Cowichan Lake Lamprey (*Entosphenus macrostomus)* Ammocoete Habitat Survey 2012

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COWICHAN LAKE LAMPREY (*Entosphenus macrostomus)* AMMOCOETE HABITAT SURVEY 2012

by

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ABSTRACT

Wade, J., and MacConnachie, S. 2016. Cowichan Lake Lamprey (*Entosphenus macrostomus)* ammocoete habitat survey 2012. Can. Manuscr. Rep. Fish. Aquat. Sci. 3088: iv + 15p.

In 2012, an electroshocking field survey of Cowichan Lake was conducted in order to determine the presence of Cowichan Lake (Vancouver) Lamprey (*Entosphenus macrostomus*) in potential locations previously identified in the fall of 2011. This report describes the catches and habitat of the eight locations in which ammocoetes were found in 2012. Six of the eight locations had catches of lamprey ammocoetes which were determined to be too numerous to count. The length of ammocoetes measured varied from 1.5 cm to 13.8 cm. It is important to identify locations where ammocoetes are found in order to determine habitat usage.

RÉSUMÉ

Wade, J., et MacConnachie, S. 2016. Relevé de 2012 sur l'habitat des ammocètes de lamproie du lac Cowichan. Can. Manuscr. Rep. Fish. Aquat. Sci. 3088: iv + 15p.

En 2012, un levé hydrographique par électrochocs a été effectué dans le lac Cowichan afin de détecter la présence de lamproies du lac Cowichan (lamproies de Vancouver) (*Entosphenus macrostomus*) à certains endroits où il avait été établi à l'automne 2011 qu'il était possible d'en trouver. Le rapport décrit les prises et l'habitat des huit endroits où des ammocètes ont été trouvées en 2012. Dans six des huit endroits, le nombre d'ammocètes de lamproie était trop élevé pour que l'on puisse les compter. La taille des ammocètes variait entre 1,5 cm et 13,8 cm. Il est important de cerner les endroits où se trouvent des ammocètes afin de déterminer l'utilisation de l'habitat.

INTRODUCTION

Cowichan lamprey (*Entosphenus macrostomus)* are known to be present only in Mesachie Lake and Cowichan Lake, BC. In 2000 and 2008, this species was assessed as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is currently listed under the *Species at Risk Act* (Vancouver Lamprey Recovery Team, 2007). Very little information is known about the biology, population status or habitat requirements of this species.

The species was first described by Beamish (1982) as a freshwater parasitic derivative of *Lampetra tridentata (*now *Entosphenus tridentatus).* There are many morphological differences between the two species including a longer prebranchial length, larger diameter eye and weakly pigmented velar tentacles (Beamish, 1982). The oral disc of immature *E. macrostomus* is 8.8 to 11.4% of total length, whereas *E. tridentatus* ranges from 4.6 to 9.1% (Beamish, 1982). In addition to these significant meristic differences, *E. macrostomus,* unlike *E. tridentatus,* can remain in freshwater and feed in freshwater prior to spawning which occurs later in the year than *E. tridentatus* and at a significantly smaller size (Beamish, 1982).

E. macrostomus has been shown to utilize shallow areas with small gravel near mouths of rivers; these areas have been identified as essential for the successful spawning of the species (Beamish and Wade, 2008). Initial studies from the late 1970s to mid-1980s involved electroshocking from accessible shoreline around Mesachie Lake. Between 1985 and 1988, after the successful identification of the "new species", selected areas around Cowichan Lake were surveyed for ammocoetes or metamorphosing lamprey. Importantly, only those areas which were found to have ammocoetes at the time of the survey were noted (R. Beamish, Personal Communication 2012).

In the 1980s ammocoetes were collected from the small gravel areas at the mouths of Shaw Creek, Nixon Creek, Cottonwood Creek and Meade's Creek where they flow into Cowichan Lake. Electroshocking upstream (survey to approximately 100m) of these areas did not result in any ammocoetes being found (Beamish and Wade, 2008). Large ammocoetes (100-170mm) from Shaw Creek were reared at the Pacific Biological Station for approximately a year and a half to allow for metamorphosis to complete. All lamprey which had completed metamorphosis were subsequently identified as *E. macrostomus* (Beamish 1982).

