



# FISH PASSAGE CENTER

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TO: Lance Hebdon (IDFG)

FROM: Michele DeHart

DATE: March 18, 2015

RE: Proportion of adult steelhead passing Lower Granite Dam during nighttime non-counting hours

In response to your request, the Fish Passage Center (FPC) staff reviewed PIT-tag detection data for adult steelhead passing Lower Granite Dam (LGR) during nighttime non-counting hours over the span of 12 years (2003–2014). The key findings from this analysis were:

- The proportion of adult steelhead passing LGR during nighttime non-counting hours was variable from year to year. Across the entire return year, this proportion ranged from as low as 5% to as high as 9.34%
- Seasonally, the proportion adult steelhead passing LGR at nighttime also varied with the highest proportions of nighttime passage occurring in the spring. The smallest proportions of nighttime passage were observed during summer months and steadily increased thereafter.
- Nighttime video count data conducted during a few select return years provided an opportunity to compare the video count data and the PIT-tag detections during non-counting hours. The limited amount of data for this comparison indicated that there is a discrepancy between these two count methods with the PIT-tag data indicating higher passage during non-count hours. However the sample sizes for this comparison were small and other factors may explain this discrepancy.

## Counting Schedule at Lower Granite Dam

As outlined in the most recent Fish Passage Plan (<http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/>), counting at LGR, either directly or via video recording, occurs from March 1 – December 30 (Table 1). For most months, counting occurs 16 hours a day from 4 AM to 8 PM. Since 2013, nighttime video counts for fish passing between 8 PM and 4 AM occurred from

June 15 – September 30. However, from 2003–2012 nighttime video counting occurred from June 15 – August 31. In order to standardize our analysis across years, we removed nighttime video count data during September of 2013 and 2014.

**Table 1. Most recent adult fish counting schedule at Lower Granite Dam (3/1/14 – 2/28/15).**

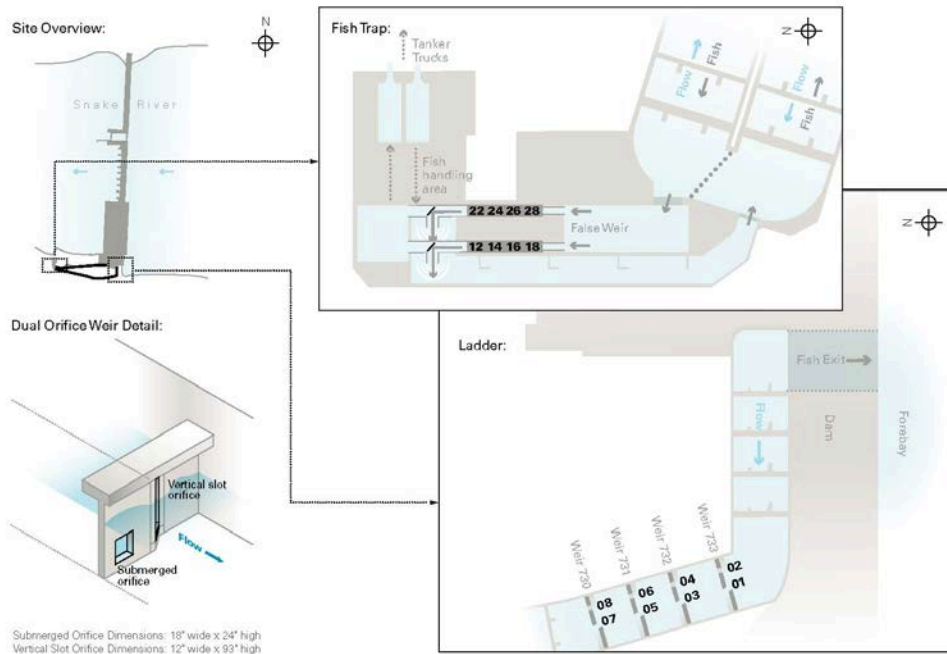
<b>Count Period</b>	<b>Counting Method</b>	<b>Hours</b>
March 1–31	Video	0400–2000 hours
April 1 – October 31	Visual	0400–2000 hours
June 15 – September 30	Night Video	2000–0400 hours
November 1 – December 30	Video	0400–2000 hours

The counting schedule in Table 1 is the general schedule for all salmon and steelhead. Video counts during nighttime hours has historically been conducted only for sockeye salmon. However, nighttime video counts for steelhead were conducted in 2007, 2013 and 2014.

