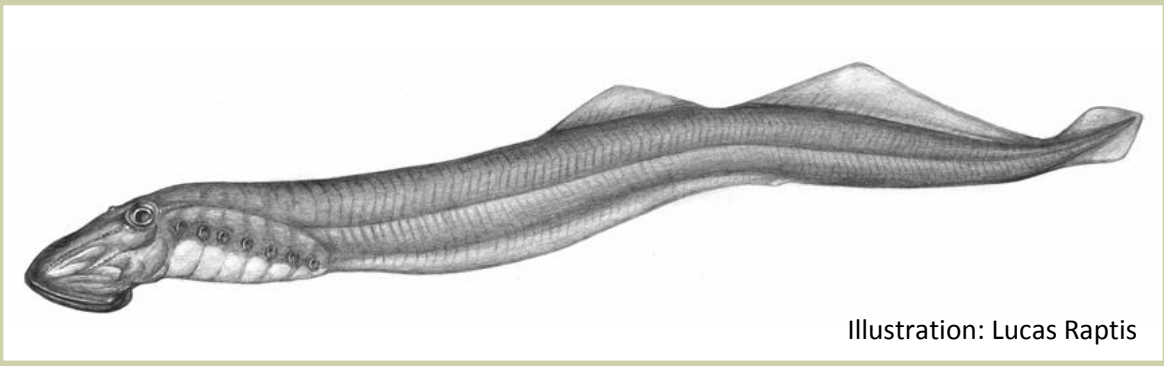
Species at Risk Act
Recovery Strategy Report Series

Report on the Progress of Recovery Strategy Implementation for Cowichan Lake Lamprey (*Entosphenus macrostomus*) in Canada for the Period 2007 – 2015

Cowichan Lake Lamprey



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Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under Section 46 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the competent ministers are responsible for reporting on the implementation of the recovery strategy for a species at risk, and on the progress towards meeting its objectives within five years of the date when the recovery strategy was placed on the Species at Risk Public Registry and in every subsequent five-year period, until its objectives have been achieved or the species' recovery is no longer feasible.

Reporting on the progress of recovery strategy implementation requires reporting on the collective efforts of the competent minister(s), provincial and territorial governments and all other parties involved in conducting activities that contribute to the species' recovery. Recovery strategies identify broad strategies and approaches that will provide the best chance of recovering species at risk. Some of the identified strategies and approaches are sequential to the progress or completion of others and not all may be undertaken or show significant progress during the timeframe of a Report on the Progress of Recovery Strategy Implementation (Progress Report).

The Minister of Fisheries and Oceans is the competent minister under SARA for the Cowichan Lake Lamprey (*Entosphenus macrostomus)* and has prepared this Progress Report.

As stated in the preamble to SARA, success in the recovery of species at risk depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in the recovery strategy and will not be achieved by Fisheries and Oceans Canada, or any other jurisdiction alone. The cost of conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the Recovery Strategy for the Cowichan Lake Lamprey for the benefit of the species and Canadian society as a whole.

Acknowledgements

This Progress Report was prepared by the Department of Fisheries and Oceans Canada. The Department of Fisheries and Oceans would also like to express its appreciation to all individuals and organizations who have contributed to the recovery of the Cowichan Lake Lamprey.

Executive Summary

The Vancouver Lamprey (*Lampetra macrostoma*), now known as the Cowichan Lake Lamprey[1], was assessed as Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2000, and subsequently listed under the *Species at Risk Act* as Threatened in June of 2003. In September of 2007 the final *Recovery Strategy for Vancouver Lamprey (*Lampetra macrostoma*) in Canada* was posted to the Species at Risk Public Registry. An updated COSEWIC assessment in 2008 reconfirmed the species' status as Threatened (COSEWIC 2008).

Threats to Cowichan Lake Lamprey, as identified in the *Recovery Strategy for Vancouver Lamprey (*Lampetra macrostoma*) in Canada*, include: water use, land use, water quality, recreation, altered prey base, and climate change (VLRT 2007). The recovery goal for Vancouver lamprey is to ensure its long-term viability within its natural range. It is likely that this species will always remain at some risk due to its extremely limited distribution.

