PROPOSED

***Species at Risk Act***
Recovery Strategy Series

# Recovery Strategy for Lake Utopia Rainbow Smelt (*Osmerus mordax*), Small-bodied Population (sympatric with the Large-bodied Population), in Canada

2016

Canada

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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk Public Registry (www.sararegistry.gc.ca).

**Cover photograph**: Fisheries and Oceans Canada, Maritimes Region

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«Programme de rétablissement de l'éperlan arc-en-ciel (*Osmerus mordax*) du lac Utopia, population d'individus de petite taille (sympatrique avec la population d'individus de grande taille), au Canada. Série des programmes de rétablissement de la *Loi sur les espèces en péril* »


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# Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (*SARA*), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress five years after the publication of the final document on the SAR Public Registry.

The Minister of Fisheries and Oceans Canada is the competent minister for the recovery of the Lake Utopia Rainbow Smelt and has prepared this Recovery Strategy for the SARA-listed Small-bodied Population, as per s. 37 of SARA. This Recovery Strategy also addresses the Lake Utopia Rainbow Smelt Large-bodied Population, which is not currently listed under SARA. To the extent possible, it has been prepared in cooperation with the Government of New Brunswick and with input from those recognized in the "Acknowledgments" section of this document and in consultation with those listed in Appendix B.

Success in the survival of these 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 (DFO), or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Rainbow Smelt, Lake Utopia Small-bodied and Large-bodied populations and Canadian society as a whole.

This Recovery Strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by DFO and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

## Acknowledgements

This document was prepared by Fisheries and Oceans Canada (DFO) using the input, advice, and insight of other researchers, interested stakeholders, Aboriginal organizations, and provincial government agencies (New Brunswick (NB), Department of Natural Resources (DNR), Department of Environment and Local Government (DELG), Department of Agriculture, Aquaculture and Fisheries (DAAF), Department of Transportation and Infrastructure (DTI)).

Much of the material presented in the “Species Information” section of this report was taken from the documentation provided to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Assessment and Update Status Report on the Rainbow Smelt, Lake Utopia Large-bodied Population and Small-bodied Population (COSEWIC 2008). This Recovery Strategy was prepared in accordance with the content requirements for SARA recovery strategies and includes advice provided by the Science Advisory Report from the “Recovery Potential Assessment for Lake Utopia Rainbow Smelt (*Osmerus mordax*) Designatable Units” (DFO 2011). Data on population size were drawn largely from field projects conducted by NB DNR, University of New Brunswick, and partners listed in Appendix C.

DFO also recognizes the dedicated efforts of the former Lake Utopia Dwarf Smelt Conservation and Recovery Team that provided valuable information, expertise, and perspectives for the development of an earlier draft of this Recovery Strategy. The Team met twice a year from 2002 to 2004 and consisted of members representing DFO, NB DNR, academic institutions, industry, and other local stakeholders (see Appendix C for full membership).

Additionally, DFO acknowledges the invaluable input provided by the broader interested public in the consultation process (see Appendix B for a record of consultations).

# Executive Summary

The native Rainbow Smelt (*Osmerus mordax*), inhabiting Lake Utopia, consists of two co-existing morphologically, ecologically, and genetically differentiated (sympatric) populations: a small-bodied form and a large-bodied form (Bradbury et al. 2011). Together the two populations are referred to as the Lake Utopia Rainbow Smelt sympatric species pair, or simply Lake Utopia Rainbow Smelt (LURS). They occur only in this single, small lake in the Magaguadavic watershed in southwestern New Brunswick.

The Lake Utopia Rainbow Smelt - Small-bodied Population (LURS-SbP), previously known as Lake Utopia Dwarf Smelt was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2000. LURS-SbP has been listed as Threatened on Schedule 1 of the *Species at Risk Act* (SARA) since the Act came into force in 2003. In 2008, COSEWIC assessed both the small-bodied and large-bodied populations of LURS and designated each as Threatened. The rationale for this designation was the same for both populations: together, they are part of a unique species pair, they are endemic, and their single occurrence is limited in extent and subject to a number of the same existing and potential threats.