The identification of habitat used by *E. macrostomus* in Cowichan Lake was undertaken in order to aid in the management of the habitat as well as the species. It is safe to say that the adult (non-spawning) stage of *E. macrostomus* uses the main body of water as its habitat as it is a parasitic freshwater fish, known to parasitize salmonids in the lake. In 2011, there was an attempt to identify and describe the habitat and/or potential habitat used by spawning lamprey and ammocoetes/metamorphosing lamprey around Cowichan Lake and its tributaries. This work was hampered by the high water flows in the Cowichan Lake area. What it did allow for was the elimination of unsuitable areas for investigation for the 2012 field season. Therefore, areas of potential lamprey habitat usage were targeted for electroshocking surveys in September of 2012.

PURPOSE OF THIS DOCUMENT

This field summary report was prepared as fulfillment of the contract between Fisheries and Oceans Canada (DFO), specifically Species at Risk section and Habitat Management, South Coast and Fundy Aqua Services Inc. (Joy Wade, Owner). A survey of lamprey habitat along the foreshore and tributaries was commissioned by Habitat Management Branch to gather data in order to make informed recommendations regarding the Cowichan Lake watershed. The *Species at Risk Act* (SARA, Section 47) requires the competent minister to prepare action plans based on the recovery strategies for listed Extirpated, Endangered and Threatened species. COSEWIC designated *Lampetra macrostoma* (now *E. macrostomus*) a species of Special Concern in 1986. It was designated as Threatened in 2000 and 2008. A recovery strategy was completed in 2007. A requirement under Section 9 of the recovery strategy is to "Develop and Implement a Long Term Monitoring Program" for the abundance and distribution of this species. This work was funded in partial fulfillment of these requirements.

METHODOLOGY

SURVEY DESCRIPTION

Based on identified areas of "potential habitat usage" from 2011, electroshocking surveys were undertaken using a Smith-Root LR-24 backpack electrofisher at specific locations around Cowichan Lake and into tributaries flowing into the lake. Sample locations were identified using a Finder Expedition C hand-held GPS. Local resident, Gerald Thom, provided expertise and assistance in accessing the sites from the water. Potential areas were electroshocked to determine presence of ammocoetes at several points within contiguous habitat, particularly substrate. If ammocoetes were found, a sub-sample was measured, photographs of the habitat were taken and location identified. The site location was recorded even if lamprey were not found. A maximum of 10 minutes of electroshocking time was spent at each location. Less time was afforded if it was determined that there were Too Many to Count (TMTC). In such cases it was determined unnecessary to unduly harass the ammocoetes.

AMMOCOETE SAMPLING AND IDENTIFICATION

Ammocoetes which were collected through electroshocking were anesthetized using TMS (Tricaine methanesulfonate); measured for length; and a finclip was removed for DNA analysis. Finclips were stored in 95% ethanol in a uniquely identified vial. Fish were placed in a bucket of fresh lake water for recovery from anesthesia. Once recovered, they were released where they were caught. Very small ammocoetes (approximately <5 cm) were not finclipped for DNA analysis as there was a concern that the procedure may prove lethal at such a small size. Representative lamprey were photographed. Because of the difficultly in positively identifying *E. macrostomus* ammocoetes, they will be referred to as "lamprey". However, pigmentation patterns around the terminus of the notochord are consistent with that described by Dr. R. Beamish (Personal Communication 2012) for *E. macrostomus*. Dr. Beamish describes the pigmentation of this area as part way between *E. tridentatus* and *Lampetra richardsoni*, which upon viewing the specimens is a remarkably accurate description. Based on Dr. Beamish's description and observations of the specimens, there is no reason to believe the ammocoetes are anything but *E. macrostomus*.