This report documents the progress of Recovery Strategy implementation for Cowichan Lake Lamprey. It summarizes progress that Fisheries and Oceans Canada, the Province of British Columbia's Ministry of Environment, and other interested parties have made towards achieving the goal and objectives set out in the Recovery Strategy, including:

- conducting new research and monitoring activities (including advancing studies to support the identification of critical habitat); and
- completing management activities that help Canadians reduce impacts on, and better understand the threats to, Cowichan Lake Lamprey.

[1] The previous species name, Vancouver Lamprey (*Lampetra macrostoma*), is referred to in this document only in relation to previously published documents and their content, such as the Recovery Strategy or COSEWIC reports.

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1 Background

1.1 Species Status

Assessment Summary – November 2008

Common name:
Vancouver Lamprey

Scientific name
Lampetra macrostoma

COSEWIC Status
Threatened

Reason for designation
This endemic parasitic species, known only from one location in British Columbia, is dependent on the availability of salmonids. Given that its primary prey is juvenile Coho Salmon in Cowichan Lake, the recent and ongoing decline of Coho adults observed returning to the lake is expected to have a significant negative impact on lamprey numbers.

Occurrence in Canada:
British Columbia

Status history:
Designated Special Concern in April 1986. Status re-examined and confirmed in April 1998. Status re-examined and designated Threatened in November 2000 and in November 2008. Last assessment based on an update status report.

***Species at Risk Act* Status:**
Listed, Threatened – 2003

1.2 Threats

1.2.1 Threats to Cowichan Lake Lamprey

Threats to Cowichan Lake Lamprey, as identified in Section 2 of the *Recovery Strategy for Vancouver Lamprey (*Lampetra macrostoma*) in Canada*, include: water use, land use, water quality, recreation, altered prey base, and climate change (VLRT 2007).

1.2.2 Activities Likely to Destroy Critical Habitat

Neither critical habitat nor activities likely to destroy critical habitat were identified in the *Recovery Strategy for Vancouver Lamprey (*Lampetra macrostoma*) in Canada* (VLLRT 2007); however, these will both be identified in a forthcoming Action Plan.

2 Recovery

2.1 Recovery Goal and Objectives

The Recovery Goal and Objectives[2] (identified in Sections 7 and 8 of the Recovery Strategy respectively), are as follows:

Recovery Goal

The recovery goal for Vancouver lamprey is to ensure its long-term viability within its natural range. It is likely that this species will always remain at some risk due to its extremely limited distribution.

Recovery Objectives

1. Maintain a self-sustaining population of Vancouver lamprey within Cowichan and Mesachie lakes that is resilient to short-term habitat perturbations.

2. Maintain, and where possible enhance, the ecological integrity of habitat for Vancouver lamprey.

3. Increase scientific understanding of Vancouver lamprey through additional investigation of its taxonomic status, natural history, critical habitat and threats to the species' persistence.

4. Foster awareness of Vancouver lamprey and its conservation status, and encourage active local involvement in stewardship and habitat protection.

2.2 Performance Measures

Performance Measures (as outlined in Table 3 of the Recovery Strategy) are reproduced in detail in Section 3.3 of this report.

[2]Referred to in the forthcoming Action Plan for Vancouver Lamprey as "population and distribution objectives."

3 Progress towards Recovery

Section 46 of the *Species at Risk Act* requires the competent Minister to report on the implementation of the Recovery Strategy, and the progress towards meeting its objectives, within five years after it is included in the public registry and in every subsequent five-year period, until its objectives have been achieved or the species' recovery is no longer feasible. In the interest of capturing the most recent progress on the recovery of Cowichan Lake Lamprey, this document includes actions completed up to the end of 2015.

3.1 Research and Monitoring Activities

Table 1. Summary of achievements towards completing the Schedule of Studies and/or identification of critical habitat, as well as new research and monitoring activities conducted and/or ongoing since the completion of the Recovery Strategy in 2007

#	Strategy	Recovery Objectives Addressed	Activities Completed or Underway	Organizations Involved[3]
Activities from Schedule of Studies Outlined in 2007 Recovery Strategy				
1.	Describe the basic habitat associations for each life stage.	3	• COSEWIC (2008) described habitats for spawning and ammocoete development.	COSEWIC[4]
			• DFO[5] (2010) described habitat associations for adults and ammocoetes.	BCMOE;[6] DFO;[7] FAS[8]
			• FAS (2011) surveyed Cowichan Lake to for potential ammocoete or spawning habitats, and conducted a follow-up survey the next year in Cowichan Lake and its tributaries (FAS 2012).	FAS; DFO
			• Monitoring efforts summarized in row 12 of Table 1 further informed habitat associations.	Refer to row 12 of Table 1.