The Lake Utopia watershed supports forestry, agriculture, a pulp mill, aquaculture, year-round human settlement, recreational use, linear developments and water storage for hydroelectric power generation. Collectively, these activities pose threats to water quality and water quantity of the Lake Utopia system, as well as cause direct mortality to LURS and additional impacts to its habitat. These threats are summarized in Table 1 in the "Threats" section of this Recovery Strategy.

For LURS, the significance of both the large- and small-bodied populations as members of a sympatric species pair in Lake Utopia was stressed as an important reason for its Threatened designation by COSEWIC. Accordingly, the survival of the two populations together as a species pair is emphasized in the broad recovery goal of this strategy. To achieve this, the conservation of one population must be treated as inherent to the survival of the other. Therefore, this Recovery Strategy focuses on the LURS species pair, and naturally, each of its constituent populations.

While both populations of LURS continue to be afforded all of the fisheries protection provisions under the *Fisheries Act*, only the SbP is listed on Schedule 1 of SARA and therefore is subject to the prohibitions and recovery planning requirements of the Act. While the Recovery Strategy focuses on the survival of the species pair, where there are legislative applications of this document to SARA, they only apply as it relates to the LURS-SbP. In the future, if the LURS-Large-bodied Population (LURS-LbP) is listed on Schedule 1 of SARA, this Recovery Strategy will be amended to reflect that SARA applies to both members of the species pair.

The broad goal of this Recovery Strategy is to:

> *Maintain the current population distribution and abundance of the small-bodied and large-bodied populations of Lake Utopia Rainbow Smelt and the genetic diversity of the Lake Utopia Rainbow Smelt sympatric species pair.*

This will be accomplished through the achievement of the following population objectives:

- **Genetic Objective**:
    - Maintenance of the genetic diversity and genetic differentiation of LURS within the Lake Utopia system.
- **Abundance Objectives**:
    - Small-bodied Population: 100,000 spawning fish distributed among Second Brook, Unnamed Brook, and Smelt Brook during nights of peak spawning.
    - Large-bodied Population: 2,000 spawning fish in Mill Lake Stream during nights of peak spawning.
- **Distribution Objectives**:
    - Small-bodied Population: Occupation of Lake Utopia year round and annual, synchronous occupation of Second Brook, Unnamed Brook and Smelt Brook for spawning, with no individual stream to be unoccupied for two consecutive years.
    - Large-bodied Population: Occupation of Lake Utopia year round and annual occupation of Mill Lake Stream for spawning.

Survival of LURS is defined by the achievement of these population objectives. Broad strategies and management approaches to work toward this achievement are presented in this Recovery Strategy. They address the limitations and threats to survival identified for the species pair.

Critical habitat for LURS-SbP is described in this Recovery Strategy to the extent possible, using the best information currently available. Following the area of occurrence approach, critical habitat for LURS-SbP has been identified as:

> *The water column, substrate and LbP features of Lake Utopia in the Magaguadavic River watershed in Charlotte County, New Brunswick (total surface area 14km$^2$), and part of the following tributaries of Lake Utopia: Smelt Brook, Unnamed Brook, and Second Brook (total combined length of 586 m)(Figure 3).*

The critical habitat represents all habitat requirements of the LURS-SbP to meet the population objectives of this Recovery Strategy. The fundamental interdependence of the two populations of LURS means that the survival of the LURS-LbP in abundances sufficient to maintain the sympatric dynamic between the two populations is an important feature of the LURS-SbP critical habitat and has been identified as such in this Recovery Strategy. Because only the LURS-SbP is listed under SARA, the critical habitat described below will be protected under SARA only as it relates to the LURS-SbP.

A Schedule of Studies to support the refinement of the identification of critical habitat is also outlined, and examples of activities likely to destroy critical habitat are provided.

