

**PROPOSED**

**Species at Risk Act**  
Recovery Strategy Series

Recovery Strategy for Morrison Creek  
Lamprey (*Lampetra richardsoni* var.  
*marifuga*) in Canada

# Morrison Creek Lamprey



August 2006



Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

**Canada**

## **About the Species at Risk Act Recovery Strategy Series**

### **What is the Species at Risk Act (SARA)?**

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003 and one of its purposes is “to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity.”

### **What is recovery?**

In the context of species at risk conservation, recovery is the process by which the decline of an endangered, threatened or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of the species' persistence in the wild. A species will be considered recovered when its long-term persistence in the wild has been secured.

### **What is a recovery strategy?**

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA ([http://www.sararegistry.gc.ca/the\\_act/default\\_e.cfm](http://www.sararegistry.gc.ca/the_act/default_e.cfm)) spell out both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

### **What's next?**

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

### **The series**

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

### **To learn more**

To learn more about the Species at Risk Act and recovery initiatives, please consult the SARA Public Registry (<http://www.sararegistry.gc.ca/>) and the web site of the Recovery Secretariat ([http://www.speciesatrisk.gc.ca/recovery/default\\_e.cfm](http://www.speciesatrisk.gc.ca/recovery/default_e.cfm)).

**Recovery Strategy for Morrison Creek Lamprey (*Lampetra richardsoni*  
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**Additional copies:**

You can download additional copies from the SARA Public Registry (<http://www.sararegistry.gc.ca/>)

**Cover illustration:** Morrison Creek lamprey. Photo by Jim Palmer.

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## DECLARATION

This proposed recovery strategy for the Morrison Creek lamprey has been prepared in cooperation with the jurisdictions described in the Preface. Fisheries and Oceans Canada has reviewed and accepts this document as its recovery strategy for the Morrison Creek lamprey as required by the *Species at Risk Act*.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Fisheries and Oceans Canada or any other jurisdiction alone. In the spirit of the National Accord for the Protection of Species at Risk, the Minister of Fisheries and Oceans invites all Canadians to join Fisheries and Oceans Canada in supporting and implementing this strategy for the benefit of the Morrison Creek lamprey and Canadian society as a whole. Fisheries and Oceans Canada will support implementation of this strategy to the extent possible, given available resources and its overall responsibility for species at risk conservation. The Minister will report on progress within five years.

This strategy will be complemented by one or more action plans that will provide details on specific recovery measures to be taken to support conservation of the species. The Minister will take steps to ensure that, to the extent possible, Canadians interested in or affected by these measures will be consulted.

## RESPONSIBLE JURISDICTIONS

The responsible jurisdiction for Morrison Creek lamprey under the *Species at Risk Act* is Fisheries and Oceans Canada. The Province of British Columbia also collaborated in the development of this recovery strategy.

## AUTHORS

DFO and the Province of British Columbia cooperated in the development of this recovery strategy. A recovery team was assembled to provide science-based recommendations to government with respect to the recovery of Morrison Creek lamprey. Members of the Morrison Creek Lamprey Recovery Team are listed below:

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Fisheries and Oceans Canada and the Province of BC are grateful to the technical experts involved in drafting this strategy, for their time and effort in attending meetings and reviewing the document. Development of this strategy was partially funded by the Habitat Conservation Trust Fund of British Columbia.

## STRATEGIC ENVIRONMENTAL ASSESSMENT

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally-sound decision making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The recovery planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats. The results of the SEA are incorporated directly in the strategy itself, but are also summarized below.

This recovery strategy will clearly benefit the environment by promoting the recovery of the Morrison Creek lamprey. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. Refer to the following sections of the document in particular: Description of the Species – General Biology, Ecological Role and Limiting Factors; Potential Management Impacts for Other Species; and Recommended Approach/Scale for Recovery.

## RESIDENCE

SARA defines residence as: “a dwelling -place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating” [SARA S2(1)].

Residence identification is part of the listing process. Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SARA public registry:

[http://www.sararegistry.gc.ca/plans/residence\\_e.cfm](http://www.sararegistry.gc.ca/plans/residence_e.cfm)

## PREFACE

The Morrison Creek lamprey is a freshwater fish and is under the jurisdiction of the federal government. The *Species at Risk Act* (SARA, Section 37) requires the competent minister to

prepare recovery strategies for listed extirpated, endangered or threatened species. The Morrison Creek lamprey was listed as endangered under SARA in August 2003. Fisheries and Oceans Canada – Pacific Region co-led the development of this recovery strategy. The proposed strategy meets SARA requirements in terms of content and process (Sections 39-41). It was developed in cooperation or consultation with:

- British Columbia Ministry of Environment

## EXECUTIVE SUMMARY

Morrison Creek lamprey is a unique life history form of the western brook lamprey (*Lampetra richardsoni*) that is believed to occur only in Morrison Creek, Vancouver Island (Beamish 1985). It was discovered in 1977, and is considered a derivative of *L. richardsoni* that has been labelled *L. richardsoni* var. *marifuga* (Beamish 1987). Although described in some detail, the Morrison Creek lamprey has not been given formal taxonomic status, and additional work is recommended to clarify the taxonomy. Its extreme endemic distribution is the principal factor in its designation as “endangered,” and likely entails that the species will always remain at some risk.

A variety of factors threaten the Morrison Creek lamprey and its associated habitat. The primary threat is impacts associated with urbanization of the watershed. This recovery strategy focuses on the goal of ensuring the long-term viability of Morrison Creek lamprey, and offers a variety of approaches to attain this goal. The priority actions are to collect information on life-history and habitat associations, fill other data gaps that inhibit conservation of the variety, and to collect information to allow delineation of critical habitat in the wild. Activities aimed at reducing impacts of urbanization are also suggested. Activities aimed at protecting and enhancing other species of fish and wildlife are likely to benefit Morrison Creek lamprey, and vice versa.



## TABLE OF CONTENTS

1.	Description of the Species .....	1
1.1	General Biology .....	1
1.2	Distribution .....	3
1.3	Abundance .....	4
1.4	Importance to People .....	4
2.	Description of Needs of the Species .....	5
2.1	Ecological Role and Limiting Factors .....	5
2.2	Habitat Needs .....	6
3.	Threats .....	7
4.	Habitat Trends .....	10
5.	Habitat Protection .....	10
6.	Critical Habitat .....	11
6.1	Identification of the Species' Critical Habitat .....	11
6.2	Schedule of Studies .....	11
6.3	Examples of Activities That Are Likely to Result in Destruction of Critical Habitat .....	12
7.	Recovery Goal .....	13
8.	Recovery Objectives .....	13
9.	Approaches to Meeting Recovery Objectives .....	13
10.	Anticipated Conflicts or Challenges .....	17
10.1	Potential Management Impacts for Other Species .....	17
11.	Recovery Feasibility .....	17
12.	Recommended Approach / Scale for Recovery .....	18
13.	Knowledge Gaps .....	19
14.	Actions Already Completed and/or Underway .....	19
15.	Statement of When Action Plans Will be Completed .....	20
16.	References Cited .....	20
	Appendix I Record of Cooperation and Consultation .....	22

## SPECIES INFORMATION

**Common Name:** Morrison Creek lamprey

**Scientific Name:** *Lampetra richardsoni* var. *marifuga*

**COSEWIC Assessment Summary:** May 2000

**COSEWIC Status:** Endangered

**SARA Status:** Endangered, August 2003

**COSEWIC Reason for Designation:** Endemic to British Columbia, this single, small population is susceptible to habitat loss from urban development and highway construction.

