Species at Risk Act
Recovery Strategy Report Series

Report on the Progress of Recovery Strategy Implementation for the Vancouver Lamprey (*Entosphenus macrostomus*) in Canada for the Period 2016 to 2021

Vancouver Lamprey

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Cover illustration: Vancouver Lamprey spawning pair. Photo by Joy Wade.

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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 the protection of species at risk throughout Canada. Under section 46 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the competent minister is responsible for reporting on the implementation of the recovery strategy for a species at risk (via a progress report), and on the progress towards meeting its objectives, within five years of the date when the final 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, 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 ensuring the survival and recovery of species at risk. Some of the identified broad 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 progress report.

The Minister of Fisheries and Oceans is the competent minister under SARA for the Vancouver Lamprey and has prepared this progress report.

As stated in the preamble to SARA, success in the protection and 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 (DFO) or any other jurisdiction alone. The cost of recovering and conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the recovery strategy for the Vancouver Lamprey for the benefit of the species and Canadian society as a whole.

Acknowledgments

This progress report was prepared by Carrie Kwok (DFO) with contributions from Heather Lamson (DFO), Ahdia Hassan (DFO), Paul Grant (DFO), and Sean MacConnachie (DFO). To the extent possible, this progress report has been prepared with inputs from species experts Joy Wade (Fundy Aqua Services Inc.) and Greg Wilson (British Columbia Ministry of Environment and Climate Change Strategy). DFO would also like to express its appreciations to all individuals and organizations who have contributed to the recovery of the Vancouver Lamprey.

Executive summary

The Vancouver Lamprey (*Entosphenus macrostomus*), also known as Cowichan Lake Lamprey or Cowichan Lamprey, was listed as threatened under the *Species at Risk Act* (SARA) in 2003. The Recovery Strategy for the Vancouver Lamprey (*Lampetra macrostoma*[1]) in Canada was published on the Species at Risk Public Registry in 2007. The latest assessment by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2017 reconfirmed the species' status as threatened.

The main threats identified in the recovery strategy for the Vancouver Lamprey include: water use, land use, water quality, alteration of prey base, recreation, and climate change, all of which have the potential to directly or indirectly impact individuals and/or their habitats.

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 level of risk due to its extremely limited distribution.

The recovery objectives for Vancouver Lamprey are to:

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

This Report on the Progress of Recovery Strategy Implementation for the Vancouver Lamprey (*Entosphenus macrostomus*) in Canada for the Period 2016 to 2021 (progress report) reports on the progress made by Fisheries and Oceans Canada (DFO) and its partners towards implementing the recovery strategy and achieving its goal and objectives. During this time period, progress has been made towards:

- research on spawning and habitat use in tributary and foreshore areas
- testing the efficacy of different survey and collection methods to inform best practices for scientific research and population monitoring
- integration of Vancouver Lamprey habitat needs in water use planning processes within the Cowichan watershed
- increased stakeholder and public awareness through outreach activities and installation of interpretative signage
- finalization and posting of the Action Plan for the Vancouver Lamprey (*Entosphenus macrostomus*) in Canada on the Species at Risk Public Registry in 2019, which includes the identification of critical habitat
- protection of Vancouver Lamprey's critical habitat from destruction in February 2020 through a SARA critical habitat order

[1] The previous scientific name for Vancouver Lamprey (*Lampetra macrostoma*) is referred to in this document only in relation to previously published documents. *Entosphenus macrostomus* is the currently accepted scientific name.

While progress has been made to increase scientific understanding of Vancouver Lamprey and address information gaps that inhibit conservation of the species, progress toward achieving the recovery goal is unknown. Vancouver Lamprey are monitored through periodic studies and continue to be encountered throughout their known range, but there is a lack of current population abundance and trend data. Significant threats to Vancouver Lamprey habitat continue to persist.

The work completed to date has built a strong foundation for continued research and management of this species over the next reporting period. Recovery implementation should continue to: monitor habitat use and availability for all life stages; assess long-term cumulative effects of climate change, lake drawdowns and other water uses on tributary and foreshore habitats that support spawning and rearing; and work collaboratively to promote Vancouver Lamprey conservation and watershed stewardship.

