



Translocation of Adult Pacific Lamprey within the Yakima Subbasin, 2015-2016 Broodstock



[Cover Photo: Sean Goudy showing an adult lamprey to White Swan Headstart School students before releasing it into Toppenish Creek (river km 54.3) on May 12, 2016]

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Abstract

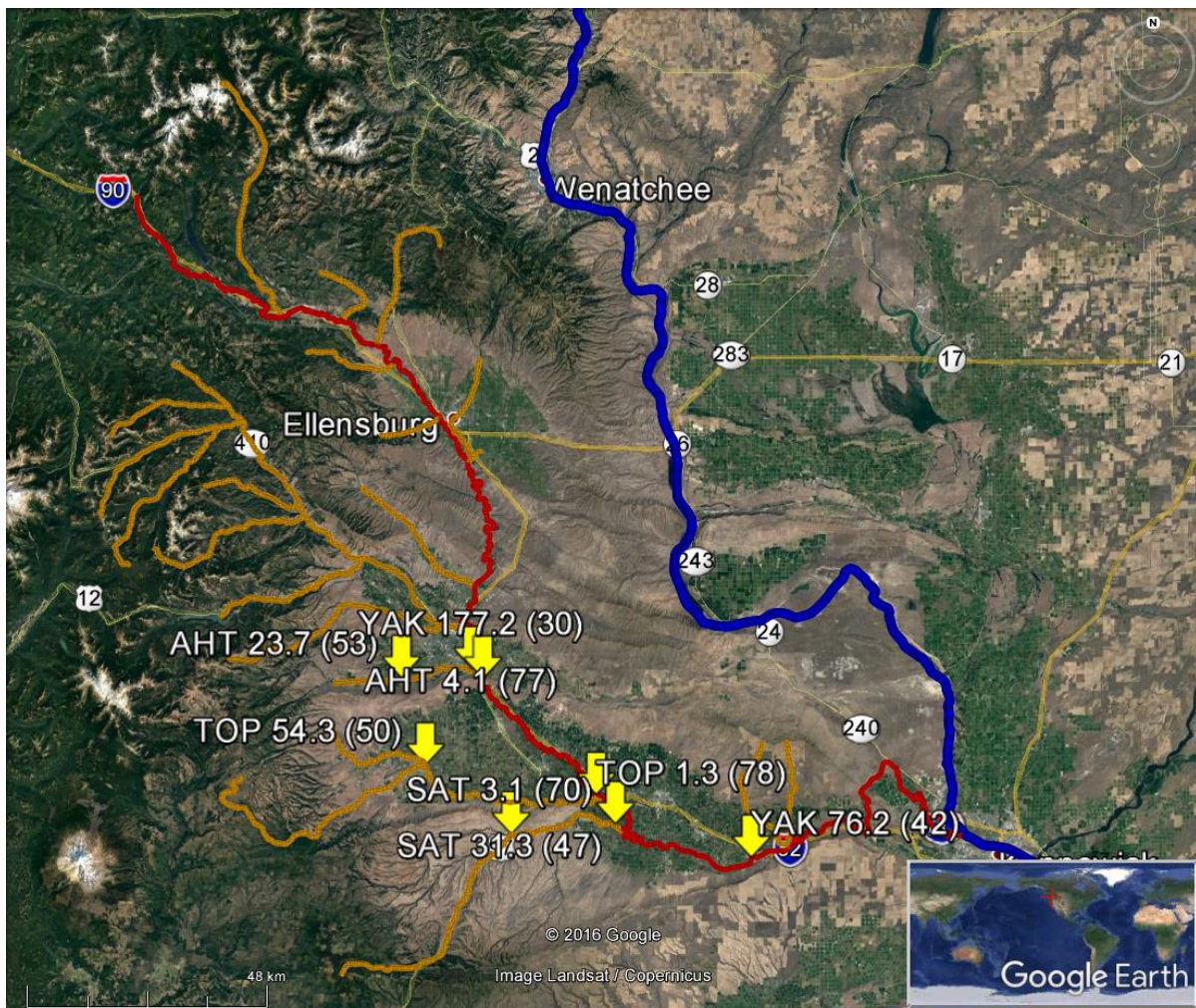
This report is composed of two parts: 1) summary of all 2015-2016 broodstock adult Pacific Lamprey releases during the spring 2016 migration season within the Wenatchee Subbasin and 2) analysis of migration data from those adults that were PIT tagged (all adults were PIT tagged). From the 2015-2016 broodstock (adults collected in summer 2015 that primarily mature in 2016), a total of 447 adult Pacific Lamprey were released within the Yakima Subbasin. A total of 117 lamprey were released in Satus Creek, 128 lamprey were released in Toppenish Creek, 130 lamprey were released in Ahtanum Creek, and 72 lamprey were released in Lower Yakima River between March 25, 2016, and May 21, 2016. Female ratio was estimated to be 43.4%, PIT tag ratio was 34.2%, and genetic tag ratio was 95.5%. This is the fifth year that adult Pacific Lamprey were translocated into the Yakima Subbasin. Translocation occurs primarily in Lower Yakima tributaries, with some release in Lower and Upper Yakima River. Larval Pacific Lamprey have not been documented upstream of Roza Diversion Dam (river km 210.5) until recently in 2016 (adult translocation in Upper Yakima occurred in 2015).

From the PITAGIS regional data base (<http://www.ptagis.org/>), using Query Builder2 Reports, the interrogation data of PIT tagged lamprey were summarized. A total of 36 lamprey (23.8%) out of 151 total PIT tagged lamprey released were detected in at least one PIT array site. The highlights from the 2015-2016 broodstock adult Pacific Lamprey translocation monitoring in the Yakima Subbasin are the following:

- Detection rates of lamprey passing through the lower Satus and lower Toppenish PIT arrays were extremely low this year (31.4% and 6.6%, respectfully), compared to the very high detection from previous years (generally 75-95%).
- Nine lamprey were detected moving downstream initially. One was detected moving downstream all the way to the Lower Columbia River to enter the lower array at Deschutes River. One was detected moving past Prosser Dam Diversion in the Yakima River.
- Of the nine lamprey that initially moved downstream, seven lamprey were detected moving upstream within the Yakima River (after initially moving downstream in the tributary stream). Four of these lamprey were detected in the middle reach of Yakima River at Sunnyside Instream Array (river km 171.1) and the other three lamprey were detected at Roza Diversion Dam (river km 210.5).
- The three lamprey detected at Roza Diversion Dam spent 5-54 days at the dam with total detections ranging between 1,588 and 53,734 (indicating extensive holding).
- Upstream migration was observed primarily in April with episodic movements in May, and June.
- Downstream migration was observed primarily in June and early July potentially indicating the post-spawn drifting.
- The fastest upstream traveling lamprey detected was 7.35 km/day (lamprey detected at Lower Satus Array).

Part I: Release Summary

From the 2015-2016 broodstock (adults collected in summer 2015, most of which mature in spring/summer 2016), a total of 447 adult Pacific Lamprey were released in three lower Yakima tributaries (Satus, Toppenish, and Ahtanum) and mainstem Yakima River between March 31, 2016, and May 21, 2016 (Map 1 and Table 1). Overall female ratio was estimated to be 43.4%, PIT tag ratio was 34.2%, and genetic tag ratio was 95.5%. All lamprey were originally captured from Bonneville Dam (12.1%), The Dalles Dam (60.9%), or John Day Dam (27.0%) in the Lower Columbia River during the summer of 2015. Total length averaged 604 mm (minimum 382 mm and maximum 767 mm), weight averaged 383.6 g (minimum 109.4 g and maximum 775.4 g), and interdorsal distance averaged 19.6 mm (minimum -2 mm and maximum 42 mm) during the PIT tagging operations in summer 2015 through spring 2016.



Map 1. Overall aerial map of 2015-2016 broodstock Pacific Lamprey translocation release sites in the Yakima River (“YAK” = Yakima, “SAT” = Satus, “TOP” = Toppenish, “AHT” = Ahtanum, the number next to the stream name is the river km, and the number in parenthesis is the total number of lamprey released). The red line represents mainstem Yakima River, the orange lines represent its tributaries, and the blue line represents the Columbia River.