**Canadian Occurrence:** British Columbia

**COSEWIC Status History:** Designated Threatened in April 1999. Status re-examined and changed to Endangered in May 2000. May 2000 assessment was based on new quantitative criteria applied to information from the existing 1999 status report (Beamish et al. 1999).

## BACKGROUND

### 1. DESCRIPTION OF THE SPECIES

#### 1.1 General Biology

Lampreys are members of the Superclass Agnatha, jawless fishes. Lampreys are distinguished by a cylindrical, eel-like, scale-less body and a round suctorial mouth armed with a series of sharp, horny teeth. They have a small caudal fin, and long dorsal fin, often with two distinct parts; they have no paired fins (Figure 1). The skeleton is cartilaginous, a trait that has contributed to a poor fossil record. Lampreys have seven pairs of gills in the form of gill pouches, each with an individual opening to the outside (Scott and Crossman 1973). There are about 40-45 species of lamprey within 9 genera, depending on the current interpretations of experts (ITIS 2005).

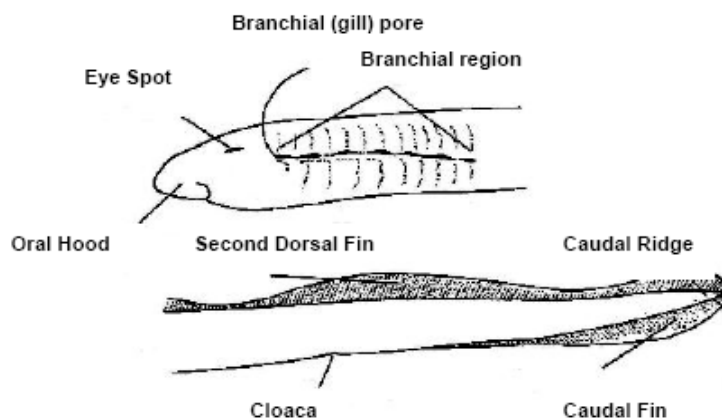
Lampreys are generally distributed in temperate marine and freshwaters; the worldwide distribution is predominantly in the Northern Hemisphere (Scott and Crossman 1973). About 1/3 of lamprey species are anadromous. As adults, lamprey species are either externally parasitic of other fish species, or do not feed at all. All lamprey are semelparous and die soon after spawning (Larson 1980).

Lampreys are difficult to age reliably (Beamish and Medland 1988; Kostow 2002). They have a distinct larval phase followed by metamorphosis (Scott and Crossman 1971), but time to metamorphosis (sometimes called transformation) varies among species. Larvae, called ammocoetes (Figure 2), live in burrows in stream and lake sediments (Scott and Crossman 1971). Ammocoetes have sightless eyes; teeth and oral disk are absent, and the mouth is covered with an oral hood. Ammocoetes feed by filtering microscopic plant and animal material and organic detritus through the oral hood (e.g., Manion 1967; Moore 1973, 1980; Sutton et al. 1994; Mundahl et al. 2005).



**Figure 1.** Photograph of Morrison Creek lamprey, taken in spring 2005. This specimen is ~ 12 cm total length, and is thought to be 3 to 4 months post metamorphosis. Photo by Jim Palmer.

In British Columbia there are 4 described species of lamprey (Beamish 1985). *Lampetra richardsoni* is a non-anadromous, non-parasitic, freshwater-resident species commonly found in streams. The Pacific Lamprey, *L. tridentata*, is anadromous and parasitic; it is commonly found in coastal streams and marine coastal areas. *L. ayresi* is anadromous and parasitic. It can be very abundant in the Fraser River, and is common in the Strait of Georgia during its parasitic phase. Little research has been done on this species outside the Georgia Basin. *L. macrostoma*, originally described by Beamish (1982), is parasitic and assumed to be derived from *L. tridentata*. It has been reported only in Cowichan and Mesachie lakes (Beamish 1998).



**Figure 2.** External features of lamprey ammocoete (from McDermott 2003).

A fifth taxon has been identified, and is believed to occur only in Morrison Creek, Vancouver Island (Beamish 1985). It was discovered in 1977 (Beamish 1985), and is believed to be a derivative of *L. richardsoni* and has been labelled *L. richardsoni* var. *marifuga* (Beamish 1987). It is an important example of a parasitic form derived from a non-parasitic form. Although described in some detail, the Morrison Creek lamprey has not been given formal taxonomic status. The taxonomy of these forms remains somewhat uncertain and detailed genetic analysis is recommended to help resolve this issue. In this recovery strategy, the common name Morrison Creek lamprey is used to refer only to *L. richardsoni* var. *marifuga*.

There are three distinct lamprey types residing in Morrison Creek. One type is *L. tridentata*, which can be readily distinguished both as an ammocoete and post-metamorphosis (Beamish 1985). The other two are forms of *L. richardsoni* that can be distinguished from each other only at certain stages of development (Beamish 1985). It remains unclear whether the two forms are different life history phenotypes of the same species or separate lineages (Beamish 1985; Beamish et al. 1999). Evidence seems to favour the idea that they are distinct life history forms within a single lineage (i.e., a polymorphism). Multiple life history forms are common within other fish species, but this is the world's only known population of lamprey with more than one life history phenotype (Beamish 1987).

One of the life history forms is the "normal" *L. richardsoni*. This type lives entirely in freshwater, is non-parasitic and does not feed as an adult. It undergoes metamorphosis in September, overwinters in the gravel, and spawns and dies the following May to July (R. Beamish, pers. comm.). Ammocoetes live in burrows in fine stream sediments for an estimated 3 to 7 years, and grow to about 13 cm in length. Reproductive adults are slightly smaller, usually 8 to 12 cm in length, and dark brown or black in colour (McDermott 2003). Teeth are present on the oral disk, but quickly wear and become blunt (Beamish 1985).

The second form is referred to as *L. richardsoni* var. *marifuga*. Most of what we know about the life history of this form has come from lab-based studies (Beamish 1987). Distinguishing between ammocoetes of *L. richardsoni* and *L. richardsoni* var. *marifuga* is not yet possible as ammocoetes have not been unequivocally matched to each form. Individuals become distinguishable shortly after metamorphosis. The *marifuga* form is notable because its teeth remain sharp, it apparently feeds by parasitizing a variety of fish, lives for up to one year longer, and retains a silver colouration until the end of September prior to spawning. It is commonly, though not always, larger (i.e., 15 to 18 cm) at spawning than the normal variety (Beamish 1985, 1987; McDermott 2003), indicating that individuals feed after metamorphosis. Mating or feeding behaviour have not been observed in the wild, though adults of *L. richardsoni* var. *marifuga* readily attacked a variety of live and dead fish in the lab (Beamish 1985). The timing of spawning and ammocoete rearing is apparently similar to that of *L. richardsoni*.

Size differences are thought to prevent cross-breeding between *L. richardsoni* and *L. richardsoni* var. *marifuga* (R. Beamish, pers. comm.); however, based on morphological characteristics, it is possible that *L. richardsoni* var. *marifuga* is a hybrid between *L. richardsoni* and *L. ayresii*. This hypothesis is deemed unlikely (R. Beamish, pers. comm.): *L. ayresii* has not been observed in Morrison Creek, and *L. richardsoni* var. *marifuga* shows no physiological tolerance to sea water (Beamish 1985), providing some evidence against the hypothesis.