[3] This column is based on the best available information; DFO acknowledges the large network of people that contribute to recovery of this species, and regrets any potential omissions in Tables 1 and 2.
[4] Committee on the Status of Endangered Wildlife in Canada.
[5] Fisheries and Oceans Canada.
[6] British Columbia's Ministry of the Environment.
[7] Fisheries and Oceans Canada.
[8] Fundy Aqua Services.

#	Strategy	Recovery Objectives Addressed	Activities Completed or Underway	Organizations Involved[3]
2.	Consolidate and report information previously collected on habitat use.	2,3	• The following further informed historic habitat availability: ○ Beamish and Wade (2008) reported on Cowichan Lake Lamprey (CLL) trapping studies conducted in 1979 to 1985; and, ○ FAS (2011; 2012) reported on CLL sampling studies conducted in the late 1970s and throughout the 1980s. ○ FAS (2011, 2012) developed maps of CLL capture records.	BCMOE; DFO; FAS
			• Wade and MacConnachie (2016) reported on CLL ammocoete abundance and habitat surveys conducted in 2012.	FAS; DFO
			• Monitoring efforts summarized in row 12 of Table 1 further informed current habitat availability.	Refer to row 12 of Table 1.
3.	Review: a) historic and b) current habitat availability.	2,3	• Refer to row 2 of Table 1	Refer to row 2 of Table 1.
4.	Determine the extent and distribution of different habitat types available to the species.	2,3	• Refer to row 2 of Table 1.	Refer to row 2 of Table 1.
5.	Establish clearly defined population recovery targets for each life stage based on population modeling and rules of thumb.	1,3	• Robust CLL abundance estimates have not been completed.	Not applicable.
			• Refer to row 12 of Table 1 for monitoring activities that further informed population abundance.	Refer to row 12 of Table 1.
6.	Review a) historic and b) current population abundance.	1,3	• Robust CLL abundance estimates have not been completed.	Not applicable.
7.	Employ expert judgement to determine quantitative relationship between critical habitat and abundance.	1,3	• Robust CLL abundance estimates have not been completed; however, DFO (2010) provides recommendations for the identification of critical habitat.	DFO
8.	Use population target, habitat type and species' abundance information to determine the	1,3	• Refer to row 7 of Table 1.	Refer to row 7 of Table 1.

#	Strategy	Recovery Objectives Addressed	Activities Completed or Underway	Organizations Involved[3]
	number and location of distinct habitats required to maintain a viable population.			
General Approach: Undertake specific research activities to fill knowledge gaps and clarify threats				
9.	Address information gaps that inhibit conservation of Vancouver Lamprey.	3	• In 2008 researchers collected information from local recreational fishers on the number and type of fish caught and the presence of scars potentially indicating they are prey species of CLL.	DFO
			• FAS (2012): o fin clipped CLL ammocoetes and two non-spawning adults for DNA analysis; and, o reported the capture of two CLL attached to two cutthroat trout.	FAS; DFO
			• Refer to row 10 of Table 1 for information gaps pertaining to threats.	Refer to row 10 of Table 1.
			• Monitoring efforts summarized in row 12 of Table 1 further informed basic biology (e.g. habitat use), and population abundance and dynamics.	Refer to row 12 of Table 1.
10.	Clarify and address threats to Vancouver Lamprey.	1,3	• COSEWIC (2008) summarized threats to CLL including: recreational fishing, declining prey base, water use, and land use.	COSEWIC
			• DFO (2010) summarized anthropogenic threats to CLL including: recreational fishing, residential development and recreation, forestry, water withdrawal and prey base decline.	DFO; BCMOE
			• FAS discussed impacts of low water levels on CLL due to water extraction with local residents (Wade pers. comm. 2015).	FAS
General Approach: Delineate and protect[9] key habitats				
11.	Conduct studies to help define critical habitat for Vancouver Lamprey.	2,3	• Activities summarized in rows 1 through 4, 6 through 9, and 12 will contribute to critical habitat identification recommendations.	Refer to rows 1 through 4, 6 through 9, and 12 of Table 1.
General Approach: Design and implement sound monitoring programs				

[9] Protection can be achieved through a variety of mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations and protected areas.

