FISH PASSAGE CENTER

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MEMORANDUM

TO: Christina Luzier (USFWS),
Howard Schaller (USFWS),
David Wills (USFWS),
Brian McIlraith (CRITFC)

FROM: Brandon Chockley,

DATE: December 3, 2013

RE: Results of 2013 lamprey monitoring

In response to a request from the Lamprey Technical Workgroup (LTWG) leadership, the Fish Passage Center (FPC) staff has summarized the lamprey monitoring data that were gathered as part of the Smolt Monitoring Program (SMP) in 2013. Migration year 2013 is the third year of including lamprey as target species in the SMP. Thus, we are providing a summary of the results from 2011 and 2012. Below is a brief summary of our findings from these analyses, followed by a more detailed description of the analyses we conducted.

- With the addition of the Imnaha River Trap, 2013 was the first year when all SMP sites collected lamprey data under the new lamprey monitoring program that was first implemented in 2011. There were no major issues with data collection in 2013.
- Lamprey condition monitoring at the Lower Columbia sites (BON, JDA, and MCN) was successful in 2013.
    - SMP personnel provided more detailed pictures to enhance the lamprey condition monitoring protocol and to better distinguishing between body injuries that are attributable to the bypass systems and those that may be caused by predators. FPC and USFWS staff will work over the offseason to incorporate these pictures into the 2014 monitoring program.

- For the third year, sample counts at the Snake River and Upper Columbia River SMP sites were relatively low. At this time the FPC still does not feel that lamprey condition monitoring can be expanded to any of these sites.
- A PIT-tag study at LGR in 2013 confirmed that Pacific macropthalmia are escaping the sample tank before being counted. This means that estimates of sample and collections at LGR are unreliable and biased low.
- It appears that lamprey juveniles, particularly Pacific macropthalmia, are experiencing higher mortality at Bonneville than salmonids. Further investigation is needed to determine why lamprey mortality rates are higher at BON.

Background

In 2010 the FPC was approached with a request to make changes to the collection of lamprey data for the SMP. The LTWG chair met with FPC staff and together developed a list of changes to lamprey monitoring that would address the critical needs that were deemed appropriate to the SMP. Among these changes were: (1) adopting a standardized approach to identifying larval and juvenile lamprey using USFWS identification methods, (2) treating larval and juvenile lamprey as target species and, thus, assigning a sample rate to lamprey samples at SMP sites (as opposed to treating them as "incidental species"), and (3) implementing a pilot study of lamprey condition monitoring. After meetings with USFWS staff and review by the Fish Passage Advisory Committee (FPAC) the FPC adopted and implemented these changes to the monitoring program in 2011 for most SMP sites.

After the 2011 SMP season ended, the FPC prepared a summary of the lamprey monitoring data for the LTWG to review. This report is available on the FPC website (http://www.fpc.org/documents/memos/169-11.pdf). The FPC also added larval and juvenile lamprey to many of the on-line queries of SMP data as well as adding lamprey to many of the daily and weekly reports of SMP data. In response to requests by the ISAB, the FPC added lamprey data to the 2011 and 2012 FPC Annual Reports and will continue including these data in future annual reports.

Following the 2011 SMP season, the FPC staff asked for guidance on lamprey monitoring in future years. Based on their review of the 2011 data, the LTWG asked that the new lamprey monitoring protocol be continued in 2012 and future years. The LTWG also requested that the lamprey condition monitoring be expanded wherever possible. The FPC determined that the lamprey condition monitoring could be expanded only in the Lower Columbia River, as these were the only sites that sampled larval and juvenile lamprey in large enough numbers.

Therefore, in 2012 and 2013, SMP sites continued to follow the lamprey monitoring protocol that was first implemented in 2011. In addition, the lamprey condition monitoring was expanded to Bonneville Dam (BON), John Day Dam (JDA), and McNary Dam (MCN) in the Lower Columbia River. Migration year 2013 is the second year of the expanded condition monitoring program for lamprey juveniles.

Methods

Lamprey Identification

As in past years, larval and juvenile lamprey were identified using guidelines developed by USFWS. Pacific lamprey (*Entosphenus tridentatus*) and Western Brook lamprey (*Lampetra richardsoni*) were the two species most likely to be encountered by SMP personnel. When a lamprey ammocoete (larva) was collected a key was used to determine species. Ammocoetes were identified as those lamprey with eyes absent and oral disk absent. If total length (TL) of the ammocoete was less than 70 mm then the fish was identified as unknown lamprey ammocoete. For ammocoetes greater than 70 mm, species could be identified based upon the color pattern of the caudal region (Figure 1). Ammocoetes that had a uniformly dark caudal fin with a caudal ridge that was faded and appeared lighter than the fin were identified as Pacific lamprey (Figure 1A). Those ammocoetes that had a mottled caudal fin with broad margins lacking pigment; or that appeared blotchy, peppered, or completely clear were identified as Western Brook lamprey (Figure 1B).

If caudal region coloration was not definitive, ventral surface coloration was also used as an additional characteristic for identification. If the ammocoete had a light ventral surface it could have been identified as a Pacific lamprey, otherwise a mottled or uniformly dark ventral surface was considered an indication of Western Brook lamprey. If no determination was possible based on these criteria, the lamprey was identified as an unknown lamprey ammocoete.

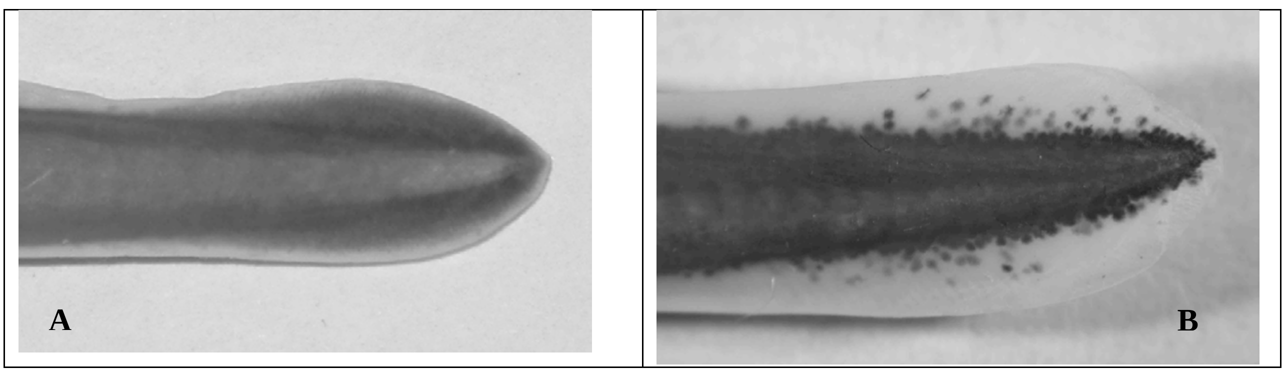

Figure 1. Comparison of caudal region of *Entosphenus tridentatus (A) and Lampetra spp (B)* ammocoete from USFWS lamprey identification guide used by the Smolt Monitoring Program.

