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Surveys of Pacific Lamprey Distribution in the Wenatchee River Watershed 2010 - 2011



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On the cover: USFWS fisheries technician Cal Yonce electrofishing for Pacific lamprey ammocoetes in the Wenatchee River, September 2010. USFWS photograph by Andy Johnsen.

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SURVEYS OF PACIFIC LAMPREY DISTRIBUTION
IN THE WENATCHEE RIVER WATERSHED
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Abstract- The Pacific lamprey is an anadromous fish native to the Columbia River and many of its tributaries. In recent decades the numbers of returning adults has declined dramatically in part due to dams, habitat degradation, stream alteration, and predation. This decline has initiated an interest in the current distribution of Pacific lamprey. Within the Wenatchee River, a major tributary to the mid-Columbia River, Pacific lampreys were historically observed up to and including Lake Wenatchee. The purpose of this study was to use electrofishing to determine the current upstream extent of Pacific lamprey presence within the Wenatchee River. We used an ABP-2 backpack electrofisher and sampled 30 sites within the Wenatchee River watershed. Sampling occurred between river kilometers 40.3 and 87.1 for a total electrofishing time of 8.3 hours. Pacific lampreys were only found at one site located 2 kilometers downstream of Tumwater Dam. The fishway on this dam was modified in the late 1980's and the modifications, along with the fishway operations schedule, may have impacted the current distribution of Pacific lamprey in the Wenatchee River. Changing the operations schedule or installing a lamprey passage structure (LPS) may allow adults to pass upstream of the dam and restore distribution to this area historically utilized by Pacific lampreys.

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Introduction

The Pacific lamprey *Entosphenus tridentatus* is an anadromous fish native to the Pacific Northwest. Numbers of adults returning to the Columbia River Basin and its tributaries have declined over the past several decades (Close et al 1995). In recent years the decline has been precipitous and in 2010 only 11,180 adults were counted passing Bonneville Dam (DART 2011). Pacific lamprey find it difficult to pass main-stem Columbia River dams and telemetry indicated that less than half of radio-tagged adults are able to pass a dam during their upstream migrations to spawning areas (Keefer *et al.* 2009). As a result, only 318 lampreys were counted at Rock Island Dam and only 268 were counted at Rocky Reach Dam in 2010 (DART 2011). Thus, only a few adult lampreys entered the Wenatchee River and where they spawned is not known.

No systematic surveys of juvenile or adult Pacific lampreys have been conducted in the Wenatchee River watershed. Our understanding of the current distribution is limited to whether or not lampreys are recorded during other fisheries management activities and all recent observations are from the lower Wenatchee River. During 2000-2007, between 650 and 3000 juvenile lampreys were captured annually in a rotary screw trap seasonally operated by Washington Department of Fish and Wildlife at river kilometer (rkm) 11.3 near the town of Monitor (Hillman et al. 2008). In 2009, approximately 6,500 juveniles were rescued and released during dredging operations in the intake of the Dryden Irrigation Canal, located just downstream of Peshastin Creek at rkm 28.3 (Mosey 2009). In 2010, juveniles were collected by electrofishing at rkm 28.7 near the mouth of Peshastin Creek (J. Pieratt, USFWS, pers. comm.).

Currently no adult lampreys are observed in the fish ladder of Tumwater Dam at rkm 49.7 (Jackson *et al.* 1997; Travis Maitland, WDFW, pers. comm.). Limited electrofishing upstream of Tumwater Dam in 2009 did not find any lampreys (B. Kelly-Ringel, USFWS, pers. comm.). Lampreys have not been recorded in several rotary screw traps currently in operation in the upper Wenatchee River basin upstream of Tumwater Dam, including in the Chiwawa River and the upper Wenatchee River (Hillman et al. 2008), Nason Creek (Prevatte 2006), and White River (Collins and Murdoch 2009). No lampreys were captured in Peshastin Creek during rotary screw trap operations in 2004 and 2005 (Cooper and Mallas 2005). No lampreys were collected or observed in 2009 during electrofishing surveys in lower Mission Creek (B. Kelly-Ringel, USFWS, pers. comm.).