## 1.2 Distribution

The Morrison Creek lamprey is an extreme endemic. It is found only in the Morrison Creek watershed, a tributary to the Puntledge River on Vancouver Island, British Columbia (Figure 3). Morrison Creek is somewhat unusual for this area because its headwaters are dominated by wetlands, but the reasons for this life history form evolving only here are not understood. It is possible that the unique features of the watershed (extensive headwater wetland habitat, large groundwater inflows and stable temperatures and flow) were instrumental in the evolution of this variety. Distribution of lamprey within Morrison Creek is not known, particularly in the headwater wetlands that are difficult to sample. However, salmonids have been observed in the upper watershed almost to its upper limits, and lamprey have been observed in areas inaccessible to coho (J. Palmer, pers. comm.). Lamprey are good swimmers, commonly

migrating to the headwaters of streams (Scott and Crossman 1971), so there is no *a priori* reason to expect lamprey to be restricted in their distribution within Morrison Creek. Ammocoetes may be more plentiful in the wetland habitats (R. Beamish, pers. comm.). Attempts to find Morrison Creek lamprey within the Puntledge River and other rivers in the area have not been successful (R. Beamish, pers. comm.).

### **1.3 Abundance**

There has been little research done on Morrison Creek lamprey, and at no time has a population estimate been made of this variety. It was regularly captured during early work (Beamish 1985), and adults continue to be captured and enumerated at a smolt counting fence operated by volunteers (J. Palmer, personal communication). At no time have the counts been high (usually < 100 individuals), but there has been no indication of large population fluctuations or declines (Beamish 1985). Catch per unit effort has not been used to assess trends because sampling was not conducted uniformly across years. Based on personal experience with sampling lamprey in BC, R. Beamish indicates that the variety is rare within the Morrison system. There is no evidence that the variety is in decline, however, no firm conclusions can be drawn with the current data.

### **1.4 Importance to People**

The special significance of the Morrison Creek lamprey is primarily its scientific value (e.g., see Section 16 for a partial list of scientific literature). There is no commercial value to the variety. As a group, lamprey are not generally well-regarded because some species are parasitic on salmonids or other highly-valued species. The fact that introduced lamprey have caused considerable harm in other systems (Fuller et al. 1999) likely adds to lamprey's poor reputation. Conversely, others view Morrison Creek lamprey as a member of the native fauna, with its own intrinsic values including its contribution to biodiversity, education, ecological role and science. As a scientific subject, the Morrison Creek lamprey is of considerable interest for its extreme endemism and unique presence of more than one life history form. It has been suggested that Morrison Creek lamprey may represent a transition between parasitic and non-parasitic forms (Beamish 1985). The cultural value of Morrison Creek lamprey to First Nations has not been investigated for this report, though it should be noted that the larger Pacific Lamprey has significant cultural value for First Nations people in some regions (Close et al. 2002). Presence of lamprey is generally a good indicator of habitat quality and suitability for Pacific salmon (R. Beamish, pers. comm.).



**Figure 3.** Distribution of Morrison Creek lamprey. (Map base obtained from Ministry of Energy, Mines and Petroleum Resources, <http://www.em.gov.bc.ca/mining/Geolsurv/MapPlace/themeMaps.htm>).

## 2. DESCRIPTION OF NEEDS OF THE SPECIES

### 2.1 Ecological Role and Limiting Factors

**Ecological Role.**— After metamorphosis *L. richardsoni* var. *marifuga* are assumed to be external parasites of other fish species, though this has not been directly observed in the wild. If true, Morrison Creek lamprey plays a role in limiting abundance of its prey species. Clearly more studies are required to assess the effect on prey abundance and distribution. It is possible that lamprey also feed on salmon carcasses (R. Beamish, pers. comm.). Lamprey are themselves preyed upon by fishes and other wildlife and thereby form part of the food base of those species. Ammocoetes are most vulnerable to predation immediately after emerging from their burrows (Close et al. 2002). Both live and spawned out adults of Pacific Lamprey are a significant component of some fish and wildlife diets (Close et al. 2002), though the extent of predation on Morrison Creek lamprey is not known.

**Limiting Factors.**— The environmental factors that limit Morrison Creek lamprey have not been well-studied. We assume that populations are affected by competition, predation, habitat quantity and quality, and food availability though the relative effect of each is not known. It is evident that to persist over the long term, all species require sufficient rearing and spawning habitat and a healthy food base.

## 2.2 Habitat Needs

*L. richardsoni* var. *marifuga* is found only in Morrison Creek, a tributary of the Puntledge River on Vancouver Island (Figure 4). The Morrison Creek watershed is in the coastal Douglas fir biogeoclimatic zone. The area experiences a variable climate that is generally warm and dry in summer and mild and wet in winter. A variety of fish species are present in Morrison Creek (Freshwater Fisheries Society of BC 2005) including, pink (*Oncorhynchus gorbuscha*), coho (*O. kisutch*), chinook (*O. tsawytscha*) and chum salmon (*O. keta*), resident and anadromous cutthroat trout (*O. clarki*), rainbow and steelhead trout (*O. mykiss*), Dolly Varden char (*Salvelinus malma*), three types of lamprey (Pacific lamprey, *Lampetra tridentata*; Western brook lamprey, *L. richardsoni*; and Morrison Creek lamprey, *L. richardsoni* var. *marifuga*).