Table 1. Summary of 2015-2016 broodstock Pacific Lamprey translocation release in the Yakima Subbasin. “F” stands for female, “M” stands for male, and “UN” stands for unknown sex. “(?)” denotes slightly lower certainty with the sex ID. Female Ratio (Est. 1) is based solely on “# F” and “# M”, whereas “Female Ratio (Est. 2)” includes “# F (?)” and “# M (?)” in the estimation.

Stream	# Total	# F # M		# UN	# with Pit Tags	# with Genetic Tags	Female Ratio (Est. 1)	Female Ratio (Est. 2)	Pit Tag Ratio	Genetic Tag Ratio		
		# F	# M									
Satus	117	33	59	10	12	15	71	100	35.9%	37.7%	60.7%	85.5%
Toppenish	128	57	47	13	9	24	82	125	54.8%	55.6%	64.1%	97.7%
Ahtanum	130	50	71	7	0	9	0	130	41.3%	44.5%	0.0%	100.0%
Lower Yakima	72	21	51	0	0	0	0	72	29.2%	29.2%	0.0%	100.0%
Overall	447	161	228	30	21	48	153	427	41.4%	43.4%	34.2%	95.5%

The number of translocated lamprey has steadily increased over the years since 2012, which started with only 15 lamprey (Table 2). The total accumulated number of translocated adult Pacific Lamprey in the Yakima Subbasin from 2012-2016 is 1,637. The number of adult lamprey released in 2016 was slightly lower compared to the previous year due to the increase in adult translocation numbers going outside of the Yakima Subbasin (e.g. Methow and Wenatchee subbasins). The female ratio has ranged between 20-44% with an average of 35.0%, resulting in higher numbers of males than females over the years, except for the 2011-2012 broodstock (with only 15 lamprey). Approximately 65% of all lamprey have been PIT tagged over the five years to improve the assessment of distribution and final destination of the released lamprey. Genetic tagging ratios have stayed close to 100% for all release years to track the success of translocation (via larval/juvenile sampling using parentage genetics) with a current running average of 96.5%.

Table 2. Summary of all Yakama Nation Fisheries Pacific Lamprey translocation (broodstock 2011-2012 through 2015-2016). *Number with genetic tags from 2012-2013 and 2013-2014 are estimates.

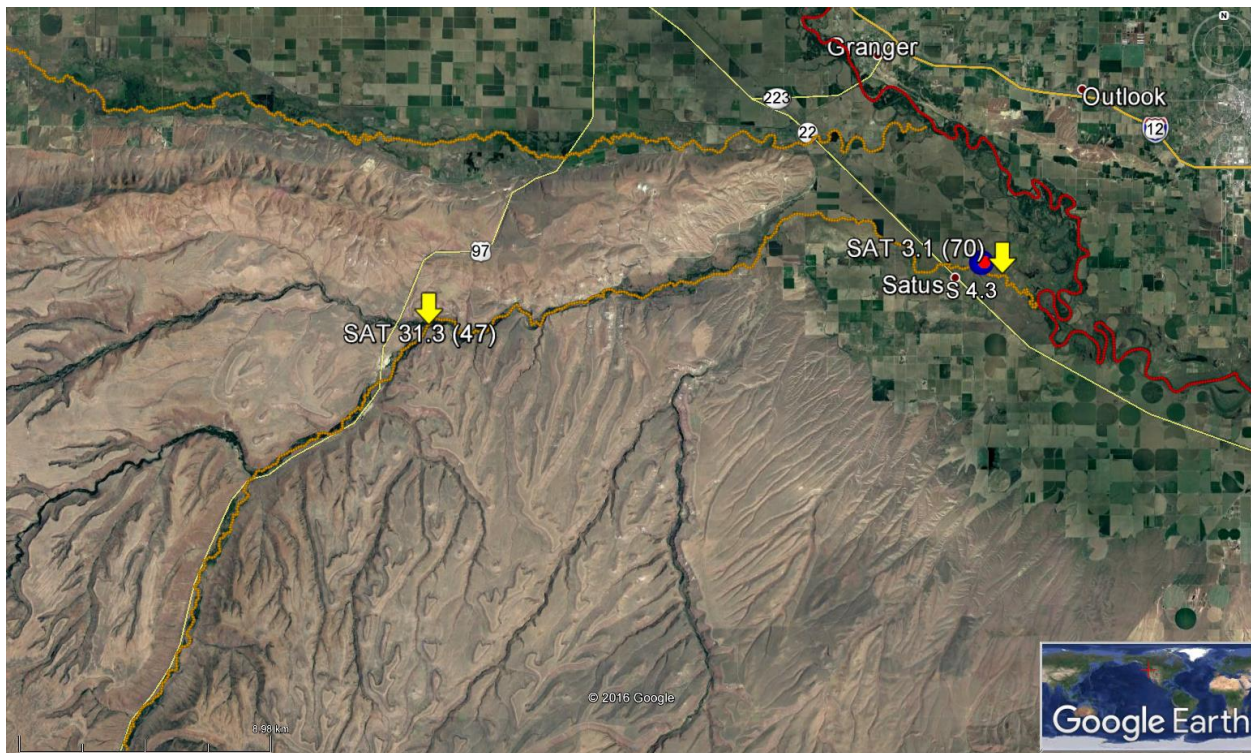
Broodstock Year	# Total	# of Female	# of Male	# of Unknown	# with Pit Tags	# with Genetic Tags	Female Ratio	Pit Tag Ratio	Genetic Tag Ratio
2012-2013	141	27	110	4	124	*135	19.7%	87.9%	95.7%
2013-2014	264	111	144	9	213	*250	43.5%	80.7%	94.7%
2014-2015	770	201	492	77	564	753	29.0%	73.2%	97.8%
2015-2016	447	191	249	7	151	427	43.4%	33.8%	95.5%
Total	1637	539	1001	97	1066	1580	35.0%	65.1%	96.5%

Satus Creek

In Satus Creek, there were two release events: 1) 70 lamprey were released at river km 3.1 on April 7, 2016, and 2) 47 lamprey were released at river km 31.3 on May 4, 2016 (Map 2 and Table 3).

The overall female ratio was 37.7%, PIT tag ratio was 60.7%, and genetic tag ratio was 85.5%. Water temperature was 12.8°C at the lower site (March 7, 2016, 4:15 PM) and 13.7°C at the regular upper site (May 4, 2016, 10:00 AM), which were within the optimal Pacific Lamprey spawning temperature range (11-15°C). Typically, we target approximately 10-12°C for the early release, and 12-14°C for the late release, and the temperature were within the desired ranges.

The primary goal was two-fold: 1) to continue to increase the population abundance of Pacific Lamprey in Satus Creek and 2) to assess upstream movement through the lower PIT array. The vast majority of PIT tagged lamprey were released at the lower release site (river km 3.1) to evaluate passage through the lower array (river km 4.3).



Map 3. Aerial map of 2015-2016 broodstock Pacific Lamprey translocation release sites in Satus Creek (bottom orange line). “SAT” stands for Satus, the number next to the stream name is the river km and the number in parenthesis is the total number of lamprey released. Also shown with the blue circle is the PIT tag array locations [one in lower Satus (river km 4.3)], and the red circle is the location of a screw trap for juvenile monitoring. Yakima River is the red line.