### **Data Source and Processing**

To estimate the proportion of steelhead adults that pass through the adult ladder at LGR during non-counting times, FPC staff relied on PIT-tag data. Specifically, FPC staff reviewed the most recent twelve years of detection data (2003–2014) for PIT-tagged adult steelhead detected in the LGR adult ladder (PTAGIS Interrogation site code GRA). (Note: Adult steelhead tagged and released at LGR were removed from this analysis). The configuration of the in-ladder slotted-weir detectors has not substantially changed since their installation in February of 2003.

The fish trap at LGR is located downstream of the slotted-weir detectors (Figure 1). Because of this, the time-stamp associated with the arrival of fish tagged and released at LGR is more indicative of the time of release following tagging, and hence is not representative of the untagged population of adult steelhead passing LGR. Removal of adult steelhead tagged and released at LGR substantially reduced the sample size of PIT-tagged fish in the five most recent years as over 25,000 adult steelhead have been tagged and released at LGR since 2009.



**Figure 1. Configuration of PIT-tag detectors at Lower Granite Dam.**

It is possible for juvenile steelhead to utilize the adult ladder as they move downstream and these individuals would not be counted as adults in the counting window. Therefore, PIT-tagged juvenile steelhead detected in the adult ladder at LGR needed to be removed from the dataset. Because juvenile steelhead have much more variable early life-history strategies compared to other salmonids, the year of tagging, or the expected migration year if tagged as a parr, is not always indicative of the year of outmigration. For this reason, determining what constitutes a juvenile detection in the adult ladder can be difficult. We relied on the sequence of coil detections within the adult ladder to identify juveniles. Any individual with a sequence of coil detections that indicated strict downstream movement, and only downstream movement, was removed. For instance, a fish detected at weir 733, 732 and 730 (Figure 1), in that order would have been removed from the dataset. However, a fish detected at weir 731, 733, 732 and 730 would have been included as an adult because the detection at weir 731 prior to the next 3 did not satisfy the condition of strict downstream movement. Based on these criteria, a total of 825 juvenile steelhead detected in the adult ladder were removed from the dataset.

Once adult steelhead tagged at LGR and juvenile steelhead detected in the adult ladder were removed from the dataset, we classified an individual passing during the daytime counting hours or nighttime non-counting hours based on the time of first detection in the adult ladder. If this time occurred anywhere between 4 AM and 8 PM, then the individual was classified as passing during daytime counting hours. An individual was classified as passing during nighttime non-counting hours if its first detection occurred between 8 PM and 4 AM.

Whenever possible, we compared day and nighttime passage proportions (determined by the PIT-tag data) to the actual count data. Daytime and nighttime count data were downloaded from: [www.nwp.usace.army.mil/Missions/Environment/Fish/Counts.aspx](http://www.nwp.usace.army.mil/Missions/Environment/Fish/Counts.aspx)