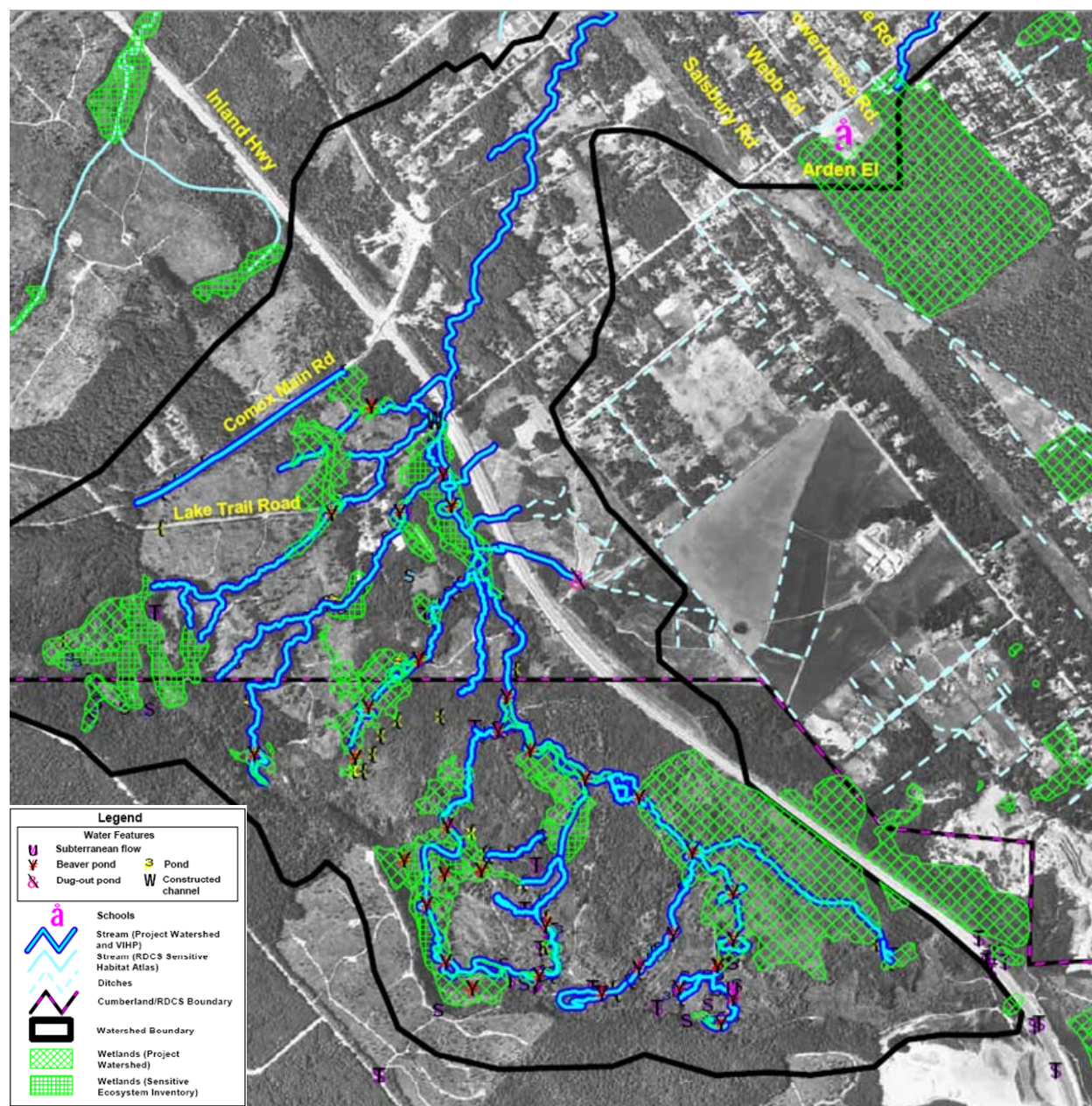
The Morrison Creek watershed is 890 ha in size (Ellefson 2003) and provides year-round fish habitat. The creek is characterized by cool, clean, year-round flows that originate from spring sources in the headwaters (Ellefson 2003). There are multiple wetlands in the upper watershed, which likely attenuate flow and temperature fluctuations throughout the year. The upper watershed is about 543 ha in size, of which over 96 ha is wetland (Ellefson 2003). The headwaters are defined at their upper reaches by an approximately 30 m scarp composed of glacial till (largely gravel and sand), with a series of spring-fed wetlands and creeks at the base of this escarpment. A key difference between Morrison Creek and other creeks on the east coast of Vancouver Island is the volume of water stored in the headwaters. The area is a complex of beaver dams and natural berms that store water and release it slowly through the dry summer months. The relatively high fish production of Morrison Creek is believed to be related to the year-round cold water, which is available in fairly high volume. It is not known whether conditions specific to Morrison Creek have allowed *L. richardsoni* var. *marifuga* to evolve and endure only here.

Spawning habitat requirements of Morrison Creek lamprey are not known in detail. Other species of lamprey require clean gravels with some water flow for spawning and incubation, so we assume Morrison Creek lamprey also require these conditions. Since natural spawning has not been observed, greater detail cannot be provided at this time.

After hatching, lamprey ammocoetes drift a short distance from the nest, where they burrow into soft fine sediments or sand (Scott and Crossman 1971). Ammocoetes of *L. richardsoni* var. *marifuga* cannot be readily distinguished from those of "normal" *L. richardsoni*, but we assume at present that habitat needs are similar for both forms. Larval habitat is thus defined generally as fine sediment areas in close proximity to spawning beds.

Habitat requirements of other life stages are not known.





**Figure 4.** Upper Morrison Creek watershed land and water features, based on aerial photography taken in 2002. This map was created by Comox Valley Project Watershed Society (from Ellefson 2003).

### 3. THREATS

Given their extremely restricted distribution, Morrison Creek lamprey can be considered vulnerable to a variety of threats. Much information is lacking on the general biology of the variety, which makes a thorough threats assessment difficult. Nevertheless, it is possible to identify general threats, and these are discussed below.

**Land Use.**— Some land-based activities have the capacity to alter aquatic habitat directly (e.g., impacts to riparian habitat, alteration of run-off rates or water storage capacity in headwaters) or



indirectly (e.g., changes to water quality through introduction of pollutants). These activities include forestry, mining, and land development for residential or industrial uses. The primary concern at present in the Morrison Creek watershed is forest harvest and urban development. Historically, forestry has been the primary concern, and the Inland Island Highway, which cuts through a broad section of the upper watershed, may also have had impact. However, with the expansion of the Village of Cumberland into the upper Morrison Creek watershed, urban development appears to now exceed other land use issues as the main threat.

Development pressures are increasing in the Morrison Creek area, and have increased especially in the last several years. Alteration of land cover through building and road development generally changes many aspects of water quality and patterns of stream flow (Chilibeck et al. 1992). Morrison Creek may be somewhat buffered from impacts to streamflow given it is fed so consistently by springs and groundwater. However, there are still a series of threats associated with urban development that remain a concern (Chilibeck et al. 1992). Assessing this threat will require additional information on distribution and utilization of spawning and rearing habitats for Morrison Creek lamprey, and identification of key areas in the watershed that are key to maintaining the natural flow regime.

Forest harvesting has been and continues to be a prominent activity in the headwaters of Morrison Creek, but impacts associated with it are likely decreasing as forestry activity declines in the watershed. Remaining threats may, however, be more difficult to regulate as much of the watershed is private land and therefore not subject to the provisions of the *Forest and Range Practices Act* (BC). The primary potential threats to aquatic habitat from forestry practises include sedimentation, riparian habitat destruction, and changes in water quality. There is a broad literature demonstrating the negative effects of suspended sediments on fish and egg survival. Moderate increases in fine sediment inputs associated with logging may be a benefit for lamprey ammocoetes in sediment-poor drainages, because ammocoetes rear in depositional habitats with fine sediments, conditions that are often lacking in high gradient coastal watersheds (Beamish 1998). Excessive sediments inputs, however, may negatively impact spawning habitat and perhaps other lamprey habitats. Sediment is unlikely to be a limiting factor for lamprey in the Morrison Creek watershed, which is relatively low gradient and has an abundance of glacially-derived substrate.

**Water Use.**— Most residents in the Morrison Creek watershed receive water from the Regional District system, which draws from Comox Lake (J. Palmer, pers. comm.). The exceptions are a small number of properties on wells and the Puntledge Townsite (also known as “Bevan”), which pipes from the springs feeding Supply Creek, a tributary of Morrison Creek. This source supplies 10 homes and, for part of the year, a small volunteer salmon hatchery (water licensee: Courtenay and District Fish and Game Protection Association).

A water licence query ([http://www.elp.gov.bc.ca:8000/pls/wtrwhse/water\\_licences.input](http://www.elp.gov.bc.ca:8000/pls/wtrwhse/water_licences.input) Land and Water BC 2005) lists 8 water licences on Morrison Creek and 12 on Supply Spring. The licences on Morrison Creek sum to  $8515 \text{ m}^3 \cdot \text{yr}^{-1}$ , but several do not specify an instantaneous limit to diversion. Licences on Supply Spring sum to  $143,907 \text{ m}^3 \cdot \text{yr}^{-1}$ , with about 93% of this allocated to the fish hatchery. Actual consumption patterns are not known (Kreye et al. 1996), so it is not possible to assess the effect of water diversions on stream flows. The future demand for water is difficult to predict, but since the main source of water for residential use is Comox Lake, it is possible that future demands for Morrison Creek water will not increase substantially.

