



Naches Subbasin Larval Lamprey Monitoring Report, 2016



[Cover Photo: Overview of river km 29.0 on the Naches River (immediately upstream of the Wapatox Diversion Inlet) where both Pacific Lamprey and Western Brook Lamprey were detected (August, 2016)]

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ABSTRACT

Pacific Lamprey is an invaluable cultural and ecological species that is declining in abundance and distribution throughout their range, including the Yakima Basin. In an effort to monitor, manage and restore the species, the Yakama Nation Pacific Lamprey Program (YNPLP) has led electrofishing surveys for larval Pacific Lamprey throughout the Yakima Basin since 2009. This report highlights our 2016 electrofishing efforts in the Naches Subbasin (confluence of the Naches River with the Yakima River is at river km 191.9).

A total of seven established index sites were surveyed in the Naches River. Three of the seven sites are within the Eschbach Side Channel, a side channel of the Naches River used for irrigation (site river km 12.8, 13.8 and 14.0). In addition a total of three exploratory sites were surveyed within the Naches River (one sites within the Eschbach Side Channel), and one site in Nile Creek (a tributary of the Naches River). One site was visited in Eschbach Park (river km 13.5) to better understand the distribution of available habitat within the park.

Pacific Lamprey was present at four of the seven index sites (57.1%). Lampreys (either Western Brook Lamprey or Pacific Lamprey) were found at six of the seven sites (85.7%). Within the Eschbach Side Channel, Pacific Lamprey was found at one of the four surveyed sites (25.0%) and lampreys (of either species) were found at two of the four survey sites (50.0%). In the mainstem (not including sites surveyed in Eschbach Park), Pacific Lamprey was found at three of the four surveyed index sites (75%), but not at the exploratory site (river km 71.9). Interestingly, no Pacific Lamprey was found at the lower reach of the Naches River (river km 1.7). Western Brook Lamprey was found at both Naches river km 71.9 and Nile Creek at river km 0.6 (a tributary to Naches River); no Pacific Lamprey were confirmed in these two sites. Out of all surveyed sites, lamprey densities in the Naches River were highest at river km 29.0 (23.0 #/m²) immediately upstream of the inlet to Wapatox Diversion. The highest estimated biomass was at river km 29.0 as well (3,042 g). The largest area of Type I habitat in a 50 m reach was in Eschbach Park (river km 14.0; 600 m²). This site also had the lowest density of any surveyed sites (0.7 #/m² within Type I habitat). Despite low densities at river km 14.0 in Eschbach Park, river km 12.8 (lower reach of the side channel) had the highest estimated number of lampreys of any site (5,013; only within Type I habitat) and a much higher density (12.5 #/m²) .

A total of five genetic samples were collected from young of the year larvae (< 36 mm) at river km 12.8 (within the Eschbach Side Channel). The larvae will be identified to species. If they are Pacific Lamprey, it will suggest that Pacific Lamprey may potentially be spawning within the side channel.

METHODS

Site Choice and Field Survey

Throughout the Yakama Nation Ceded Lands, the YNPLP (Yakama Nation Pacific Lamprey Project) has conducted surveys for larval lampreys (beginning in 2009). Index sites, or long-term repeat monitoring sites, have been established throughout the Ceded Lands. The index sites are spatially distributed within watersheds with the potential to hold Pacific Lamprey. The primary goal of these index sites is to monitor the status and trend of Pacific Lamprey in the lower, middle, and upper reaches of interest watersheds. In addition to the index sites, exploratory sites are established each year to further our knowledge on Pacific Lamprey distribution and habitat availability within each watershed.

For all site types, survey sites were chosen based on aerial images from Google Earth and GIS software and site visits. Sites that had higher chances of being a Type I habitat [such as visibly recognizable areas on aerial image with slow water, shallow channel margin with dark tints (usually indicating fine sediment), backwater eddies, confluence of side channels, behind island bars, and tail end of deposition bars, etc.] were given priority. We determined that targeting the preferred habitat more effectually will provide us with a better framework for evaluating presence/absence, distribution, and relative abundance. Further, due to restricted survey time, the ease of access to a survey site (e.g. sites with public road access, short hikes, or near bridges, or private properties who permit access to the rivers/streams) was a critical issue and strongly considered when choosing sites. By prioritizing accessibility, more ground could be covered throughout the expansive area of interest. Chosen habitat sites were ultimately spatially distributed throughout individual watersheds.

Surveys were focused on Type I (preferred) and/or Type II (acceptable) habitat to provide optimal opportunity to capture the largest number of larval lamprey. Type I habitat primarily consists of fine sand, silt and/or clay and is absent of coarse substrate (gravel/cobble/boulder/bedrock). Type II habitat is coarse shifting sand or other fine substrate mixed with coarse substrate. Type III (unsuitable) habitat consists of no fine sediments and was not surveyed. Type I and II habitat is generally found in backwater areas, point bars, mainstem channel margins, and side channels.

Site surveys were categorized as “Full”, “Short” or “Visit”. During a full survey, both Type I and Type II habitat were surveyed. At short surveys, only Type I habitat (or Type II habitat, in the case of no Type I habitat available) was surveyed. At visited sites, no electrofishing occurred, and were primarily designed to further assess available lamprey habitat in different reaches of a river/stream. In general, a full survey was performed at each index site (to gain the most knowledge possible). A short survey (in general) was conducted at exploratory sites, designed to focus on the best habitat and get a quick assessment of lampreys at the site (habitat availability, density, and presence/absence).

At each electrofished site (index or exploratory), a 50 m reach was measured out which encompassed the most accessible and abundant Type I and Type II larval lamprey habitat. The total area (m²) of Type I and Type II larval lamprey habitat was estimated within the 50 m reach. Electrofishing surveys were conducted separately over Type I and Type II habitat, and covered representative areas of each habitat type. At full survey sites, a minimum area of Type I and Type II habitat was surveyed (10 m² and 5 m², respectively). At short survey sites, a minimum area of 5 m² of either habitat type was surveyed. Sediment type (sand, silt or clay) was recorded for the specific area (1 m²) where the most lampreys were observed. The sediment depth (cm), water depth (cm), and plot temperature (°C) were also recorded at this location. If no fish were observed, plot temperature was taken where the best available habitat was observed. Thalweg temperature was also recorded to represent the main channel temperature.

Electrofishing surveys were conducted with an AbP-2 Backpack Electrofisher (ETS Electrofishing Systems Inc., Madison, WI), specially designed for the sampling of larval lampreys, was used to survey available (wetted) larval habitat, using standard survey methods (slow tickle pulse of 3 pulses/sec and fast stunning pulse of 30 pulses/sec, 25% duty cycle, 3:1 burst pulse train, and 125 volts). Another person, equipped with a fine-mesh hand net was also present to help capture any electrofished larvae.