Indications are that the current distribution of Pacific lampreys in the Wenatchee River has declined from historic areas. Although the historical distribution of Pacific lamprey in the Wenatchee River watershed is not well documented, records were located for 1935, 1937, 1949-1950, 1955, and 1981 and the data indicates that lamprey were distributed throughout a large portion of the watershed. Interpretation of the historical records is complicated by the fact that the species or life stage was usually not noted. However, no other lamprey species including western brook lamprey *Lampetra richardsoni* have been definitively documented as occurring in the watershed. Thus, all historic and modern records are presumed to be of Pacific lamprey whether named so or not.

In 1937, lampreys were recorded in the catches of by-pass traps on various irrigation ditches in the lower Wenatchee River watershed, including Peshastin Creek, Icicle Creek, and lower Wenatchee River (WDF 1938). Two lampreys were recorded in the fish ladder at Tumwater Dam in 1935 (WDF 1938) and since these were moving upstream in the ladder, they are assumed to be Pacific lamprey adults. A trap was operated in the fingerling bypass at Tumwater Dam in 1955 and both *Lampetra* sp. and *Entosphenus* sp. were described as abundant (French and Wahle 1959); presumably these were juveniles but no details were provided as to why two genera were listed. In 1981, juvenile lampreys were collected both downstream of Tumwater Dam and upstream in Lake Jolanda (the pool formed by the dam) during electrofishing surveys conducted by Chelan County Public Utility District (Hays 1981). A gill netting survey of Lake Wenatchee in 1949 and 1950 found “six small lampreys” in the stomachs of northern pikeminnow *Ptychocheilus oregonensis* that were captured at the head of the lake near the Little Wenatchee and White rivers (USFWS 1950, Gangmark and Fulton 1952). Records also show a Pacific lamprey was collected from Lake Wenatchee in 1958 (Burke Museum, 2012)

It is noteworthy that no adult Pacific lampreys have been observed in the fishway at Tumwater Dam since it was reconstructed in 1987 and 1988. Because juveniles were observed upstream of Tumwater Dam as recently as 1981, it is apparent that the old fish ladder passed adult Pacific lampreys. It appears that Tumwater Dam may be limiting Pacific lamprey distribution by preventing adults from accessing the upper Wenatchee basin, an area they historically occupied. However, some adults may be able to pass the dam undetected and spawn in upstream areas so surveys to detect juvenile lampreys in the Wenatchee River watershed upstream of Tumwater Dam are needed.

The purpose of this study was to sample the Wenatchee River using electrofishing to identify the current upstream extent of juvenile Pacific lamprey presence. Juvenile Pacific lampreys, known as ammocoetes, rear in freshwater for up to seven years. After hatching, ammocoetes drift downstream and find a suitable area to burrow into the sediment where they feed by filtering algae and other organisms from the water (Beamish 1980, Kostow 2002). Pacific lamprey ammocoetes are relatively poor swimmers and it is unlikely that they move great distances upstream of where they were spawned or where they burrow into the sediment (Mesa *et al.* 2003). Therefore, the presence of ammocoetes should provide an indication of spawning areas, the upstream distribution of the species and whether adult lampreys are able to pass obstacles such as a dam or waterfall.

Methods

The Wenatchee River is located on the east side of the Cascade Mountains in central Washington. Its associated watershed drains an area of 3,450 km². It flows 87.3 km in a southeast direction from Lake Wenatchee to its confluence with the Columbia River. Major tributaries to the river are the Little Wenatchee and White rivers, which flow into Lake Wenatchee, as well as the Chiwawa River, Nason Creek, Chiwaukum Creek, Icicle Creek, and

Peshastin Creek. Tumwater Dam is located at river kilometer 49.7 and forms Lake Jolanda (Figure 1).