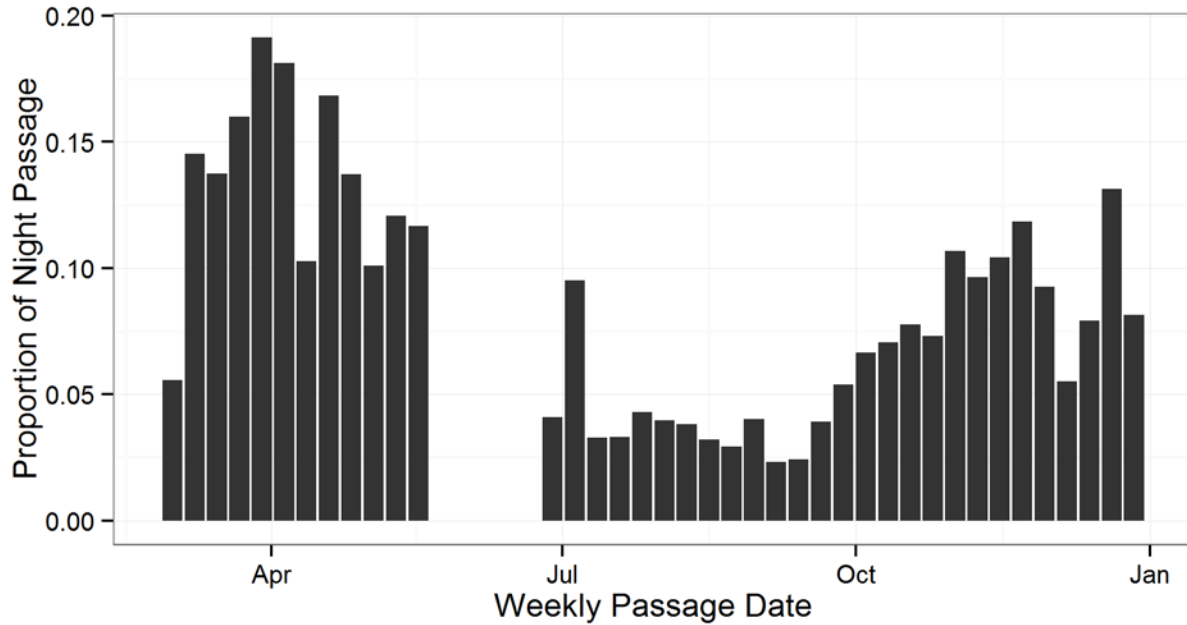
### **Nighttime Passage Results**

Based on PIT-tag detections, the proportion of adult steelhead passing LGR during nighttime non-counting hours was variable from year to year, and range from as low as 5% in 2007 to as high as 9.34% in 2011 (Table 2). The average proportion across all years was approximately 7%. The total number of PIT-tagged returning adults is much larger in the 5 most recent years compared to the years prior to this.

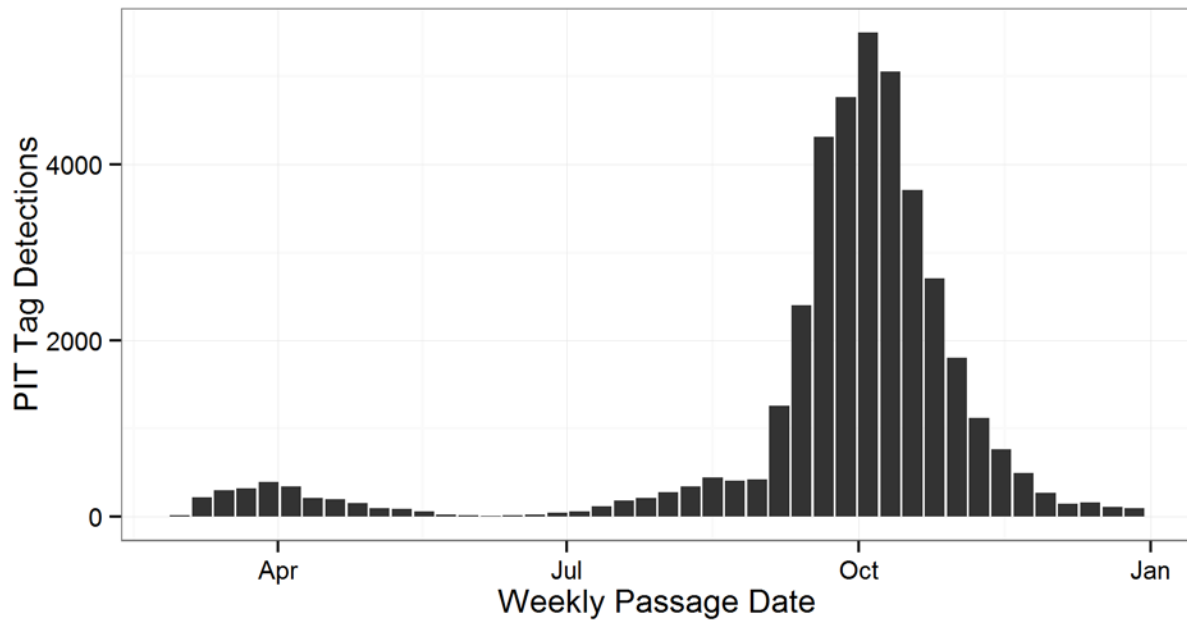
**Table 2. Detections of PIT-tagged adult steelhead at LGR during daytime counting and nighttime non-counting time periods from March 1 – December 30.**