DFO remains committed to ensuring the long-term viability of the Vancouver Lamprey within its natural range. The progress made to date would not have been possible without successful collaborations. DFO looks forward to continued collaboration and welcomes the participation of additional partners.

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1. Introduction

The Report on the Progress of Recovery Strategy Implementation for the Vancouver Lamprey[2] (*Entosphenus macrostomus)* in Canada for the Period 2016 to 2021 (progress report) outlines the progress made towards meeting the recovery goal and objectives listed in the Recovery Strategy for the Vancouver Lamprey (*Lampetra macrostoma*[3]) in Canada during the indicated time period. The progress report is part of a series of documents for this species that should be taken into consideration together, including: the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessment and status reports (COSEWIC 2008, 2017), recovery potential assessment (RPA; DFO 2010), Recovery Strategy for the Vancouver Lamprey (*Lampetra macrostoma*) in Canada (VLRT 2007), Action Plan for the Vancouver Lamprey (*Entosphenus macrostomus*) in Canada (DFO 2019), and Report on the Progress of Recovery Strategy Implementation for Cowichan Lake Lamprey (*Entosphenus macrostomus*) in Canada for the Period 2007 to 2015 (DFO 2016).

Section 2 of the progress report summarizes key information on the threats to the species, recovery goal and objectives for achieving its recovery, strategies for meeting the objectives, and performance measures to measure the progress toward recovery. For more details, readers should refer to the Recovery Strategy for the Vancouver Lamprey (*Lampetra macrostoma*) in Canada (VLRT 2007), herein referred to as the recovery strategy. Section 3 reports the progress of activities identified in the recovery strategy to support achieving the recovery goal and objectives. Section 4 summarizes the progress toward achieving the recovery goal and objectives.

2. Background

2.1 COSEWIC assessment summary and threats to the species and its critical habitat

In 2000, COSEWIC assessed the Vancouver Lamprey as threatened. The subsequent listing under Schedule 1 of SARA in 2003 as threatened led to the 2007 publication of the recovery strategy. COSEWIC re-examined and confirmed the status of the Vancouver Lamprey as threatened in 2008 and 2017, as described in the COSEWIC assessment and status report (COSEWIC 2017).

[2] Vancouver Lamprey is also commonly referred to as Cowichan Lake Lamprey or Cowichan Lamprey.
[3] The previous scientific name for Vancouver Lamprey (*Lampetra macrostoma*) is referred to in this document only in relation to previously published documents. *Entosphenus macrostomus* is the currently accepted scientific name.

Assessment Summary – November 2017

Common name
Vancouver Lamprey

Scientific name
Entosphenus macrostomus

Status
Threatened

Reason for designation
This endemic parasitic fish is known from only three connected lakes and the lower reaches of larger tributaries within a single watershed on Vancouver Island. The species' spawning areas and juvenile rearing habitats have a restricted distribution in tributary deltas and lakeshore littoral habitat. Slow but ongoing declines in habitat quality and quantity due to threats from droughts and water management, sediment mobilized following upslope logging, and shoreline development threaten the species' long-term persistence.

Occurrence
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, in November 2008, and in November 2017.

Section 3 of the recovery strategy provides information on the threats to the survival and recovery of the Vancouver Lamprey. These threats include: water use, land use, water quality, alteration of prey base, recreation, and climate change; all of which have the potential to directly or indirectly impact individuals and/or their habitats.

Critical habitat for the Vancouver Lamprey was identified, to the extent possible, in section 3 of the action plan. The action plan also provides examples of activities that are likely to result in destruction to critical habitat (that is, threats to critical habitat). The list of activities provided in this table is neither exhaustive nor exclusive, and their inclusion has been guided by the relevant threats to habitat described in the recovery strategy. For more details on the activities likely to result in the destruction of critical habitat, consult section 3.2 of the action plan. Protection of Vancouver Lamprey's critical habitat from destruction was accomplished in February 2020 through a SARA critical habitat order made under subsections 58(4) and (5), which invoked the prohibition in subsection 58(1) against the destruction of the identified critical habitat.

2.2 Recovery

This section summarizes the information, found in the recovery strategy, on the recovery goal and recovery objectives that are necessary for ensuring the long-term viability of the Vancouver Lamprey within its natural range and on performance measures that provide a way to define and measure progress toward achieving the recovery goal and objectives.

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 level of risk due to its extremely limited distribution.