In addition to licensed users there are likely unlicensed water users in the Morrison Creek watershed. The threats to Morrison Creek lamprey posed by unlicensed water users is not known, but seems unlikely to exceed the threats posed by licensed users.

**Water Quality.**— Water quality issues have not been raised as a severe threat to this point, although there are several concerns. Contaminated groundwater from the Pidgeon Lake landfill discharges into Morrison Creek and Nellie Creek to the northeast, and Comox Lake to the west. Potential impacts on water quality associated with this pollutant source have not been evaluated. The boundary expansion of the Village of Cumberland into the upper Morrison Creek watershed will likely be followed by increased urbanization. Run-off from additional developed area is likely to lead to water quality declines in the stream, as water comes into contact with roads, buildings, lawns and other urban surfaces. This threat may require additional assessment in the future as related information becomes available.

**Prey Base.**— Based on lab studies, adult *L. richardsoni* var. *marifuga* are believed to be external parasites of other fish species, although feeding behaviour has not been observed in the field (Beamish 1985; Beamish et al. 1999). Human impacts on prey species (e.g., recreational and commercial fishing, habitat degradation and destruction) are therefore expected to directly affect abundance of Morrison Creek lamprey. Ammocoetes are filter feeders, feeding on detritus and suspended organic matter while living in burrows in soft sediments. Activities that alter the productivity of this food base are expected to also affect abundance of Morrison Creek lamprey. There have been no quantitative assessments of the threats to the prey base of Morrison Creek lamprey, but Ellefson (2003) lists a number of concerns associated with forest harvest and urban development in the Morrison Creek watershed and their effect on fish and fish habitat.

**Climate Change.**— Scientific evidence clearly indicates that climate is changing and animal and plant distributions are responding to these changes (Parmesan and Yohe 2003). Since climate affects precipitation, water flow and temperature in many ways, it may also affect Morrison Creek lamprey abundance and distribution. This threat is of concern; however, it presents a less immediate risk to the lamprey population than other threats, and at present the topic is considered beyond the scope of this recovery strategy. The threat may be assessed and addressed at future stages of recovery planning for Morrison Creek lamprey. Ensuring the stability of groundwater and headwater flows to the system is probably the most effective way to buffer against impacts associated with climate change. The existence of significant groundwater inputs to baseflow in Morrison Creek indicates that it may be more resilient to climatically-driven increases in air temperature than other systems on the east coast of Vancouver Island, so that the watershed may become a potential refuge for coldwater species in the future.

**Research.**— Scientific study itself may have an impact on this form, although the magnitude of effect is not known. Specific activities that may impact the population status include electrofishing for salmonid assessments (this may especially affect ammocoetes), installation and operation of salmonid fish-counting fences (this may hinder migration of adult lamprey), and capture of individuals for study (this may affect lamprey population status if the take rate is high relative to abundance and reproductive rate).

**Recreation.**— The Morrison Creek watershed is a popular recreation area for local residents. Hiking, mountain biking, and horseback riding are all common. The threats to Morrison Creek lamprey from these activities do not appear to be substantial.

#### 4. HABITAT TRENDS

Current and historic data are lacking for quantity and quality of Morrison Creek lamprey habitat, so trends are unknown. Land use practices, water diversion, and other human activities have likely caused some decline in habitat quantity and quality, but the magnitude of change is difficult to determine. In general, there has been considerable residential and commercial development in the lower watershed, whereas the upper watershed has been affected more by historic and ongoing forest harvest as well as some historic coal mining. The Village of Cumberland has recently expanded its boundaries to include half of the upper Morrison Creek watershed (Ellefson 2003). This expansion will likely increase urbanization of the watershed, with associated loss or degradation of aquatic habitat. This potential for future urbanization is of serious concern and must be addressed if Morrison Creek lamprey are to be adequately protected. Land-use impacts are evident in some parts of the mainstem of Morrison Creek, where streambanks have been degraded and there has been a loss of pool-riffle complexes (B. Allen, personal communication cited in Beamish et al. 1999). Contaminated groundwater from the Pidgeon Lake landfill discharges partially into Morrison Creek (Ellefson 2003) and there is concern that leachate from defunct coal mines is continuing to affect water quality (J. Palmer, pers. comm.).

Two Environmental Conservation Areas are found in the Morrison Creek headwaters. Beecher Linton donated a 9.66 hectare wetland lot encompassing part of the mainstem of Morrison Creek and parts of seven tributaries. In addition, Comox Timber Ltd. constructed two fish habitat mitigation channels encompassing a total of 2.8 hectares (Ellefson 2003).

The upper portion of the watershed is largely rural, much of it second growth managed forest land currently owned by Hancock Timber Resources. This land is apparently in the process of being sold (J. Palmer, pers. comm.). The lower portion of Morrison Creek is highly urbanized, but remains intact and relatively healthy.

#### 5. HABITAT PROTECTION

There are no habitat protection provisions specifically for Morrison Creek lamprey, however, the variety likely benefits from existing legislation (Fisheries Act) that protects fish habitat generally. Further, the Riparian Area Regulation under the *Fish Protection Act* (BC) requires municipal governments to protect riparian habitats subject to urban development, the *Water Act* (BC) regulates any proposed works 'in and about a stream', and provisions under provincial forestry legislation address some habitat protection issues related to forest harvesting on private lands. Lamprey likely also benefit from habitat protection and enhancement efforts aimed at other fish species. These include the two Environmental Conservation Areas in the Morrison Creek headwaters, a 9.66 ha lot encompassing wetlands, the mainstem of Morrison Creek and portions of seven tributaries (donated by Beecher Linton), and two fish habitat mitigation channels of 2.8 ha (donated by Comox Timber Ltd.).

The Fisheries Act provides legal protection of fish and fish habitat and would apply to much of Morrison Creek. The Species at Risk Act has legal prohibitions that protect Morrison Creek lamprey individuals, residences and critical habitats.

## 6. CRITICAL HABITAT

Identification and protection of critical habitat is vital for management of species at risk. While defining critical habitat is one of the most challenging aspects of species management, it is vital to ensuring a species' long-term survival. This rationale is central to endangered species legislation in general, and specifically to the Species at Risk Act (SARA), where critical habitat is defined as:

*"...the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species."* [s. 2(1)]

The need to designate and protect critical habitat is clearly recognized by scientists, resource managers, and the general public. Despite its complexity, the core issue is the same for all species: to determine the role of habitat in population limitation, and to answer the question, How much habitat is necessary for the survival and recovery of a listed wildlife species?

### 6.1 Identification of the Species' Critical Habitat

At this point, it is possible to indicate some habitats that are important. For example, it is understood that as an ammocoete Morrison Creek lamprey inhabits fine sediments, often along the stream margin, and in small, low gradient tributaries. It is also known that during spawning, Morrison Creek lamprey use shallow gravel beds for their nests. Clearly, these habitats, or portions of them, may feature in the identification of the species' critical habitat. However, due to a number of information gaps, we are unable to provide a defensible demarcation of critical habitat at this time.