Captured lampreys were separated by habitat type, and tallied by life stage and identified to species (if of identifiable length > 50 mm). For each group of captured lampreys, 15 representative lengths were taken (+/- 1 mm). Four of these lampreys were measured to the nearest 0.01 gram (length and weight was taken on the largest, smallest and two medium sized larvae relative to the site). The combined weight of all captured lampreys were also measured (nearest 0.01 g). Missed larvae were also counted and tallied.

Genetic samples were collected from Pacific Lamprey (> 50 mm) with scissors or 2 mm whole punch (top or bottom of the caudal fin). Lampreys less than 50 mm were generally collected as whole samples (by placement on a genetic sheet or preservation in 70% Ethanol), but efforts were made to take genetic clips from larger unidentifiable larvae (> 35mm) rather than whole samples. Samples were primarily collected in areas where adult Pacific Lamprey translocation efforts are ongoing, or where the distribution of Pacific Lamprey is uncertain.

Analysis

Captured and missed larvae were tallied together and added to the number captured, to determine the total number of observed lampreys from electrofishing for each habitat type. If the number of captured lampreys was less than half of the observed total, the number of captured lampreys was doubled, and used as the final observed total. If the number of captured lampreys was equal to or more than half, the recorded observed number was used as the final observed total (represented by “observed total” in the following report).

In many cases, survey visibility was less than ideal, and many lampreys went unseen. To account for unseen lamprey, the total number of lampreys observed (final observed total) was adjusted (increased) based on the following 1-5 visibility scale: (1) poor (60%), (2) fair (70%) , (3) good (80%), (4) very good (90%) and (5) excellent (100%). For each survey, the total number of observed lampreys was increased (by the percentage listed above) based on the survey's visibility rank. Survey densities ($\#/m^2$) were calculated using the adjusted observed number of lampreys.

To calculate the number of lampreys within each 50 m reach, survey densities were extrapolated over their respective habitat type (estimated area within the 50 m reach) to arrive at the total number of lampreys for each habitat type. The estimated number from both habitat types was then summed together for an estimated total number of lampreys by site. The number of Pacific Lamprey within a 50 m reach was calculated from the Pacific Lamprey ratio (from identified lampreys) multiplied by the total number of lampreys estimated to reside within the reach.

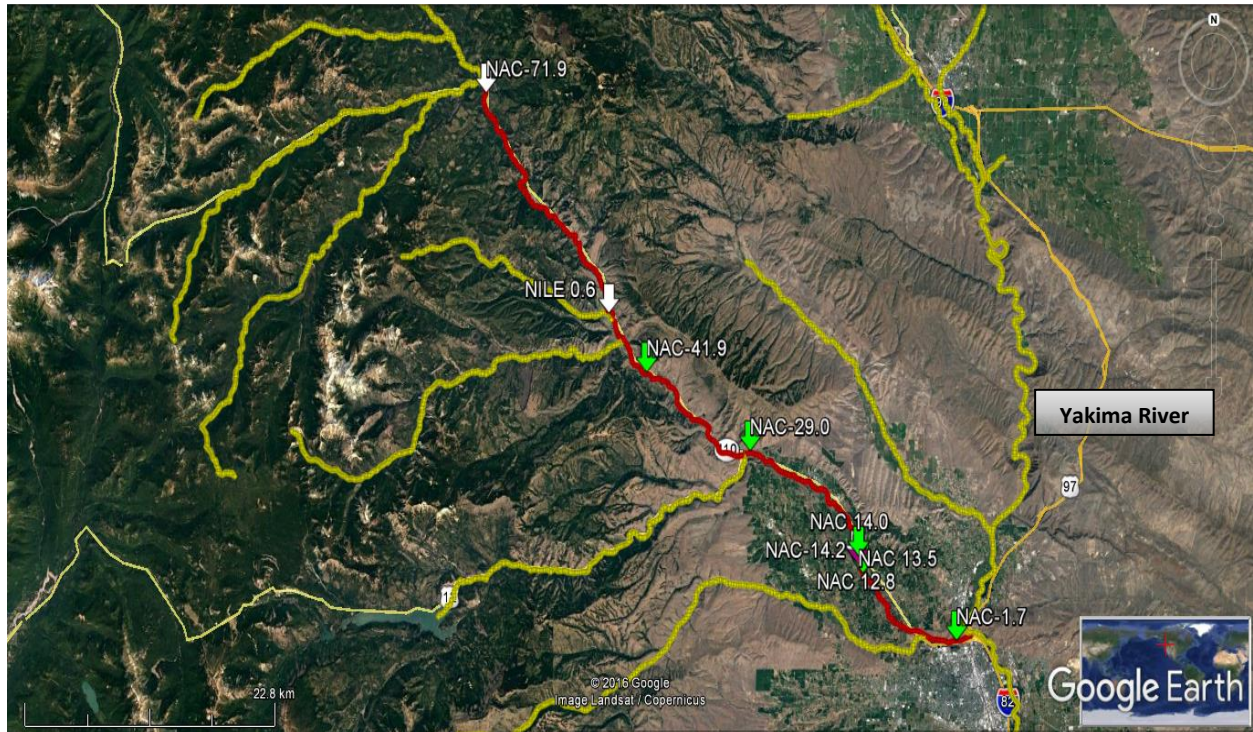
A condition factor for each site was calculated by averaging the condition factor for each of the fish measured by both length and weight. The average weight of the captured lamprey (total weight g/# weighed) was calculated for each site. In the event, that not all of the captured lampreys were weighed together, the average capture weight was multiplied by the total number of captured lampreys.

To arrive at an estimated biomass within a 50 m reach, the electrofishing density (by mass) was calculated separately for captured and missed lampreys. The biomass densities for captured and missed lampreys was summed together to get the total biomass density for the survey. The estimated final biomass density was then extrapolated over the respective habitat type. The estimated biomass for each habitat type was then summed together to arrive at a total site biomass (g).

RESULTS

Naches River

A total of nine electrofishing surveys were conducted in August, 2016 at spatially distributed sites between river km 1.7 and 71.9. Seven index sites were surveyed and two exploratory sites were surveyed (Map 1). One additional exploratory site (river km 13.5 in Eschbach Side Channel) was visited but not surveyed to explore the distribution of larval habitat in the area.



