Opportunistic Observations of Nest Building and Spawning of the Endangered Western Brook Lamprey, Morrison Creek Population (Lampetra richardsoni)

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Opportunistic observations of nest building and spawning of the endangered Western Brook Lamprey, Morrison Creek population (*Lampetra richardsoni*)

by

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ABSTRACT

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Western Brook Lamprey (*Lampetra richardsoni*), Morrison Creek population is an endangered species, endemic to the Morrison Creek watershed in Courtenay, British Columbia. Despite the risk of extinction the species is currently facing, many knowledge gaps still exist which may limit recovery or conservation efforts. Therefore, basic habitat and biological data were collected in 2021 from lamprey actively spawning in Morrison Creek to help better inform the habitat requirements for nest building and spawning. Specifically, this report documents the conditions under which lamprey were observed nest building or spawning and provides recommendations for future research.

RÉSUMÉ

Wade, J., and Grant. 2022. P Observations opportunistes de la construction de nids et du frai de la lamproie de l'Ouest en voie de disparition, population du ruisseau Morrison (*Lampetra richardsoni*). Can. Manuscr. Rep. Fish. Aquat. Sci. 3251: v + 11 p.

Lamproie de l'Ouest (*Lampetra richardsoni*), population du ruisseau Morrison, est une espèce en voie de disparition, endémique du bassin versant du ruisseau Morrison à Courtenay, en Colombie-Britannique. Malgré le risque d'extinction auquel l'espèce est actuellement confrontée, de nombreuses lacunes dans les connaissances subsistent, ce qui peut limiter les efforts de rétablissement ou de conservation. Par conséquent, des données de base sur l'habitat et la biologie ont été recueillies en 2021 auprès de la lamproie frayant activement dans le ruisseau Morrison afin de mieux informer les besoins en matière d'habitat pour la construction de nids et le frai. En particulier, ce rapport documente les conditions dans lesquelles les lamproies ont été observées en train de construire leur nid ou de frayer et fournit des recommandations pour les recherches futures.

INTRODUCTION

Western Brook Lamprey (*Lampetra richardsoni*) can be found in tributaries on the west coast of North America from California to southern Alaska (Vladkyov and Follett 1965, Boguski et al. 2012, Moyle et al. 2011, Moyle 2002). The Morrison Creek population of Western Brook Lamprey, also known as Morrison Creek Lamprey, is an evolutionarily significant population found only in the Morrison Creek watershed in Courtenay, British Columbia. This unique lamprey population has two distinct life history types, a typical non-parasitic and parasitic type. The non-parasitic type is recognized by its darker colouration and smaller size, whereas the parasitic type is silver in colour, larger in size and capable of feeding as an adult after metamorphosis (Wade et al. 2015). However, both types are indistinguishable as ammocoetes, prior to metamorphosis.

In 2003, Morrison Creek Lamprey was listed under Schedule 1 of the *Species at Risk Act* (SARA) as endangered due to its small distribution and increasing threats to the species and its habitat. SARA contains provisions that allow for the protection of certain listed species at risk, their residences, as well as their critical habitat, or the habitat that is necessary for the survival or recovery of a wildlife species, on which they depend directly or indirectly in order to carry out their life processes. Critical habitat for this species was designated in 2019 and included Morrison Creek and Arden Creek, as well as surrounding riparian areas of those water bodies. SARA defines a residence as "*a dwelling place, such as a den, nest or other similar area or place that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating*;" [s. 2(1)]. For Morrison Creek Lamprey, the nests they construct meet the definition of residence and are also afforded protection under SARA.

As outlined in the Action Plan (DFO 2018) for the population, a long term monitoring program is needed to ensure the persistence of the population within its natural range. Additional recovery objectives include maintaining, and where possible enhancing, ecological integrity of habitat for the species. Yet despite the risk of extinction the species is currently facing, many knowledge gaps still exist which limit recovery or conservation efforts. This includes habitat requirements for nest building and spawning. Understanding the environmental requirements for nest building and spawning is particularly important as the surrounding habitat where this population exists is largely urban and heavily used.