Subsection 83(4) of SARA allows for specific prohibitions of the Act to not apply to people undertaking activities that have been permitted by a recovery strategy and authorized under another Act of Parliament. This Recovery Strategy describes several such activities, the scope to which this exception will be applied, and the conditions on which the exceptions rely. These are provided in the section titled “Activities Permitted by the Recovery Strategy”.

One or more action plans for LURS will be developed. Action plans outline actions to be taken to implement the broad strategies and management approaches to work toward the broad goal and population objectives identified in this Recovery Strategy. An action plan will be completed within five years of posting the final Recovery Strategy.

A review of the progress toward the implementation of this Recovery Strategy will take place within five years. It will measure progress toward the achievement of the population objectives using indicators presented in the “Measuring Progress” section of this Recovery Strategy. Success in the survival of this species depends on the commitment and cooperation of many different contributors that will be involved in implementing the directions set out in this Strategy. This will not be achieved by Fisheries and Oceans Canada, or any other jurisdiction alone.

# Recovery Feasibility Summary

Based on the best available information, including information provided by COSEWIC (2008), and the Recovery Potential Assessment (DFO 2011), it has been determined that the survival of both large-bodied and small-bodied populations of Lake Utopia Rainbow Smelt is technically and biologically feasible. For the small-bodied population of LURS, which is listed under SARA, the feasibility of survival or recovery mandates the development and implementation of a recovery strategy.

This determination was made because the following four criteria were met:

1. ***Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.***
   Research indicates that reproductive individuals are available. During the years between 1999 and 2009 when estimates were acquired, daily spawner abundance of the LURS-SbP varied between 3,000 and 150,000 individuals and seasonal estimates of reproductive individuals from years with extensive assessment were in the hundreds of thousands to millions (Curry et al. 2004). The few estimates of population size available for the LURS-LbP are highly variable but all are in great excess of 500 mature individuals, a value associated with self-sustaining salmonid populations. While LURS is not a salmonid, this number was used as a conservative proxy for the minimum number of LURS-LbP required for a self-sustaining population during the 2010 Recovery Potential Assessment (DFO 2011).

2. ***Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.***
   LURS uses Lake Utopia and some of its tributaries to support all its life functions. This existing habitat is currently sufficient to support both the small-bodied and large-bodied populations of the species. The likelihood that additional habitat will be used by the species for spawning is unknown, but opportunities may exist to make additional potential habitat areas accessible to the species (DFO 2011).

3. ***The primary threats to the species or its habitat can be avoided or mitigated.***
   All identified threats to the species are directly related to human activities (COSEWIC 2008). Because of this, and because of the existing regulatory framework and opportunities for stewardship that can be applied, the activities and practices associated with existing threats can be modified to eliminate or reduce their impact on the LURS, or its habitat (DFO 2011).

4. ***Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.***
   The recovery techniques necessary to work toward the achievement of the population and distribution objectives for this species have been identified in this Recovery Strategy (i.e. conducting research to fill knowledge gaps, and using legislation, stewardship, and education to mitigate threats). At present, these

recovery techniques exist and can be used. The specific research questions to be answered and mitigation measures to be taken can be feasibly addressed through the implementation of these existing recovery techniques.

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# 1. COSEWIC Species Assessment Information

**COSEWIC Assessment Summary**

**Date of Assessment:** November 2008

**Common Name (population):** Rainbow Smelt, Lake Utopia **Small-bodied Population** (formerly Lake Utopia Dwarf Smelt)

**Scientific Name:** *Osmerus mordax*.

**Status:** Threatened

**Reason for Designation:** This population is part of a genetically divergent sympatric pair of *Osmerus* that is endemic to a single lake in Canada with an extremely small index of area of occupancy (6 sq. km). It spawns in only three (3) small and ephemeral[1] streams in the watershed and could quickly become extinct through degradation of spawning streams from increasing development around the lake shore. There may be impacts through illegal dip-net fishery. This population is threatened by introduction of exotic species and by increasing eutrophication.

**Canadian Occurrence:**
NB

**Status History:** Designated Threatened in April 1998. Status re-examined and confirmed in May 2000 and November 2008. Last assessment based on an updated status report.