Cataracts were used to access Icicle Creek and the majority of the Wenatchee River. Sample areas within Tumwater Canyon on the Wenatchee River were accessed on foot due to unsafe rafting conditions. During surveys, areas were visually selected for electrofishing based on habitat types categorized by Hansen *et al.* (2003). Type-I, the preferred habitat for ammocoetes, is comprised of sand, fine organic material, detritus, and/or aquatic vegetation. Type-II habitat is considered suitable for ammocoetes and is composed of shifting sand or gravel with little fine organic material. Type-III habitat is composed of bedrock or hardpan clay along with larger gravel and is not suitable for ammocoete burrows.

Ammocoetes were collected with an AbP-2 backpack electrofisher, set at 125 volts DC, 3 pulses/second, 25% duty cycle, and 3:1 pulse train. Electrofishing was conducted at a slow walking pace in wade-able water depths and sampling time was recorded. Waypoints for each site were recorded with a Garmin Rino 530HCx GPS unit.

Captured ammocoetes were placed into an aerated holding bucket. The ammocoetes were identified to species using a field identification key and released back to their capture location.

Results

The Wenatchee River was surveyed for lamprey ammocoetes between September 9 and November 4, 2010 and on May 6, 2011 (Table 1). Sample sites were between the city of Leavenworth at rkm 40.2 and Lake Wenatchee at rkm 87, with five sample sites downstream of Tumwater Dam and eighteen sites upstream of Lake Jolanda. The majority of sites were classified as Type I habitat (Table 1). Electrofishing occurred for a total of 202.2 minutes, ranged between 1.3 and 46.7 minutes, and had an average of 8.8 minutes (SD10.7) per site.

Ammocoetes were present only at the rkm 47.6 sample site located downstream of Tumwater Dam (Figure 2). A total of 10 ammocoetes were collected there, one of which was preserved as a locality specimen and identified as a Pacific lamprey.

Lake Jolanda was intensively surveyed on October 28, 2010 and May 6, 2011. Sampling occurred for a total of 248.7 minutes along the west side of the lake as well as around the island in its center. Sampling locations consisted of both Type-I and Type-II habitats (Figure 3). No lamprey ammocoetes were found.

Icicle Creek between the Leavenworth National Fish Hatchery (LNFH) (rkm 4) and the confluence with the Wenatchee River was surveyed on September 10, 2010 (Table 2). Four Type-1 locations were sampled as well as one site composed of both Type-I and II habitats. Electrofishing occurred for a total of 40 minutes with an average of 8 minutes per site (SD 2.9). No ammocoetes were found (Figure 2).

Chumstick Creek was surveyed on May 13, 2011. Sampling occurred between rkm 0.32 and 0.48. The majority of habitat was classified as Type-III, but seven small pockets of Type-I were found. These areas were electrofished for approximately 45 seconds each. No ammocoetes were found.

Discussion

No ammocoetes were observed or collected in the Wenatchee River above Tumwater Dam during our surveys in 2010 and 2011. The only ammocoetes found were collected approximately 2 kilometers downstream of the dam. Our findings, along with records of historical distribution, suggest that Tumwater Dam is currently limiting the upstream extent of Pacific lamprey within the Wenatchee River. Originally built in the early 1900's to supply electricity for trains using the railroad tunnel on Stevens Pass, the dam is now solely used as a weir to aid salmonid research and management. The modifications to the fishway during the late 1980's appear to have impacted the upstream passage of adult Pacific lamprey. In addition, from April to November the fishway is manipulated to only allow passage during daylight hours so all upstream migrating salmonids can be sampled by fisheries personnel (Chelan County PUD 2011). Because Pacific lampreys move primarily at night this operations schedule may also have a significant impact on lamprey passage. It is possible that opening the fishway during night hours may allow for some passage of Pacific lampreys above the dam. Another possible solution to aid in returning Pacific lamprey to their historic distribution within the Wenatchee River is a lamprey passage structure (LPS) (Reinhardt *et al.* 2008). LPS have been installed at Bonneville Dam and some Columbia River tributary dams and provide Pacific lampreys with a series of inclined ramps on which they can "climb" over the dam. This method may be preferred by salmonid researchers as their sampling would continue unchanged, however, radio-telemetry studies would be necessary to determine if a suitable location exists for a LPS.