RESULTS

Based on preliminary information from 2011, a survey of specific locations was undertaken to determine if lamprey were present or absent in habitats determined suitable for ammocoetes. Many of the locations identified for further investigation in 2011 were completely unsuitable for lamprey when re-examined in 2012. This is not a surprise as this was considered a long-list for further investigation. For example some unidentified creeks were non-existent when re-examined as they were only overland water flow in 2011 during a time of high rainfall. Table 1 outlines the areas in which electroshocking resulted in the determination of presence of lamprey. If presence is not noted, the habitat was unsuitable for electroshocking and/or lamprey habitat.

In addition to the electroshocking survey, two individual *E. macrostomus* attached to two different Cutthroat Trout (*Oncorhynchus clarkii*) were caught by local fishermen and sampled according to methods described for ammocoetes. The first fish was captured on September 14, 2012 and measured 19.7cm long. The second fish was captured on September 22, 2012 and measured 17 cm long.

Table 1: Locations investigated in 2012 field surveys for potential lamprey habitat. Presence or absence of lamprey as determined through electroshocking (when possible to shock) (*=2 locations in which ammocoetes were found in 2011).

Location	Latitude	Longitude	Lamprey (presence/absence)	Comment
Meade's Creek (N)	48°50.707'N	124°07.074'W	Present *	Ammocoetes found in both 2011 and 2012
Meade's Creek (S)	48°49.805'N	124°06.439'W	Absent	Creek dry
Miracle Creek	48°51.591'N	124°09.188'W	Present*	Too dry to shock in 2012
Swordfern (Youbou)				Too dry to shock, habitat unsuitable
Gordon Bay	48°50.126'N	124°11.663'W		Could not shock, too deep; potential habitat
Sutton Creek	48°49.383'N	124°10.861'W	Present	
Near Robertson Creek/Bear Lake	48°49.003'N	124°08.002'W	Absent	Potentially anoxic area
Robertson Creek	48°48.926'N	124°07.807'W	Present	TMTC
Ben's marina	48°52.203'N	124°11.719'W		Too muddy to shock
Old motel area	48°52.192'N	124°11.688'W	Present	Very muddy, had to shock from wharf
Arbutus Creek	48°52.558'N	124°13.243'W		Unsuitable habitat
Cottonwood	48°52.473'N	124°14.165'W		Unsuitable habitat
Campsite (from here A)	48°53.568'N	124°17.045'W		Unsuitable habitat
Campsite (to here B)	48°53.613'N	124°17.222'W		Unsuitable habitat
Wardroper Creek	48°54.281'N	124°18.725'W		Unsuitable habitat
Hawes Bay	48°55.285'N	124°22.624'W	Present	
Shaw Creek	48°55.045'N	124°24.530'W	Present	
Nixon Creek	48°54.102'N	124°22.404'W	Present	
Float house near Nixon Creek			Present	

Bill's Lagoon	48°51.387'N	124°14.175'W		Too muddy and deep to shock
Freaky Creek	48°51.220'N	124°13.647'W		Unsuitable habitat

Locations where lamprey were found to be present are displayed on the map in Figure 1. The two locations which were identified in 2011 are also displayed. The float house near Nixon Creek is represented by Nixon Creek as it is in such close proximity it was not possible to determine a more precise location.