Map 1. Overview of all surveyed sites in the Naches River (red line) in August, 2016 displaying index sites (green arrows) and surveyed exploratory sites where electrofishing occurred (white arrows). Exploratory sites where electrofishing did not occur are highlighted in purple.

Naches River Index Sites

- All survey sites in the Naches River were in side channels. Three of the seven index sites are located within the Eschbach Side Channel (river km 12.8, 13.8 and 14.0).
- Pacific Lamprey was present at four of the seven index sites (57.1%). Pacific Lamprey was found at one of the three sites in the Eschbach Side Channel (33.3%). Interestingly, no Pacific Lamprey was found at the lower reach of the Naches River (river km 1.7). In the mainstem (not including sites surveyed in Eschbach Park), Pacific Lamprey was found at three of the four surveyed index sites (75%).
- Lamprey densities in the Naches River were highest at river km 29.0 (23.0 #/m²). The highest estimated biomass was at river km 29.0 as well (3,042 g).
- Eschbach Park, river km 12.8 (near the outlet of the side channel) had the highest estimated number of lampreys of any site (5,013; only within Type I habitat) and a relatively high density compared to other sites within the Eschbach Side Channel (12.5 #/m²).

Table 1. Larval lamprey habitat details from index sites surveyed in the Naches River. Under “Survey Type”, a “Full” indicates that all available habitat types were electrofished (when available); while “Short” indicates that only Type I or Type II habitat was surveyed. The percent of larval habitat shown is the ratio between available Type I and Type II habitat, and excludes Type III (unusable) habitat within the 50 m survey reach. Under “Type I Habitat Type”, “Edge” indicates that the primary survey location (for Type I habitat) was on the edge of the main channel. Plot temp was taken where the most lampreys were found, and thalweg temp was taken in the main channel flow.

Site Type	Stream	River KM	Date	Survey Type	% Type I in 50 m	% Type II in 50 m	Type I Habitat Type	Primary Fine Sediment (Type I)	Primary Fine Sediment (Type II)	Plot Temp °C (Best)	Thalweg Temp °C
Index	Naches	1.7	8/2/16	Full	86%	14%	Side Chan.	Clay	Sand	22.0	22.0
Index	Naches	12.8	8/16/16	Short	80%	20%	Side Chan.	Sand	-	18.9	18.9
Index	Naches	13.8	8/4/16	Short	52%	48%	Side Chan.	Clay	-	-	-
Index	Naches	14.0	8/4/16	Short	100%	0%	Side Chan.	Clay	-	18.6	-
Index	Naches	14.2	8/4/16	Full	40%	60%	Side Chan.	Sand	Coarse	19.8	21.2
Index	Naches	29.0	8/2/16	Full	62%	38%	Side Chan.	Sand	Silt	18.7	18.7
Index	Naches	41.9	8/3/16	Full	13%	87%	Side Chan.	Sand	Sand	17.7	17.2

Table 2. Survey details, separated by habitat type, for Naches River index sites surveyed in in August, 2016. The total number of lampreys observed was adjusted (increased) based on the following 1-5 visibility scale (estimated % visibility in parenthesis): (1) poor (60%), (2) fair (70%), (3) good (80%), (4) very good (90%) and (5) excellent (100%). Survey densities (#/m²) were calculated using the adjusted observed number of lampreys. The summary rows are a sum of presented values, except for e-fish density which is a mean of presented values.

Site Type	Stream	River KM	Habitat Type Surveyed	Shock Time (sec)	Shock Area (m2)	# Captured	# Observed	Survey Visibility (1-5)	Total # Observed (Adjusted)	E-Fish Density (#/m2)
Index	Naches	1.7	Type I	932	14.5	52	104	3	130	9.0
Index	Naches	12.8	Type I	407	7.5	23	94	5	94	12.5
Index	Naches	13.8	Type I	241	6	0	0	5	-	-
Index	Naches	14.0	Type I	262	6	1	4	5	4	0.7
Index	Naches	14.2	Type I	689	12	68	136	5	136	11.3
Index	Naches	29.0	Type I	700	10.5	121	242	5	242	23.0
Index	Naches	41.9	Type I	755	12	73	146	5	146	12.2
Index	Naches	1.7	Type II	452	7	12	24	5	24	3.4
Index	Naches	12.8	Type II	0	-	-	-	-	-	-
Index	Naches	13.8	Type II	0	-	-	-	-	-	-
Index	Naches	14.0	Type II	0	-	-	-	-	-	-
Index	Naches	14.2	Type II	285	7	11	22	3	28	3.9
Index	Naches	29.0	Type II	366	7	9	18	5	18	2.6
Index	Naches	41.9	Type II	571	12	7	20	5	20	1.7
Site Summary		1.7		1384	22	64	128		154	6.2
		12.8		407	8	23	94		94	12.5
		13.8		241	6	0	0		-	-
		14.0	-	262	6	1	4	-	4	0.7
		14.2		974	19	79	158		164	7.6
		29.0		1066	18	130	260		260	12.8
		41.9		1326	24	80	166		166	6.9
Habitat Summary			Type I	3986	69	338	726	-	752	11.5
			Type II	1674	33	39	84		90	2.9

Table 3. Measurement details of captured lampreys, separated by habitat type, for Naches River index sites surveyed in August, 2016 (sites without lampreys are excluded). The summary rows are a sum of presented values, except for mean weight, mean length and mean condition factor, which are a mean of presented values, and min and max length, which are the lowest and highest value, respectively.

Site Type	Stream	River KM	Habitat Type Surveyed	# Weighed	Total Weight of Captured (g)	Mean Weight of Captured (g)	Min. Length (mm)	Max. Length (mm)	Mean Length (mm)	Mean Condition Factor
Index	Naches	1.7	Type I	52	100.7	1.94	44	195	107	1.001
Index	Naches	12.8	Type I	0	-	-	-	-	-	-
Index	Naches	14.0	Type I	0	-	-	-	-	-	-
Index	Naches	14.2	Type I	68	403.9	5.94	74	205	138	1.189
Index	Naches	29.0	Type I	121	311.2	2.57	62	162	119	1.204
Index	Naches	41.9	Type I	73	236.1	3.23	49	160	123	1.363
Index	Naches	1.7	Type II	12	22.6	1.88	63	165	96	1.081
Index	Naches	12.8	Type II	-	-	-	-	-	-	-
Index	Naches	14.0	Type II	-	-	-	-	-	-	-
Index	Naches	14.2	Type II	11	62.4	5.67	80	213	142	1.011
Index	Naches	29.0	Type II	9	30.3	3.37	58	147	115	1.257
Index	Naches	41.9	Type II	7	23.3	3.33	54	138	121	1.118
Site Summary		1.7		64	123.3	1.91	44	195	102	1.041
		12.8		0	-	-	-	-	-	-
		14.0	-	0	-	-	-	-	-	-
		14.2		79	466.3	5.81	74	213	140	1.100
		29.0		130	341.5	2.97	58	162	117	1.230
		41.9		80	259.4	3.28	49	160	122	1.241
Habitat Summary	-		Type I	314	1051.8	3.42	44	205	122	1.189
			Type II	39	138.6	3.56	54	213	118	1.117

Table 4. Lamprey identification details, separated by habitat type, for Naches River index sites surveyed in August, 2016. The summary rows are a sum of presented values except for % values, which are a weighted average.