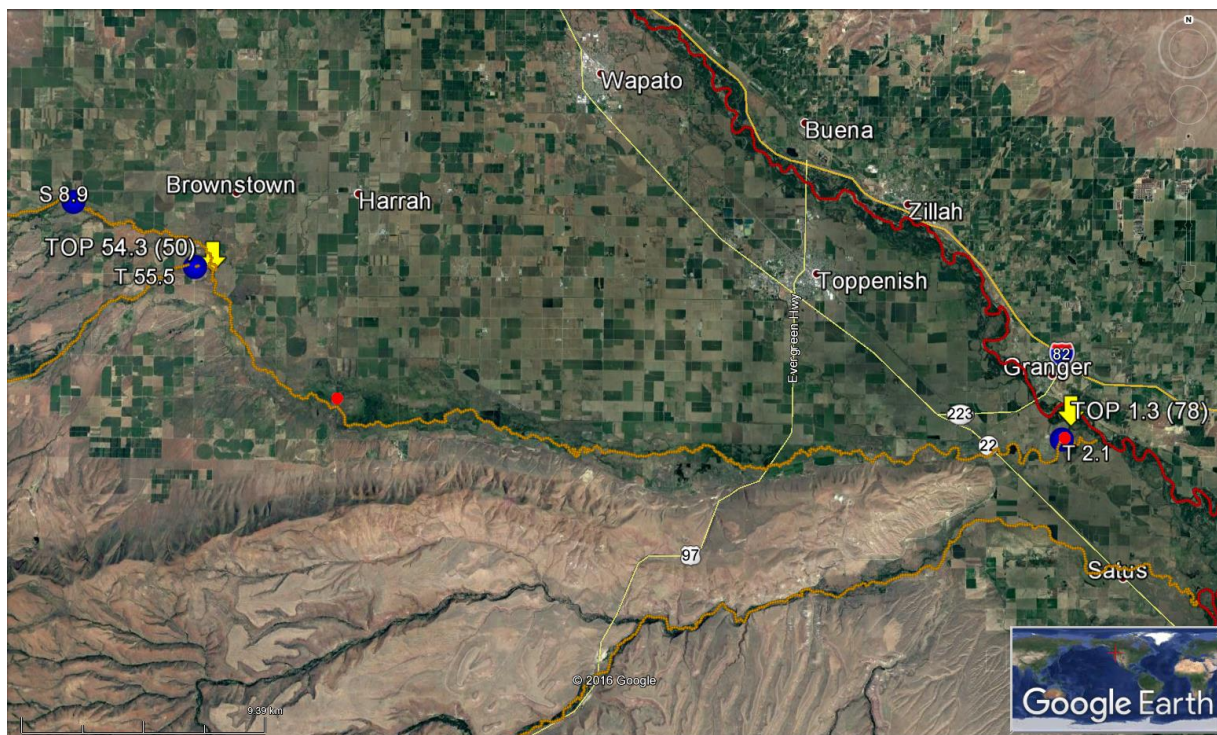
Table 4. Summary of 2014-2015 broodstock Pacific Lamprey translocation release information for Satus Creek. “F” stands for female, “M” stands for male, and “UN” stands for unknown sex. “(?)” denotes slightly lower certainty with the sex ID. Female Ratio (Est. 1) is based solely on “# F” and “# M”, whereas “Female Ratio (Est. 2)” includes “# F (?)” and “# M (?)” in the estimation.

Stream	River km	Date	Time	Water Temp (C°)	# Total	# with					# with Genetic Tags	Female Ratio (Est. 1)	Female Ratio (Est. 2)	Pit Tag Ratio	Genetic Tag Ratio	
						# F	# M	# (?)	# M (?)	# UN						
Satus	3.1	4/7/2016	16:15	12.8	70	15	37	6	10	2	70	54	28.8%	30.9%	100.0%	77.1%
Satus	31.3	5/4/2016	10:00	13.7	47	18	22	4	2	1	1	46	45.0%	47.8%	2.1%	97.9%
Total	-	-	-	-	117	33	59	10	12	15	71	100	35.9%	37.7%	60.7%	85.5%

Toppenish Creek

In Toppenish Creek, there were three release events: 1) 78 lamprey were released at river km 1.3 on April 7, 2016, 2) 25 lamprey were released at river km 54.3 on May 5, 2016, and 3) 25 lamprey were released at river km 54.3 on May 12, 2016 (Map 3 and Table 4).

The overall female ratio was 55.6%, PIT tag ratio was 64.1%, and genetic tag ratio was 97.7%. The vast majority of PIT tagged lamprey were released at the lower release site (river km 1.3) to test passage through the lower array (river km 2.1). Both upper arrays in upper Toppenish (river km 55.5) and Simcoe Creek (river km 8.9) were not running during 2016. Water temperature was 15.6°C at the lower release site (April 7, 2016, 2:30 PM), 13.4 and 14.3°C at the upper release site on May 5, 2016, 12:30 PM and on May 12, 2016, 1:20 PM, respectfully. Typically, we target approximately 10-12°C for the early release, and 12-14°C for the late release; the temperature for the upper release was within the desired range, but the lower release could have been scheduled earlier (perhaps in mid- to late-March) to reduce the warm water conditions experienced at this site.



Map 5. Aerial map of 2015-2016 broodstock Pacific Lamprey translocation release sites in Toppenish Creek (upper orange line). “TOP” stands for Toppenish, the number next to the stream name is the river km and the number in parenthesis is the total number of lamprey released. Also shown with the blue circles are the PIT tag array locations [one in lower Toppenish (river km 2.1), one in upper Toppenish (river km 55.5), and one in Simcoe Creek (river km 8.9)], and the red circles are the locations of screw traps for juvenile monitoring (the lower screw trap is currently out of commission). Yakima River is the red line.

Table 5. Summary of 2014-2015 broodstock Pacific Lamprey translocation release information for Toppenish Creek. “F” stands for female, “M” stands for male, and “UN” stands for unknown sex. “(?)” denotes slightly lower certainty with the sex ID. Female Ratio (Est. 1) is based solely on “# F” and “# M”, whereas “Female Ratio (Est. 2)” includes “# F (?)” and “# M (?)” in the estimation.

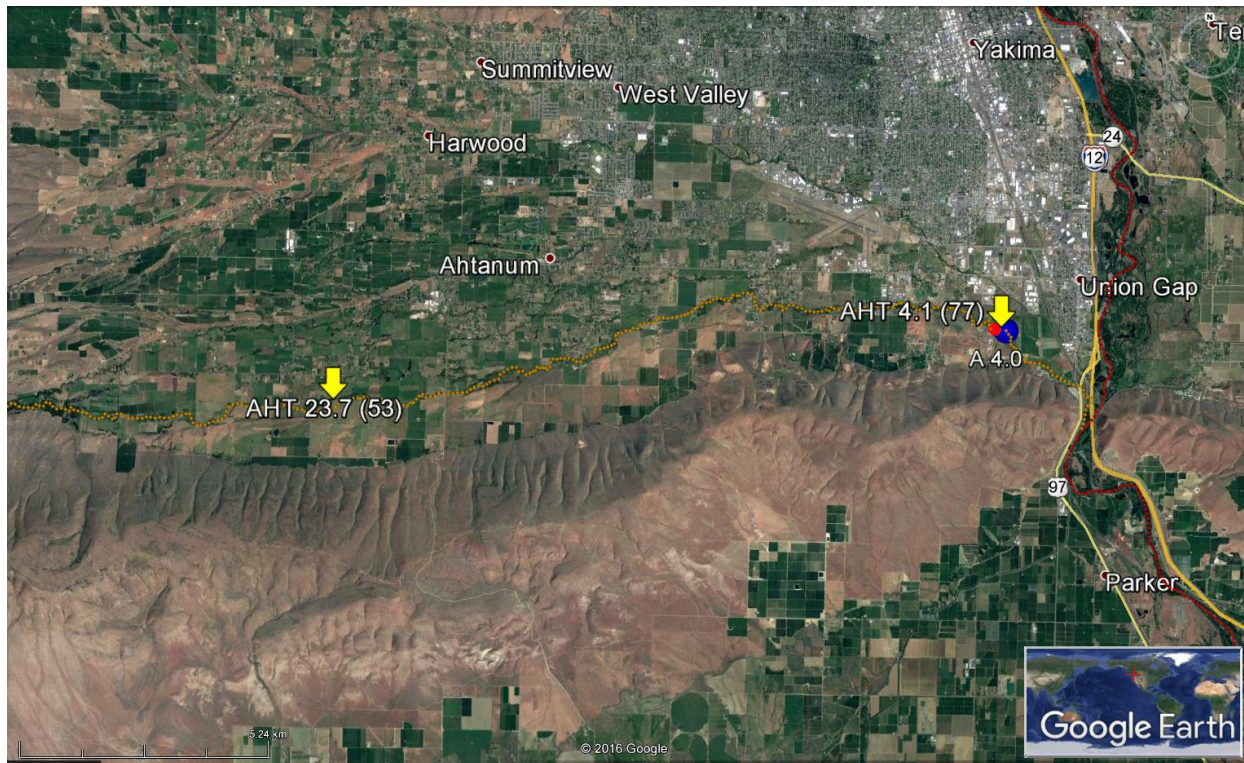
Stream	River km	Date	Time	Water Temp (C)	# of Female	# of Male	# of Unknown	# with Pit Tags	# with Genetic Tags		Female Ratio	Pit Tag Ratio	Genetic Tag Ratio
									Genetic Tags	Total			
Toppenish	1.7	3/25/2015	2:00 PM	13.6	22	59	0	81	81	81	27.2%	100.0%	100.0%
Toppenish	54.3	4/9/2015	5:00 PM	11.7	1	24	0	1	14	25	4.0%	4.0%	56.0%
Toppenish	54.3	4/30/2015	4:00 PM	14.3	29	58	15	102	102	102	33.3%	100.0%	100.0%
Toppenish	61.6	5/13/2015	11:00 AM	11.4	3	4	4	10	10	11	42.9%	90.9%	90.9%
Total	-	-	-	-	55	145	19	194	207	219	27.5%	88.6%	94.5%