There are few published reports on the basic biology of Western Brook Lamprey and in particular, requirements for successful nest building and spawning. Pletcher (1963) and Stone (2006) are the most comprehensive studies available. There are several other papers which provide basic biology or spawning information (i.e., McIntyre 1969; Kan 1975; Schultz 1930) but using this information is problematic because "brook lampreys" were first identified as European Brook Lamprey (*L. planeri*). This was further confounded with overlapping distributions between Pacific Brook Lamprey (*L. pacifica)* and Western Brook Lamprey, therefore, we cannot be certain which species these studies actually examined.

The requirements for nest building and spawning as outlined in the 2018 Action Plan for the population are general and include statements such as “cool, free flowing water” as well as the more specific “pebbles no greater than 1 cm diameter for building nests”. Citations for many of these types of unsubstantiated statements are not provided, and may have been based on expert opinion when other evidence was not available.

Given the knowledge gaps that exist for the species and this species is considered at risk of extinction, basic habitat and biological data were collected in 2021 from lamprey actively spawning in Morrison Creek to help better inform the habitat requirements for nest building and spawning. These data are presented here in an effort to help begin filling knowledge gaps and provide species specific information to inform the conservation and survival of the population.

In this paper, we do not make correlations between environmental conditions (water temperature and discharge) and lamprey spawning activity as this work was undertaken after the initiation of spawning activities. This report only documents the conditions under which lamprey were observed nest building or spawning during the observation period.

METHODS

On May 15, 2021, spawning activity was reported in Morrison Creek in Puntledge Park. Several interested volunteers agreed to periodically monitor the area for signs of nest building and spawning activity. New nests were only identified if lamprey were actively tending the area. Data, including time of day, number of lamprey present, sex (if discernable), and location were recorded. Efforts were made to look for lamprey at various points throughout the day as well as in the evening, after dark. The amount of time spent searching was not standardized and therefore effort is not calculated.

There are many knowledge gaps regarding the substrate requirements for nest building and spawning. As this study was opportunistic the potential risk to successful spawning and incubation outweighed the value for data collection in this instance. Therefore, substrate size was not classified quantitatively, but was qualitatively described. On one occasion, water depth and corresponding nest diameter were measured using a standard meter stick after lamprey had left the area. As nests were shallow depressions, it was not possible to measure the depth of the nest itself relative to the surrounding area with any accuracy therefore depth was measured at three points, at the midpoint of the nest and near two edges.

Nest building and spawning in this location was fortuitous as the provincial environmental monitoring station is located 150 m upstream. Hourly water temperature and discharge data were downloaded from this publicly available dataset for analysis. Results have been summarized based on the approximate hour in which the observation was made as data are available on an hourly basis. For example, if an observation period was from 0815 to 0845, environmental data from 0800 was attributed to that event.

RESULTS

Lamprey observations

All observations occurred within an area of approximately 55 m^2 in Morrison Creek near the confluence with Puntledge River in the City of Courtenay (Figure 1). Upon discovery of spawning activity on May 15th 2021, the area was monitored at least once daily until June 9th, with the exception of the May 28th and June 8th when no observations occurred (**Table 1**). In this 26 day period, a total of 36 observation events occurred.