### 6.2 Schedule of Studies

Very little is known about Morrison Creek lamprey. We therefore propose undertaking a series of tasks to allow delineation in the wild of critical habitat for Morrison Creek lamprey. The precise nature of each task will be developed in the Action Plan.

**Habitat Use.**— The first task is to develop a better understanding of habitat use by different life stages of Morrison Creek lamprey. A description of the basic habitat associations for each life stage is a core information need for defining critical habitat (Rosenfeld and Hatfield 2006). There is a general understanding of habitat types used by Morrison Creek lamprey ammocoetes and spawning adults. A more precise definition would be beneficial. Where possible, habitat requirements will be defined in terms of microhabitat components such as depth, substrate type and condition, water velocity, etc. There are related items within this task. One is the development of tools that would allow definitive identification of individual ammocoetes as belonging to either *L. richardsoni* or *L. richardsoni* var. *marifuga*. Another is to synthesize and report on information collected during previous investigations, such as those by R. Beamish. (Projected start date: 2007; Projected completion date: 2008)

**Habitat Availability.**— The second task is to review historic and current habitat availability. Information on the extent and distribution of different habitat types available to a species is also a key component of critical habitat delineation. Studies are required that describe abundance and distribution of different habitats in the wild. Where possible, historic habitat availability should be explored to help provide context for the present condition and the final delineation of critical habitat. (Projected start date: 2007; Projected completion date: 2008)

**Historic and Present Population Abundance.**— Task 3 will be to review historic and current population abundance, as part of the process of setting recovery targets. Both the current and historic population abundance provide meaningful context for the recovery target, though we recognize that historic abundance may be difficult to ascertain with accuracy. It may be possible to assess historic abundance through the analysis of trapping data collected during R. Beamish's earlier investigations. (Projected start date: 2007; Projected completion date: 2009)

**Recovery Targets.**— Clearly defined population recovery targets for each life stage are integral to the identification of critical habitat because the quantity of habitat designated as critical must be related to a population benchmark (Rosenfeld and Hatfield 2006). Setting recovery targets may require several steps and the collection of several pieces of information. Recovery targets may be based on rules of thumb (e.g., Thomas 1990; IUCN 2001; Reed et al. 2003), numeric analyses such as population viability analysis (PVA; Morris and Doak 2002), or using a combination of techniques. For organisms such as Morrison Creek lamprey, where relatively little information exists and additional information takes a long time to collect, it may be beneficial to use targets based on rules of thumb. However, it is nevertheless valuable to examine such targets by assessing key population parameters (e.g., survival and fecundity) and to undertake specific population modeling (e.g., elasticity analysis, see Gross et al. 2002) to explore which life stages are most limiting to lamprey abundance. It will be necessary to set targets for each major life stage (Rosenfeld and Hatfield 2006). (Projected start date: 2007; Projected completion date: 2008)

**Relationship Between Habitat and Abundance.**— Designation of critical habitat requires quantitative relationships between habitat and abundance because these relationships are needed to establish the amount of habitat required to achieve a population recovery target (Rosenfeld and Hatfield 2006). Developing such a relationship is not a straightforward task and may need to rely, at least in part, on expert judgement. (Projected start date: 2007; Projected completion date: 2009)

**Define Critical Habitat.**— The final step in delineating critical habitat is to use population targets and relationships between habitat types and abundance to determine how much of the different habitats are required to maintain a viable population of Morrison Creek lamprey, and to then identify the specific locations of these habitats in the wild. (Projected start date: 2007; Projected completion date: 2010)

### **6.3 Examples of Activities That Are Likely to Result in Destruction of Critical Habitat**

Until critical habitat is formally delineated it is not possible to provide specific guidance on which activities are most likely to destroy critical habitat, other than in very general terms. For example, lamprey have habitat requirements similar in many respects to those of salmonids, so activities likely to degrade salmonid habitats can be expected to also have negative impacts on lamprey. The more general threats to some of the important habitat types for Morrison Creek lamprey are discussed in Section 3. These threats and activities should be assessed for their effects on critical habitat and the steps necessary to mitigate negative effects.

## RECOVERY

### 7. RECOVERY GOAL

The recovery goal for Morrison Creek lamprey is to secure 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.

### 8. RECOVERY OBJECTIVES

Recovery objectives are stated as follows:

1. Maintain a self-sustaining population of Morrison Creek lamprey within Morrison Creek.
2. Maintain, and where possible enhance, the ecological integrity of habitat for Morrison Creek lamprey.
3. Resolve taxonomic uncertainties related to Morrison Creek lamprey for the purposes of its effective protection and recovery.
4. Increase scientific understanding of Morrison Creek lamprey through additional investigation of its natural history, critical habitat and threats to its persistence.
5. Foster awareness of Morrison Creek lamprey and its conservation status, and encourage active local involvement in stewardship and habitat protection.

### 9. APPROACHES TO MEETING RECOVERY OBJECTIVES

The general approach recommended in this recovery strategy includes:

- establish and support stewardship initiatives,
- undertake specific research activities to fill knowledge gaps and clarify threats,
- delineate and protect key habitats,
- minimize impacts from land and water use within the context of a broader watershed development plan, and
- design and implement sound monitoring programs.

A description of the recommended approaches and actions is presented in Table 1. These actions will be further detailed in the Action Plan, to be created by the Recovery Implementation Group. Further plans and decisions may require involvement of stakeholders and participants including government agencies, First Nations, private land owners, industry and local stewardship groups.

**Table 1.** Prioritized strategies and recommended actions for the recovery of Morrison Creek lamprey.

Priority <sup>1</sup>	Strategy	Actions	Performance Measure <sup>2</sup>
Necessary	Establish and support a Recovery Implementation Group (RIG) for Morrison Creek Lamprey.	<ol style="list-style-type: none"> <li>1. Invite stakeholders and interested parties to participate in a RIG.</li> <li>2. Encourage local governments to have membership or representation on RIGs to facilitate Recovery Action Plan communication and implementation.</li> <li>3. Establish the RIG leadership (chair, facilitator, etc.), develop terms of reference, and obtain necessary funding to support RIG activities.</li> <li>4. Develop and implement an Action Plan, which is to be guided by the Recovery Strategy.</li> </ol>	Has a RIG been established? Is the RIG adequately supported with funding and technical expertise? Has the RIG developed an Action Plan? Is the RIG achieving the goals outlined in the Recovery Strategy?
Necessary	Address information gaps that inhibit conservation of Morrison Creek lamprey.	<p>Address key information gaps including:</p> <ol style="list-style-type: none"> <li>1. synthesis and reporting of information from previous studies,</li> <li>2. phylogenetic studies to clarify taxonomic status,</li> <li>3. adult diets,</li> <li>4. habitat use and requirements,</li> <li>5. life history information and identification procedures for different life stages,</li> <li>6. causes of mortality (e.g., temperature, pollutants, predation, siltation of incubation habitat, etc.)</li> <li>7. limiting factors to population growth.</li> </ol>	Are there key information gaps that inhibit conservation of Morrison Creek lamprey?
Primary	Clarify threats to Morrison Creek lamprey.	<p>Undertake appropriate research to clarify threats, including:</p> <ol style="list-style-type: none"> <li>1. Assess effects of land and water use on the productivity of lamprey habitats.</li> <li>2. Develop guidelines to mitigate potential threats related to development or water use.</li> </ol>	Have threats been clarified and assessed? Are threats being mitigated?