Sampling on Icicle Creek was limited to below Leavenworth National Fish Hatchery (rkm 4). While lampreys have been historically documented within Icicle Creek, for the past several years no ammocoetes have been observed during electrofishing sampling downstream of LNFH (B. Kelly-Ringel, USFWS, pers. comm.). Lampreys were also not observed during electrofishing in the LNFH channel just upstream of the hatchery (C. Yonce, USFWS, pers. comm.). Our results are consistent with these findings, indicating that Icicle Creek may not be a primary spawning area within the Wenatchee River watershed or that lampreys have been extirpated from the creek.

More intensive sampling within the tributaries to the Wenatchee River such as Peshastin, Nason, and Chiwaukum creeks and Chiwawa River is needed to determine the distribution of Pacific lamprey within the watershed as a whole.

To our knowledge this was the first large scale survey for lampreys to be conducted in the Wenatchee River watershed. Hays (1981) found lamprey ammocoetes in Lake Jolanda immediately upstream of Tumwater Dam but that was during general fish surveys and lampreys were not targeted. However, his weekly surveys occurred from April 21 to July 21 with the highest numbers of ammocoetes observed during the month of June and no lampreys found during the monthly surveys in August and September. Thus it is possible that Lake Jolanda was only seasonally used by juvenile lampreys. Because our sampling efforts in Lake Jolanda occurred primarily in the fall, additional surveys in spring and summer are needed to definitively confirm that lampreys are not currently present upstream of Tumwater Dam. Our future surveys will use a generalized random tessellation stratified (GRTS) survey design (<http://www.epa.gov>). This design allows for surveys to be conducted at random sites and gives a percentage of confidence as to the presence of lampreys even if none are observed.

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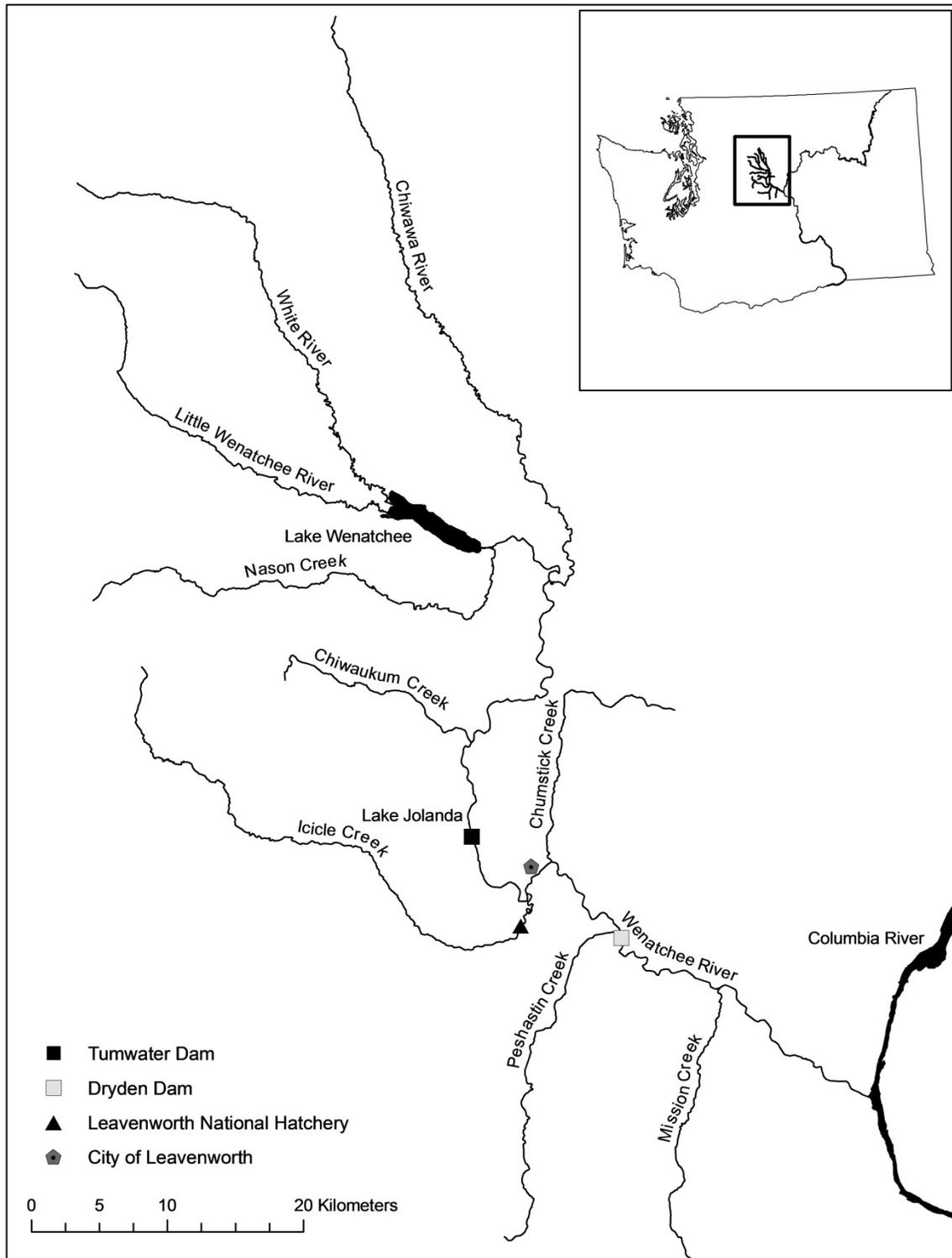