Ahtanum Creek

In Ahtanum Creek, there were two release events: 77 lamprey were released at river km 4.1 on March 31, 2016, with La Salle High School students and 53 lamprey were released at river km 23.7 on May 21, 2016, as part of the World Fish Migration Day celebratory event (Map 4 and Table 5).

The overall female ratio was 44.5%, PIT tag ratio was 0.0%, and genetic tag ratio was 100.0%. Water temperature was 7.5°C at the lower release site (March 31, 2016, 9:00 AM) and 9.3°C at the upper release site (May 21, 2016, 12:00 PM). Typically, we target approximately 10-12°C for the early release, and 12-14°C for the late release. Due to the lower temperature available at Ahtanum Creek, the temperature were still cool at both of these release events.

The primary goal was to continue to increase the population abundance of Pacific Lamprey in Ahtanum Creek through two releases (one early lower release and one late upper release). In the past, we have released PIT tagged lamprey downstream of the lower PIT array (river km 4.0), but this array was out of commission this year due to flood damage. As a result, the lower release site was moved upstream from river km 1.7 to 4.1 this year to provide the easiest access for the participating La Salle High School students; there was no point in releasing PIT tagged lamprey downstream of the PIT array this year.



Map 4. Aerial map of 2015-2016 broodstock Pacific Lamprey translocation release sites in Ahtanum Creek. “AHT” stands for Ahtanum, the number next to the stream name is the river km and the number in parenthesis is the total number of lamprey released. Also shown with the blue circle is the PIT tag array location [one in lower Ahtanum (river km 4.0)], and the red circle is the location of a screw trap for juvenile monitoring (currently out of commission). Yakima River is the red line.

Table 5. Summary of 2015-2016 broodstock Pacific Lamprey translocation release information for Ahtanum Creek. “F” stands for female, “M” stands for male, and “UN” stands for unknown sex. “(?)” denotes slightly lower certainty with the sex ID. Female Ratio (Est. 1) is based solely on “# F” and “# M”, whereas “Female Ratio (Est. 2)” includes “# F (?)” and “# M (?)” in the estimation.

Stream	River km	Date	Time	Water Temp (C°)	# Total	# F	# M	# F (?)	# M (?)	# UN	# with Pit Tags	# with Genetic Tags	Female Ratio (Est. 1)	Female Ratio (Est. 2)	Pit Tag Ratio	Genetic Tag Ratio
Ahtanum	4.1	3/31/2016	9:00	7.5	77	31	37	7	0	2	0	77	45.6%	50.7%	0.0%	100.0%
Ahtanum	23.7	5/21/2016	12:00	9.3	53	19	34	0	0	0	0	53	35.8%	35.8%	0.0%	100.0%
Total	-	-	-	-	130	50	71	7	0	9	0	130	41.3%	44.5%	0.0%	100.0%

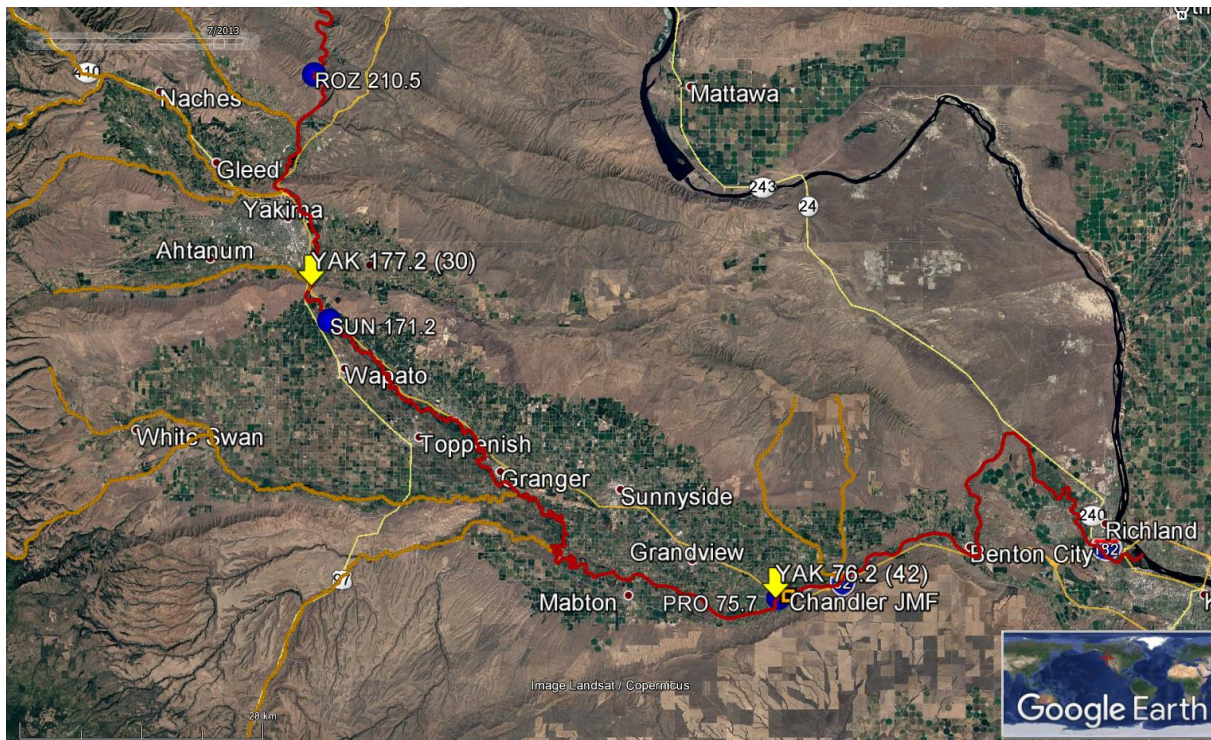
Lower Yakima River

In the Yakima River, there were three release events: 1) 41 lamprey were released at river km 76.2 (Prosser Hatchery) on April 22, 2016, 2) 1 lamprey was released at river km 76.2 (Prosser Hatchery) on April 26, 2016, and 3) 30 lamprey were released at river km 177.2 on April 18, 2016 (Map 5 and Table 6).

The overall female ratio was 29.2%, PIT tag ratio was 0.0% (lamprey were too sexually mature to insert PIT tags), and genetic tag ratio was 100.0%. Water temperature was 13.8°C at the lower

site (April 22, 2016) and 11.4°C at the upper release site (April 18, 2016). Typically, we target approximately 10-12°C for the early release, and 12-14°C for the late release; the temperature for the upper release was within the desired range, but the lower release could have been scheduled earlier (perhaps in mid- to late-March) to reduce the warm water conditions experienced at this site.

The primary goal was to release the more sexually mature adults into the rivers/streams quickly so they can find spawning grounds on their own (prior to over ripening). Lamprey for these three releases were predominantly sexually mature lamprey from Prosser Hatchery (many lamprey matured simultaneously around this time) that could not be held much longer in the tanks (due to their advanced sexual maturation stage). To ensure some can reach upstream of the Sunnyside and Wapato diversion dams, we released the second group upstream of these two dams.