Since Western Brook lamprey do not exhibit a macropthalmia (or juvenile) life stage the macropthalmia designation was used for lamprey identified as Pacific lamprey. Macropthalmia are eyed juvenile lamprey with oral disk present and for Pacific lamprey these individuals range in size between 100 and 160 mm TL. Because Western Brook lamprey adults range between 100 and 200 mm TL it was important that distinct characteristics were used to identify these different species (and life stages). Based on the USFWS key, the SMP used the relative size of the eye of Pacific lamprey juvenile compared to Western Brook lamprey adults as a key to identifying the different species/life stages (Figure 2). Pacific lamprey macrothalmia were identified by the large eye that was equal in diameter to the distance between the posterior edge of the eye to the first branchial pore (Figure 2A). By comparison, the Western Brook lamprey adults were identified by the much smaller eyes on lamprey between 100 and 200 mm TL (Figure 2B).

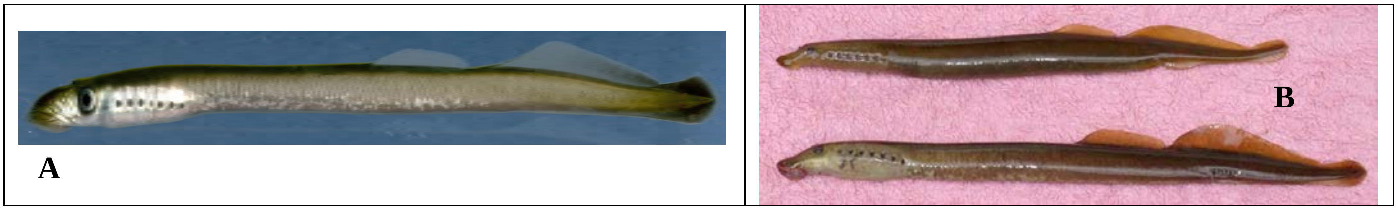

Figure 2. Comparison of the relative eye size of Pacific lamprey macrothalmia (A) and Western Brook lamprey adults (B). Figure from the USFWS key to lamprey identification used by the SMP.

In addition, adult lamprey collected in the SMP samples were identified using USFWS pamphlets as well as the guide book **"**Inland fishes of Washington: First Addition" (1979: R. Wydoski and R. Whitney Eds). Adult lamprey continue to be recorded as incidental species.

Lamprey Counts, Passage Timing, and Mortality

In 2013, the SMP continued to use the new data entry procedure that began in 2011. This new data entry procedure allowed larval and juvenile lamprey sample data to be directly related to sample rates used in fish collection. In the past, the SMP staff recorded larval and juvenile lamprey as "incidental species" such that all fish in the sample were simply counted and reported and no sample rate information was available. Without sample rate information, estimation of collections was not possible. Under the new procedures developed for 2011, SMP sites were able to report larval and juvenile lamprey sample numbers with an associated sample rate similar to what is done for juvenile salmon. This allowed for the estimation of collection counts, based on when and where each larval or juvenile lamprey was sampled (i.e., separate sample rates for different tanks or at different times of the day).

Estimates of collection are made by expanding the sample count based on the sample rate that was being used when the sample was made. Each site has the ability to adjust the sample rate, either to different sample tanks and/or at different times of the day. The sample rate determines how much time the sample gate is open in a given hour. For example, a sample rate of 10% corresponds to having the sample gate open for 6 minutes in an hour. Sample rates are chosen by site personnel based on how many total fish are expected to be handled each day. As a general goal, the SMP aims to sample between 300 and 500 total target fish per day. This sampling goal weighs the desire to limit handling while still allowing for the collection of accurate and precise estimates of collection. In addition, lamprey mortality data were also collected, which allows for comparisons of mortality rates between lamprey and other species and between sites.

Lamprey Condition Monitoring

A pilot study was carried out at John Day Dam in 2011 to gather information of the condition of juvenile lamprey entering the bypass systems at the dam. Information gathered during this pilot study resulted in the development of a lamprey condition monitoring protocol, which is available on the FPC website (ftp://ftp.fpc.org/FPC32.net/Manuals/ConditionSamplingProtocol_2013.pdf).

Based on the results of this pilot study, the LTWG requested that this condition monitoring be expanded to as many sites as possible. In 2012, condition monitoring was expanded to Bonneville Dam, John Day Dam, and McNary Dam. This expanded condition monitoring was continued in 2013. All three of these sites followed the above mentioned lamprey monitoring protocol.

Results

Lamprey Counts, Passage Timing, and Mortality (2011–2013)

Larval and Juvenile Lamprey Counts

As mentioned above, lamprey juveniles have been recorded as target species and have been identified to life-stage and species at all SMP sites since 2011, except the Imnaha River Trap. However, the Imnaha River Trap began using the same lamprey sampling protocol for the 2013 season. The four life-stage/species combinations for lamprey juveniles were: (1) Pacific Macropthalmia (MP), (2) Pacific Ammocoete (AP), (3) Western Brook Ammocoete (AB), and (4) Unknown Ammocoete (AS). In 2012, the SMP added a fifth juvenile lamprey category, Unidentified Lamprey (LU). This category was intended to be used for lamprey juveniles that were collected during separator clean-out procedures where species and life-stage identification may not have been possible. It was expected that this category would rarely be used.

Below is a summary of the sample and collection counts that were recorded in 2013 at each of the SMP sites, as well as the sample and collection counts from 2011 and 2012 (Table 1 and Table 2). Although larval and juvenile lamprey are target species at all SMP sites, the SMP traps collect very few lamprey juveniles. In fact, only one SMP trap (IMN) collected lamprey juveniles in 2013 (Table 2). Furthermore, no western brook lamprey ammocoetes have been encountered by SMP site personnel since the new monitoring program began in 2011 (Table 1 and Table 2).

For almost all sites, in all three years, Pacific lamprey macropthalmia made up the majority of the lamprey sample and collection (Table 1). The only exception to this was at Lower Granite Dam (LGR) where Pacific ammocoetes made up the majority of the collection in 2011. In past years, the SMP personnel at LGR and the FPC have warned that caution is warranted when interpreting collection counts at LGR, as there was suspicion that juvenile lamprey were escaping from the sample tank before being counted. A PIT-tag study of pacific macropthalmia at LGR in 2013 confirmed this suspicion. During this study, there were at least three days where more PIT-tagged macropthalmia were detected as having entered the sample tank than were counted in the sample. Given this, it is clear that estimates of sample and collection for juvenile lamprey at LGR are unreliable and biased low.