Figure 1. The Wenatchee River, its major tributaries, and points of interest.

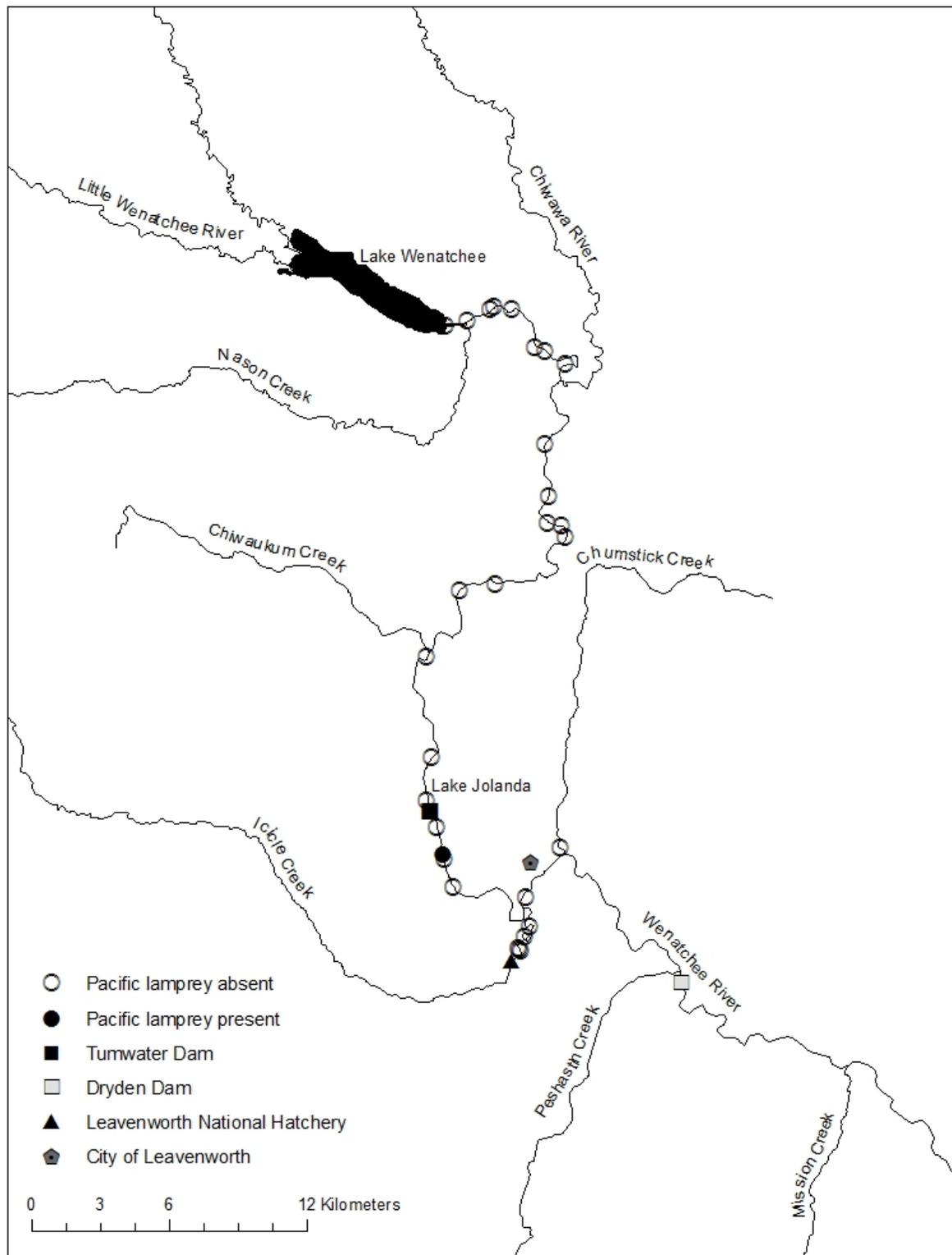


Figure 2. Pacific lamprey ammocoete electrofishing sample sites within the Wenatchee watershed, 2010 and 2011.