	PIT-tag Detections		
	Day	Night	Percent Night
2003	1,046	85	7.52%
2004	891	76	7.86%
2005	583	47	7.46%
2006	553	33	5.63%
2007	1,424	75	5.00%
2008	2,315	128	5.24%
2009	6,649	382	5.43%
2010	4,766	336	6.59%
2011	4,768	491	9.34%
2012	3,478	256	6.86%
2013	3,339	193	5.46%
All	29,812	2,102	7.05%

The weekly proportion of adult steelhead passing LGR during nighttime non-counting hours varied over the course of the return year (Figure 2). The highest proportion of nighttime passage was observed in the spring months from March to mid-May. Nighttime passage proportions remained under 5% for the summer months and steadily increased from September to November. No fish were observed passing at nighttime during the month of June, but this is explained by the very few number of steelhead that return to LGR during this month (Figure 3). Across all return years, the peak of the return typically occurs during the beginning of October.



**Figure 2. Weekly proportion of PIT-tagged adult steelhead passing LGR during nighttime non-counting hours. The weekly proportions are averaged across all return years from 2003–2014.**



**Figure 3. Weekly number of PIT-tagged adult steelhead passing LGR across all return years from 2003-2014.**

### Adequacy of PIT-Tag Data

Video counts of steelhead passing LGR during nighttime hours are available in return years 2007, 2013 and 2014. Nighttime video counts are typically conducted only for sockeye salmon, but steelhead were additionally counted in these three years which provided a unique opportunity to evaluate how representative the PIT-tag data are of the actual count data, and vice versa. For these summaries, we restricted the PIT-tag data to only days when night video counts were conducted. This, for the most part, spanned the same period of night video counts, but a few days of night video counts were missing and so PIT-tag detections from these days were also omitted from the summaries.

The proportion of adult steelhead passing LGR at night, determined by video counts and PIT-tag detections, were similar in 2007, but noticeably different in 2013 and 2014 (Table 3). In the latter two years, the proportion of fish passing at night was approximately 2 and 4.5 times higher respectively, when comparing the PIT-tag data to the night video count data. The sample size of the PIT-tag data was much smaller, implying higher uncertainty, than the count data.

**Table 3. Comparison of nighttime passage proportions from June 15<sup>th</sup> to August 31<sup>st</sup> determined from observer count data and PIT-tag detection data.**

	Observer Counts			PIT-tag Detections		
	Day	Night	Percent Night	Day	Night	Percent Night
2007	5,602	165	2.95%	116	3	2.52%
2013	5,234	85	1.62%	136	5	3.55%
2014	10,238	65	0.63%	268	8	2.90%

If the observer count data are assumed to be the “truth” for which the PIT-tag data should be compared against, then Table 3 suggests that the PIT-tag data used in this analysis may overestimate the true proportion of nighttime passage. Possible reasons for discrepancies between these two proportions include:

1. If a fish falls back within the adult ladder and never reascends, the net contribution to the total count is zero. The PIT-tag data does not account for this; so if during nighttime non-counting hours a PIT-tagged individual were to ascend the ladder, fallback and never reascend it would still be counted as an individual passing at night.
2. The total sample size for the PIT-tag data used for this comparison was much smaller than the count data. These PIT-tag data may not be representative of the untagged population and the probability that this phenomena could occur would tend to increase for smaller sample sizes.
3. The nighttime video count data are inaccurate. If there is a bias or tendency to undercount adult steelhead videotaped during nighttime, then the proportion passing at night would also be underestimated.