Recovery objectives

The recovery objectives for Vancouver Lamprey are to:

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

Section 9 of the recovery strategy includes the following performance measures to define and measure progress towards achieving the recovery goal and objectives:

1. Has a Recovery Implementation Group (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?
2. Are there key information gaps that inhibit conservation of Vancouver Lamprey?
3. Have threats been clarified and assessed? Are threats being mitigated?
4. Has critical habitat been defined for Vancouver Lamprey?
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?
6. Have water quality and water use objectives been established and communicated to relevant regulators and stakeholders?
7. Does the water management plan adequately address the needs of Vancouver Lamprey? Has it been implemented?
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?
9. Have forest harvest and land management criteria been developed? Is forest harvest and land development meeting the criteria? Have Best Management Practices (BMPs) been developed and communicated? Is there compliance with BMPs?
10. Have scientific investigation protocols been set and communicated? Have they been implemented?

3. Progress towards recovery

The recovery strategy divides the recovery effort into 10 strategies. Progress in carrying out these strategies is reported in section 3.1 of this report. Section 3.2 reports on the activities identified in the schedule of studies to identify critical habitat. Section 3.3 reports on the

progress made towards meeting the performance measures and other commitments (for example, action plan and critical habitat order) identified in the recovery strategy.

3.1 Activities supporting recovery

Table 1 provides information on the implementation of activities undertaken to address the strategies identified in the recovery planning table of the recovery strategy. A number of recovery activities were implemented prior to 2016 which have been documented in the Report on the Progress of Recovery Strategy Implementation for Cowichan Lake Lamprey (*Entosphenus macrostomus*) in Canada for the period 2007 to 2015 (DFO 2016).

Table 1. Details of activities supporting the recovery of the Vancouver Lamprey from 2016 to 2021.

#	Strategy	Activity description and results	Participants[4]
1	Establish and support a recovery implementation group (RIG) or alternative working group for Vancouver Lamprey	A Vancouver Lamprey RIG has not been established; however, broad watershed-based stewardship initiatives are being undertaken by government agencies, the regional water board, and local stewardship groups. These initiatives contribute to increasing understanding and awareness of Vancouver Lamprey throughout the Cowichan watershed.	First Nations, local and regional governments, stakeholders, and stewardship groups
2	Establish and support a RIG or alternative working group for Vancouver Lamprey	The Action Plan for the Vancouver Lamprey (*Entosphenus macrostomus*) in Canada was posted on the Species at Risk Public Registry in August 2019 and identifies 14 recovery measures for implementation to support Vancouver Lamprey survival and recovery. The action plan was not developed by an established RIG as outlined in the recovery strategy; instead, it was developed by Fisheries and Oceans Canada (DFO) with participants from an action planning workshop contributing valuable information and ideas towards its development. The record of cooperation and consultation is found in appendix B of the action plan.	**DFO**
3	Address information gaps that inhibit conservation of Vancouver Lamprey	From 2016 to 2021, studies were undertaken to address knowledge gaps regarding spawning and habitat use. These studies: - assessed availability of spawning and rearing tributary habitats at different lake water levels, including collection of bathymetry data at tributary mouths (Wade et al. 2017, Damborg et al. 2021) - quantified the relationship between lake levels and available spawning habitat (Chaudhuri et al. 2020) - confirmed nest building, spawning, and sexual dimorphism for the first time in Bear Lake at the alluvial fan of Robertson River (Wade et al. 2018a) - collected data to inform timing, locations, environmental cues, substrates, and preferred habitats for spawning and nest building (Wade et al. 2018a, b, Damborg et al. 2021) - collected preliminary data on ammocoete (lamprey larva) density (Damborg et al. 2021) - observed spawning behaviour in Shaw Creek. It is also suggested that lakeshore spawning exists due to ammocoetes captured on the foreshores of Goat Island and Cowichan Lake away from tributary outlets (Damborg et al. 2021)	British Columbia Conservation Foundation (BCCF), **British Columbia Ministry of Environment and Climate Change Strategy (BC ENV)**, **DFO**, **Fundy Aqua Services Inc.**

[4] Participants are listed in alphabetical order, key participants are bolded. DFO acknowledges the large network of people that contribute to recovery of Vancouver Lamprey and regrets any potential omissions of contributors.