Map 5. Aerial map of 2015-2016 broodstock Pacific Lamprey translocation release sites in the Yakima River. “YAK” stands for Yakima, the number next to the stream name is the river km and the number in parenthesis is the total number of lamprey released (yellow text). Also shown with the blue circles are the PIT tag array locations, and the orange box is the location of Chandler Juvenile Monitoring Facility. Yakima River is the red line and orange lines are tributaries.

Table 6. Summary of 2015-2016 broodstock Pacific Lamprey translocation release information for the Yakima River. “F” stands for female, “M” stands for male, and “UN” stands for unknown sex. “(?)” denotes slightly lower certainty with the sex ID. Female Ratio (Est. 1) is based solely on “# F” and “# M”, whereas “Female Ratio (Est. 2)” includes “# F (?)” and “# M (?)” in the estimation.

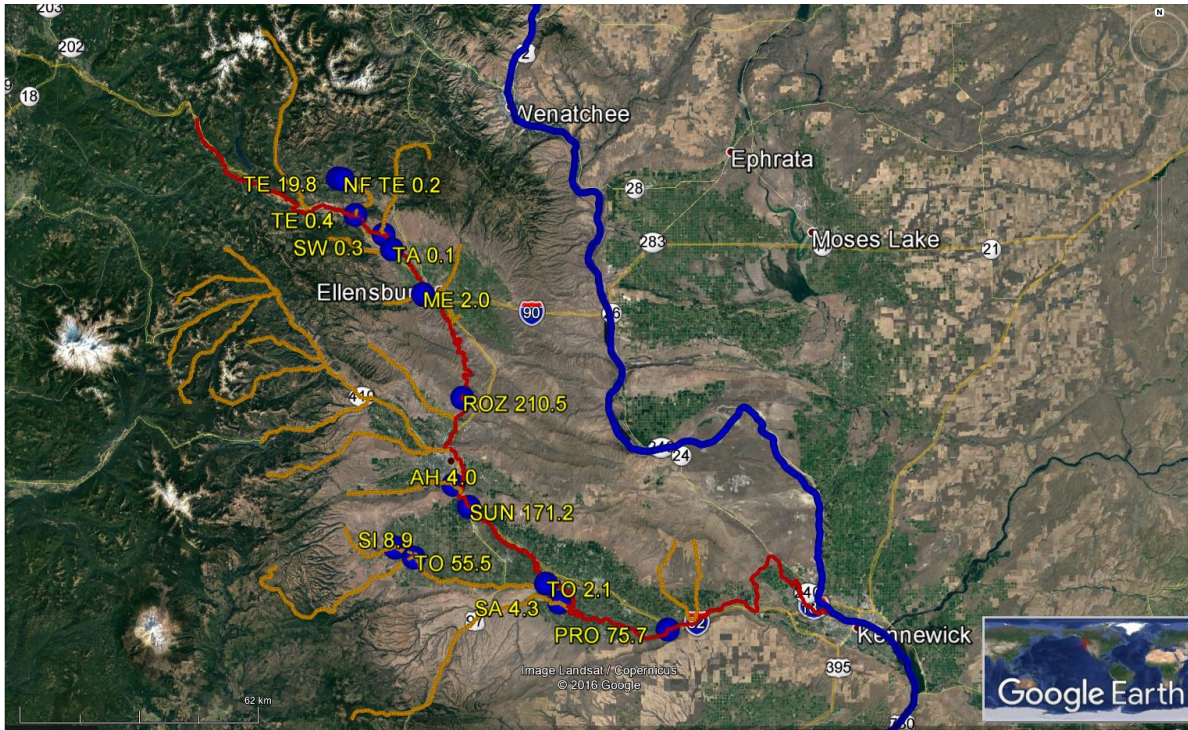
Stream	River km	Date	Time	Water Temp (C°)	# Total	# F	# M	# F (?)	# M (?)	# UN	# with Pit Tags	# with Genetic Tags	Female Ratio (Est. 1)	Female Ratio (Est. 2)	Pit Tag Ratio	Genetic Tag Ratio
Yakima	76.2	4/22/2016	16:30	13.8	41	11	30	0	0	0	0	41	26.8%	26.8%	0.0%	100.0%
Yakima	76.2	4/26/2016	15:45	-	1	0	1	0	0	0	0	1	0.0%	0.0%	0.0%	100.0%
Yakima	177.2	4/18/2016	16:15	11.4	30	10	20	0	0	0	0	30	33.3%	33.3%	0.0%	100.0%
Total	-	-	-	-	72	21	51	0	0	0	0	72	29.2%	29.2%	0.0%	100.0%

Part II: Pit Tag Detection and Analysis

From the PITAGIS regional data base (<http://www.ptagis.org/>), using Query Builder2 Reports, the interrogation data of individual PIT tagged lamprey is summarized. A total of 36 lamprey (23.8%) out of 151 total PIT tagged lamprey released were detected in at least one PIT array site.

There are a total of three instream PIT array sites on the mainstem Yakima River (river km 75.7, 171.2, and 210.5) and many more within the tributaries (Map 6). Within the Lower Yakima, there are two sites in Toppenish Creek (river km 2.1 and 55.5), and one site each in Simcoe (river km 8.9), Satus (river km 4.3), and Ahtanum (river km 4.0) creeks. Within the Upper Yakima, there are three sites within Teanaway River (river km 0.4, 19.8, and North Fork Teanaway river km 0.2), one site each within Swaulk (river km 0.3), Taneum (river km 0.1), and Menastash (river km 2.0) creeks. Some of these arrays are temporary and are not running year around. Most sites have a pair of arrays, consisting of lower (downstream) and an upper (upstream) array.

Based on data provided by the flow monitoring stations within Satus Creek (river km 4.3), Toppenish Creek (river km 72.9), Ahtanum Creek (river km 1.0), and Yakima River (river km 177.7), the release events occurred primarily towards the tail end of the snow melt peak flow (Figure 1, 2, 3, and 4). Discharge ranged between 5,000-10,000 cfs within the Yakima River and 100-500 cfs in both Upper Toppenish Creek and Lower Ahtanum and 175-300 cfs in Satus Creek during the adult release period. The last detection was on July 2, 2016, which corresponds to the tail end of the rapid decline in water flow in all of these streams/ivers.



Map 6. Overall aerial map of PIT tag arrays within the Yakima Subbasin. The two- to three-letter abbreviation and its associated river km is labeled in yellow font. The red line represents mainstem Yakima River, the orange lines represent its tributaries, and the blue line represents the Columbia River.