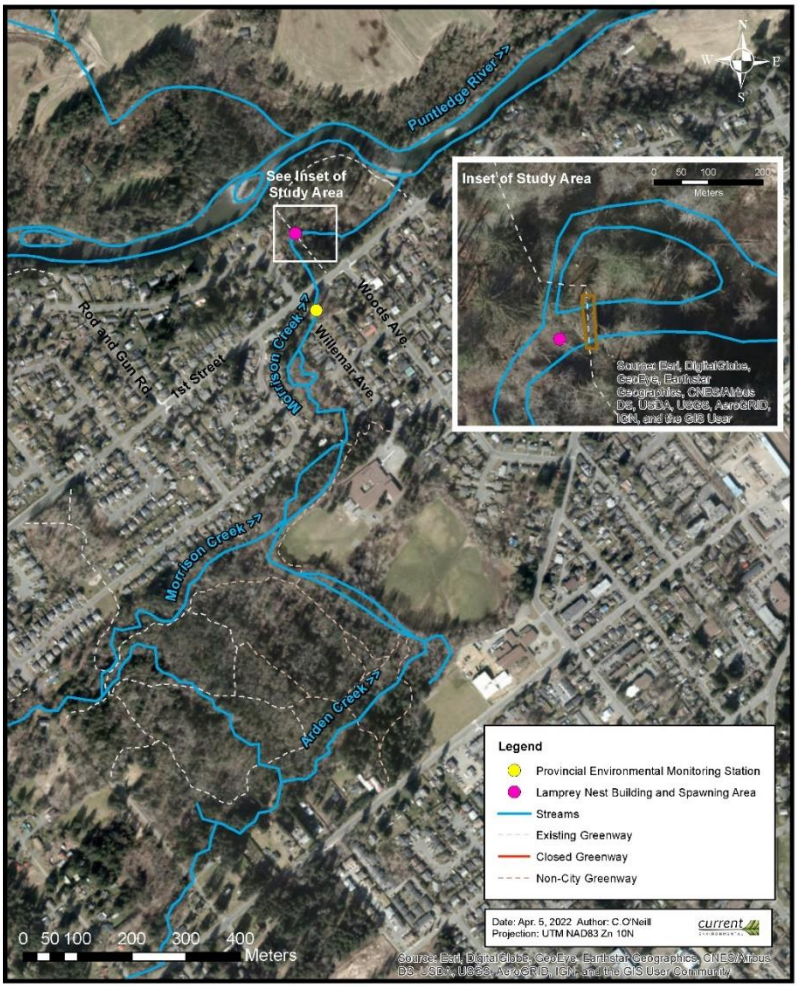

Figure 1. Location of nest building and spawning observation area and provincial environmental monitoring station on Morrison Creek, Courtenay, British Columbia.

The number of lamprey observed during each event ranged from zero to seven. At least one lamprey was seen during 19 of the 36 observations (53%); no lamprey were seen during 17 of the 36 observations (47%). A total of 59 lamprey were seen tending nests or spawning, males and females were both seen, but for most sightings, sex was not determined (**Table 1**).

A maximum of six different nesting areas were seen throughout this period but at any one observation time, a maximum of two nests were being used.

Table 1. Western Brook Lamprey, Morrison Creek population, nest building and spawning observation data, May–June 2021.

Observation event	Date	Number of lamprey observed				Nests with lamprey (number)
		Male	Female	Unidentified	Total	
1	15 May			7	7	1
2	15 May			3	3	1
3	16 May	0	0	0	0	0
4	16 May			2	2	1
5	16 May			0	0	0
6	17 May	2	2		4	1
7	17 May			6	6	2
8	18 May			1	1	2
9	18 May			7	7	2
10	19 May	1	1	1	3	2
11	19 May	0	1	0	1	1
12	20 May			0	0	0
13	21 May			0	0	0
14	22 May			1	1	1
15	23 May			5	5	1
16	24 May			0	0	0
17	25 May			1	1	1
18	25 May			0	0	0
19	26 May			0	0	0
20	27 May			0	0	0
	28 May	no observations				
21	29 May	1	1	2	4	2
22	29 May			0	0	0
23	30 May			0	0	0
24	30 May			0	0	0
25	31 May			0	0	0

26	31 May			0	0	0
27	1 June			0	0	0
28	1 June			3	3	2
29	2 June		1	1	2	2
30	2 June				0	0
31	3 June		1		1	1
32	4 June		2	3	5	2
33	5 June				0	0
34	6 June			1	1	1
35	7 June				0	0
	8 June	no observations				
36	9 June			2	2	1
Total		**4**	**9**	**46**	**59**	**27**

Environmental monitoring

Observation time was rounded to the nearest hour to coincide with the interval recorded by the environmental monitoring station. There were 20 observations between 0800 and 1200 (inclusive), eight between 1300 and 1700 (inclusive) and eight observations between 1800 and 2100. Lamprey were found in all of these time periods. The earliest lamprey were seen was 0800, the latest 2000 (Table 2). Lamprey were seen tending nests or spawning at temperatures ranging from 9.49 to 16.47°C and water flows ranging from 0.18 to 0.25 m^3/sec.