<sup>1</sup> Priority has been assigned based on professional judgement into one of three groups, from highest to lowest: necessary, primary, secondary.

<sup>2</sup> Performance measures plot the progress toward meeting the stated objectives. The performance measures are presented here as questions, the answers to which can be plotted in time to monitor progress.

<b>Priority<sup>1</sup></b>	<b>Strategy</b>	<b>Actions</b>	<b>Performance Measure<sup>2</sup></b>
Primary	Conduct studies to help define critical habitat for Morrison Creek lamprey.	Undertake necessary research to define critical habitat and to delineate it in the wild. See Section 6.2 for a list of necessary research activities.	Has critical habitat been defined for Morrison Creek lamprey?
Primary	Develop a watershed-scale sustainability plan that includes: 1) identification of key habitat, flow, and water quality values for lamprey, and 2) guidelines to avoid localized and watershed-scale impacts, that can be incorporated into effective decision making.	RIG will work with stakeholders to ensure that watershed development plans for the drainage address key habitat concerns.	Have key areas in the watershed (i.e., those that are disproportionately important for maintaining habitat and the natural flow regime) been identified? Has a watershed plan that recognizes these habitats as important been developed? Have key habitats been effectively protected?
Primary	Develop and implement a long-term monitoring program.	Recovery Team and RIG to develop a monitoring program to assess population response to management activities or threats. Monitoring may include: <ul style="list-style-type: none"> <li>• trends in abundance of Morrison Creek lamprey and its prey species,</li> <li>• trends in habitat quantity and quality,</li> <li>• water quality,</li> <li>• land use, and</li> <li>water use.</li> </ul>	Have monitoring programs been implemented? How long has a monitoring program been in place? Is it effective? Is it a benign activity for the population? Is funding secure for the long term?
Primary	Establish water quality and water use objectives for Morrison Creek.	<ol style="list-style-type: none"> <li>1. Assess the need for species-specific water quality or quantity objectives.</li> <li>2. Work with relevant agencies as required to achieve objectives</li> <li>3. Assess the need for a comprehensive water management plan for Morrison Creek.</li> </ol>	Have water quality and water use objectives been established and communicated to relevant regulators and stakeholders?



Priority <sup>1</sup>	Strategy	Actions	Performance Measure <sup>2</sup>
Secondary	<p>Develop and implement an information and education plan that includes the following elements:</p> <ol style="list-style-type: none"> <li>1. public education material regarding the variety and the threats to its persistence</li> <li>2. presentation materials for public schools</li> <li>3. educational signage for appropriate placement</li> </ol>	<p>RIG to work with government agencies and educators to develop</p> <ol style="list-style-type: none"> <li>1. educational material (e.g., an educational brochure, web-based material) to explain the general biology of the variety, its biodiversity values and threats to its persistence. Consider developing material for project WILD &lt; <a href="http://www.hctf.ca/wild/about.htm">http://www.hctf.ca/wild/about.htm</a>&gt;</li> <li>2. educational material for use in public schools, particularly schools in the vicinity of Morrison Creek.</li> <li>3. educational signage for placement at specific locations (e.g., road crossings, habitat enhancement projects, etc.). Obtain funding for sign construction and maintenance.</li> </ol>	<p>Have educational materials been produced? Has public perception and awareness been affected? How many classes have received educational presentations? Has public perception and awareness been affected? Has public perception and awareness been affected?</p>
Secondary	<p>Work with local government, land developers, and others to improve and encourage watershed stewardship.</p>	<p>Develop criteria for assessing effects of land developments (including forest harvest and urban development) on lamprey habitats, develop guidelines for good stewardship, establish Wildlife Habitat Areas where appropriate, and establish Special Development Areas where appropriate. For private lands, work with land owners to encourage good stewardship. Develop and implement Best Management Practices, as needed. Develop and use conservation covenants where useful.</p>	<p>Have forest harvest and land management criteria been developed? Have WHAs been established where needed? Is forest harvest and land development meeting the criteria? Have BMPs been developed and communicated? Is there compliance with BMPs?</p>
Secondary	<p>Develop sound protocols for scientific investigations (e.g., limit number of fish collected each year, etc.)</p>	<p>Recovery Team to work with government agencies to set boundaries for experimental work and collection activities. Note: SARA permits are required to legally collect and undertake research on a listed wildlife species.</p>	<p>Have scientific investigation protocols been set and communicated? Have they been implemented?</p>

## 10. ANTICIPATED CONFLICTS OR CHALLENGES

Morrison Creek lamprey are currently of little or no economic value, and this is unlikely to change. By contrast there are other public, private and commercial interests in watersheds in which the variety resides. These interests include forestry, water extraction, roads, and residential and commercial property development. It is possible or likely that mitigating threats to lampreys will conflict with development pressures. Recovery of the variety will therefore benefit from stewardship and specific research over the long-term. It is important to understand that many of the threats to Morrison Creek lamprey can be reduced but not eliminated.

Stewardship – The present model for managing most species at risk relies on establishing community-based stewardship groups that will be responsible for implementing recovery actions in one or more watersheds. This model assumes that there is, over the long term, a pool of willing volunteers, sufficient funding to support the necessary management activities, and available technical expertise to support participants in the stewardship groups. The validity of these assumptions is not known.

Research – There are two areas that require immediate targeted research to overcome specific challenges: defining critical habitat, and clarifying threats to lamprey habitat. A description of these needs is provided in Section 6 and 13.

### 10.1 Potential Management Impacts for Other Species

Morrison Creek lamprey are parasitic and have the potential to affect the abundance of other fish species, including salmonids. Thus, the introduction of this variety into other watersheds is not recommended. No goal of establishing this variety in other watersheds has been put forward.

It is unlikely that recovery efforts aimed at Morrison Creek lamprey will have a negative effect on other fish or wildlife species indigenous to Morrison Creek. For example, the impact of lamprey on the adult population of resident and anadromous prey species is not known, but unlikely to be substantial. Numeric enhancement of the variety is not being recommended, and protection of lamprey habitats will likely benefit other species too.

## 11. RECOVERY FEASIBILITY

Morrison Creek lamprey are found only in Morrison Creek and they are unlikely to be purposely transplanted elsewhere in BC. Thus, their population will continue to be limited to a small area. Indeed, it is this extreme endemism that supports its current status as endangered, and which likely entails that the species will always remain at some risk. Recovery actions will be aimed at maintaining or improving current habitat conditions (including hydrology and water quality), monitoring the population, and undertaking specific research tasks. With the support of local governments, local industry and the public, recovery is deemed to be technically and biologically feasible.

As part of the SARA process, the competent minister must determine the feasibility of recovery for each species at risk. To help standardize these determinations, the current Policy on Recovery Feasibility (Government of Canada 2005) poses four questions, which are to be addressed in each recovery strategy. These questions are posed and answered here.

1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?

Yes. Morrison Creek lamprey naturally have a very restricted distribution. The population is believed to be self-supporting, although population status is unknown. Regardless of population abundance and trends the variety will continue to be at risk due to limited geographic range.

2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?

Yes. Sufficient suitable habitat exists in Morrison Creek.

3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?

