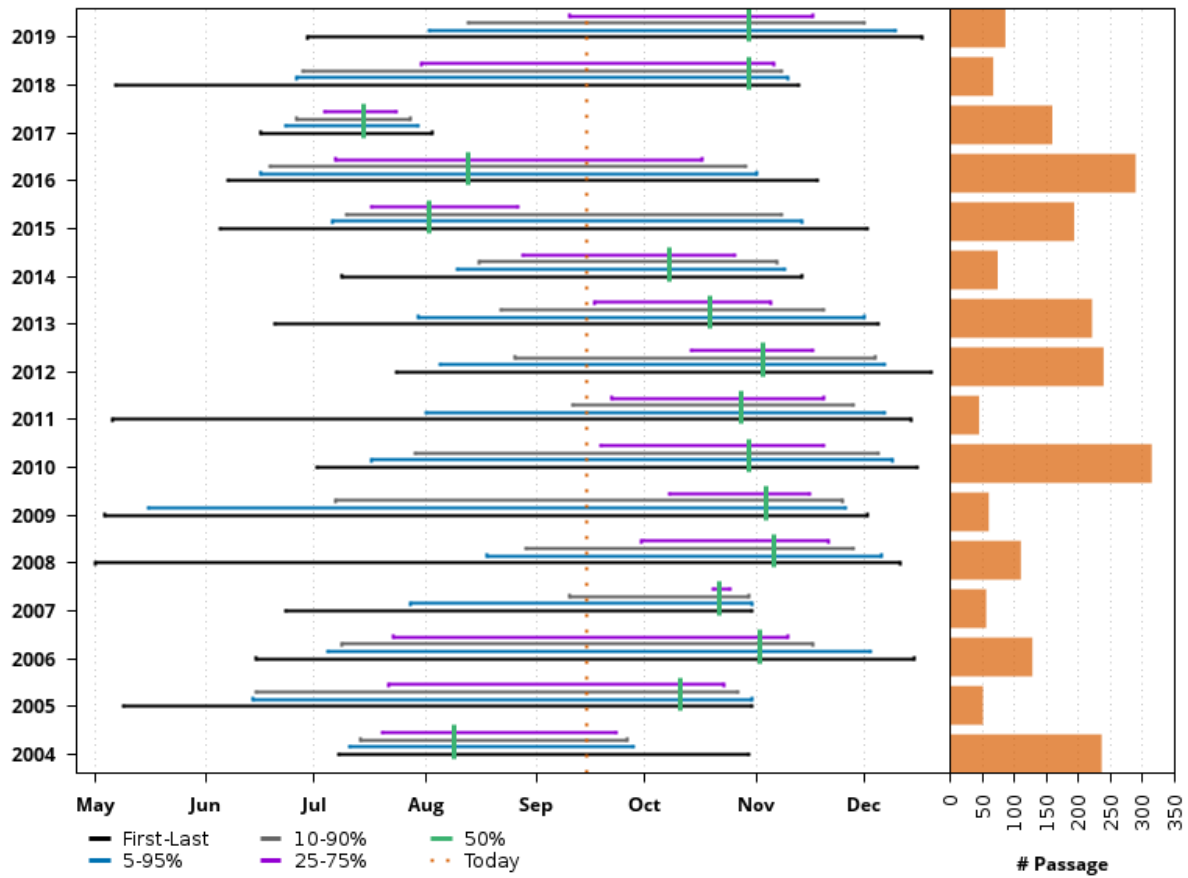


Figure 2 – Replicated Figure 2 from Connor et al (2011). Weekly passage indices at Lower Granite Dam during migration years 2010 and 2011 for Snake River and Clearwater river natural (top panel), surrogate (middle panel) and production (bottom panel) fall Chinook salmon juveniles based on fish that were PIT tagged and released in 2010. The weekly indices were summed across migration years 2010 and 2011 (I^{\wedge}) and within each migration year 2010 (i^{\wedge}_{2010}) and 2011 (i^{\wedge}_{2011}).

**Historical Run Timing, 2004 - 2019
 Juvenile PIT Tag Wild Fall Chinook
 Released in River KM 522.224
 Lower Granite Dam, 5/1 - 12/31**



www.cbr.washington.edu/dart

14 Sep 2020 11:29:31 PDT

Figure 3. Passage timing of natural (wild) origin fall Chinook salmon from the Clearwater River spawning aggregate of the Snake River population. Data generated by Nez Perce Tribe, downloaded from DART (http://www.cbr.washington.edu/dart/query/smolt_hrt) on September 14, 2020.