Site Type	Stream	River KM	Habitat Type	# Identified	# of Pacific	# of Western Brook	% Pacific	% Western Brook	% of Cap. Identified
Index	Naches	1.7	Type I	49	0	49	0%	100%	94%
Index	Naches	12.8	Type I	18	7	11	39%	61%	78%
Index	Naches	14.0	Type I	1	0	1	0%	100%	100%
Index	Naches	14.2	Type I	48	14	34	29%	71%	71%
Index	Naches	29.0	Type I	74	41	33	55%	45%	61%
Index	Naches	41.9	Type I	71	1	70	1%	99%	97%
Index	Naches	1.7	Type II	12	0	12	0%	100%	100%
Index	Naches	12.8	Type II	-	-	-	-	-	-
Index	Naches	14.0	Type II	-	-	-	-	-	-
Index	Naches	14.2	Type II	11	4	7	36%	64%	100%
Index	Naches	29.0	Type II	9	6	3	67%	33%	100%
Index	Naches	41.9	Type II	7	0	7	0%	100%	100%
Site Summary		1.7		61	0	61	0%	100%	95%
		12.8		18	7	11	39%	61%	78%
		14.0	-	1	0	1	0%	100%	100%
		14.2		59	18	41	31%	69%	75%
		29.0		83	47	36	57%	43%	64%
		41.9		78	1	77	1%	99%	98%
Habitat Summary		-	Type I	261	63	198	24%	76%	77%
		-	Type II	39	10	29	26%	74%	100%

Table 5. Lamprey population and biomass estimates within a 50 m reach, separated by habitat type, for Naches River index sites surveyed in August, 2016. “Estimated # of Pacific Lamprey” is calculated based on the identified ratio of Pacific Lamprey (to Western Brook Lamprey) generally > 50 mm in length. Summary rows are a sum of presented values, except for e-fish density and mean weight of captured, which are a mean of presented values.

Site Type	Stream	River KM	Habitat Type	50 m		Estimated # in 50 m	Estimated # of Pacific Lamprey in 50 m	Mean Weight of Cap. (g)	Estimated Mass Density (g/m ²)	Estimated Mass (g) in 50 m
				Habitat Area (m ²)	E-Fish Density (#/m ²)					
Index	Naches	1.7	Type I	100	9.0	897	0	1.94	11.41	1141
Index	Naches	12.8	Type I	400	12.5	5013	1950	-	-	-
Index	Naches	14.0	Type I	600	0.7	400	0	-	-	-
Index	Naches	14.2	Type I	56	11.3	635	185	5.94	48.08	2693
Index	Naches	29.0	Type I	66	23.0	1521	843	2.57	42.33	2794
Index	Naches	41.9	Type I	60	12.2	730	10	3.23	28.10	1686
Index	Naches	1.7	Type II	16	3.4	55	0	1.88	4.61	74
Index	Naches	12.8	Type II	100	-	-	-	-	-	-
Index	Naches	14.0	Type II	0	-	-	-	-	-	-
Index	Naches	14.2	Type II	85	3.9	334	121	5.67	14.64	1245
Index	Naches	29.0	Type II	40	2.6	51	34	3.37	6.19	248
Index	Naches	41.9	Type II	390	1.7	650	0	3.33	3.49	1359
		1.7		116	6.2	951	0	1.91	8.01	1215
		12.8		500	12.5	5013	1950	-	-	0
Site Summary		14.0	-	600	0.7	400	0	-	-	0
		14.2		141	7.6	969	307	5.81	31.36	3937
		29.0		106	12.8	1573	877	2.97	24.26	3042
		41.9		450	6.9	1380	10	3.28	15.80	3046
Habitat Summary		-	Type I	1282	11.5	9196	2988	3.42	32.48	8314
			Type II	631	2.9	1090	156	3.56	7.23	2926

Additional Index Site Observations

- **River km 1.7** – This site is located near the Highway 12 exit to 16th Avenue, Yakima, WA and accessed from the Greenway Trail. The site is a side channel that connects a two channel braids of the Naches River. We observed limited flow in this side channel in August, 2016, though the water was not stagnant. Type I habitat is distributed throughout this side channel; our survey was focused on the middle section of the side channel. Many salmonids were observed in the side channel during the survey.
- **River km 12.8** – This site is located approximately 1.0 km downstream of Congdon Diversion. The site is near the outlet of the Eschbach Side Channel. Our survey was focused on the left bank (opposite of the road). Many other fish were observed at this site (Pikeminnow? Salmonids?). Eschbach Park is a planned location for the outplanting of artificially propagated Pacific Lamprey, so it is important to understand the current abundance and distribution of lampreys within the side channel.
- **River km 14.0** – This site is located near the second vehicle crossing bridge upstream of Congdon Diversion in the Eschbach Side Channel. Type I habitat expands the whole 50 m channel. Our survey focused on Type I habitat intermixed with riparian vegetation.
- **River km 14.2** – This site is located approximately 0.5 km downstream of the inlet to the Eschbach Side Channel. The site is a natural side channel of the Naches River. The site

receives subsurface flow during the summer months. Type I habitat is abundant, and our survey focused near the inlet area on the edges of a deep pool.

- **River km 29.0** – This site is located immediately upstream of the inlet to Wapatox Diversion. The site is a small side channel (~1 m wide and 30 m long) that is downstream of a large beaver dam. The side channel is mostly composed of Type I habitat. In the mainstem, Type I habitat is limited to the mouth of the small side channel.
- **River km 41.9** – This site is located off of Highway 410 west of Naches, WA on private property. The landowners are very welcoming and support our surveys for lampreys on their property. This site is a large side channel, with Type I habitat mainly collected in the middle reach of the side channel; overall, Type II habitat is more abundant throughout the side channel.