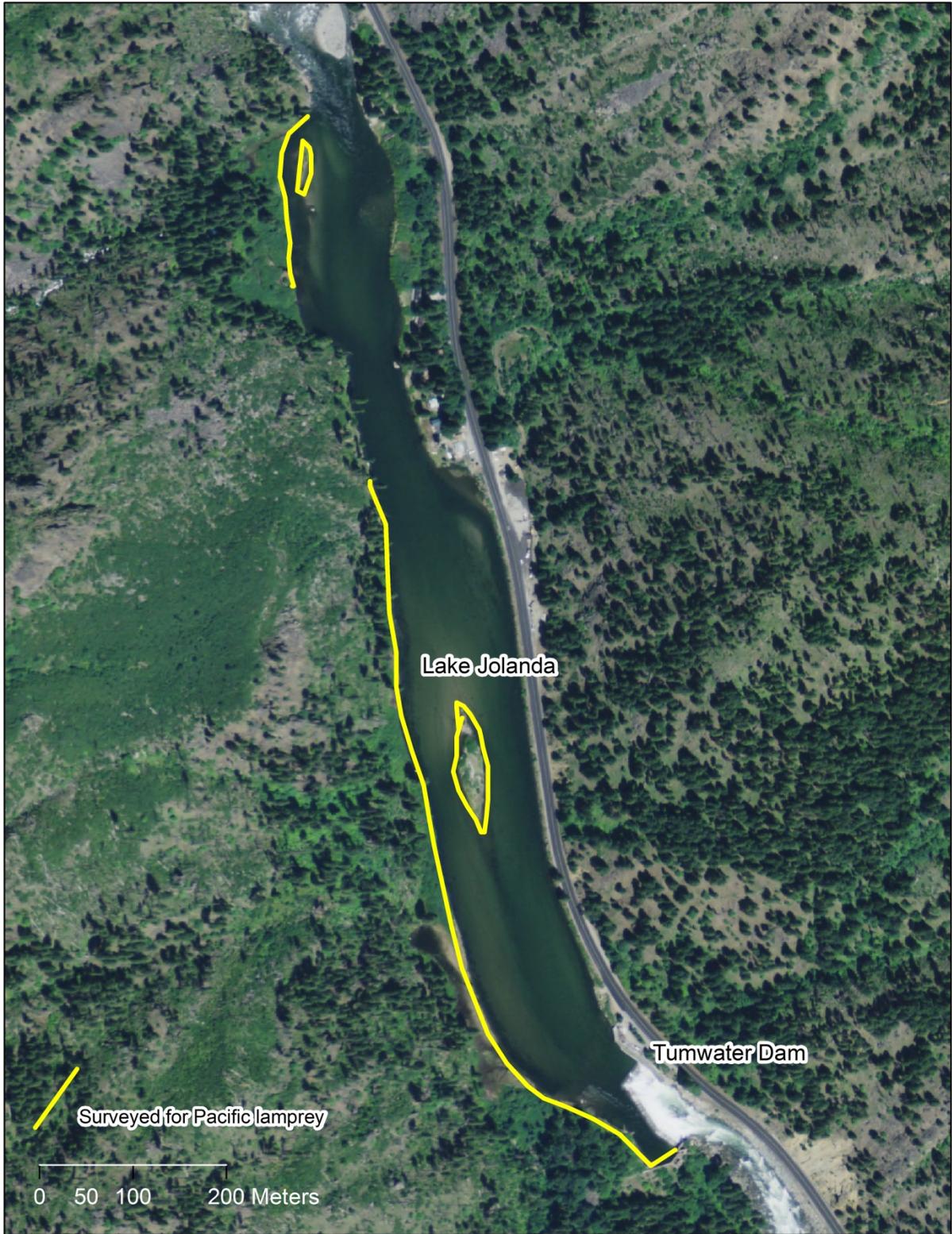


Figure 3. Map of Lake Jolanda showing the locations (highlighted in yellow) of electrofishing on October 28, 2010 and May 6, 2011.

Table 1. Date, location, sampling duration, habitat type, and presence of ammocoetes for each electrofishing site within the Wenatchee River, 2010-2011.

RKM	Date	Latitude	Longitude	Time Sampled (min)	Habitat Type	Lamprey Observed
40.3	9/24/2010	47.58463	-120.663594	46.7	N/A	No
46	11/4/2010	47.58681	-120.707755	6.4	I	No
47.3	10/27/2010	47.59786	-120.713749	20.0	I	No
47.6	10/27/2010	47.59958	-120.715216	16.0	I	Yes
48.9	10/27/2010	47.6097	-120.719098	30.0	II	No
52.5	9/9/2010	47.63812	-120.722534	4.1	I	No
57.7	10/29/2010	47.67781	-120.728538	3.3	I	No
62.1	10/29/2010	47.70472	-120.711681	1.3	I	No
63.7	10/29/2010	47.70709	-120.689435	4.3	I	No
69	10/29/2010	47.72694	-120.651368	1.3	I	No
69.5	10/29/2010	47.7302	-120.653477	3.5	I	No
70	10/29/2010	47.73229	-120.661072	1.8	II	No