#	Strategy	Activity description and results	Participants[4]
4	Address information gaps that inhibit conservation of Vancouver Lamprey	Previous research on Vancouver Lamprey was synthesized to identify remaining information gaps on species biology and life history, including duration of life stages, and water temperature ranges/cues for spawning (Wade 2019). Literature was also reviewed on similar parasitic freshwater lamprey species as potential proxy species to guide the management and science of Vancouver Lamprey (Wade 2019).	DFO, **Fundy Aqua Services Inc.**
5	Clarify and address threats to Vancouver Lamprey	The action plan identifies investigation of preferred prey, their abundance and abundance trends to help clarify and address the threat of alteration of prey base as a high priority measure (recovery measure 9). To date, minimal work has been conducted on the relationship between Vancouver Lamprey and its prey. Vancouver Lamprey scarring has been observed on adult Kokanee Salmon during trawl surveys (BC ENV pers. comms. 2021). Vancouver Lamprey have also been observed feeding on adult Rainbow Trout, Coastal Cutthroat Trout, and Sockeye Salmon in the lake and feeding on Brown Trout in the river during snorkel surveys (BC ENV pers. comms. 2021).	**BC ENV**
6	Clarify and address threats to Vancouver Lamprey	To assess effects of water use on the productivity of lamprey habitats, an analysis was conducted on the effects of meteorological variables and anthropogenic controls on Cowichan Lake water level and habitat availability for Vancouver Lamprey during the critical spawning period (Chaudhuri et al. 2020). Results show that the major driver of habitat area during the critical spawning period was water level during the storage season (April to June). Recommendations were provided for improved weir regulation procedures.	**DFO**, **Fundy Aqua Services Inc., Wilfrid Laurier University**
7	Clarify and address threats to Vancouver Lamprey	In response to increasing frequency of critically low summer flows in the Cowichan River and to address the need for a balanced, long-term solution for water storage (WRGI 2007), a Water Use Plan for Cowichan Lake and Cowichan River was developed in 2018 (CRM 2018). Vancouver Lamprey habitat values and potential impacts were considered in ranking different water use alternatives in the plan. Engineering design studies and impact assessments have been undertaken to implement the Water Use Plan recommendations with funding from the British Columbia Salmon Restoration Innovation Fund.	**Catalyst Paper, Cowichan Valley Regional District (CVRD), Cowichan Tribes, Cowichan Watershed Board (CWB),** DFO, Province of British Columbia, Public Advisory Group for the Cowichan Water Use Plan

#	Strategy	Activity description and results	Participants[4]
8	Clarify and address threats to Vancouver Lamprey	Bathymetry data was collected in 2018 at spawning tributaries to conduct preliminary assessments of ammocoete habitat availability below zero lake storage, which could be potential refugia during lake drawdowns (BC ENV pers. comms. 2020).	**BC ENV,** DFO
9	Conduct studies to help define critical habitat for Vancouver Lamprey	Critical habitat for Vancouver Lamprey was identified in the action plan to the extent possible, using the best available information. Critical habitat identification was informed by a peer review process undertaken through DFO's Canadian Science Advisory Secretariat (CSAS; MacConnachie and Wade 2016, DFO 2017). Table 2 summarizes completed studies to identify critical habitat.	**DFO**
10	Conduct studies to help define critical habitat for Vancouver Lamprey	Studies described in row 3 of this table contribute to filling information gaps on the use of tributary and littoral habitats throughout the Cowichan watershed and on specific parameters of existing critical habitat attributes. These studies may result in identification of additional areas and/or further refinement of critical habitat in the future. The role of lacustrine[5] riparian habitats in Vancouver Lamprey life processes has not been further investigated during this reporting period but is identified as a priority in recovery measure 7 of the action plan.	BCCF, **BC ENV**, **DFO**, **Fundy Aqua Services Inc.**
11	Develop and implement a long-term monitoring program	A standardized long-term monitoring program has not been developed or implemented; however, Vancouver Lamprey are monitored through periodic studies and continue to be encountered throughout their known range (refer to row 3 of this table). The action plan identifies monitoring plan development as a medium level priority and should focus on monitoring progress towards securing the species' long-term viability within its natural range and maintaining a self-sustaining population. Monitoring efforts may include lamprey distribution and a relative abundance index (recovery measures 1 and 4 in the action plan). Preliminary studies to develop a long-term monitoring program include testing various survey methods (that is, daytime and nighttime snorkel surveys, straw traps, electrofishing, and midwater trawling) to investigate sampling efficacy for different Vancouver Lamprey life stages (Damborg et al. 2021). Detection of adults was highest during nighttime snorkel surveys from June to August. Detection of ammocoetes was highest during electrofishing from August to October.	BCCF**, BC ENV,** DFO