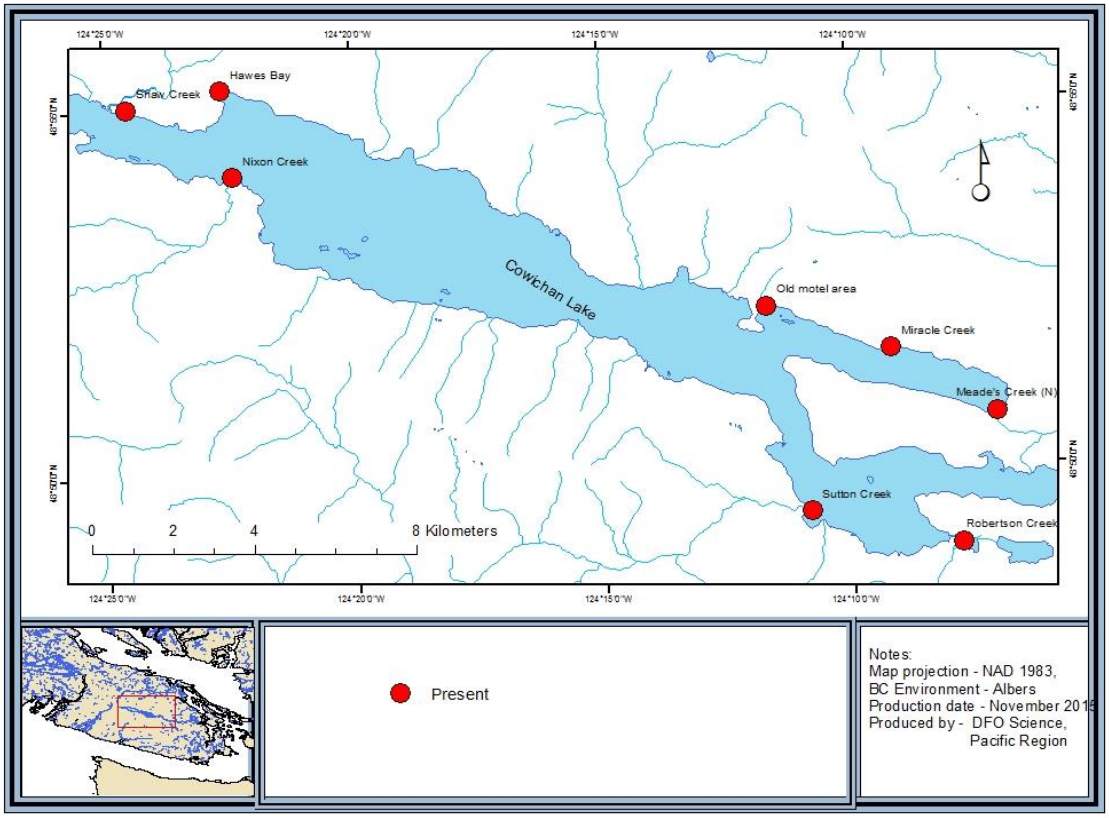

Figure 1. Locations where lamprey ammocoetes were present (2011 and 2012) as determined through electroshocking

INDIVIDUAL HABITAT RESULTS

Photographs have been provided to illustrate the varying sizes of ammocoetes and life stages of lamprey captured during the 2012 field season (Figure 2). Ammocoetes were found at eight different locations ranging in size from 1.5 cm to 12.0 cm (Table 2). A description of the habitat as well as commentary on the lamprey found at each of those locations is provided below.

Figure 2. Photographs of various sizes of lamprey sampled from 2012 in Cowichan Lake. **Top:** Examples of very small ammocoetes captured during electroshocking. **Middle left:** Example of larger ammocoete captured during electroshocking. **Middle right:** Photograph of the two metamorphosing lamprey captured at the mouth of Robertson Creek. **Bottom:** *E. macrostomus* captured by a fisherman when reeling in a Cutthroat Trout on Cowichan Lake (left: full body, right: dentition).

Table 2: Summary of ammocoete length measurements 2012 (TMTC= Too Many to Count).

Location	# Ammocoetes measured	Length range (cm)	Average ammocoete length (cm)	Comment
Meade's Creek (N)	7	4.5-12	9.31	TMTC
Sutton Creek	5	1.5-8.1	3.58	TMTC
Robertson Creek	10	9.7-13.8	11.88	TMTC
Old motel area	1	11.1	11.1	A total of 2 animals were seen, one was captured
Hawes Bay	4	9.9-10.7	10.35	
Shaw Creek	9	4.9-10.1	8.1	TMTC
Nixon Creek	9	4.2-13.2	10.9	TMTC
Float house near Nixon Creek	4	5.1-10.4	7.73	TMTC

Meade's Creek (North)