Table 1. Total sample and collection counts of larval and juvenile lamprey at dams from the 2011–2013 SMP sampling seasons. Species/life-stage codes are as follows: (1) Pacific Ammocoetes (AP), (2) Pacific Macropthalmia (MP), (3) Unknown Ammocoete (AS), (4) Unidentified Lamprey (LU). So far, no Brook Ammocoetes (AB) have been identified by SMP Personnel.

Site	Species/ Life Stage	2013 Sample	2013 Collection	2012 Sample	2012 Collection	2011 Sample	2011 Collection
BON*	AP	14	100	21	180	76	729
	MP	503	6,257	3,157	31,784	2,209	25,412
JDA*	AP	21	217	172	12,317	1,984	28,215
	MP	4,894	175,931	24,531	490,856	10,680	466,479
MCN*	AP	0	0	2	200	27	1,170
	AS	0	0	0	0	2	30
	MP	2,995	176,398	2,280	242,532	6,567	319,568
RIS*	AP	9	9	8	8	53	54
	AS	0	0	1	1	1	1
	MP	178	178	126	126	271	272
LMN*	AP	3	3	7	69	1	1
	MP	904	63,854	124	2,155	8	1,045
	LU	3	3	0	0	0	0
LGS*	AP	30	1,389	105	2,553	2,472	6,837
	MP	605	57,383	404	11,053	320	21,467
LGR†	AP	15	132	63	1,453	372	6,165
	MP	73	4,878	90	5,557	68	4,420

* Sample and collection counts were extrapolated for non-sample days at these sites. Extrapolation was based on the previous and subsequent days sample and collection counts. LMN and LGS typically samples every 3rd or 4th day from early April to early/mid-May; MCN has every-other-day sampling from April to July or August (entire season for 2013); and BON and JDA often has non-sample days in August and/or September due to high temperature sampling protocols. RIS missed a few samples in July of 2013 due to mechanical issues.

† Due to confirmed escapement from the sample tank at LGR, estimates of sample and collection of juvenile lamprey at LGR are unreliable and biased low.

Table 2. Total sample counts of larval and juvenile lamprey at SMP traps from the 2011–2013 SMP sampling seasons. SMP Trap site codes are as follows: (1) Salmon River Trap at Whitebird, ID (WTB), and (2) Imnaha River Trap (IMN).

Site	Species/ Life Stage	2013	2012	2011
WTB	AP	0	6	0
	MP	0	0	0
IMN	AP	6	N/A	N/A
	MP	2	N/A	N/A

Passage Timing

By incorporating larval and juvenile lamprey as target species in 2011, actual sample rates can be applied to lamprey sample counts, which allows for the estimation of collection counts. This is particularly important when addressing lamprey passage timing through the hydrosystem, as collection counts are more reliable than sample counts when describing passage timing. For this report, we estimated passage timing based on the estimated collection counts in 2011–2013. Specifically, we estimated the 10%, 50%, and 90% passage dates for Pacific lamprey ammocoetes and macropthalmia (Table 3). In addition, we provide passage timing curves for both life-stages across all 3 years at all sites (Figure 3 for Pacific macropthalmia and Figure 4 for Pacific ammocoetes). Please note that a passage timing curve for Pacific ammocoetes in 2013 at MCN was not included because no Pacific ammocoetes were sampled in 2013.

Table 3. Estimated 10%, 50%, and 90% passage dates for Pacific lamprey ammocoetes and macropthalmia at SMP dams in 2011, 2012, and 2013, based on estimated collection counts.

	Species/	2013 Timing			2012 Timing			2011 Timing		
Site	**Life Stage**	**10%**	**50%**	**90%**	**10%**	**50%**	**90%**	**10%**	**50%**	**90%**
BON	AP	3/22	5/29	8/12	3/29	4/14	8/3	4/9	5/29	8/11
	MP	3/24	6/4	7/17	3/22	4/14	6/22	3/25	4/15	5/29
JDA	AP	4/5	4/14	5/22	4/26	4/26	5/22	4/5	5/18	6/24
	MP	4/20	5/26	7/5	6/5	6/5	7/7	5/24	5/24	6/16
MCN	AP	---	---	---	7/3	7/4	7/5	5/20	6/20	7/10
	MP	5/15	5/25	8/20	5/2	5/18	7/10	4/23	5/24	6/17
RIS	AP	4/7	5/16	7/5	4/18	5/1	8/28	4/30	5/18	7/21
	MP	4/11	6/27	8/13	4/29	4/29	7/30	5/17	5/17	6/8
LMN	AP	4/17	4/19	4/21	6/9	6/9	8/3	8/26	8/26	8/26
	MP	5/15	5/17	5/22	5/24	6/9	6/17	5/18	5/19	5/20
LGS	AP	4/14	5/21	7/11	5/2	5/5	7/9	6/21	8/4	8/4
	MP	5/15	5/17	5/20	4/20	5/2	6/12	4/6	4/12	5/19
LGR	AP	4/7	5/22	7/2	4/3	6/8	6/25	5/13	7/8	7/17
	MP	4/12	5/15	5/17	3/29	4/27	4/29	4/6	4/8	5/17