Table 2. Daily environmental data (water temperature and discharge) and lamprey occurrence (May–June 2021). Time of observation rounded to the hour to coincide with environmental data collection interval. Environmental data source Province of British Columbia.

Date	Time	Temperature (°C)	Discharge (m^3/sec)	Total lamprey observed (number)
15 May	1600	13.32	0.22	7
15 May	1900	13.74	0.22	3
16 May	1000	12.25	0.21	0
16 May	1500	13.65	0.22	2
16 May	1900	14.17	0.21	0
17 May	1000	13.10	0.20	4
17 May	1600	13.27	0.21	6
18 May	0800	10.67	0.25	1
18 May	1600	11.62	0.25	7
19 May	0800	9.50	0.23	3
19 May	0900	9.50	0.24	1

20 May	0800	9.15	0.21	0
21 May	0800	10.18	0.20	0
22 May	1000	11.24	0.20	1
23 May	1200	12.56	0.20	5
24 May	0800	12.96	0.20	0
25 May	0800	11.92	0.24	1
25 May	1900	13.47	0.23	0
26 May	0800	12.34	0.20	0
27 May	1100	11.14	0.40	0
28 May	no observations			
29 May	1300	11.87	0.22	4
29 May	2100	13.35	0.21	0
30 May	1000	12.37	0.21	0
30 May	1700	13.05	0.24	0
31 May	1000	12.79	0.22	0
31 May	2000	14.06	0.21	0
1 June	0800	13.53	0.20	0
1 June	1800	15.75	0.20	3
2 June	0800	14.92	0.18	2
2 June	2000	15.67	0.18	0
3 June	2000	16.47	0.18	1
4 June	1500	14.76	0.18	5
5 June	0800	12.75	0.18	0
6 June	1200	11.84	0.19	1
7 June	0800	10.94	0.23	0
8 June	no observations			
9 June	1400	11.91	0.22	2

Throughout the observation period (May 15th to June 9th, 2021), the average temperature was 12.6 $^{\circ}$C; daily temperature ranged from 9.15°C (20 May) to 16.47°C (June 3; **Figure 2**).

During this same period, discharge ranged from 0.18 (June 4) to 0.40 m^3/sec (May 27). The average discharge over this time period was 0.22 m^3/sec (**Figure 3**).