[5] Relating to lakes

#	Strategy	Activity description and results	Participants[4]
12	Establish water quality and water use objectives for Cowichan and Mesachie lakes	This strategy was completed and reported out on in the previous progress report (DFO 2016).	N/A
13	Develop a comprehensive water management plan for each basin	This strategy was completed and reported out on in the previous progress report (DFO 2016).	N/A
14	Inform and educate stakeholders and the general public about the species and general biodiversity values	Educational materials have been developed and public outreach has been conducted with stakeholders and the general public to raise awareness and reduce stigma towards Vancouver Lamprey. Completed outreach activities include: - development and distribution of outreach posters and interpretive signage in key locations in the Cowichan watershed in 2020 and 2021. Posters highlight information on life history, species value to the ecosystem, threats, critical habitat, and federal regulations. Interpretive signage highlight information on SARA prohibitions and a contact for reporting violations - delivery of over 25 public outreach presentations and events to local schools, DFO Conservation and Protection Officers, and local environmental stewardship/community groups from 2016 to 2021 - creation of an educational display at the Cowichan Estuary Centre in 2020 - increasing species and critical habitat awareness on multiple media outlets such as local newsletters and online social media platforms - publication of an article in Frontiers for Young Minds, a journal for kids, describing the first recording of spawning and nest building in Vancouver Lamprey (Wade et al. 2019)	DFO, **Fundy Aqua Services Inc, Save our Holmes**

#	Strategy	Activity description and results	Participants[4]
15	Work with local governments, land developers, and others to improve and encourage watershed stewardship	A Water Use Plan Public Advisory Group, consisting of representatives from government, First Nations, stakeholders, and interest groups, was formed in 2017 to develop recommendations for the Cowichan Water Use Plan. Criteria, guidelines, or best management practices for land developments on lamprey habitats have not been developed. The action plan provides detailed recovery measures for identifying and evaluating land and water management options to satisfy both conservation and stakeholder needs (recovery measures 10, 13, and 14 in the action plan), some of which have been initiated as outlined in rows 6 to 8 of this table.	CVRD, First Nations, Catalyst Paper, residents, local community and interest groups (for example, lakefront property owners, environmental, recreation, agriculture), provincial and federal governments, CWB
16	Develop sound protocols for scientific investigations (for example, limit number of fish collected each year)	Capture and handling guidelines are in draft development stages. The DFO Science Advisory Report previously indicated that there is no scope for human-induced mortality given the low and highly uncertain population abundance estimates, the reported recent declines in catch rates and the restricted, endemic population range of Vancouver Lamprey (DFO 2010). Testing of various survey methods to investigate sampling efficacy, as outlined in row 11 of this table, could contribute to the identification of minimally invasive sampling and handling techniques as part of future collection guidelines.	BCCF**, BC ENV,** DFO

3.2 Activities supporting the identification of critical habitat

Table 2 provides information on the implementation of the studies outlined in the schedule of studies to identify critical habitat within the recovery strategy. Each study has been assigned one of four statuses:

1) completed*:* the study has been carried out and concluded
2) in progress: the planned study is underway and has not concluded
3) not started: the study has been planned but has yet to start
4) cancelled: the planned study will not be started or completed

Table 2. Status and details of the implementation of the schedule of studies to identify critical habitat for the Vancouver Lamprey as outlined in the recovery strategy.