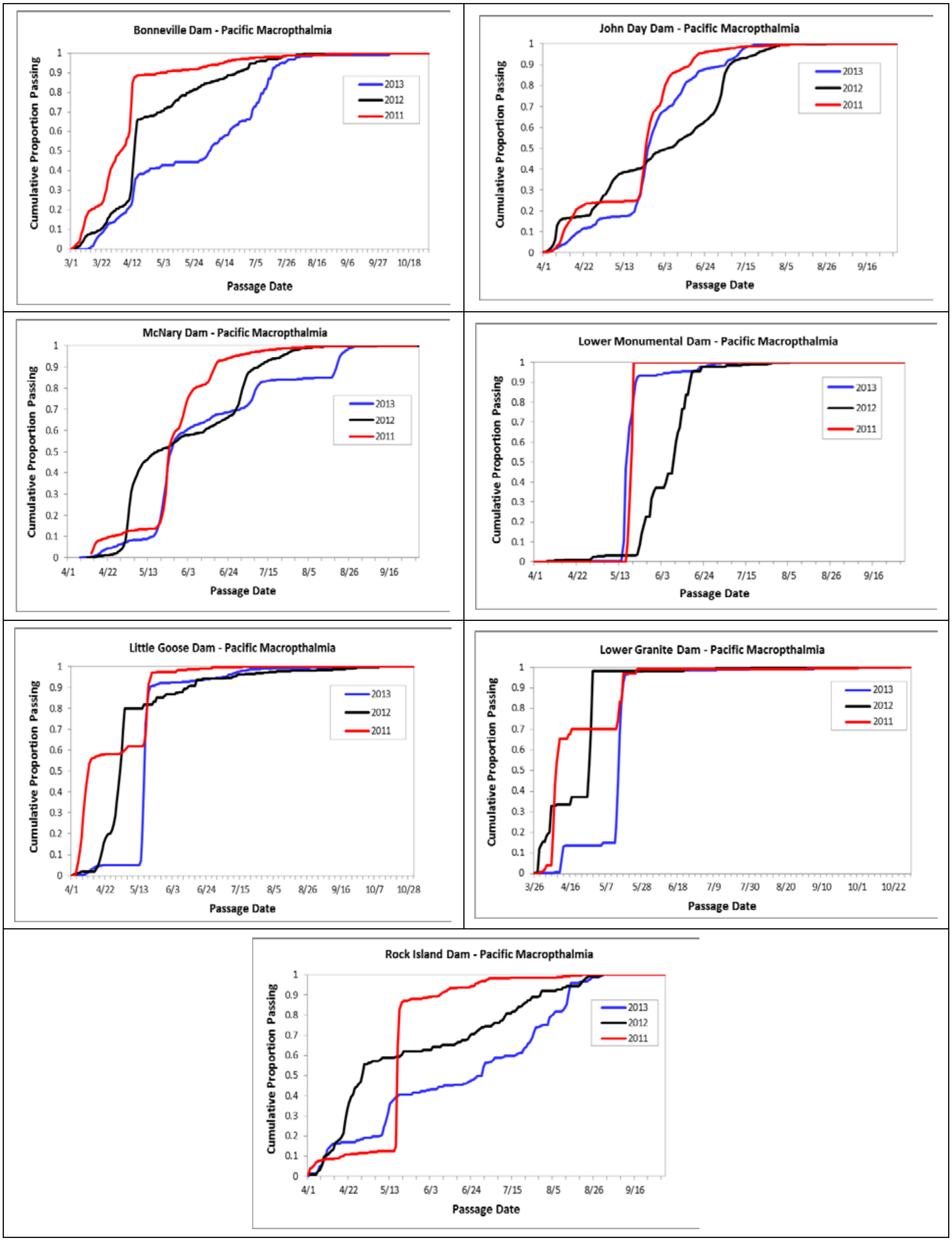

Figure 3. Cumulative passage timing curves for Pacific lamprey macropthalmia at BON, JDA, MCN, LMN, LGS, LGR, and RIS in 2011–2013, based on estimated collection counts. Note the x-axis may be different for projects due to different sampling schedules.

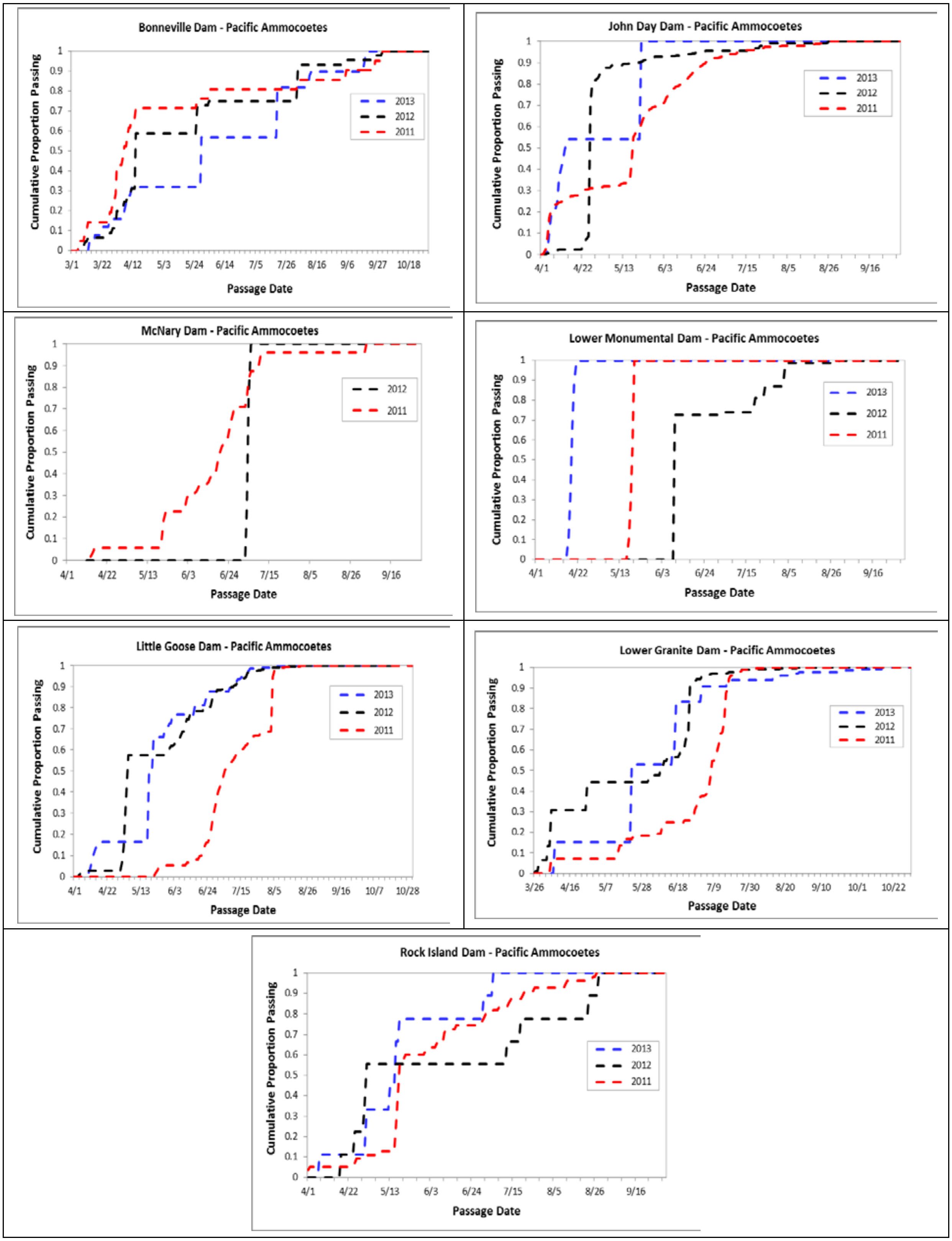

Figure 4. Cumulative passage timing curves for Pacific lamprey ammocoetes at BON, JDA, MCN, LMN, LGS, LGR, and RIS in 2011–2013, based on estimated collection counts. Note the x-axis may be different for projects due to different sampling schedules.