Where Meade's Creek North empties into Cowichan Lake, water was approximately 1 m deep and <3 m in diameter. There was a large fluvial plane with a sand bar at the terminus (Figure 3). The substrate in which lamprey ammocoetes were found was very loamy and consisted mostly of mud, sand and fine gravel; consistent with the substrate in which they were found in 2011. The slope where the ammocoetes were found was approximately 10%. Meade's Creek (North) and immediate lakeshore are surrounded with deciduous shrubbery. The upland area through which this creek meanders is called Spring Beach Recreation Site; it is so named because it has natural springs which are reported to flow year round. We spoke with the owner of the property which borders the creek and he was very interested to know about the lamprey. He indicated that the type of substrate found near the mouth was also found through the area bordering his property. The loamy substrate found at the mouth of this creek is unique to all areas investigated around Cowichan Lake.

Figure 3. Photographs taken at the Meade Creek (North) on September 19, 2012 during electroshocking surveys on Cowichan Lake. **Top left**: Standing at the outflow of Mead Creek, photographing along the shore to depict the long gravel bed and low water level. **Top right**: Photograph looking up the outflow of Meade Creek to the top right; of note is the overhanging shrubbery. **Bottom left**: Immediate outflow of Meade Creek. **Bottom right**: View of outflow of Meade Creek, flowing from left to right in the photograph.

As reported in Table 2, there were too many lamprey to count in this area, a sub-sample was taken for measurements described previously. Finclips for DNA analysis were also taken on six of the seven animals measured. The smallest animal was not finclipped as it measured 4.5 cm and the procedure was deemed potentially harmful to its survival.

Sutton Creek

The substrate where Sutton Creek enters Cowichan Lake varies from sand to small and medium pebble. The mouth of the creek is wide with low slope. During the sampling period there was no visible water flowing into Cowichan Lake. Where Sutton Creek meets Cowichan Lake is a sandy area which drops off quickly (Figure 4). Sutton Creek could be classified as a high use area with many recreational and possibly permanent properties bordering it, near where it enters Cowichan Lake. As such, the immediate area has been altered significantly to accommodate "beaches" for pleasure use. Because Sutton Creek does handle a large water flow during some times of the year, it is often necessary to remove large logs and woody debris from the creek with large machinery. This description is only provided to illustrate the point that this is a high activity area.

Figure 4. Photographs taken at Sutton Creek on September 19, 2012 during electroshocking surveys on Cowichan Lake. The lack of overhanging shrubbery, aquatic plants, grasses etc.is evident in all three pictures. **Top left**: Side view of water and substrate where Sutton Creek enters Cowichan Lake. **Right**: Photograph looking up the outflow of Sutton Creek, water flow was minimal. **Bottom left**: Side view of Meade Creek where it enters Cowichan Lake.

As reported in Table 2, there were too many lamprey to count in this area, in particular very small lamprey (approximately <5cm). A sub-sample of five animals was taken for measurements described previously. A finclip for DNA analysis was taken on only one animal as most were too small to finclip safely.

Robertson Creek

The area where Robertson Creek enters Cowichan Lake is very similar in habitat to that described for Nixon Creek. That is, there is a large fluvial plane which mounded into a sandy ledge due to low water flows from the creek (Figure 5). Substrate was composed of sand as well as small, medium and large pebbles. There was no overhanging vegetation, submerged vegetation, and only one large piece of woody debris. The ledge of sediment leading from the creek quickly dropped off into deep water.

Figure 5. Photographs taken at the mouth of Robertson Creek on September 19, 2012 during electroshocking surveys on Cowichan Lake. **Top left:** Standing at the outflow of Robertson Creek, photographing up the Creek; small gravel and pebbles visible throughout the area. **Top right:** Standing in the same location as Top left, photographing Robertson Creek and Cowichan Lake. The visible "sand bar" is covered in small gravel and silt, quickly dropping off into deep water even during this low water season. **Bottom left and right:** Side view of "sand bar".

As reported in Table 2, there were too many lamprey to count in this area, in particular, too many very small lamprey (approximately <5cm) to count. A sub-sample of 10 animals was taken for measurements described previously. Finclips for DNA analysis were taken on all 10 animals measured. Two metamorphosing lamprey (12.3 cm and 12.7 cm) were captured at this location.