#	Strategy	Recovery Objectives Addressed	Activities Completed or Underway	Organizations Involved[3]
12.	Develop and implement a long term monitoring program.	1,4	• In 2008 researchers trapped and photographed spawning CLL in Mesachie Lake.	DFO
			• FAS (2011, 2012) measured and photographed captured ammocoetes in Cowichan Lake (further informing abundance), and recorded habitat parameters associated with their locations.	FAS; DFO
			• In 2015 DFO attempted to conduct CLL ammocoete surveys at select locations around Cowichan Lake to inform both population abundance and population trends over time; however, weather conditions rendered surveys ineffective.	DFO
			• Water quality assessments for Cowichan Lake are summarized in technical reports published by the Province of British Columbia (Province of British Columbia n.d.).	BCMOE
			• The BCLSS[10] and BCMOE (2013) collected data on surface temperature and water clarity as part of a lake stewardship and monitoring program for Cowichan Lake between 2004 and 2013.	BCLSS; BCMOE
13.	Develop sound protocols for scientific investigations (e.g., limit the number of fish collected each year, etc.)	1,3	• Harvey and Brown (2013a, 2013b) incorporated best collection and monitoring approaches into draft SARA multi-species compendium reports.	DFO

3.2 Management Activities

Table 2. Summary of activities undertaken to reduce or eliminate threats to Cowichan Lake Lamprey threats to critical habitat and/or threats to its residence

#	Strategy	Recovery Objectives Addressed	Activities Completed or Underway	Organizations Involved
General Approach: Establish and support stewardship initiatives				
14.	Establish and support a Recovery Implementation Group (RIG) or alternative working group for Vancouver Lamprey.	4	• A RIG or working group has not been established.	Not applicable.

[10] British Columbia Lake Stewardship Society.

#	Strategy	Recovery Objectives Addressed	Activities Completed or Underway	Organizations Involved
15.	Inform and educate stakeholders and the general public about the species and general biodiversity values.	4	• In August 2010 SCCP[11] produced an online factsheet[12] detailing habitat preferences, threats, and conservation requirements for CLL.	BCMOE; CF;[13] IF;[14] SCCP
			• BCCF[15] (2012a) prepared "The Shoreline of Cowichan Lake: A Report Card," with the objective of increasing awareness of the need for proactive protection of Cowichan Lake's biodiversity; information specific to CLL includes SARA status, rearing sites and reference to the 2012 Field Survey report (FAS 2012).	BCCF; CLRSS
			• FAS attended fishing derbies to enumerate lamprey scars on captured fish, and educate recreational fishers about CLL (Wade pers. comm. 2015).	FAS, DFO
16.	Work with local governments, land developers, and others to improve and encourage watershed stewardship.	4	• In 2014 the CWB[16] began holding "Speaker Series" promoting watershed stewardship awareness and addressing topics such as: groundwater and surface water, water laws in BC, and a virtual tour of the Cowichan Watershed.	CWB
			• The CLRSS facilitates numerous watershed projects[17] regarding: Cowichan shoreline stewardship, riparian education, Cowichan river cleanup, water quality monitoring, and water access identification for the public.	CLRSS
			• BCCF[18] (2012b) developed a Shoreline Habitat Assessment to provide guidance for land and water use planners working in and around Cowichan Lake.	BCCF
General Approach: Undertake specific research activities to fill knowledge gaps and clarify threats				

[11] South Coast Conservation Program.
[12] http://ibis.geog.ubc.ca/biodiversity/factsheets/pdf/Lampetra_macrostoma.pdf.
[13] Capacity Forestry.
[14] International Forest Products.
[15] Cowichan Lake River and Stewardship Society.
[16] Cowichan Watershed Board.
[17] http://www.cowichan-lake-stewards.ca/Projects.htm.
[18] British Columbia Conservation Foundation.