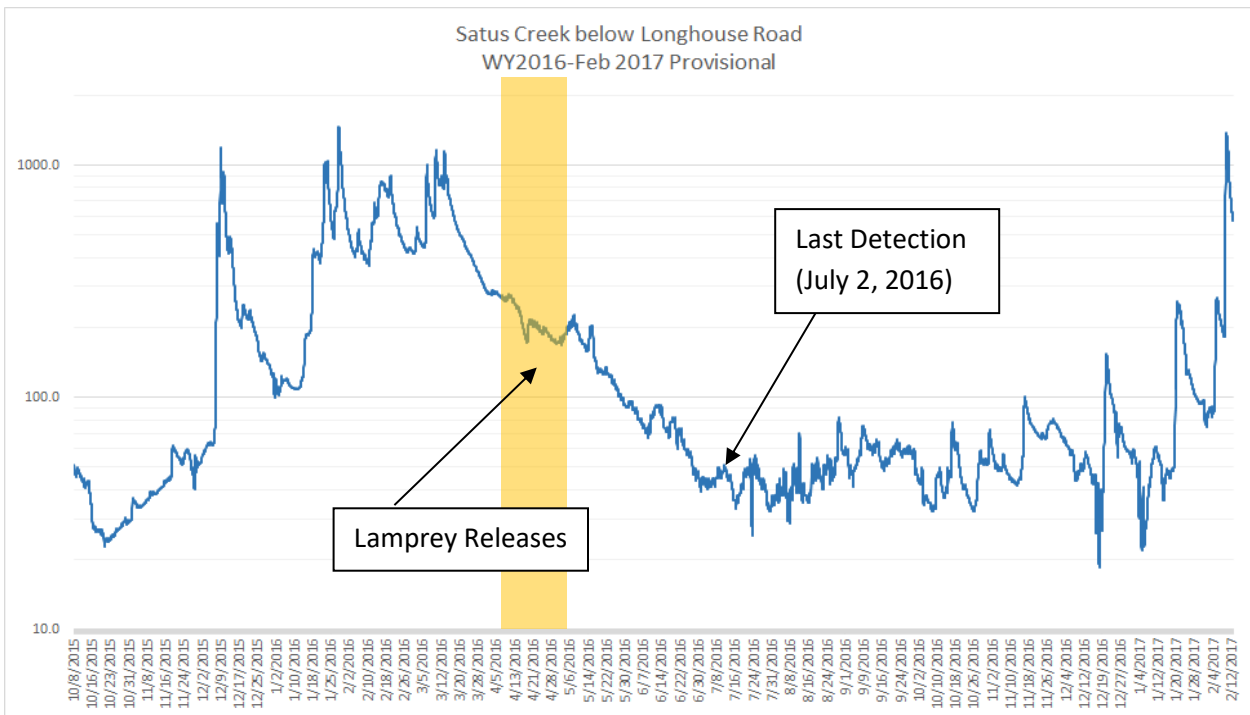


Figure 1. Discharge (cubic feet per second) data of Satus Creek in Satus, WA, below Satus Longhouse Road (river km 4.3) between October 1, 2015, and February 12, 2017 (Yakama Nation Water Resources Program).

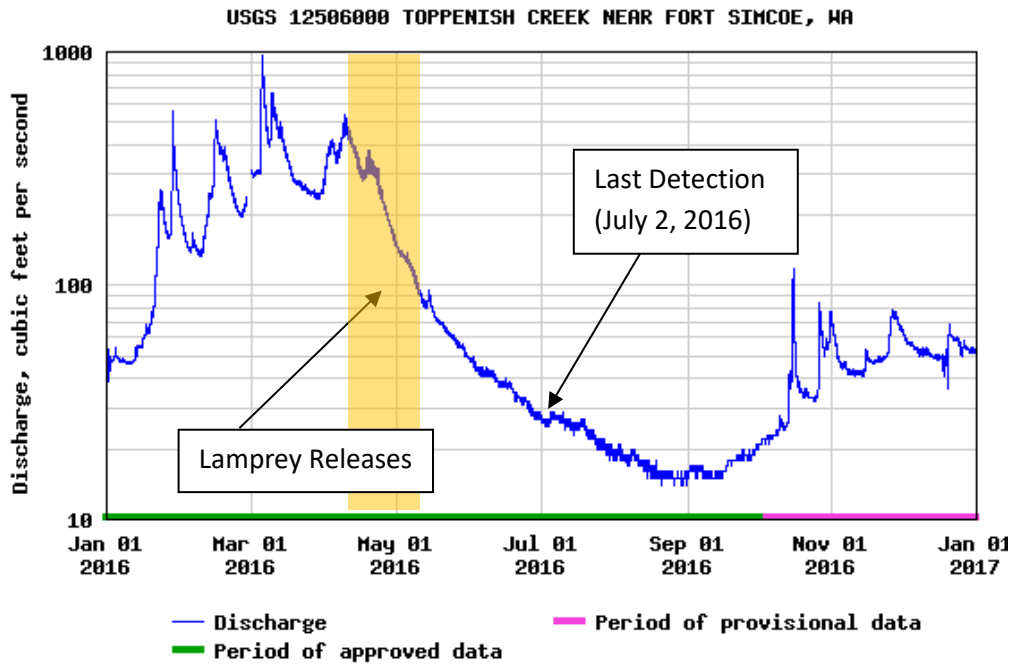


Figure 1. Discharge (cubic feet per second) data of Toppenish Creek near Fort Simcoe, WA (river km 72.9) between January 1, 2016, and December 31, 2016 (US Geological Survey National Water Information System: Web Interface).

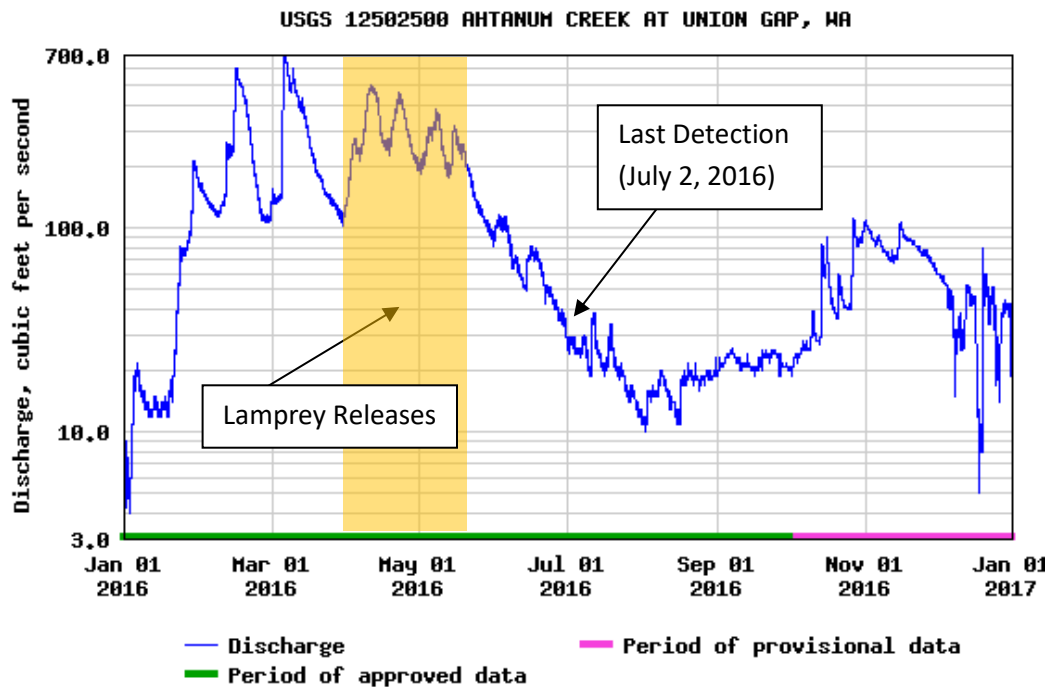


Figure 2. Discharge (cubic feet per second) data of the Ahtanum Creek at Union Gap, WA (river km 1.0) between January 1, 2016, and December 31, 2016 (US Geological Survey National Water Information System: Web Interface).

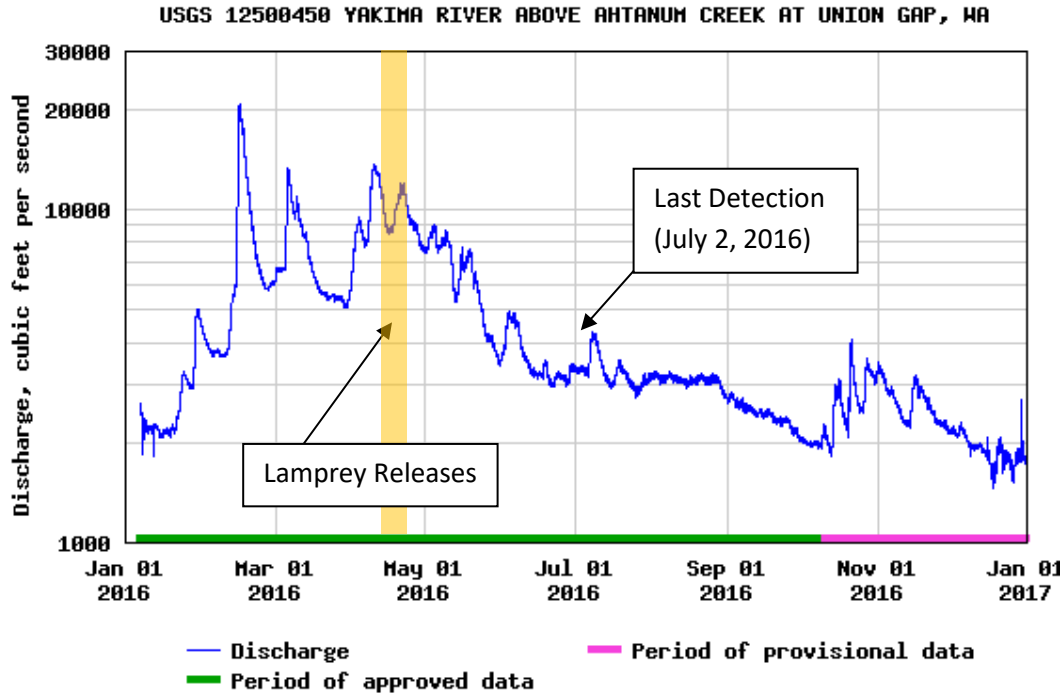


Figure 3. Discharge (cubic feet per second) data of the Yakima River at Union Gap, WA (river km 177.7) between January 1, 2016, and December 31, 2016 (US Geological Survey National Water Information System: Web Interface).