Old Motel Area

The area surrounding the "old motel" is replete with lily pads, large and small woody debris, old stumps and a muddy silty substrate. The shoreline is populated by private residences and the area immediately adjacent to the shocking area was primarily covered with grass (Figure 6). A small creek flows into the area between the old motel and the property from which we electroshocked. This property adjacent to the old motel, immediately east was selected for electroshocking as G. Thom knew the owners and had asked permission to use their wharf.

Figure 6. Photographs taken at location named Near Old Motel on September 10, 2012 during electroshocking surveys on Cowichan Lake. **Top left:** Private dock from which we electroshocked for lamprey ammocoetes; residence visible on the shore. **Top right:** Photograph of the habitat in which lamprey ammocoetes were collected; private residence to the right of the photograph, old motel to the left. **Bottom left:** Photograph of ammocoete collected and sampled at this location. **Bottom right:** Photograph illustrating the type of growth, primarily lilipads, in which lamprey were found.

Because of the type of substrate, electroshocking was deemed unsuitable from the shoreline. Standing and moving in muddy silty substrate amongst lily pads and debris would make it very difficult to see lamprey if they did emerge. Instead, we electroshocked the area around the wharf, from the wharf.

As reported in Table 2, there were only two lamprey seen in this area, one was not captured, the other was measured and a finclip was taken for DNA analysis.

Hawes Bay

The Hawes Bay area is currently under significant shoreline development. Conversations with resident, Gerald Thom have indicated that the development began in 2010. Specific property

rights in the area are not confirmed but it is believed that large parcels of land which were previously forestry land, were purchased and subdivided. Land has been cleared to what appears to be the waterline and trailers have been installed. In the area which was electroshocked, the substrate was firm sand with small and large submerged woody debris including chunks of bark. One side of the area was completely devoid of woody debris of any kind but was entirely populated by vegetation (reeds) (Figure 7). There was no visible discharge from a river or stream into the Hawes Bay area. The shoreline has a very low slope, bordered with short grasses and vegetation.

Figure 7. Photographs taken at Hawes Bay on September 10, 2012 during electroshocking surveys on Cowichan Lake. **Top left:** "Residential" area of Hawes Bay. **Top right:** Photograph of the habitat in which lamprey ammocoetes were collected. **Bottom left:** Joy Wade and Gerald Thom electroshocking for lamprey ammocoetes in the nearshore area of Hawes Bay.

There were four lamprey sampled from this area, the total number of animals seen and collected (Table 2). Finclips for DNA analysis were also taken on all animals measured.

Shaw Creek

The area immediately to the west of Shaw Creek was electroshocked for lamprey. This area had a very low slope with wide fluvial plane, segregating pockets of water into what can best be described as low flow "retention ponds" during low water events (Figure 8). These retention areas although connected to the main lake had a very low water flow. The substrate in these areas was mud with some silt and aquatic vegetation. Surrounding the retention area were small pebbles. There was no overhanging vegetation.

Figure 8. Photographs taken at Shaw Creek on September 10, 2012 during electroshocking surveys on Cowichan Lake. **Top left:** Joy Wade and Gerald Thom electroshocking for lamprey ammocoetes in a "retention pond" at the mouth of Shaw Creek. **Top right:** Photograph of the retention pond at the mouth of Shaw Creek. **Bottom left and right:** Photograph of Shaw Creek illustrating the low slope, vegetation and debris typical in the shocking area where lamprey ammocoetes were captured.

There were too many lamprey to count in this area, a sub-sample was taken for measurements described previously. Finclips for DNA analysis were also taken on all nine animals measured.

Nixon Creek

Where Nixon Creek enters Cowichan Lake could be described as text-book lamprey spawning and rearing habitat. There was a large fluvial plane, mounded into a sandy ledge due to low water flows from the creek, substrate was sand as well as small, medium and large pebbles (Figure 9). There was no overhanging vegetation, submerged vegetation, large or small woody debris. The ledge of sediment leading from the Creek quickly dropped off on both sides as well as the terminus into deep water.