Naches River Exploratory Sites

- The largest area of Type I habitat in a 50 m reach was in Eschbach Park (river km 14.0; 600 m²). This site also had the lowest density of any surveyed sites (0.7 #/m² within Type I habitat).
- No Pacific Lamprey was found at river km 73.2, but Western Brook Lamprey was present.

Table 6. Larval lamprey habitat details from the exploratory sites surveyed in the Naches River in September, 2016. Under “Survey Type”, a “Short” survey indicates that either Type I or Type II habitat was surveyed, while a “Visit” survey indicates that no electrofishing occurred. The percent of larval habitat shown is the ratio between available Type I and Type II habitat, and excludes Type III (unusable) habitat within the 50 m survey reach. Under “Type I Habitat Type”, “Edge” indicates that the primary survey location (for Type I habitat) was on the edge of the main channel. Plot temp was taken where the most lampreys were found, and thalweg temp was taken in the main channel flow. Plot temp was taken where the most lampreys were found, and thalweg temp was taken in the main channel flow.

Site Type	Stream	River KM	Date	Survey Type	% Type I in 50 m	% Type II in 50 m	Type I Habitat Type	Primary Fine Sediment (Type I)	Primary Fine Sediment (Type II)	Plot Temp °C (Best)	Thalweg Temp °C
Expl.	Naches	13.5	8/4/16	Visit	100%	0%	Side Chan.	-	-	-	-
Expl.	Naches	13.9	8/4/16	Short	100%	0%	Side Chan.	Clay	-	-	-
Expl.	Naches	71.9	8/3/16	Short	5%	95%	Edge	-	Sand	17.7	17.4

Table 7. Survey details, separated by habitat type, for the Naches River exploratory sites surveyed in August, 2016. The total number of lampreys observed was adjusted (increased) based on the following 1-5 visibility scale (estimated visibility % in parenthesis): (1) poor (60%), (2) fair (70%), (3) good (80%), (4) very good (90%) and (5) excellent (100%). Survey densities (#/m²) were calculated using the adjusted observed number of lampreys. The summary rows are a sum of presented values, except for e-fish density which is a mean of presented values.

Site Type	Stream	River KM	Habitat Type Surveyed	Shock Time (sec)	Shock Area (m2)	# Captured	# Observed	Survey Visibility (1-5)	Total # Observed (Adjusted)	E-Fish Density (#/m2)
Expl.	Naches	13.9	Type I	458	6	0	0	5	-	-
Expl.	Naches	71.9	Type I	0	-	-	-	-	-	-
Expl.	Naches	13.9	Type II	0	-	-	-	-	-	-
Expl.	Naches	71.9	Type II	336	6	18	36	4	40	6.7
Site Summary		13.9	-	458	6	0	0	-	-	-
		71.9		336	6	18	36		40	6.7
Habitat Summary			Type I	458	6	0	0	-	0	-
			Type II	336	6	18	36		40	6.7

Table 8. Measurement details of captured lampreys, separated by habitat type, for the Naches River exploratory site surveyed in August, 2016 (sites without lampreys are excluded). The summary rows are a sum of presented values, except for mean weight, mean length and mean condition factor, which are a mean of presented values, and min and max length, which are the lowest and highest value, respectively.

Site Type	Stream	River KM	Habitat Type	# Identified	# of Pacific	# of Western Brook	% Pacific	% Western Brook	% of Cap. Identified
Expl.	Naches	71.9	Type I	-	-	0	-	-	-
Expl.	Naches	71.9	Type II	18	0	18	0%	100%	-
Site Summary		71.9		18	0	18	0%	100%	100%
Habitat Summary			Type I	-	-	0	-	-	-
			Type II	18	0	18	0%	100%	-

Table 9. Lamprey population and biomass estimates within a 50 m reach, separated by habitat type, for the Naches River exploratory site surveyed in August, 2016. “Estimated # of Pacific Lamprey” is calculated based on the identified ratio of Pacific Lamprey (to Western Brook Lamprey) generally > 50 mm in length. Summary rows are a sum of presented values, except for e-fish density and mean weight of captured, which are a mean of presented values.

Site Type	Stream	River KM	Habitat Type	50 m		Estimated # in 50 m	Estimated # of Pacific Lamprey in 50 m	Mean Weight of Cap. (g)	Estimated Mass Density (g/m ²)	Estimated Mass (g) in 50 m
				Habitat Area (m ²)	E-Fish Density (#/m ²)					
Expl.	Naches	71.9	Type I	6	-	-	-	-	-	-
Expl.	Naches	71.9	Type II	120	6.7	400	0	-	-	-
Site Summary		71.9	-	126	6.7	400	0	-	-	-
Habitat Summary		-	Type I	6	-	0	0	-	-	-
			Type II	120	6.7	400	0			

Additional Exploratory Site Observations:

- **River km 13.5** – This site is located in Eschbach Park. The goal of this survey was to try to find an additional survey site in Eschbach Park, but there was no surveyable habitat (water level and sediment was too deep to survey). Eschbach Park is a planned location for the outplanting of artificially propagated Pacific Lamprey, so it is important to understand the current abundance and distribution of lampreys within the side channel.
- **River km 13.9** – This site is located in Eschbach Park upstream of Congdon Diversion. This site was recently restored (newly connected channel and woody debris). Type I habitat is abundant throughout this area, though survey potential is limited to the riparian banks, which limits survey area.
- **River km 71.9** – This site is located approximately 1.0 km downstream of the confluence with the Little Naches River. The goal of this survey was to explore the upper distribution of Pacific Lamprey in the Naches River. The site was primarily Type II habitat (fine sediments packed between large cobble and boulders).

Genetic Samples – Naches River

A total of 5 genetic samples were collected from the Naches River (Table 10). If these young of the year larvae (< 36 mm) are Pacific Lamprey, it will suggest that Pacific Lamprey are spawning within the Eschbach Side Channel.

Table 10. Genetic samples collected from the lower Yakima River mainstem downstream of the Naches River confluence in September and October, 2016.