Mortality

We assessed mortality of larval and juvenile lamprey in two ways. First, we estimated a seasonal average mortality for Pacific macropthalmia and Pacific ammocoetes (where possible). For comparison, we also estimated a seasonal average mortality for yearling Chinook, subyearling Chinook, steelhead, and sockeye. Daily mortality was estimated as the number of sample mortalities divided by the daily sample count. Sample mortalities are those fish that are dead in the sampling tank or GBT fish that die after being sampled at the separator. These mortalities include fish that died prior to being diverted to the sample and that died as a part of the sampling process. When summarizing the daily mortality data, we included only days where a minimum of 20 individuals were sampled. This was done in order to remove days with low sample sizes and, thus, potentially inflated mortality rates. Daily mortality estimates were then weighted based on the daily estimated collection. This weighting allowed us to estimate a weighted average mortality for each species. A weighted average mortality is a more fair representation of the overall seasonal mortality, as it gives more weight to the days where a higher number of juveniles passed, versus giving equal weight to all days. We did this for all 3 years (2011–2013).

In addition, we constructed histograms of daily sample mortality estimates for the 2013 out-migration season. These histograms were also limited to days where a minimum of 20 individuals were sampled. In general, limiting the analyses of mortality to days with a minimum of 20 sampled individuals resulted in being able to conduct these analyses only for the Lower Columbia sites (BON, JDA, and MCN) in 2011 and 2012. However, for 2013, there were two Snake River sites (LGS and LMN) that had several days where a minimum of 20 individuals were sampled. Furthermore, limited sample counts for Pacific ammocoetes meant that a weighted average mortality estimate was possible only for JDA, LGR, and LGS in 2011. The 2011 weighted average mortality rates (min and max in parentheses) for Pacific ammocoetes at these sites were: (1) JDA – 0.2% (0.0%-3.0%), (2) LGR – 1.9% (0.0-12.5%), and (3) LGS - 0.2% (0.0-1.9%). The estimates of the weighted average seasonal mortality rates for Pacific macropthalmia and target salmonids in 2011–2013 are provided in Table 4.

Table 4. Weighted average mortality (percent) for Pacific macropthalmia (MP), subyearling Chinook (CH0), yearling Chinook (CH1), sockeye (SO), and steelhead (ST) at Bonneville (BON), John Day (JDA), McNary (MCN), Little Goose (LGS), and Lower Monumental (LMN) dams in 2011–2013. Minimum and maximum daily mortality rates are provided in parentheses.

Site	Year	MP	CH0	CH1	SO	ST
BON	2011	8.0 (0.0-30.0)	1.1 (0.0-41.7)	1.0 (0.0-8.5)	2.0 (0.0-9.1)	0.1 (0.0-2.5)
	2012	8.9 (0.0-24.7)	2.6 (0.0-15.4)	1.8 (0.0-4.3)	7.0 (0.0-11.0)	0.3 (0.0-4.8)
	2013	4.7 (0.0-9.5)	0.8 (0.0-8.9)	0.5 (0.0-4.8)	1.1 (0.0-4.1)	0.3 (0.0-5.0)
JDA	2011	0.4 (0.0-3.3)	0.4 (0.0-4.3)	0.4 (0.0-3.7)	1.6 (0.0-12.5)	0.2 (0.0-4.2)
	2012	0.2 (0.0-3.2)	0.3 (0.0-1.5)	0.3 (0.0-4.0)	1.2 (0.0-8.0)	0.1 (0.0-5.4)
	2013	0.0 (0.0-0.9)	0.3 (0.0-2.2)	0.3 (0.0-2.9)	0.4 (0.0-1.9)	0.2 (0.0-4.1)
MCN	2011	5.4 (0.0-25)	2.1 (0.0-8.4)	1.3 (0.0-23.1)	1.3 (0.0-14.0)	0.3 (0.0-3.1)
	2012	2.9 (0.0-10.3)	0.9 (0.0-9.4)	0.4 (0.0-2.0)	0.8 (0.0-5.1)	0.4 (0.0-4.5)
	2013	1.5 (0.0-14.3)	1.4 (0.0-5.2)	0.7 (0.0-2.2)	1.4 (0.0-8.7)	0.1 (0.0-4.3)
LGS	2013	1.9 (0.0-7.4)	0.3 (0.0-13.6)	0.1 (0.0-5.9)		0.1 (0.0-1.0)
LMN	2013	1.7 (0.0-75.0)	0.5 (0.0-34.3)	0.3 (0.0-4.5)		0.2 (0.0-7.1)

It appears that the weighted average mortality rates of Pacific macropthalmia at BON, JDA, and MCN were lower in 2013 than 2011 and 2012. However, it still appears that Pacific macropthalmia at BON have higher weighted average mortality rates than all species of salmonids. Furthermore, it appears that Pacific macropthalmia had higher weighted average mortality rates in 2013 at LGS and LMN than do all species of salmonids (Table 4). For example, the weighted average mortalities for Pacific macropthalmia passing through BON, LGS, and LMN in 2013 were 4.7%, 1.9%, and 1.7%, respectively (Table 4). The weighted average mortality rates for salmonids at these sites ranged from 0.3–1.1% at BON, 0.1–0.3% at LGS, and 0.2–0.5% at LMN (Table 4). As in 2011 and 2013, Pacific macropthalmia passing through JDA in 2013 seem to have similar mortality rates as salmonids (Table 4).

In previous years, histograms of mortality data seemed to indicate that high mortality events were more frequent for Pacific macropthalmia than salmonid juveniles at BON and MCN (see FPC memos from Nov. 22, 2011, and Nov. 14, 2012). This pattern appears to have continued at these two sites in 2013 (Figure 5 and 6). For example, at MCN, daily mortalities for Pacific macropthalmia were in the 8%–9% range for about 11.1% of the days and exceeded 10% for about 11.1% of the days (Figure 6). Daily mortalities for salmonids and steelhead at MCN never exceeded 10% and were only in the 8%–9% range for sockeye for about 3.6% of the days (Figure 6). Some caution should be used when interpreting the data for BON, as there were only four days when sample counts of Pacific macropthalmia exceeded 20 individuals. This pattern of more frequent high mortality events for Pacific macropthalmia than for salmonids was also observed at LGS and LMN in 2013 (Figures 7 and 8). Finally, as in the past years, the frequencies of daily sample mortalities were similar for Pacific macropthalmia and most salmonids at JDA (Figure 9).