Satus Creek

Of the 70 PIT tagged lamprey released in lower Satus Creek at river km 3.1 on April 7, 2016, 24 lamprey (34.3%) were detected at least once at one of the PIT array sites in the Columbia Basin. Of those lamprey detected, none were detected in more than one PIT array site. Of those detected, 22 lamprey (31.4% of overall) were detected at the Lower Satus site at river km 4.3, indicating a 1.2 km upstream movement. Of the 22 lamprey detected here, 17 lamprey (77.2%) moved within the first 24 hours post release; four additional lamprey were detected within five days post release and one lamprey was detected 13 days post release. The first lamprey arrived at 7:10 PM, which was approximately 4 hours after the release (migration speed of 7.35 km/day). While most lamprey (81.8%) had detections lasting no more than 15 min at this site (indicating passing through the two arrays quickly), two lamprey (9.1%) displayed detections lasting between 3 and 18 hours and two lamprey (9.1%) displayed detections that spanned 5-28 days (potentially indicating downstream movement later on). Number of detections per lamprey ranged between 1 and 11 (no lamprey stayed right by the array for an extensive amount of time).

Two lamprey (2.9%) were initially detected moving downstream of the release location. One of these lamprey was detected at Prosser Dam Diversion (Smolt Bypass Separator/Sample) on June 4, 2016, indicating that it traveled 3.1 km downstream to the mouth of Satus Creek and traveled another 36.6 km downstream to reach Prosser Dam diversion. Another lamprey was detected in Deschutes River (river km 0.8) on July 2, 2016, indicating that it traveled 3.1 km downstream to the mouth of Satus Creek, traveled another 112.3 km downstream to the mouth of Yakima River,

traveled another 207.5 km downstream to reach the mouth of Deschutes River and began moving upstream there. The speed of downstream migration for this individual lamprey was 3.75 km/day.

Detections at Lower Satus Creek have been relatively high in the past few years (79.2-96.3%), but this year we saw a large decrease in detection (was only 31.4%). The flow was relatively high during the lower release and the detection rates may have been compromised considerably this year. The downstream array detection was only 50% among the lamprey that were detected at this site; in the past years, the detection efficiency of the two arrays have been much higher.

One lamprey from the upper release (river km 31.3) was PIT tagged, but there was no detection from this lamprey.

Toppenish Creek

Of the 76 PIT tagged lamprey released in lower Toppenish Creek at river km 1.3 on April 7, 2016, only 12 lamprey (15.7%) were detected at least once at one of the PIT array sites in the Columbia Basin. Of those lamprey detected, none were detected in more than one PIT array site. Of those detected, five lamprey (6.6% of overall) were detected at the Lower Toppenish site at river km 2.1, indicating a 0.8 km upstream movement. All five lamprey were detected moving within the first 24 hours post release. The first lamprey arrived at 8:12 PM, which was approximately 7 hours after the release (migration speed of 2.86 km/day). All detections lasted less than 1 min, indicating they passed through the two arrays quickly. Number of detections per lamprey ranged between 2 and 3 (no lamprey stayed right by the array for an extensive amount of time).

Seven lamprey (9.2%) were initially detected moving downstream of the release location. Four of these lamprey (5.3%) were initially detected in the Yakima River at the Sunnyside Instream Array (river km 171.1) just downstream of Sunnyside Diversion Dam, indicating these lamprey traveled 1.3 km downstream to the mouth of Toppenish Creek and then traveled 40.3 km upstream in the Yakima River. The first detection at this site ranged between April 14 and 27, 2016, which is 7-19 days post release (migration speed of 2.07-5.78 km/day). Each of the four lamprey only had one detection at this site.

The remaining three lamprey (3.9%) were initially detected in the Yakima River at Roza Diversion Dam (river km 210.5), indicating these lamprey traveled 1.3 km downstream to the mouth of Toppenish Creek and then traveled 79.7 km upstream in the Yakima River. The fact that all three of these lamprey passed through the Sunnyside Instream Array undetected showcases the limited detection efficiency at this site. The first detection at the Roza Diversion Dam ranged between May 8, 2016, and June 23, 2016, which is 31-76 days post release (migration speed of 1.04-2.54 km/day). Unlike the lamprey at Sunnyside Instream Array,

lamprey at Roza Dam stayed much longer at the site, ranging between 5-54 days. Number of detections ranged from 1,588 to 53,734, indicating long continuous holding within the dam. Two of the three lamprey were last detected at the Downstream Weir, indicating it eventually moved downstream (after making 9-13 attempts going back and forth between Downstream and Upstream Weir). The only lamprey that was last detected at the Upstream Weir also repeatedly moved between Downstream and Upstream Weir (made at least three attempts moving back and forth) till it finally disappeared at the Upstream Weir (hopefully indicating passage). Although a hole was drilled at the upper holding pool in 2015 to allow lamprey to pass upstream volitionally without the need to be netted and handled by fish passage personnel, this indicates that there are still substantial issues remaining at Roza Diversion Dam for adult Pacific Lamprey passage (as the radio telemetry study has indicated). There was one lamprey from the previous broodstock year that also showed the same behavior (moving repeatedly between Downstream and Upstream Weir arrays).

Detections at Lower Toppenish Creek have been relatively high in the past two years (75.9 and 91.4%), but this year we saw a large decrease in detection (was only 6.6%). The flow was relatively high during the lower release and the detection rates may have been compromised considerably this year.

Four lamprey from the upper release (river km 54.3) were PIT tagged, but there were no detection from any of these lamprey. Because the PIT arrays in Simcoe and Upper Toppenish creeks were out of commission, we did not release a large number of PIT tagged lamprey at the upper release site this year.

Ahtanum Creek

None of the lamprey released in Ahtanum Creek were PIT tagged this year. The Lower Ahtanum Array at river km 4.0 was out of commission.

Yakima River

None of the lamprey released in the Yakima River were PIT tagged this year due to the adults being excessively sexually mature (too far along the sexual maturation process to PIT tag them).

Summary

The highlights from the 2015-2016 broodstock adult Pacific Lamprey translocation monitoring are the following (Table 7 and Figure 4):

- Detection rates of lamprey passing through the lower Satus and lower Toppenish PIT arrays were extremely low this year (31.4% and 6.6%, respectfully), compared to the very high detection from previous years (generally 75-95%). The high flow experienced during release may played a large part in this low detection.
- The majority of lamprey that were detected passing the lower Satus or lower Toppenish PIT arrays passed within the first 24 hours post release.
- Nine lamprey were detected moving downstream initially. One was detected moving downstream all the way to the Lower Columbia River to enter the lower array at Deschutes River. One was detected moving past Prosser Dam Diversion in the Yakima River.
- Of the nine lamprey that initially moved downstream, seven lamprey were detected moving upstream within the Yakima River (after initially moving downstream in the tributary stream). Four of these lamprey were detected in the middle reach of Yakima River at Sunnyside Instream Array (river km 171.1) and the other three lamprey were detected at Roza Diversion Dam (river km 210.5).
- The three lamprey detected at Roza Diversion Dam spent 5-54 days at the dam with total detections ranging between 1,588 and 53,734 (indicating extensive holding). One lamprey that was last detected at the Upstream Weir made at least three attempts moving back and forth between the Downstream and Upstream Weirs. The other two lamprey that were last detected at the Downstream Weir made 9-13 attempts moving back and forth between the Downstream and Upstream Weirs.
- Upstream migration was observed primarily in April with episodic movements in May, and June (Figure 5).
- Downstream migration was observed primarily in June and early July potentially indicating the post-spawn drifting (Figure 6).
- The fastest upstream traveling lamprey detected was 7.35 km/day (lamprey detected at Lower Satus Array).