**COSEWIC Assessment Summary**

**Date of Assessment:** November 2008

**Common Name (population):** Rainbow Smelt, Lake Utopia **Large-bodied Population**

**Scientific Name:** *Osmerus mordax*.

**Status:** Threatened

**Reason for Designation:** This population is part of a genetically divergent sympatric pair of *Osmerus* that is endemic to a single lake in Canada with an extremely small index of area of occupancy (6 sq. km). It spawns in only three (3) small streams in the watershed and could quickly become extinct through degradation of spawning streams from increasing development around the lake shore and impacts of the dip-net fishery. This population is threatened by introduction of exotic species and by increasing eutrophication.

**Canadian Occurrence:**
NB

**Status History:** Designated Threatened in November 2008. Assessment based on a new status report.

[1] streams are low-flow rather than ephemeral (Bradford pers. comm. 2011)

# 2. Species Status Information

The small-bodied population of Rainbow Smelt in Lake Utopia, New Brunswick was previously known as Lake Utopia Dwarf Smelt (LUDS) (Figure 1). The species was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2000 and was included on Schedule 1 of the *Species at Risk Act* (SARA) as Threatened in 2003. As new information became available, it was recognized that the native Rainbow Smelt (*Osmerus mordax*) inhabiting Lake Utopia consists of two co-existing morphologically, ecologically, and genetically differentiated populations (Taylor & Bentzen 1993; Bradbury et al. 2011); one being the SARA-listed LUDS, and the other, a larger-bodied form. The two populations are recognized as a rare example of sympatric speciation, whereby a species diverges genetically into two or more populations in spite of their shared geography and the incidence or potential of interbreeding.

In 2008, when LUDS was to be re-assessed by COSEWIC, the assessment included both populations. Each population was treated by COSEWIC as a Designatable Unit (DU) of Rainbow Smelt, having met a criterion commonly used by COSEWIC when deciding whether a species should be assessed as one or more populations (i.e. that the populations are genetically different from one another). They were called the Lake Utopia Small-bodied Population and the Lake Utopia Large-bodied Population. The COSEWIC assessment resulted in a Threatened classification for each DU. The rationale for this classification was the same for both populations and rests on the concept that as a sympatric species pair, Lake Utopia Rainbow Smelt (LURS) represents a unique and irreplaceable unit of biodiversity and that their single occurrence is limited in extent and subject to a number of existing and potential threats.

In this document, the pair is collectively referred to as LURS, and when required separately referred to as the LURS Small-bodied Population (LURS-SbP or SbP) and LURS Large-bodied Population (LURS-LbP or LbP).

The SbP continues to be represented on Schedule 1 of SARA as Threatened. The LbP is currently undergoing the listing recommendation process that is applied for any species newly designated by COSEWIC to determine if it will be listed on Schedule 1 of SARA. In 2010, a single Recovery Potential Assessment (RPA) was held for the two populations of LURS that reinforced the notion that the conservation of LURS as a pair is important. Nonetheless, at the time this recovery document is posted, only one of the two populations of LURS is listed on Schedule 1 of SARA (the SbP) and this has implications on the scope of the Recovery Strategy, which will be discussed in the next section.

# 3. Scope of the Recovery Strategy

The recovery goal and population objectives for a species in a SARA recovery strategy are directly related to the reasons the species was given its COSEWIC designation. In many cases, trends in population size or distribution provide the basis for the designation. Recovery is therefore measured by the achievement of population abundance and distribution objectives that aim to improve the current situation. In the case of LURS, the COSEWIC assessment did not identify negative trends in population abundance or distribution as the reasons for the Threatened designations for the two DUs. Rather, the designations were motivated in part by the notion that the survival of a significant sympatric species pair, representing a globally unique unit of biodiversity, relies precariously on a single occurrence with a limited distribution where a number of threats occur. The focus of recovery for Lake Utopia Rainbow Smelt is therefore more accurately described as the survival of the sympatric species pair (i.e. its continued existence), which involves the survival of each its constituent populations.