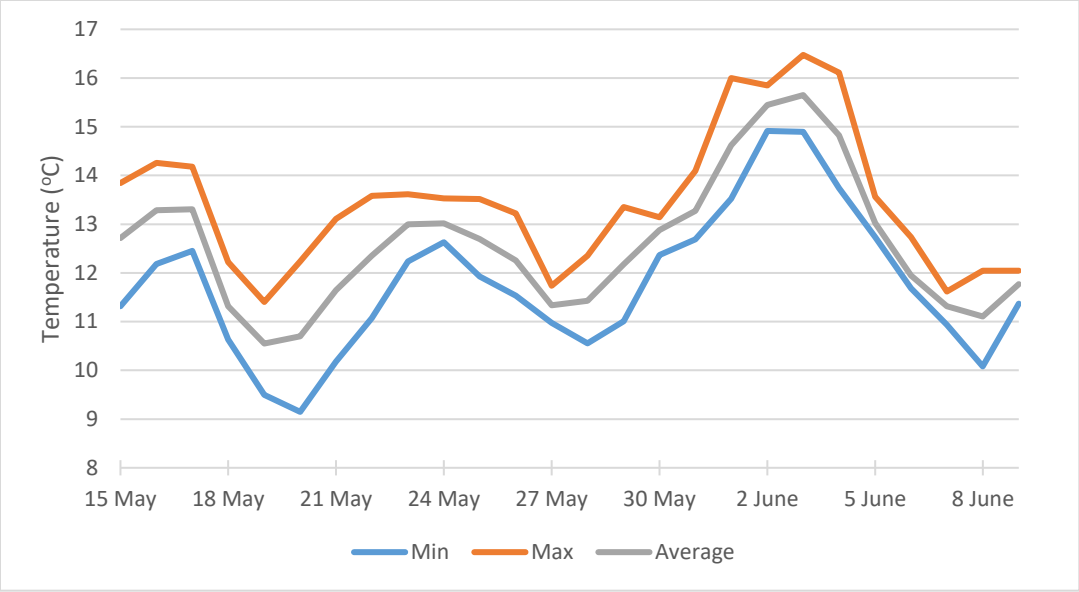

Figure 2. Daily water temperature (minimum, maximum, average) for the observation period (May 15 to June 9, 2021 as recorded by the Province of BC monitoring station 08HB0018.

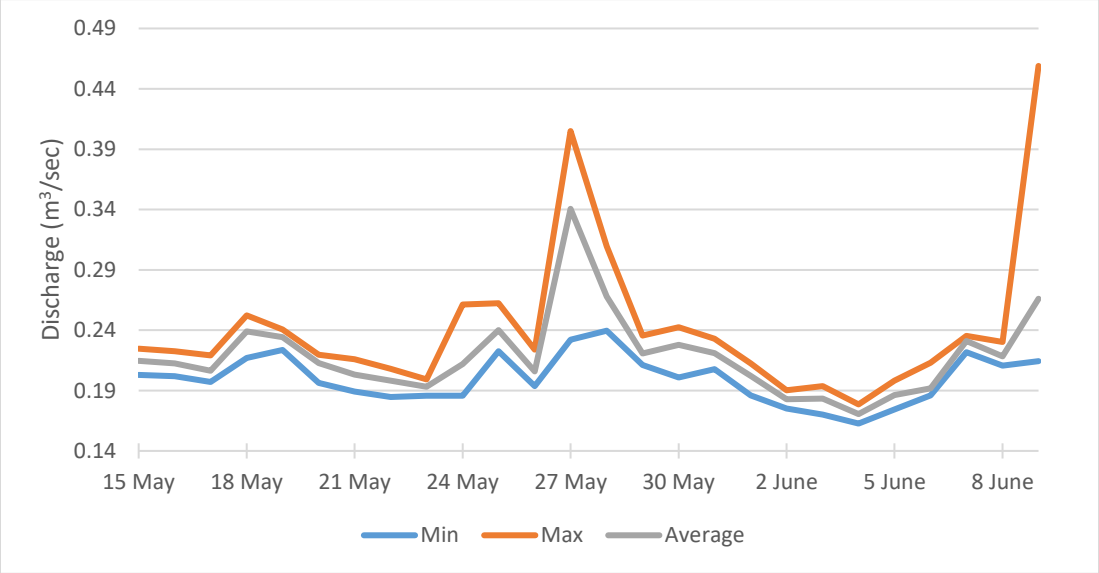

Figure 3. Daily discharge (minimum, maximum, average) for the observation period (May 15 to June 9, 2021) as recorded by the Province of BC monitoring station 08HB0018.

Nesting and spawning substrate

As we did not wish to disturb nests, substrate was not measured. However, after watching the lamprey move relatively large stones with it's oral disc, one stone which was moved to the nest edge was removed for measurement after the lamprey left the area. It weighed 34 g and was approximately 3.5 cm x 3.0 cm x 1.8 cm. The size of this

stone was typical of other, large stones being moved to the edge of the nesting area by lamprey as shown by still photograph taken from video in Figure 4.

Figure 4. Western Brook Lamprey, Morrison Creek population (non-parasitic form), moving pebbles for nest building. Still photo taken from video in Morrison Creek near the confluence with the Puntledge River, May 2021. Rock outline added to show size of pebble moved. Photo: Joy Wade.