Figure 9. Photographs taken at Nixon Creek on September 10, 2012 during electroshocking surveys on Cowichan Lake. **Top left**: Ledge of small gravel leading from Nixon Creek into Cowichan Lake. **Top and bottom right:** Joy Wade and Gerald Thom electroshocking for lamprey ammocoetes just off of the ledge. **Bottom left:** Outflow area of Nixon Creek where lamprey ammocoetes were found through electroshocking. Photograph of the retention pond at the mouth of Shaw Creek.

As reported in Table 2, there were too many lamprey to count in this area, a sub-sample was taken for measurements described previously. The lamprey were so small it was not possible to collect them even with an aquarium dip net. Finclips for DNA analysis were taken on all nine animals measured.

Float House Near Nixon Creek

There was a float house moored near the mouth of Nixon Creek which had been in place for as long as local resident G. Thom could remember. It appears to be maintained. The best description for the area in which it is moored would be a sheltered lagoon with open access to the lake (Figure 10). The periphery of the lagoon was electroshocked where possible. There was a

steep drop-off into the middle of the sheltered area which is completely populated by lily pads, large and small woody debris and other aquatic plants. The substrate in the shallower areas in which it was possible to electroshock varied from small pebbles on loose shifting ground to muddy substrate in shallow pools connected to the main water body. The shoreline had a low slope with grasses and aquatic vegetation.

Figure 10. Photographs taken at the Float House on September 10, 2012 during electroshocking surveys on Cowichan Lake. Left: Photograph of the float house. **Right:** Photograph of Joy Wade and Gerald Thom electroshocking for lamprey ammocoetes behind the float house.

As reported in Table 2, there were too many lamprey to count in this area, a sub-sample was taken for measurements described previously. Finclips for DNA analysis were taken on all four animals measured. It was observed that the majority of the lamprey were very small (approximately <5cm) and consequently very difficult to capture.

CONCLUSION

The presence of lamprey ammocoetes at many different locations and in such high numbers is highly significant. Discussions of the survey results with R. Beamish confirmed that in the 1980s, he had found very few locations where lamprey ammocoetes were present and no areas which he would deem suitable for spawning; keeping in mind that Dr. Beamish did not survey the entire lake.

If one infers that extremely small ammocoetes would have derived from spawning activity in close proximity to where they were the ammocoetes were electroshocked, it can be surmised that Meade's Creek (north), Sutton Creek, Robertson Creek, Shaw Creek, Nixon Creek and the float house near Nixon Creek have a high likelihood of being spawning areas.

Ammocoetes were found in all of these locations and in addition, near the old motel and Hawes Bay. Very few locations around the shoreline of Cowichan Lake were found suitable as lamprey habitat. However, given the dynamic nature of nearshore areas and the potential for significant change in habitat due to changes in river flow and sediment deposition, habitat which was not found suitable for ammocoetes this field season may be suitable under different environmental conditions. Conversely, depending on environmental conditions, areas which were suitable in 2012 for lamprey ammocoetes may not be suitable at other times of the year or in other years.

RECOMMENDATIONS

- Ruth Withler, DFO molecular biology research scientist at the Pacific Biological Station, has performed a preliminary analysis of a sub-sample of the ammocoete finclips collected from this study. Preliminary results indicate that the ammocoete tissues are both consistent with each other as well as with the finclips from the two attached *E. macrostomus* sampled. Ms. Withler indicated that a minimum of six more positively identified *E. macrostomus* would be adequate to determine if the ammocoetes which were sampled were *E. macrostomus*. Therefore, a recommendation of this study is to collect additional finclips from a minimum of 6 positively identified *E. macrostomus* for genetic analysis. It is important, for conservation purposes, to confirm that *E. macrostomus* is the only lamprey species in Cowichan Lake.
- Work with local community groups to increase awareness of the lamprey ecology as well as lamprey spawning and rearing habitat.
- Trapping during spawning season is recommended in order to conclusively identify spawning areas.

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