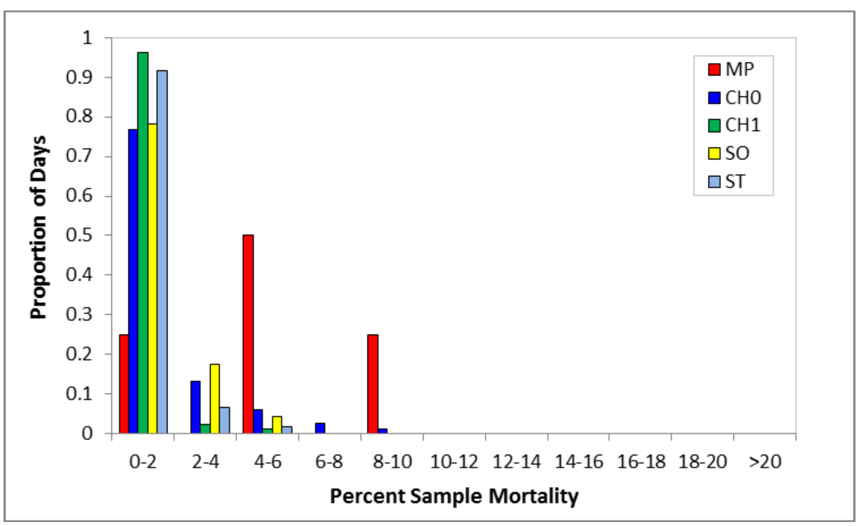

Figure 5. Frequency histogram of sample mortalities for Pacific macropthalmia (MP), subyearling Chinook (CH0), yearling Chinook (CH1), sockeye (SO), and steelhead (ST) at Bonneville Dam in 2013.

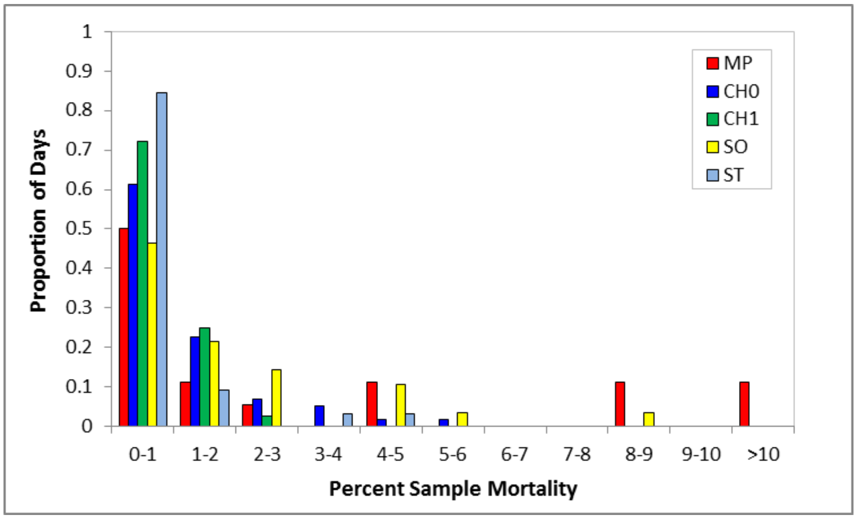

Figure 6. Frequency histogram of sample mortalities for Pacific macropthalmia (MP), subyearling Chinook (CH0), yearling Chinook (CH1), sockeye (SO), and steelhead (ST) at McNary Dam in 2013.

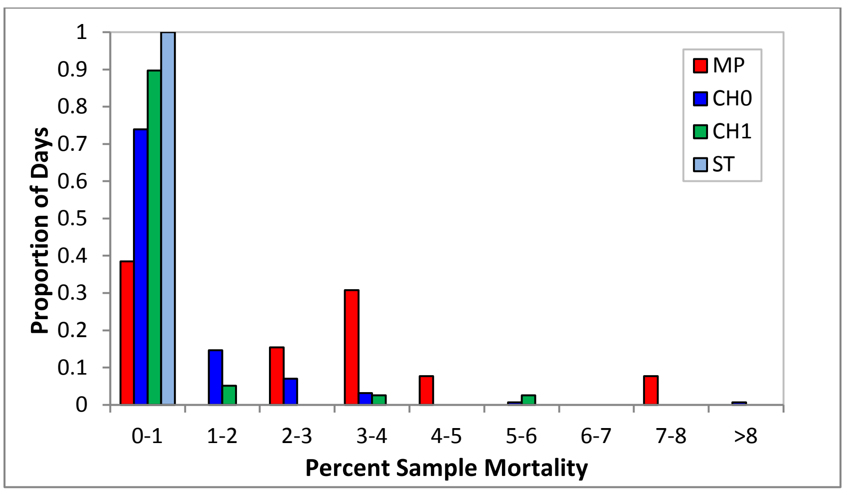

Figure 7. Frequency histogram of sample mortalities for Pacific macropthalmia (MP), subyearling Chinook (CH0), yearling Chinook (CH1), and steelhead (ST) at Little Goose Dam in 2013.

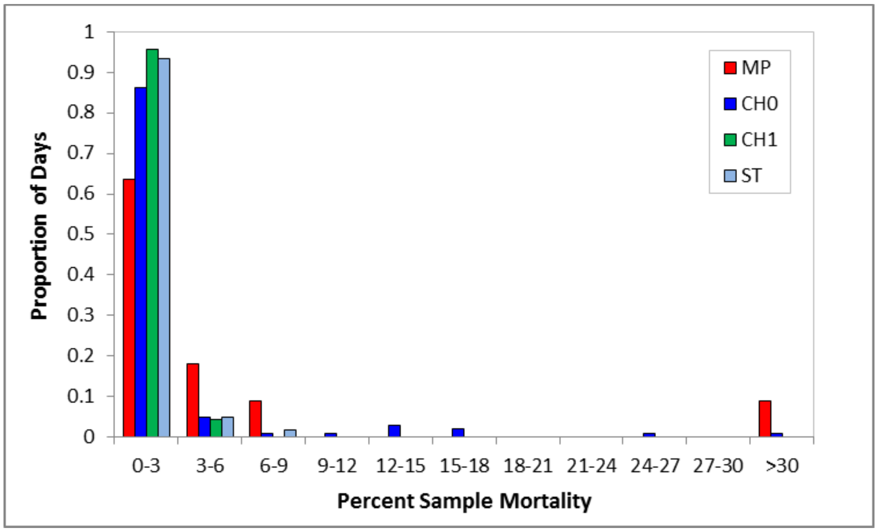

Figure 8. Frequency histogram of sample mortalities for Pacific macropthalmia (MP), subyearling Chinook (CH0), yearling Chinook (CH1), and steelhead (ST) at Lower Monumental Dam in 2013.