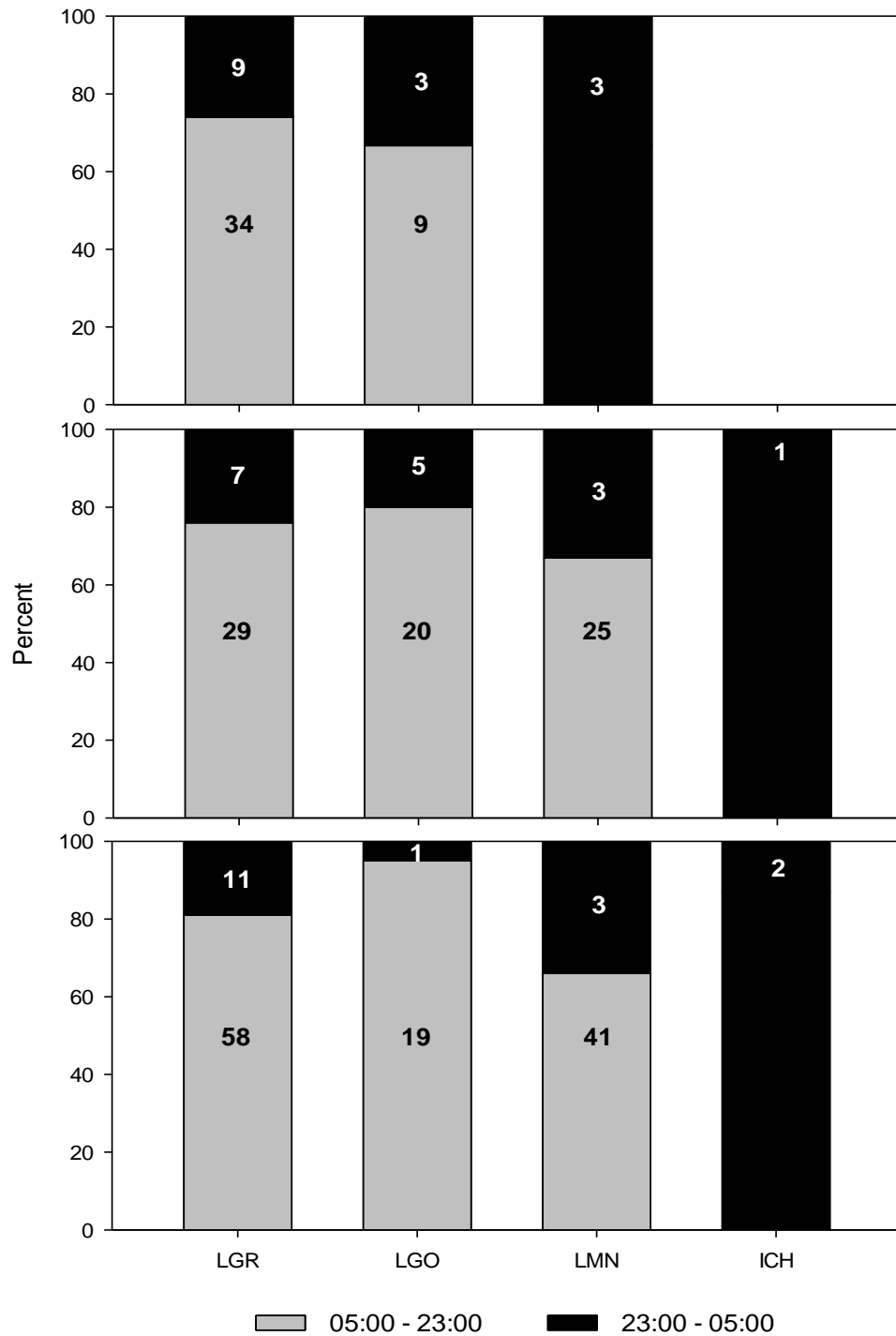


Figure 4. Percentage of radio-tagged subyearling fall Chinook salmon passing dams during periods of proposed zero-flow (black bars) and all other times (gray bars) from Nov 1 to March 19 during 2004-2005 (top panel), 2005-2006 (middle panel), and 2006-2007 (bottom panel). Numbers of fish detected are shown within each bar. Dams are abbreviated LGR (Lower Granite), LGO (Little Goose), LMN (Lower Monumental), and ICH (Ice Harbor). All fish were collected, tagged, and released in the forebay of Lower Granite Dam. Analysis and graphic provided by K. Tiffan – modification of Tiffan et al 2012.