#	Study	Status	Descriptions and results	Participants
1	Habitat use	In progress	Critical habitat for Vancouver Lamprey was identified in the action plan to the extent possible, using the best available information. Basic habitat associations for each life stage are described. As stated in the action plan, the identified critical habitat is sufficient to achieve the species' recovery goal and objectives. Critical habitat identification was informed by a peer review process undertaken by Fisheries and Oceans Canada's (DFO's) Canadian Science Advisory Secretariat (CSAS; MacConnachie and Wade 2016, DFO 2017). Information on Vancouver Lamprey collected during previous studies was synthesized and reported during that CSAS process (MacConnachie and Wade 2016). Additional surveys were undertaken from 2016 to 2021 to refine understanding of locations and attributes of habitat suitable for Vancouver Lamprey spawning (refer to row 3 of table 1). Continued investigation with respect to the extent of tributary habitat usage, the role of lacustrine riparian habitats in lamprey life processes, and specific parameters of existing critical habitat attributes are addressed by recovery measures 2, 7, and 8 respectively in the action plan. Completion of these recovery measures may result in identification of additional areas and/or further refinement of critical habitat in the future.	**British Columbia Ministry of Environment and Climate Change Strategy (BC ENV), DFO, Fundy Aqua Services Inc.**

#	Study	Status	Descriptions and results	Participants
2	Habitat availability	In progress	Historical and current habitat availability for Vancouver Lamprey was reviewed and taken into consideration for the identification of critical habitat in the action plan. Critical habitat identification was informed by a peer review process undertaken by DFO's CSAS (MacConnachie and Wade 2016, DFO 2017). Additional surveys were undertaken from 2016 to 2021 to refine understanding of habitat availability for Vancouver Lamprey, such as observed reductions in spawning and rearing habitat availability during drought conditions and collection of bathymetry data in tributary habitats (refer to row 3 of table 1). Continued investigation with respect to the extent of tributary habitat usage, the role of lacustrine riparian habitats in lamprey life processes, and specific parameters of existing critical habitat attributes are addressed by recovery measures 2, 7, and 8 respectively in the action plan. Completion of these recovery measures may result in refining the knowledge on the extent and distribution of different habitat types available to Vancouver Lamprey.	**BC ENV, DFO, Fundy Aqua Services Inc.**
3	Population abundance	Cancelled	No current robust population estimates are available for Vancouver Lamprey. Historical population abundance was estimated and included in the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) report (COSEWIC 2017). The planned study is no longer needed because critical habitat has been identified without current population abundance data.	N/A
4	Recovery targets	Cancelled	The recovery strategy stated that clearly defined population recovery targets for each life stage would be integral to the identification of critical habitat; however, critical habitat features and attributes for each life stage were identified in the action plan using best available knowledge without actually needing to define population recovery targets. No current robust population estimates are available for Vancouver Lamprey to establish population abundance recovery targets. The planned study is no longer needed because critical habitat has been identified without the establishment of population recovery targets.	N/A
5	Relationship between habitat and abundance	Cancelled	The recovery strategy stated that the quantitative relationship between habitat and abundance would be required for the designation of critical habitat by establishing the amount of habitat required to achieve a population recovery target. However, critical habitat features and attributes for each life stage were identified in the action plan using best available knowledge without this information. Population abundance estimates do not exist for Vancouver Lamprey, and the relationship between habitat and abundance has not been investigated. The planned study of the relationship between habitat and abundance is no longer needed because critical habitat has already been identified.	N/A

#	Study	Status	Descriptions and results	Participants
6	Define critical habitat	Completed	Critical habitat for Vancouver Lamprey was identified in the action plan to the extent possible, using the best available information, and provides the functions, features, and attributes necessary to support the species' life-cycle processes and to achieve the species' recovery goal and objectives. Critical habitat identification was informed by a peer review process undertaken by DFO's CSAS (MacConnachie and Wade 2016, DFO 2017). Remaining information gaps with respect to the extent of tributary habitat usage, the role of lacustrine riparian habitats in lamprey life processes, and specific parameters of existing critical habitat attributes are addressed by recovery measures 2, 7 and 8 respectively in the action plan. Completion of these recovery measures may result in identification of additional areas and/or further refinement of critical habitat in the future. Protection of Vancouver Lamprey's critical habitat from destruction was accomplished in 2020 through a *Species at Risk Act* (SARA) critical habitat order made under subsections 58(4) and (5), which invoked the prohibition in subsection 58(1) against the destruction of the identified critical habitat.	**DFO**

3.3 Summary of progress towards recovery

3.3.1 Status of performance measures

Table 3 provides a summary of the progress made toward meeting the performance measures outlined in section 9 of the recovery strategy. Each performance measure has been assigned one of four statuses:

1) not met: the performance measure has not been met, and little to no progress has been made
2) partially met, underway: moderate to significant progress has been made toward meeting one or more elements of the performance measure, and further work is ongoing or planned
3) met: the performance measure has been met and no further action is required
4) met, ongoing: the performance measure has been met, but efforts will continue until such time the population is considered to be recovered

Table 3. Details of the progress made toward meeting the performance measures outlined in the recovery strategy for the Vancouver Lamprey.