17.	Establish water quality and water use objectives for Cowichan and Mesachie lakes.	2	• WRGI[19] (2007) included objectives addressing water use in the Cowichan Basin Water Management Plan.	BCMOE; CPC;[20] CT;[21] CVRD;[22] DFO; PSC;[23] WRGI
			• Water quality objectives for Cowichan Lake are included in technical reports published by the Province of British Columbia (Province of British Columbia n.d.).	BCMOE
General Approach: Delineate and protect key habitats				
18.	Develop a comprehensive water management plan for each basin.	2	• WRGI (2007) developed a Cowichan Basin Water Management Plan.	BCMOE; CPC; CT; CVRD; DFO; PSC; WRGI

[19] Westland Resource Group Inc.
[20] Catalyst Paper Corporation.
[21] Cowichan Tribes.
[22] Cowichan Valley Regional District.
[23] Pacific Salmon Commission.

3.3 Summary of Progress towards Recovery

Action Planning

DFO, in collaboration with the BCMOE, is developing an Action Plan for Cowichan Lake Lamprey as part of the Government of Canada's ongoing commitment to the conservation of species at risk through the implementation of the *Species at Risk Act*.

Report on Performance Measures

1. **Has a RIG or working group been established? Is the RIG adequately supported with funding and technical expertise? Has an Action Plan been developed? Is the RIG achieving the goals outlined in the Recovery Strategy?**

   A RIG or working group has not been established.

   DFO is developing a draft *Action Plan for the Cowichan Lake Lamprey (*Entosphenus macrostomus*) in Canada* in cooperation with the Province of British Columbia's Ministry of Environment.

   The recovery goal for Cowichan Lake Lamprey to "ensure its long-term viability within its natural range" may never be fully achieved due to its endemic nature; however, in the timeframe of this report many achievements (outlined in Tables 1 and 2) contributed to the recovery goal of the species.

2. **Are there key information gaps that inhibit conservation of Vancouver lamprey?**

   Refer to row 9 of Table 1 for activities addressing information gaps. Several additional items remain to be addressed, namely related to: population abundance; life history; habitat use; and, susceptibility to different causes of mortality (VLRT 2007; DFO 2010).

3. **Have threats been clarified and assessed? Are threats being mitigated?**

   Threats are further summarized and expanded upon in a Status Report (COSEWIC 2008) and a CSAS[24] Science Advisory Report (DFO 2010).

4. **Has critical habitat been defined for Vancouver lamprey?**

   DFO (2010) provides recommendations for the identification of critical habitat.

5. **Have monitoring programs been implemented? How long has a monitoring program been in place? Is it effective? Is funding secure for the long term?**

   Between 2004 and 2013 the BC LSS and MOE (2013) designed and implemented a water quality monitoring program, which included Cowichan Lake. Water quality assessments for Cowichan Lake are summarized in technical reports published by the Province of British Columbia (Province of British Columbia n.d.).

[24] Canadian Science Advisory Secretariat.

Though an official Cowichan Lake Lamprey monitoring program has not been established, refer to row 12 of Table 1 for details of monitoring conducted by researchers, non-profit organizations and government.

Harvey and Brown (2013a, 2013b) incorporated best collection and monitoring approaches into draft SARA multi-species compendium reports, which will inform the development and implementation of a comprehensive monitoring plan.

Effectiveness of a monitoring program is pending full implementation and analysis of data from multiple years. Funding is largely obtained on a year-to-year basis. Though expected to be benign, population level impacts from existing monitoring are not assessable until robust population estimates are established.

6. Have water quality and water use objectives been established and communicated to relevant regulators and stakeholders?

Westland Resource Group Inc. (2007) included objectives addressing water use in the Cowichan Basin Water Management Plan. Government, industry, First nations and community interests worked together to develop this document and it is publicly available to regulators and stakeholders on both the CVRD and CWB websites. Water quality objectives for Cowichan Lake are also included in technical reports published by the Province of British Columbia, available online (Province of British Columbia n.d.).

7. Does the water management plan adequately address the needs of Vancouver lamprey? Has it been implemented?

Westland Resource Group Inc. (2007) developed a Cowichan Basin Water Management Plan on behalf of the Cowichan Valley Regional District. While this document does not specifically address Cowichan Lake Lamprey, it does address the maintenance of aquatic habitats, and conservation of salmonids (potential prey). In 2010, the Cowichan Watershed Board reported on the status of the Water Management Plan, and provided recommendations on future actions.

8. Have educational materials been produced? How many classes have received educational presentations? How many educational signs have been erected? Has public perception and awareness been affected?