Stream Name	River KM	Collection Date	# of Pacific Samples (Larvae)	# of Pacific Samples (Macro.)	# of Western Brook Samples	# Unknown Species Samples (< 50 mm)	Primary Collection Purpose
Naches	12.8	8/16/16	0	0	0	5	Species Identification
Total			0	0	0	5	

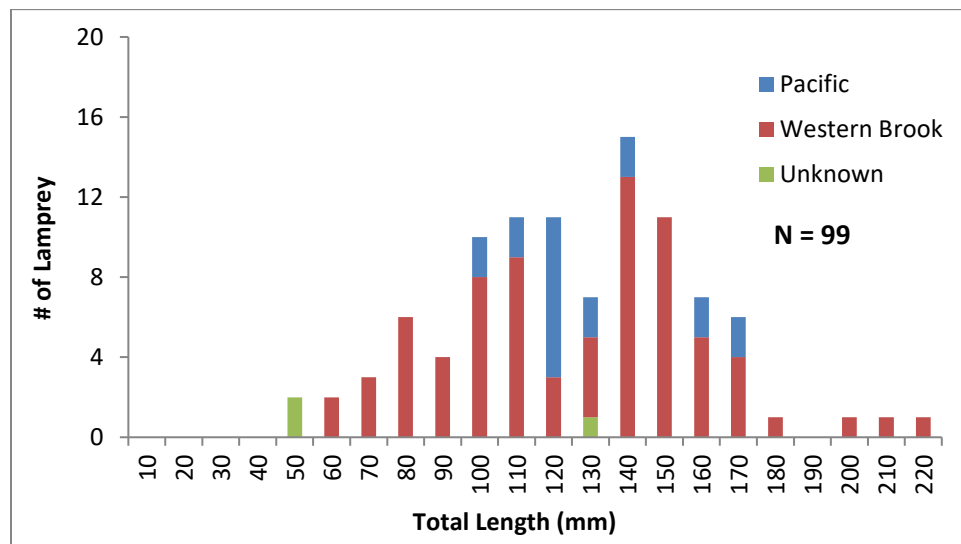
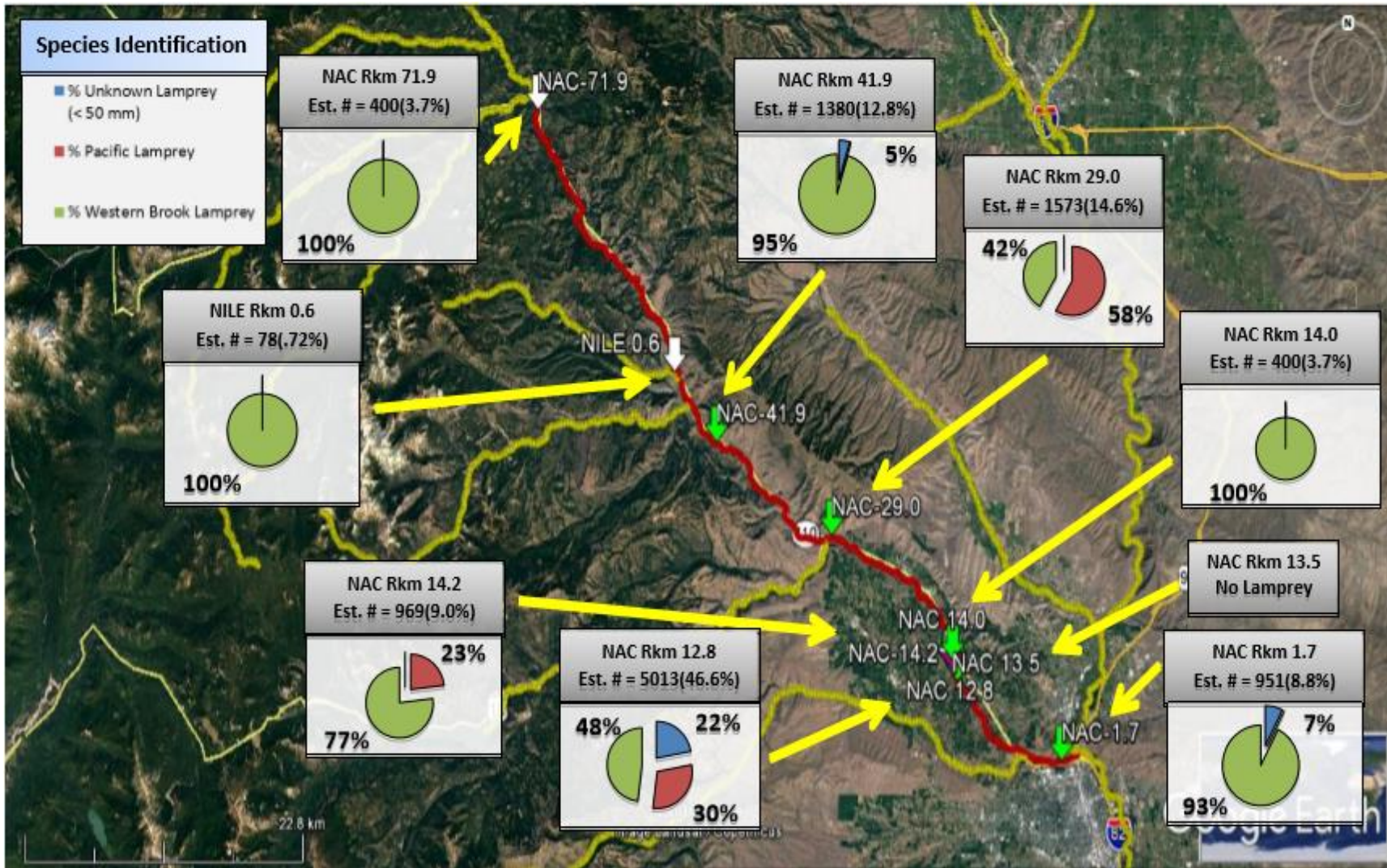


Figure 4. Histogram of all measured lampreys captured during electrofishing surveys, separated by species (“PA”= Pacific Lamprey (blue), “UN”=Unknown Lamprey <50 mm (green), “WB” Western Brook Lamprey (Red), in the Naches River in August, 2016.