Table 7. Summary of 2015-2016 broodstock Pacific Lamprey translocation detection sites from the Yakima Subbasin releases.

Stream	River KM	Site ID	# of Lamprey Detected	% Detected
Satus	4.3	SAT	22	14.6%
Toppenish	2.1	TOP	5	3.3%
Yakima	75.7	PRO	1	0.7%
Yakima	171.1	SUN	4	2.6%
Yakima	210.5	ROZ	3	2.0%
Deschutes	0.8	DRM	1	0.7%

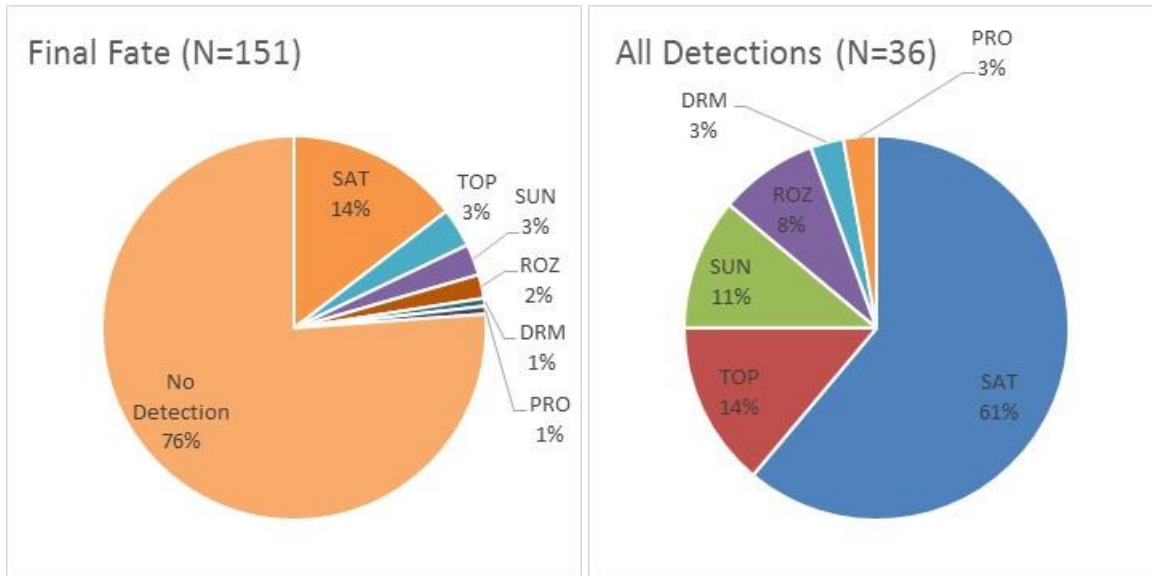


Figure 4. The final fate of the 151 Pacific Lamprey from the Spring 2016 release in the Wenatchee Subbasin based on PIT tag detection data (last detection site) (left pie chart) and a detailed view of all the detections from the 36 lamprey (right pie chart).

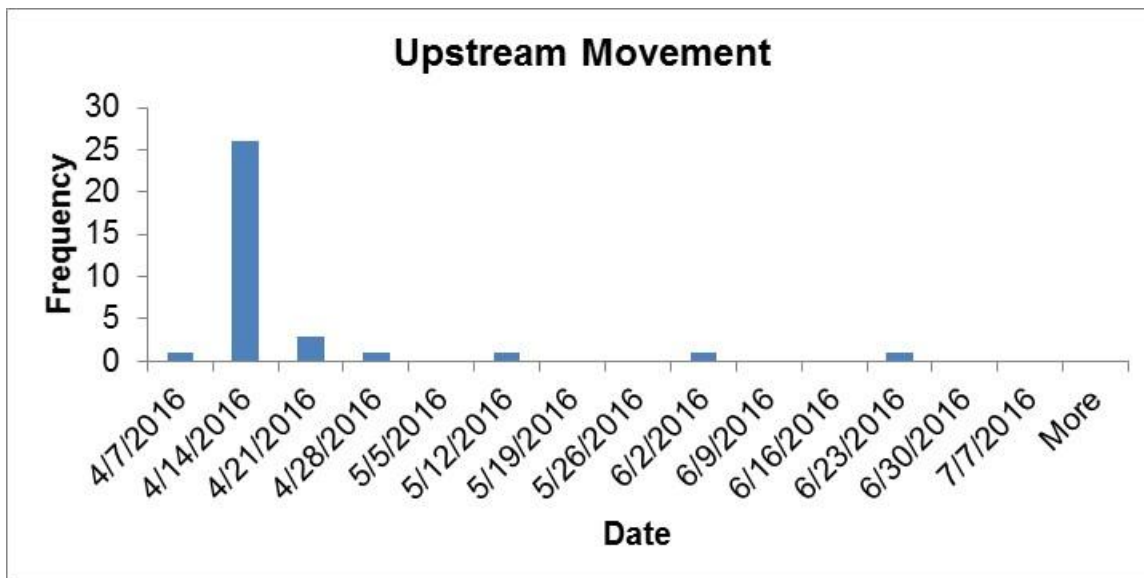


Figure 5. Frequency of upstream movement displayed by Pacific Lamprey from the Spring 2016 release in the Yakima Subbasin based on PIT tag detection data.

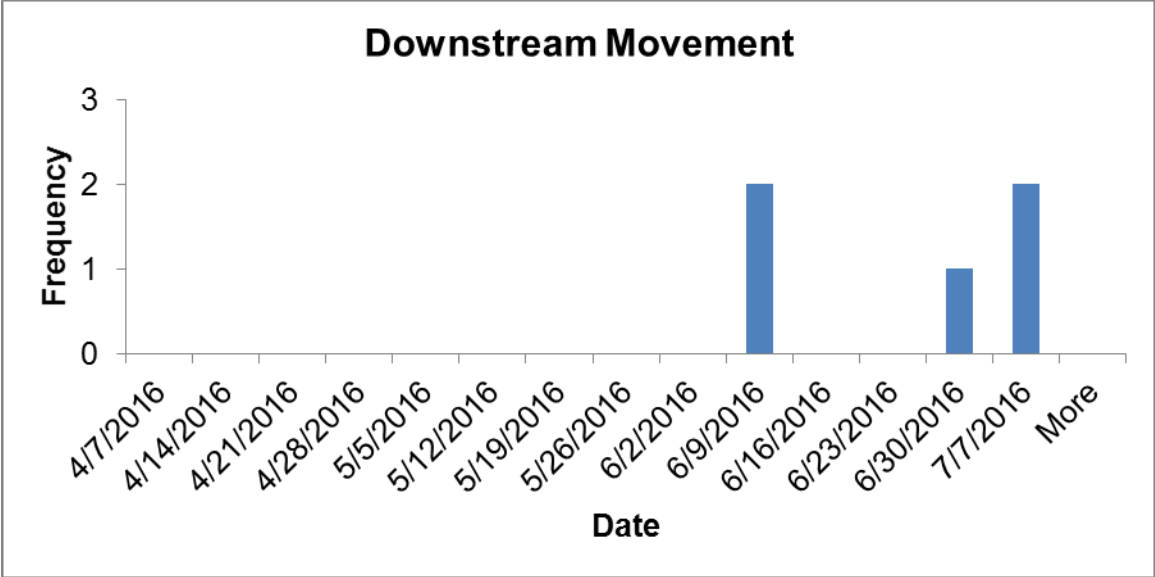


Figure 6. Frequency of downstream movement displayed by Pacific Lamprey from the Spring 2016 release in the Yakima Subbasin based on PIT tag detection data.