Yes. Controlling threats to Morrison Creek lamprey is feasible, but rests more on social than technical considerations. For example, the primary threats are urban expansion, water management and general land use. Most threats, such as those from excessive water use and land development, can be managed with existing regulations, but will require consultation with stakeholders.

4. Do the necessary recovery techniques exist and are they demonstrated to be effective?

Yes. Special recovery techniques are not required for recovery of Morrison Creek lamprey. What is required is effective watershed management and mitigation of current and future threats, which is believed to be entirely feasible. It should be stressed, however, that Morrison Creek lamprey will likely always be very restricted in their distribution. As a result, they will likely always remain at some risk. Recovery efforts are best concentrated on controlling threats. There are no significant technical challenges in this regard.

In conclusion, with the support of local governments, local industry and the public, recovery is deemed to be technically and biologically feasible.

## **12. RECOMMENDED APPROACH / SCALE FOR RECOVERY**

This recovery strategy recommends the use of a single species approach (rather than an ecosystem approach) because it addresses a single taxonomic unit. There are no apparent opportunities to combine recovery efforts for Morrison Creek lamprey with recovery efforts for other listed species in the immediate area. There is an opportunity to share information with recovery efforts for the Cowichan Lake Lamprey, another extreme endemic on Vancouver Island. In addition, every effort should be made to provide input to management planning initiatives, actions, or policies.

Although very little is known about the Morrison Creek lamprey, it is likely that there is a significant overlap between the types of habitats used by salmonids, especially with regards to spawning. As such, there are opportunities to co-ordinate recovery efforts with those of efforts by local stewardship groups currently focused on salmonid populations. Efforts to protect salmonid habitats in Morrison Creek are likely to help protect lamprey also.

Stream habitat quality is directly affected by upstream activities, so it is recommended that the approach for recovery occur at both the watershed and site scales. Development must consider the potential that cumulative impacts may lead to significant changes in the natural flow regime or habitat quantity and quality, which requires planning at the watershed scale and compliance with existing regulations and best management practices. Pending sufficient information, specific sites or tributaries may be identified as critical habitat and therefore a priority for instream habitat protection.

### **13. KNOWLEDGE GAPS**

Basic knowledge exists about the natural history of this variety; however, gaps exist with respect to population demographics, critical habitat, and tolerance to changes in physical habitat. Less is known about the ecology of Morrison Creek lamprey, the environmental factors that affect abundance and distribution, and the threats to this variety. Meeting conservation goals will require addressing several knowledge gaps. The gaps fall into three main categories, as outlined below.

#### **Basic Biology**

- Taxonomic status and phylogenetic relationships,
- Habitat use and requirements by life stage (e.g., population distribution within the drainage; differential use of particular tributaries)
- Which habitats are most likely to be limiting,
- Life history information,
- Adult diets,
- Causes of mortality (e.g., temperature, pollutants, predation, siltation of incubation habitat, etc.),
- Factors limiting population growth.

#### **Threat Clarification**

- Effects of changes in water flow and water quality,
- Status of key habitats and potential threats to these habitats,
- Effect of present and future human activities and prioritization of threats.

#### **Population Abundance and Dynamics**

- Current population abundance of Morrison Creek lamprey,
- Natural population fluctuations of Morrison Creek lamprey,
- Current and historic trends in abundance,
- Effect of demographics on habitat use.

### **14. ACTIONS ALREADY COMPLETED AND/OR UNDERWAY**

Several recovery actions have been completed or initiated.

1. A National Recovery Team for Non-game Freshwater Fish Species was established in 2003, and the team developed a draft Recovery Strategy for Morrison Creek Lamprey in 2006.
2. A public consultation process for the draft recovery strategy has been initiated.
3. A variety of scientific investigations have been completed by R.J. Beamish and co-workers (DFO, Nanaimo) and by the Morrison Creek Streamkeepers.

- a. taxonomic investigations, including some molecular genetics work,
  - b. basic biological investigations,
  - c. assessment of the status of Morrison Creek lamprey,
  - d. mapping aquatic habitat in the watershed.
4. Extensive public awareness and education including: brochure creation and distribution; the creation and distribution of stewardship packages to watershed landowners; watershed workshop and walks; public presentations and aiding liaison between the public and governmental agencies concerning local stewardship, web-based information presentation.
5. Habitat restoration projects (not specifically targeting lamprey) have been successfully completed, including instream complexing and bank stabilization, riparian planting, fish passage restoration, and weir construction.

## 15. STATEMENT OF WHEN ACTION PLANS WILL BE COMPLETED

Within two years of the approval of the Recovery Strategy, a Morrison Creek Lamprey Recovery Action Plan will be developed. This plan will include descriptions of programs, plus a timeline of programs with estimated budgets. The plan will encompass a timeframe of at least five years.

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## **APPENDIX I - RECORD OF COOPERATION AND CONSULTATION**

Morrison Creek lamprey is listed on Schedule 1 of the Species at Risk Act (SARA) and as an aquatic species are under federal jurisdiction and managed by Fisheries and Oceans Canada (DFO): 200 - 401 Burrard Street, Vancouver, BC.

To assist in the development of an initial draft of this Recovery Strategy, as well as those for other listed freshwater fishes in British Columbia, DFO in cooperation with the Province of BC assembled a group of experts from various levels of government, academia, consultants, and non-governmental organizations to form the Pacific Region Non-Game Freshwater Fish Recovery Team. This team, co-chaired by DFO and the Province of BC, is responsible for drafting recovery strategies for Pacific Region freshwater fish species listed under SARA, including Morrison Creek lamprey.

Public and stakeholder consultation on the draft Recovery Strategy was provided through a Community Dialogue Session. Invitations were sent to 20 stakeholder groups related to Morrison Creek and area, including provincial and local government, conservations groups, and industry. Notices announcing the session were also placed in six local newspapers. The Community Dialogue Session, consisting of a presentation and discussion on the proposed Recovery Strategy for Morrison Creek lamprey, was held in Courtenay in May 2006, with 15 attendees. Comments from the session were recorded and archived.

First Nations input on the proposed Recovery Strategy was sought through an information exchange session with the Hamatla Treaty Society, which represents local bands near Morrison Creek, including the Comox, Campbell River, Cape Mudge, and Kwiakah First Nations. The session, consisting of a presentation and discussion on the proposed Recovery Strategy for Morrison Creek lamprey, was held in Vancouver in May 2006, with two representatives of the Hamatla Treaty Society. Dialogue from the information exchange was recorded and archived.

Additional input on the draft Recovery Strategy was sought through a discussion guide and feedback form available on the internet (May – June 2006). Two responses were received, from Hancock Forest Management and the Morrison Creek Streamkeepers. Input from the Province of BC was received through recovery team participation. An external peer review was conducted by Dr. Margaret Docker of the University of Manitoba. All feedback received was considered in the finalization of the Recovery Strategy.

### **Recovery Team:**

Jordan Rosenfeld, British Columbia Ministry of Environment (Co-chair)  
Dan Sneep, Fisheries & Oceans Canada (Co-chair)  
Todd Hatfield, Solander Ecological Research (Coordinator)  
Dick Beamish, Fisheries & Oceans Canada  
Don McPhail, University of British Columbia  
John Richardson, University of British Columbia  
Dolph Schluter, University of British Columbia  
Eric Taylor, University of British Columbia  
Jim Palmer, Morrison Creek Streamkeepers

### **External Review:**

Dr. Margaret Docker, University of Manitoba