The spawning area in general is composed of hard packed substrate covered by sand, pebbles, and small stones (Figure 5). Cleared nesting areas could be easily seen as detritus on the substrate was absent, and larger stones delineated the spawning area. However, unless lamprey were actively seen tending the nests, a cleared area or depression are not sufficient to identify an unknown area as a nest as cleared areas could also be the result of people or animals walking through the creek.

On May17th, 2021 water depth was measured at two of the nesting sites after lamprey had moved off the nests. Three measurements were taken at each nest, depth ranged from 17–28 cm at one nest and 33–36cm at the other.

Figure 5. Female Western Brook Lamprey (non-parasitic form), Morrison Creek population. Photo taken on active nest building and spawning site in Morrison Creek, near the confluence with the Puntledge River May 2021. Substrate is typical of that found in the area. Photo: Joy Wade.

CONCLUSION

Although this paper presents information collected opportunistically, it highlights the importance of having species specific information to inform features, functions, and attributes of critical habitat and conservation activities for species at risk. For example, the 2018 Action Plan for the population outlines the attributes for egg incubation, rearing and spawning. There is a specification for “pebbles, no greater than 1 cm diameter for building nests” (DFO 2018; Table 5). This study demonstrated that small stones or pebbles much greater than 1 cm in diameter were moved and placed at the edge of the nest, indicating our understanding of the habitat requirements for nest building and spawning needs to be revised.

We found that during the observation period, lamprey could be seen throughout the day and into the evening undertaking nest building and/or spawning activities. We cannot say if nest building or spawning is most common during the day or night as there were very few observations after dark. Peak activity period for spawning remains a knowledge gap.

We cannot confirm the temperature or water discharge level which may trigger the onset or termination of nest building or spawning. However, based on the data from a nearby data recorder, we observed lamprey tending nests and/or spawning at temperatures ranging from 9.50 to 16.47°C and water discharge ranging from 0.18 to 0.25 m^3/sec.

Recommendations for future studies include:

1. Begin monitoring potential sites at the end of April and terminate monitoring at the end of June/beginning of July to capture the pre and post spawn period.
2. Install environmental monitoring devices within a meter upstream of nesting sites for more localized data.
3. Standardize observations within a set area (transects) and time period, including late night and early morning monitoring.
4. Collect data on nest size, water depth and substrate composition.

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REFERENCES

COSEWIC. 2010. COSEWIC assessment and status report on the Western Brook Lamprey *Lamptera richardsoni*, Morrison Creek population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 27 pp.

Kan, T.T. 1975. Systematics, variation, distribution, and biology of lampreys of the genus *Lampetra* in Oregon. PhD thesis Oregon State University. 207p.

McIntyre, J.D. 1969. Spawning behaviour of the brook lamprey, *Lampetra planeri*. Journal of the Fisheries Research Board of Canada 26(12):3252–3254.

Moyle, P. B. 2002. Inland fishes of California. University of California Press, Berkeley and Los Angeles, CA. 502 pp.

Moyle, P.B., Katz, J.V.E., and R.M. Quinones. 2011. Rapid decline of California's native inland fishes: A status assessment. Biological Conservation 144:2414–2423.

Pletcher, F.T. 1963. The life history and distribution of lampreys in the Salmon and certain other rivers in British Columbia, Canada. University of British Columbia, Department of Zoology, MSc. Thesis. 209pp.

Schultz, L.P. 1930. The life history of *Lampetra planeri* Bloch, with a statistical analysis of the rate of growth of the larvae from western Washington. Occasional Papers of the Museum of Zoology, University of Michigan 221:1–40.

Stone, J. 2006. Observations on nest characteristics, spawning habitat, and spawning behaviour of Pacific and western brook lamprey in a Washington stream. Northwestern Naturalist 87:225–232.

Vladykov, V.D., and Follett, W.I. 1965. *Lampetra richardsoni*, a new nonparasitic species of lamprey (Petromyzonidae) from western North America. Journal of the Fisheries Research Board of Canada 22 (1):139–158.