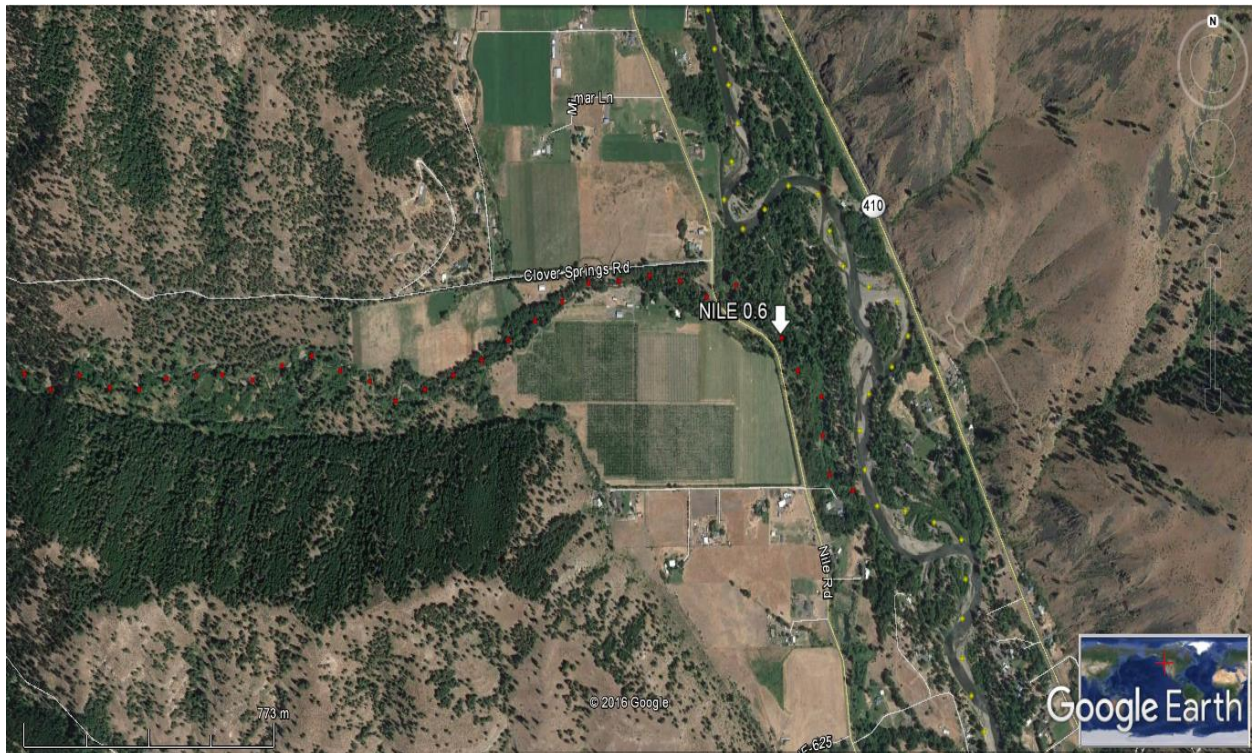


Map 2. Displayed is the distribution of Unknown Lamprey <50 mm (blue), Pacific Lamprey (red) and Western Brook Lamprey (green) in Wenas Creek from August, 2016 electrofishing surveys. Species ratio of lampreys is based on captured and measured data only. Also shown is the estimated number of lampreys at each surveyed site (within a 50 m reach). Index sites are labeled by green arrows, exploratory sites labeled by white arrows, and sites where no electrofishing surveys labeled by purple arrows. * Species ratio calculated from counted and identified fish (no lengths taken).

Naches River Tributaries

Nile Creek

One short survey was conducted in Nile Creek in August, 2016 (Map 3).



Map 3. Overview of all surveyed sites in the Nile Creek (red line) in August, 2016 displaying index surveyed exploratory sites where electrofishing occurred (white arrows).

Nile Creek Exploratory Sites\

- Western Brook Lamprey (no Pacific Lamprey) was found at river km 0.6 in Nile Creek.

Table 14. Lamprey population and biomass estimates within a 50 m reach, separated by habitat type, for Nile Creek index sites surveyed in August, 2016. “Estimated # of Pacific Lamprey” is calculated based on the identified ratio of Pacific Lamprey (to Western Brook Lamprey) generally > 50 mm in length. Summary rows are a sum of presented values, except for e-fish density and mean weight of captured, which are a mean of presented values.

Site Type	Stream	River KM	50 m Habitat		E-Fish Density (#/m2)	Estimated # in 50 m	Estimated # of Pacific Lamprey in 50 m	Mean Weight of Cap. (g)	Estimated Mass Density (g/m2)	Estimated Mass (g) in 50 m
			Habitat Type	Area (m2)						
Expl.	Nile	0.6	Type I	10	7.8	78	0	-	-	-
Expl.	Nile	0.6	Type II	40	-	-	-	-	-	-
Site Summary			-	50	7.8	78	0	-	-	-
Habitat Summary			-	Type I	7.8	78	0	-	-	-
			-	Type II	-	-	-	-	-	-

Additional Exploratory Site Observations

- River km 0.6** – This site is located at the bridge of Nile Road near the intersection with Highway 410. Larval lamprey habitat is limited within the lower reach of Nile Creek (our survey explored river km 0.5 to 0.6), isolated to just a few deep pools. The goal of this survey was to 1) assess presence/absence of lampreys in Nile Creek and 2) identify the presence/absence of Pacific Lamprey in Nile Creek. One lamprey redd (smaller – likely Western Brook) was located upstream of the survey site near a landowner vehicle crossing bridge.

Appendix: Additional Site Maps and Photos

Naches River Mainstem



Map A1. Site map of Naches River index site at river km 1.7 (surveyed in August, 2016); yellow balloon indicates that lamprey of unknown species (<50 mm) were present at this site. The small red dots indicate stream distance of 100 m.



Photo A1. Naches River index site at river km 1.7; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/clay (right) from 2016 survey.



Map A2. Site map of Naches River index site at river km 12.8 (surveyed in August, 2016); red balloon indicates presence of Pacific Lamprey. The small red dots indicate stream distance of 100 m.



Photo A2. Naches River index site at river km 12.8; overview of Type I habitat (left) and close-up of best Type I habitat (right) from 2016 survey.



Map A3. Site map of Naches River index site at river km 14.2 (surveyed in August, 2016); red balloon indicates presence of Pacific Lamprey. The small red dots indicate stream distance of 100 m.



Photo A3. Naches River index site at river km 14.2; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/clay (right) from 2016 survey.



Map A4. Site map of Naches River exploratory site at river km 13.5 (visited in August, 2016); purple balloon indicates that no electrofishing survey took place in 2016.



Photo A4. Naches River exploratory site at river km 13.5; overview of site (left) and overview of best Type I habitat (right) from 2016 survey.



Map A5. Site map of Naches River index site at river km 13.8 (surveyed in August 2016); white balloon indicates that no Lamprey was present at this site.