Performance measure	Status	Details
1. Has a recovery implementation group (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?	Partially met, underway	A Vancouver Lamprey RIG has not yet been established; however, broad stewardship initiatives undertaken in the Cowichan watershed contribute to increasing understanding and awareness of the species (refer to row 1 of table 1). A Vancouver Lamprey action plan has been developed (refer to row 2 of table 1).
2. Are there key information gaps that inhibit conservation of Vancouver Lamprey?	Partially met, underway	Studies have been conducted to address key information gaps regarding spawning and habitat use (refer to row 3 of table 1), and a synthesis of previous studies has been completed (refer to row 4 of table 1). Additional information gaps that inhibit the conservation of Vancouver Lamprey remain, and the action plan identifies recovery measures to address these gaps, including confirmation of suspected spawning locations (recovery measure 5 in the action plan), bathymetry mapping (recovery measure 6 in the action plan), and measures related to critical habitat identification and refinement (refer to performance measure 4 of this table).

Performance measure	Status	Details
3. Have threats been clarified and assessed? Are threats being mitigated?	Partially met, underway	An initial analysis of various water use scenarios and alternatives was conducted to clarify and assess the threat of water use on Vancouver Lamprey and the Cowichan watershed (refer to rows 6 and 7 of table 1). Recommendations to improve weir regulation procedures in order to mitigate the threat of water use on Vancouver Lamprey habitats were outlined in Chaudhuri et al. 2020. Lake drawdowns below zero storage is an emerging threat to ammocoetes. Preliminary bathymetry data has been collected to assess ammocoete habitat availability (refer to row 8 of table 1). The action plan identifies, as a high priority measure, the investigation of preferred prey, their abundance and abundance trends as a measure to help clarify and address the threat of alteration of prey base; minimal work has been initiated on this measure (refer to row 5 of table 1).
4. Has critical habitat been defined for Vancouver Lamprey?	Met, ongoing	Critical habitat was identified in the action plan (DFO 2019; refer to table 2). Protection of Vancouver Lamprey's critical habitat from destruction was accomplished in 2020 through the making of a SARA critical habitat order (refer to rows 9 and 10 of table 1). Completion of recovery measures 2, 7, and 8 in the action plan may result in identification of additional areas and/or further refinement of critical habitat in the future.
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?	Partially met, underway	A standardized monitoring program for Vancouver Lamprey has not been implemented; however, periodic monitoring of Vancouver Lamprey spawning and habitat use occurred from 2016 to 2021 and continue to be encountered throughout their known range (refer to row 3 of table 1). Various Vancouver Lamprey survey methods were tested for sampling efficacy at different life stages. Results of this study may inform future long-term population monitoring techniques (refer to row 11 of table 1). Recovery measures 1 and 4 in the action plan address development and implementation of a monitoring plan to provide a clear indication of progress towards securing the long-term viability within the Vancouver Lamprey's natural range and maintaining a self-sustaining population.
6. Have water quality and water use objectives been established and communicated to relevant regulators and stakeholders?	Met	Water quality and water use objectives have been established as reported in the previous progress report (DFO 2016).