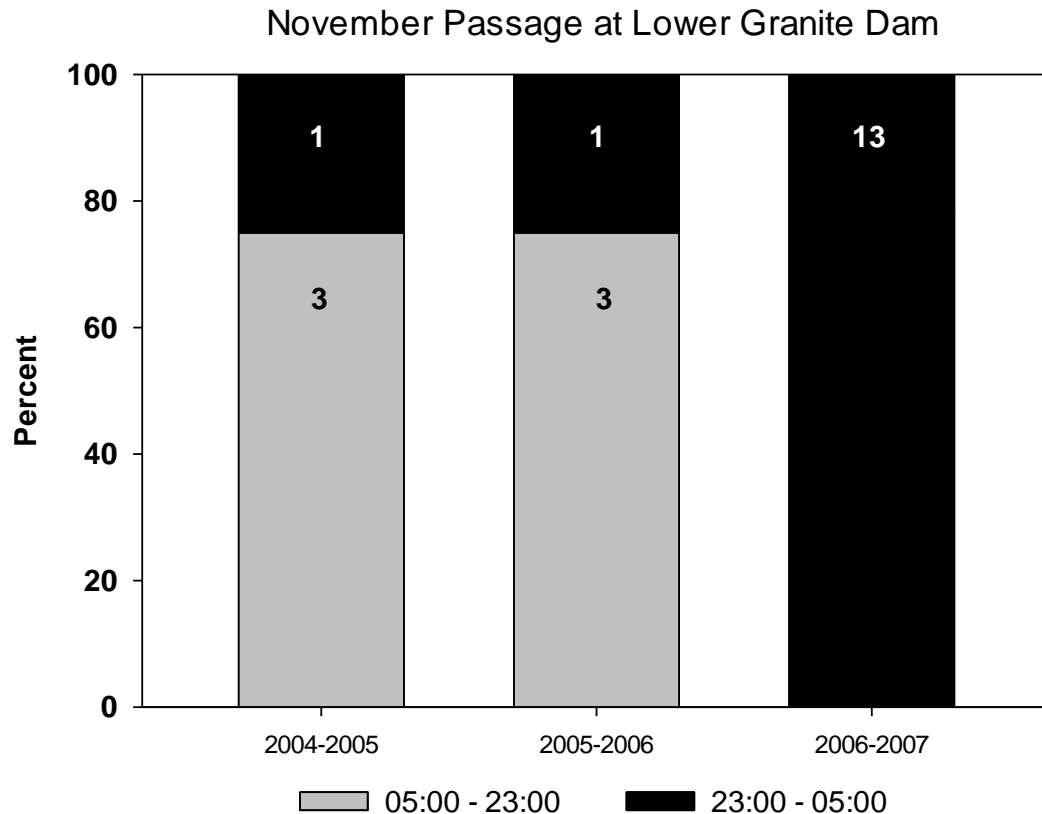


Figure 5. Percentage of radio-tagged subyearling fall Chinook salmon passing Lower Granite Dam during periods of proposed zero-flow (black bars) and all other times (gray bars) from Nov 1 to Nov 30 during 2004-2005, 2005-2006, and 2006-2007. Numbers of fish detected are shown within each bar. All fish were collected, tagged, and released in the forebay of Lower Granite Dam. Analysis and graphic provided by K. Tiffan – modification of Tiffan et al 2012.

System Operations Request 2005-22 defined “few” migrating adults; this SOR has guided operations through 2019. Over time, these criteria have been slightly modified to include:

1. The number of adults migrating per day is defined as the number of upstream counts minus the number of downstream counts, as reported on the Fish Passage Center’s website (https://www.fpc.org/currentdaily/HistFishTwo_7day-ytd_Adults.htm).
2. A three-day moving average will be used to determine if the few migrating adult criterion has been met.
3. The criteria apply to both “Unclipped” and “total” categories of returning adult steelhead. “Unclipped” and “total” returns will be calculated separately. Only one of the categories is necessary to show that more than a few adults are migrating.
4. The run to date is defined as the cumulative number of adult steelhead in the “Unclipped” and “total” categories passing Lower Granite Dam since July¹ 1st of the return year.

¹ SOR 2005-22 based adult steelhead counts on a June 1st start date. July 1st is currently used for return year abundance quantification.

The ‘few’ migrating adult criteria triggers are defined on a sliding scale (Table 1). Juvenile fish-based criteria are not practical given the JBS is typically shutdown prior to December 1, precluding the ability to monitor juvenile fish abundance.

Table 1. Sliding scale adult steelhead abundance at Lower Granite Dam and associated criteria allowing zero flow operations to occur at Snake River project between December 1 and February 28.

Run to date > #	Run to date ≤ #	Few criteria < #
0	30,000	10
30,000	60,000	20
60,000	100,000	35
100,000	150,000	50
150,000	200,000	65
200,000	250,000	80
250,000		100

Water stored under zero river flow conditions may maximize power production from the Columbia River basin system, but zero river flow operations are not recommended at lower Snake River projects when juvenile and/or adult fish are actively migrating or dispersing into available critical habitat in the Snake River. The salmon managers recommend zero flow operations not be implemented prior to December 1st and that the longstanding ‘few fish’ criteria be used, after December 1, for initiating zero nighttime flow operations.

References

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Tiffan et al. 2012. Downstream movement of fall Chinook salmon juveniles in the Lower Snake River reservoirs during winter and early spring. *Transactions of the American Fisheries Society* 141: 285-293.