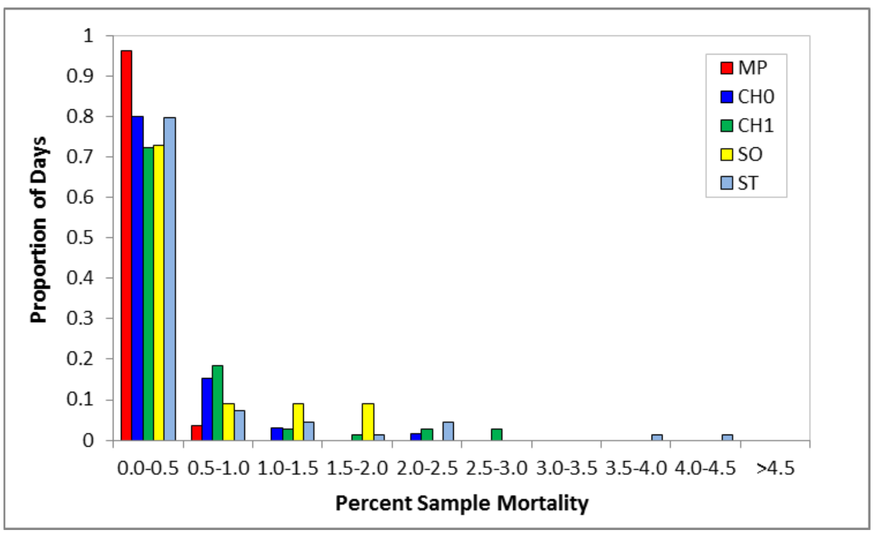

Figure 9. Frequency histogram of sample mortalities for Pacific macropthalmia (MP), subyearling Chinook (CH0), yearling Chinook (CH1), sockeye (SO), and steelhead (ST) at John Day Dam in 2013.

Lamprey Condition Monitoring at John Day, McNary, and Bonneville Dams

Introduction

In 2011, a pilot study was carried out by the SMP at the John Day Dam Smolt Monitoring Facility to gather information on the condition of out-migrating, bypassed juvenile Pacific lamprey (*Entosphenus tridentatus*). Condition exam results represent a combination of in-river baseline conditions such as disease and predation marks and also provide data about injuries incurred while passing through the bypass systems and other routes at the dam(s) as well as injuries that may have occurred due to encounters with predators. Based on information gathered in 2011, the FPC staff and staff from JDA developed a handling and condition sampling protocol for future monitoring efforts. After the 2011 pilot study it was determined that lamprey condition monitoring would be expanded to the other sites on the Lower Columbia River (BON, JDA, and MCN) in 2012, as these were the only sites with high enough sample counts to warrant condition monitoring. This expanded lamprey condition monitoring was continued in 2013. All sites conducting lamprey condition monitoring in 2013 were provided copies of the Lamprey Condition Monitoring Protocol, which is available on the FPC website: ftp://ftp.fpc.org/FPC32.net/Manuals/ConditionSamplingProtocol_2013.pdf.

Lamprey Condition Results

Sample Numbers

In 2013, JDA sampled a total of 21 Pacific ammocoetes and 4,894 Pacific macropthalmia (Table 1). Of these, a subsample of 21 ammocoetes (100%) and 4,226 macropthalmia (86.4%) were examined for condition. At BON, the total sample for Pacific ammocoetes was 14 and the total sample for Pacific macropthalmia was 503 (Table 1). For condition monitoring, BON examined a subsample of 8 Pacific ammocoetes (57.1%) and 318 Pacific macropthalmia (63.2%). Finally, the total sample of Pacific ammocoetes and Pacific macropthalmia at MCN was 0 and 2,995, respectively (Table 1). Of the macropthalmia, 635 (21.2%) were examined for condition.

Length and Weight

Over the past two years of condition monitoring, Pacific ammocoetes have been shorter and lighter than Pacific macropthalmia at BON (Table 5). However, at JDA, Pacific ammocoetes have been slightly longer and substantially heavier than Pacific macropthalmia (Table 5). The average length and weight of Pacific macropthalmia at MCN in 2013 was 142.1 mm TL and 4.2 grams (Table 5). Finally, for the second year in a row, Pacific ammocoetes at BON were much smaller than those at JDA (Table 5). As with timing (Table 3), this may indicate a large influence of local populations, particularly at BON.

Table 5. Average length (mm TL) and weight (g) of Pacific ammocoetes and Pacific macropthalmia sampled for condition monitoring at BON, JDA, and MCN in 2011–2013. Numbers in parentheses are 95% confidence intervals.

Site	Migration Year	Ammocoetes		Macropthalmia	
		Length (mm)	Weight (g)	Length (mm)	Weight (g)
BON	2012	109.7 (94.6-124.8)	2.7 (1.2-4.3)	144.6 (144.0-145.1)	4.3 (4.2-4.3)
	2013	103.9 (78.2-129.5)	3.0 (1.3-4.7)	137.1 (135.7-138.5)	3.6 (3.5-3.7)
JDA	2011	145.6 (145.0-146.2)	5.2 (5.1-5.3)	143.3 (143.0-143.6)	4.2 (4.1-4.3)
	2012	145.4 (144.0-146.7)	5.1 (5.0-5.3)	144.9 (144.7-145.1)	4.3 (4.3-4.3)
	2013	149.2 (142.9-155.5)	5.5 (4.8-6.2)	144.0 (143.7-144.3)	4.1 (4.1-4.2)
MCN	2012	N/A	N/A	142.0 (141.4-142.7)	3.9 (3.9-4.0)
	2013	N/A	N/A	142.1 (141.3-142.9)	4.2 (4.1-4.2)

Injuries and Predation

In 2013, lamprey condition monitoring continued using the protocol that "injuries" were to be recorded only for instances that could not be clearly attributed to disease, parasites, and/or predators. Therefore, marks that were thought to be consistent with bird marks were recorded as Predator Bird, instead of body injury. In order to provide additional insight on this issue, FPC staff asked the SMP personnel in 2013 to document body injuries versus injuries that could be attributable to predators. The FPC will continue to work with the USFWS staff to develop a better protocol on distinguishing between true injuries that are caused by the bypass system at the projects and those that may be attributable to predators for future years.

In 2013, the only injuries that were recorded for Pacific ammocoetes at JDA were attributable to avian predators (Pred-Bird) (Table 6). Although the numbers examined were low, no injuries were recorded for Pacific ammocoetes at BON in 2013 (Table 6). For Pacific macropthalmia, the most common injuries in 2013 were those attributable to avian predators (Table 7). This was true for all three sites where condition monitoring took place. Overall, Pred-Bird injury rates ranged from 3.5% at MCN to nearly 17% at JDA in 2013 (Table 7).

Table 6. Summary of Pacific ammocoete injury and predator marks at John Day (JDA) and Bonneville (BON) in 2011–2013. No Pacific ammocoetes were examined for condition at MCN in 2013 and only 1 in 2012.

Site	Year	Number Examined	Body Injury	Eye Injury	Head Injury	Fin Injury	Pred-Bird
JDA	2011	851	5.3%	0.0%	0.7%	0.9%	0.0%
	2012*	165	7.9%	0.0%	0.0%	0.6%	0.0%
	2013	21	0.0%	0.0%	0.0%	0.0%	4.8%
BON	2012	18	5.6%	0.0%	0.0%	0.0%	0.0%
	2013	8	0.0%	0.0%	0.0%	0.0%	0.0%

* In 2012, FPC provided clarification that "injuries" are recorded only for instances that cannot be clearly attributable to disease, predator, or parasite. Pilot monitoring program at JDA in 2011may have entered suspected "predator marks" as injuries.