Performance measure	Status	Details
7. Does the water management plan adequately address the needs of Vancouver Lamprey? Has it been implemented?	Partially met, underway	The Cowichan Basin Water Management Plan was developed in 2007 (refer to row 13 of table 1) as reported in the previous progress report (DFO 2016). The Water Use Plan for Cowichan Lake and Cowichan River was developed in 2018 (CRM 2018) to evaluate different water use alternatives with consideration of Vancouver Lamprey needs. Implementation of this plan is ongoing (refer to row 8 of table 1).
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?	Met, ongoing	Vancouver Lamprey educational materials have been developed and distributed throughout the community. Over 25 groups have received educational presentations, and over 30 educational posters and signs have been erected (for details refer to row 14 of table 1). A direct measurement of change in public perception is not available; however anecdotal evidence suggests ongoing local interest in educational materials and outreach events.
9. Have forest harvest and land management criteria been developed? Is forest harvest and land development meeting the criteria? Have Best Management Practices (BMPs) been developed and communicated? Is there compliance with BMPs?	Not met	No forest harvest and land management criteria or a BMP document specific to Vancouver Lamprey has yet been developed. Forest harvest practices are managed through provisions under the BC *Forest and Range Practices Act* and *Private Managed Forest Land Act.* Additional work to develop BMPs for land development are addressed by recovery measure 13 in the action plan. Vancouver Lamprey's critical habitat is protected from destruction through a SARA critical habitat order made under subsections 58(4) and (5). Furthermore, any works, undertakings, or activities that result in the death of fish or the harmful alteration, disruption, or destruction of fish habitat are subject to regulatory review and authorization under the federal *Fisheries Act*.
10. Have scientific investigation protocols been set and communicated? Have they been implemented?	Not met	Various survey methods have been tested to investigate sampling efficacy for different Vancouver Lamprey life stages (refer to rows 11 and 16 of table 1). Capture and handling guidelines are in draft development stage.

3.3.2 Completion of action plan

The Action Plan for the Vancouver Lamprey (*Entosphenus macrostomus*) in Canada was published in 2019 (DFO 2019). The action plan outlines measures that provide the best chance of achieving the recovery goal and objectives for Vancouver Lamprey, including the measures to be taken to address the threats and monitor the recovery of the species, and identification of critical habitat.

3.3.3 Critical habitat identification and protection

Critical habitat for Vancouver Lamprey was identified to the extent possible in the 2019 action plan, using the best available information, and provides the functions, features, and attributes necessary to support the species' life-cycle processes and to achieve the species' recovery goal and objectives. A SARA critical habitat order was made in February 2020 under subsections 58(4) and (5) of SARA which invoked the prohibition in subsection 58(1) against the destruction of critical habitat. Section 3.2 of the action plan provides examples of activities likely to result in the destruction of critical habitat. Section 3.2 of this progress report provides information on the implementation of the studies outlined in the schedule of studies to identify critical habitat within the recovery strategy. Remaining information gaps with respect to the extent of tributary habitat usage, the role of lacustrine riparian habitats in lamprey life processes, and specific parameters of existing critical habitat attributes are addressed by recovery measures 2, 7 and 8, respectively, in the action plan. Completion of these recovery measures may result in identification of additional areas and/or further refinement of critical habitat in the future.

3.3.4 Recovery feasibility

Based on the current best available information, recovery of Vancouver Lamprey is determined to be feasible (VLRT 2007; DFO 2019). No new information has been gathered that would suggest that Vancouver Lamprey population no longer meets the feasibility criteria laid out in the recovery strategy. The studies and initiatives outlined in sections 3.1 and 3.2 of this report demonstrate progress toward better understanding of this species and its recovery potential.

4. Concluding statement

Over the last five years, through the implementation of recovery activities identified in the Recovery Strategy for the Vancouver Lamprey (*Lampetra macrostoma*) in Canada, progress has been made to refine the scientific understanding of Vancouver Lamprey and address information gaps that inhibit conservation of the species, including life history information, habitat use, and potential limiting factors to population growth. While there is a lack of current population abundance and trend data, Vancouver Lamprey are monitored through periodic studies and continue to be encountered throughout their known range.

Significant threats to Vancouver Lamprey habitat continue to persist. Further recovery implementation should continue to: monitor timing of habitat use and habitat availability for different life stages; assess long-term cumulative effects of climate change, lake drawdowns and other water uses on tributary and foreshore habitats that support spawning and rearing; and work with local governments, Indigenous groups, stakeholders, land developers, and others to implement measures that promote Vancouver Lamprey conservation and watershed stewardship. With respect to further critical habitat identification and refinement, remaining

information gaps include: the extent of tributary habitat usage, the role of lacustrine riparian habitats in lamprey life processes, and specific parameters of existing critical habitat attributes.

DFO remains committed to the survival and recovery of the Vancouver Lamprey. The work underway and completed to date has built a strong foundation for continued research, recovery and management of this species over the next reporting period.

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