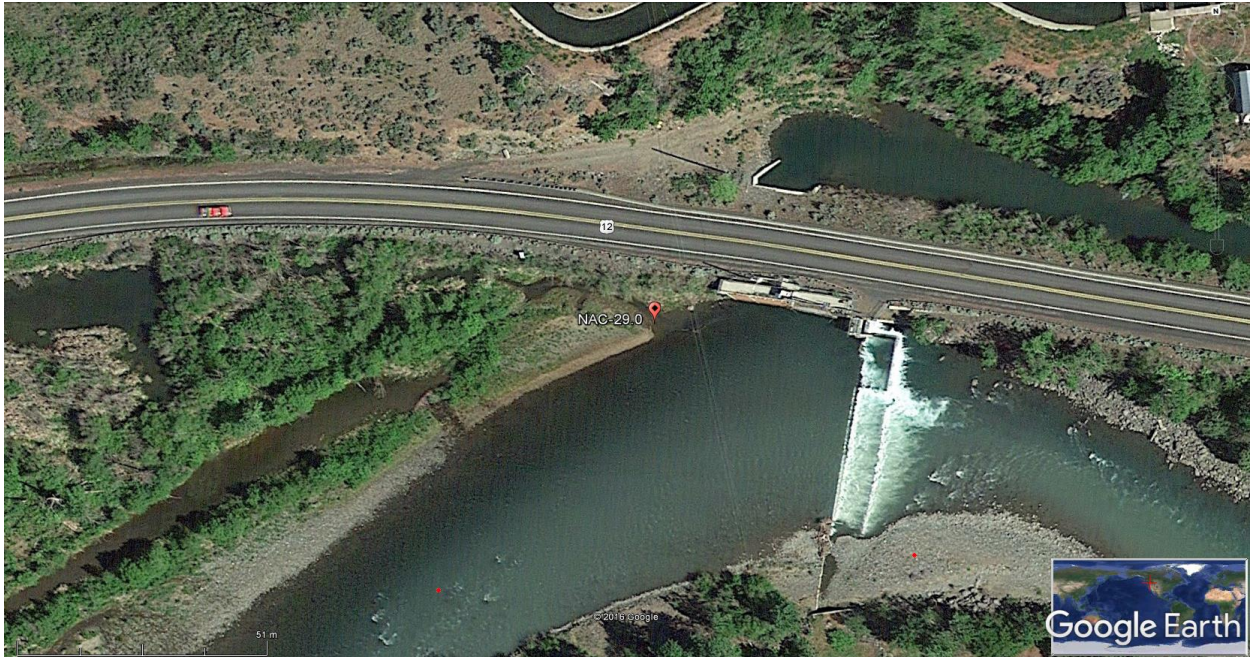
Photo A5. Naches River index site at river km 13.8; close-up of best habitat (left) and close-up of best Type II habitat sediment composed of silt/large rocks/organic debris (right) from 2016 survey.



Map A6. Site map of Naches River index site at river km 14.0 (surveyed in August, 2016); green balloon indicates all captured Lamprey was > 50 mm and identified as Western Brook Lamprey.



Photo A6. Naches River index site at river km 14.0; overview of Type I habitat (left) and close-up of best Type I habitat (right) from 2016 survey.



Map A7. Site map of Naches River index site at river km 29.0 (surveyed in August, 2016); red balloon indicates presence of Pacific Lamprey. The small red dots indicate stream distance of 100 m.



Photo A7. Naches River index site at river km 29.0; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/clay (right) from 2016 survey.



Map A8. Site map of Naches River site at river km 41.9 (surveyed in August, 2016); yellow balloon indicates that lamprey of unknown species (<50 mm) were present at this site. The small red dots indicate stream distance of 100 m.



Photo A8. Naches River index site at river km 41.9; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/clay (right) from 2016 survey.



Map A9. Site map of Naches River exploratory site at river km 71.9 (surveyed in August, 2016); green balloon indicates all captured Lamprey was > 50 mm and identified as Western Brook Lamprey. The small red dots indicate stream distance of 100 m.

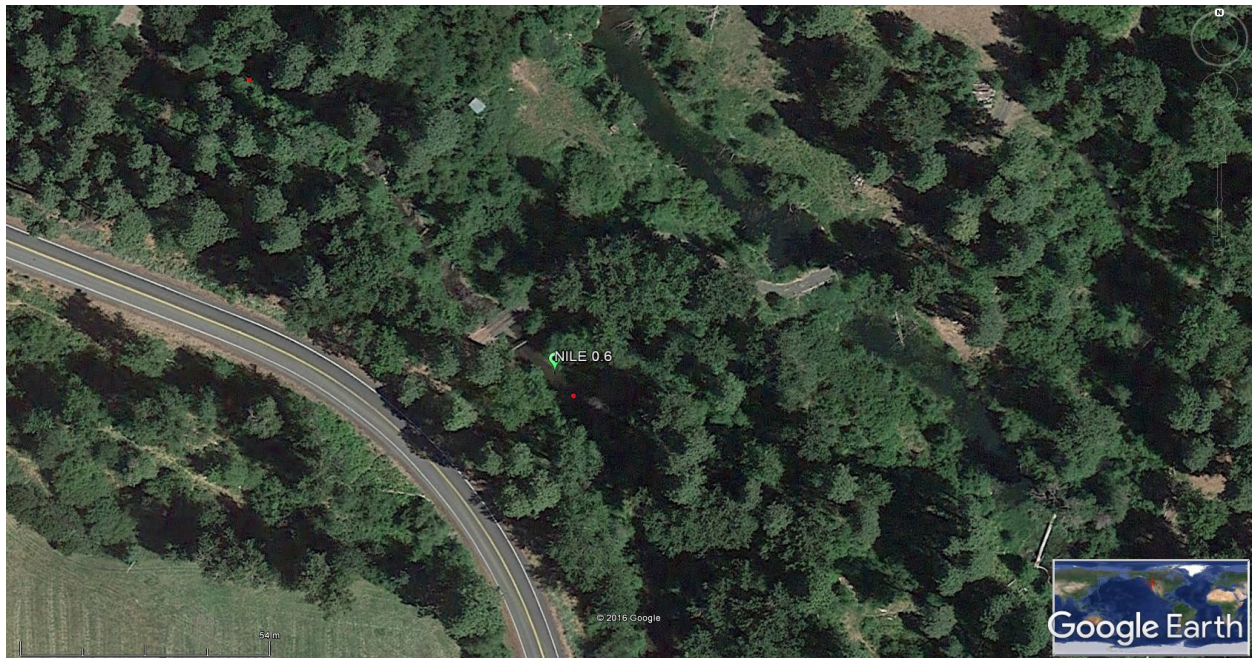


Photo A9. Naches River exploratory site at river km 71.9; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/clay/organic debris (right) from 2016 survey.

Naches River Tributaries

Nile

Creek



Map A10. Site map of Nile Creek exploratory site at river km 0.6 (surveyed in August, 2016); green balloon indicates all captured Lamprey was > 50 mm and identified as Western Brook Lamprey. The small red dots indicate stream distance of 100 m.



Photo A10. Nile Creek site at river km 0.6; overview of Type I habitat (left) and close-up of best Type I habitat sediment composed of silt/sand (right) from 2016 survey.