In August 2010, SCCP produced an online factsheet detailing habitat preferences, threats, and conservation requirements for Cowichan Lake Lamprey. Though not specific to Cowichan Lake Lamprey, in 2012 the CLRSS prepared “The Shoreline of Cowichan Lake: A Report Card”, with the objective of providing awareness to the general public of the need to become proactive in the protection of Cowichan Lake’s biodiversity.

The number of educational signs and classes receiving educational presentations is unknown. Without a follow-up survey on educational outreach it is difficult to measure whether public perception and awareness have been affected by such activities.

9. Have forest harvest and land management criteria been developed? Is forest harvest and land development meeting the criteria? Have BMPs been developed and communicated? Is there compliance with BMPs?

Currently, the "Official Community Plan Bylaw No. 910-2011," which is publicly available online, includes policies for development permit areas including "watercourse and streamside protection" (Town of Lake Cowichan 2011).

The CWB (2010) reports that progress is ongoing to implement best management practices for stormwater management and protection of ground water resources in the region. DFO is unaware of compliance monitoring for best management practices.

10. Have scientific investigation protocols been set and communicated? Have they been implemented?

Harvey and Brown (2013a, 2013b) incorporated best collection and monitoring approaches into draft SARA multi-species compendium reports, which will inform the development and implementation of a comprehensive monitoring plan. Communication and implementation of protocols are pending publication.

4 References

Beamish, R. J., and J. Wade. 2008. Critical habitat and the conservation ecology of the freshwater parasitic lamprey, *Lampetra macrostoma*. Canadian Field-Naturalist 122(4): 327-337.

BCCF. 2012a. Cowichan Lake Shoreline Habitat Assessment. Assessment prepared for Fisheries and Oceans Canada. Nanaimo, British Columbia, Canada. Available online at: Cowichan Lake Shoreline Habitat Assessment [accessed November 2015].

BCCF. 2012b. The Shoreline of Cowichan Lake: A Report Card (2012). Available online at: The Shoreline of Cowichan Lake: A Report Card (2012) [accessed November 2015].

BCLSS and BCMOE. 2013. BC Lake stewardship and monitoring program Cowichan lake 2004-2013. Available online at: CLRSS Projects [accessed November 2015].

CLRSS. 2015. CLRSS Projects. Cowichan Lake and River Stewardship Society. Available online at: CLRSS Projects [accessed November 2015].

CWB. 2010. Status of Cowichan Basin Water Management Plan and Recommended Actions. Cowichan Watershed Board. Available online at: Current Status of Cowichan Basin Water Management Plan and Recommended Actions [accessed November 2015].

COSEWIC. 2008. COSEWIC assessment and update status report on the Vancouver Lamprey Lampetra macrostoma in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 39 pp.

DFO. 2010. Recovery potential assessment of Vancouver Island lamprey (*Lampetra macrostoma Beamish*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/077.

Fundy Aqua Services. 2011. Cowichan Lake Lamprey habitat survey. Field survey final report 2011. Report prepared for Fisheries and Oceans Canada, Nanaimo, BC. 15pp.

Fundy Aqua Services. 2012. Cowichan Lake Lamprey (*L. macrostoma*) habitat use. field survey final report 2012. Report prepared for Fisheries and Oceans Canada, Nanaimo, BC. 18pp.

Harvey, B., and T.G. Brown. 2013a. [Draft] Guidance on protocols for collection of coastal freshwater species. Government of Canada, Ottawa. 27 pp.

Harvey, B., and T.G. Brown. 2013b. [Draft] Monitoring recovery in a group of SARA-listed freshwater fish species. Government of Canada, Ottawa. 56 pp.

Province of British Columbia. n.d. Water quality objectives: West coast region. Available online at: Water quality objectives: West coast region [accessed September 2016].

Town of Lake Cowichan. 2011. Official Community Plan Bylaw No. 910-2011. Available online at: Bylaw No. 910-2011 [accessed November 2015].

VLRT (Vancouver Lamprey Recovery Team). 2007. Recovery Strategy for the Vancouver Lamprey (*Lampetra macrostoma*) in Canada. Species at Risk Act Recovery Strategy Series, Fisheries and Oceans Canada, Ottawa, ix + 21 pp.

Wade, J., pers. comm. 2015. *E-mail communication with A. Gerick*. December 2015. Biologist, Fundy Aqua Services.

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

WRGI. 2007. Cowichan basin water management plan. Available online at: Cowichan Basin Water Management Plan [accessed November 2015].