71.8	10/29/2010	47.74251	-120.663377	2.4	I	No
74.5	10/29/2010	47.76329	-120.666586	3.1	I	No
79	9/14/2010	47.79505	-120.654547	1.9	I	No
81.6	9/14/2010	47.79906	-120.668117	6.2	I, II	No
81.9	9/14/2010	47.80105	-120.672977	4.4	I	No
84.2	9/14/2010	47.81588	-120.687503	6.7	I	No
85	9/14/2010	47.81658	-120.699145	18.3	I	No
85.2	9/14/2010	47.81553	-120.699855	5.0	I	No
86.3	9/14/2010	47.81066	-120.713031	6.2	I, II	No
87.1	9/14/2010	47.80787	-120.725494	3.5	II	No
N/A	10/29/2010	N/A	N/A	5.8	I	No

Table 2. Date, location, sampling duration, habitat type, and presence of ammocoetes for each electrofishing site within Icicle Creek, 2010.

RKM	Date	Latitude	Longitude	Time Sampled (min)	Habitat Type	Lamprey Observed
1.3	9/10/2010	47.57309	-120.66066	11.0	I	No
2.3	9/10/2010	47.56917	-120.66304	10.1	I	No
3.5	9/10/2010	47.56432	-120.66917	9.8	I	No
3.6	9/10/2010	47.56370	-120.66846	5.2	I	No
3.7	9/10/2010	47.56314	-120.66755	3.8	I, II	No

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