Table 7. Summary of Pacific macropthalmia injury and predator marks at John Day (JDA), Bonneville (BON), and McNary dams in 2011–2013.

Site	Year	Number Examined	Body Injury	Eye Injury	Head Injury	Fin Injury	Pred-Bird
JDA	2011	4,245	6.1%	0.2%	0.5%	5.8%	0.0%
	2012*	7,136	0.8%	0.1%	0.5%	1.4%	8.3%
	2013	4,226	0.2%	0.1%	0.4%	1.5%	16.9%
BON	2012	2,291	2.9%	0.0%	0.3%	3.4%	3.7%
	2013	318	1.6%	0.3%	0.0%	4.4%	11.6%
MCN	2012	941	2.8%	0.0%	1.1%	1.9%	5.4%
	2013	635	0.9%	0.3%	0.6%	0.0%	3.5%

* In 2012, FPC provided clarification that "injuries" are recorded only for instances that cannot be clearly attributable to disease, predator, or parasite. Pilot monitoring program at JDA in 2011may have entered suspected "predator marks" as injuries.

Table 8. Summary of total lamprey injury and predator marks at John Day (JDA), Bonneville (BON), and McNary dams in 2011–2013.

Site	Year	Number Examined	Body Injury	Eye Injury	Head Injury	Fin Injury	Pred-Bird
JDA	2011	5,096	5.9%	0.2%	0.6%	5.0%	0.0%
	2012*	7,301	1.0%	0.1%	0.5%	1.4%	8.1%
	2013	4,247	0.2%	0.1%	0.4%	1.5%	16.9%
BON	2012	2,309	2.9%	0.0%	0.3%	3.4%	3.6%
	2013	326	1.5%	0.3%	0.0%	4.3%	11.3%
MCN	2012	942	2.9%	0.0%	1.2%	1.9%	5.4%
	2013	635	0.9%	0.3%	0.6%	0.0%	3.5%

* In 2012, FPC provided clarification that "injuries" are recorded only for instances that cannot be clearly attributable to disease, predator, or parasite. Pilot monitoring program at JDA in 2011may have entered suspected "predator marks" as injuries.

Hemorrhaging

At JDA, no signs of eye hemorrhaging were noted in 2013 but fin hemorrhaging was noted for both Pacific ammocoetes and macropthalmia (Tables 9 and 10). At BON, no signs of hemorrhaging were noted for Pacific ammocoetes but both eye and fin hemorrhaging were noted among Pacific macropthalmia (Tables 9 and 10). As with BON, both eye and fin hemorrhaging were noted among Pacific macropthalmia at MCN (Table 10). For the second year, signs of fin hemorrhaging were highest at BON, with approximately 6.0% of Pacific macropthalmia exhibiting signs (Table 10).

Table 9. Summary of Pacific ammocoete hemorrhaging at John Day (JDA) and Bonneville (BON) in 2011–2013. No Pacific ammocoetes were examined for condition at MCN in 2013 and only 1 in 2012.

Site	Year	Number Examined	Eye Hemm	Fin Hemm.
JDA	2011	851	0.1%	1.3%
	2012	165	0.0%	0.6%
	2013	21	0.0%	4.8%
BON	2012	18	0.0%	11.1%
	2013	8	0.0%	0.0%

Table 10. Summary of Pacific macropthalmia hemorrhaging at John Day (JDA), Bonneville (BON), and McNary dams in 2011–2013.

Site	Year	Number Examined	Eye Hemm	Fin Hemm.
JDA	2011	4,245	0.0%	1.1%
	2012	7,136	0.1%	1.1%
	2013	4,226	0.0%	0.9%
BON	2012	2,291	0.2%	6.8%
	2013	318	0.3%	6.0%
MCN	2012	941	0.0%	1.9%
	2013	635	0.2%	0.6%

Table 11. Summary of total lamprey hemorrhaging at John Day (JDA) and Bonneville (BON) in 2011–2013.

Site	Year	Number Examined	Eye Hemm	Fin Hemm.
JDA	2011	5,096	0.1%	1.2%
	2012	7,301	0.1%	1.1%
	2013	4,247	0.0%	0.9%
BON	2012	2,309	0.2%	6.8%
	2013	326	0.3%	5.8%
MCN	2012	942	0.0%	1.9%
	2013	635	0.2%	0.6%

Diseases

For all three years, observations of external disease were observed only on Pacific macropthalmia but were very rare (Tables 12–14). Fungus has been the most common disease observed on Pacific macropthalmia. For 2013, fungus was observed in 0.4% of the macropthalmia at JDA, 0.0% at BON, and 0.8% at MCN (Table 13). Deformities were also observed in Pacific macropthalmia in 2013, but only at JDA.

Table 12. Summary of Pacific ammocoete disease at John Day (JDA) and Bonneville (BON) dams in 2011–2013. No Pacific ammocoetes were examined for condition at MCN in 2013 and only 1 in 2012.

Site	Year	Examined	Columnaris	Fungus	Deformity
JDA	2011	851	0.0%	0.0%	0.0%
	2012	165	0.0%	0.0%	0.0%
	2013	21	0.0%	0.0%	0.0%
BON	2012	18	0.0%	0.0%	0.0%
	2013	8	0.0%	0.0%	0.0%

Table 13. Summary of Pacific macropthalmia disease at John Day (JDA), Bonneville (BON), and McNary dams in 2011–2013.

Site	Year	Examined	Columnaris	Fungus	Deformity
JDA	2011	4,245	0.0%	0.2%	0.0%
	2012	7,136	0.0%	1.2%	0.1%
	2013	4,226	0.0%	0.4%	0.1%
BON	2012	2,291	0.0%	0.2%	0.0%
	2013	318	0.0%	0.0%	0.0%
MCN	2012	941	0.0%	0.1%	0.0%
	2013	635	0.0%	0.8%	0.0%

Table 14. Summary of total lamprey disease at John Day (JDA), Bonneville (BON), and McNary dams in 2011-2013.

Site	Year	Examined	Columnaris	Fungus	Deformity
JDA	2011	5,096	0.0%	0.2%	0.0%
	2012	7,301	0.0%	1.2%	0.1%
	2013	4,247	0.0%	0.4%	0.1%
BON	2012	2,309	0.0%	0.2%	0.0%
	2013	326	0.0%	0.0%	0.0%
MCN	2012	942	0.0%	0.1%	0.0%
	2013	635	0.0%	0.8%	0.0%