That two populations of the same species whose survival is implicitly tied are also considered separate DUs is a paradox brought upon by the rare situation that they maintain genetic discreteness in sympatry. Typically, different DUs of the same species are considered discrete entities whose survival should be independent of one another. They are often evaluated using genetic criteria that indicate that the two populations are reproductively isolated. Despite meeting this COSEWIC criterion to be assessed as two DUs, the focus of recovery for LURS (i.e. the continued co-existence of two genetically distinct populations) recognizes the fundamental interdependence on the survival of both populations (DUs). This requirement, and the fact that the two populations are subject to many of the same threats and limitations, warrants that recovery planning focus on the species pair rather than the individual populations. Therefore, the scope of this Recovery Strategy is the survival of LURS, making distinctions between the two populations where relevant.

Primarily, this Recovery Strategy aims to meet the commitments of SARA and its policies, and as such, distinctions will be made between the two populations to reflect that only the SbP is listed on Schedule 1 of SARA. For example, s. 58 of SARA protects the critical habitat of a listed wildlife species identified in a recovery strategy or action plan. The critical habitat described in this Recovery Strategy is therefore protected by SARA but only as it relates to the SbP. Likewise, s. 83(4) of SARA outlines that exceptions to the prohibitions of SARA are afforded to those activities identified in a recovery strategy. Since the prohibitions of SARA only currently apply to the SbP, the "Activities Permitted by the Recovery Strategy" section of this document only applies to those affecting the SbP.

In the future, if the LbP is listed on Schedule 1 of SARA, the portions of this Recovery Strategy that are intended for legislative applications of SARA will be amended. This document serves the dual purpose of 1) meeting the needs of a SARA recovery strategy for the listed LURS-SbP, and 2) setting out what is needed to achieve the survival of the sympatric species pair. Both populations of LURS are also afforded all of the fish and fisheries protection provisions provided under the *Fisheries Act.*

# 4. Species Information

## 4.1 Species Description

Rainbow Smelt are found in fresh and salt water along the North American coast (Scott and Crossman 1973; Scott and Scott 1988). In New Brunswick, anadromous populations occur in most coastal streams, and lake populations have been detected within approximately 50 inland water bodies, including Lake Utopia (DFO 2011). Adult Rainbow Smelt that occupy freshwater lake habitats are schooling, pelagic fishes that occupy the mid to deep, cool waters of lakes and use tributary streams for spawning (Scott and Crossman 1973; Curry et al. 2004).

The Rainbow Smelt found in Lake Utopia and its tributaries consist of two reproductively isolated populations that are considered to be a sympatric species pair (Curry et al. 2004; Bradbury et al. 2011). Sympatric species pairs are relatively rare and occur where isolating mechanisms result in genetic divergence of the co-existing populations. Aboriginal Traditional Knowledge (ATK) collected from six Maliseet First Nation communities in New Brunswick indicated a “cultural and socio-economic significance of smelts to First Nations and the long-term relationship of Maliseet Indians with the Rainbow Smelt in Lake Utopia” (MNCC 2012). Interestingly, Maliseet elders and knowledge-holders knew little of the existence of the two forms (MNCC 2012).

The two populations of LURS differ with respect to aspects of their physical appearance, most notably their size (Figure 1), which is recommended as the most useful and practical criterion for the general description and operational definition of the SbP (<170 mm fork length) and LbP (>=170 mm fork length) (DFO 2011). The two populations also differ with respect to other physical features: the SbP has larger eyes and a smaller upper jaw relative to its body size, and more gill rakers than the LbP. The SbP also exhibits within population bi-modality in body length within the same age classes (Curry et al. 2004; Bradford et al. 2012; Shaw and Curry 2011). The two populations also differ in aspects of their life-history (Curry et al. 2004; Bradford et al. 2012) and are genetically different (Taylor and Bentzen 1993; Curry et al. 2004; Bradbury et al. 2011). Detailed information describing LURS has been summarized in a Fisheries and Oceans Canada (DFO) research document (Bradford et al. 2012).

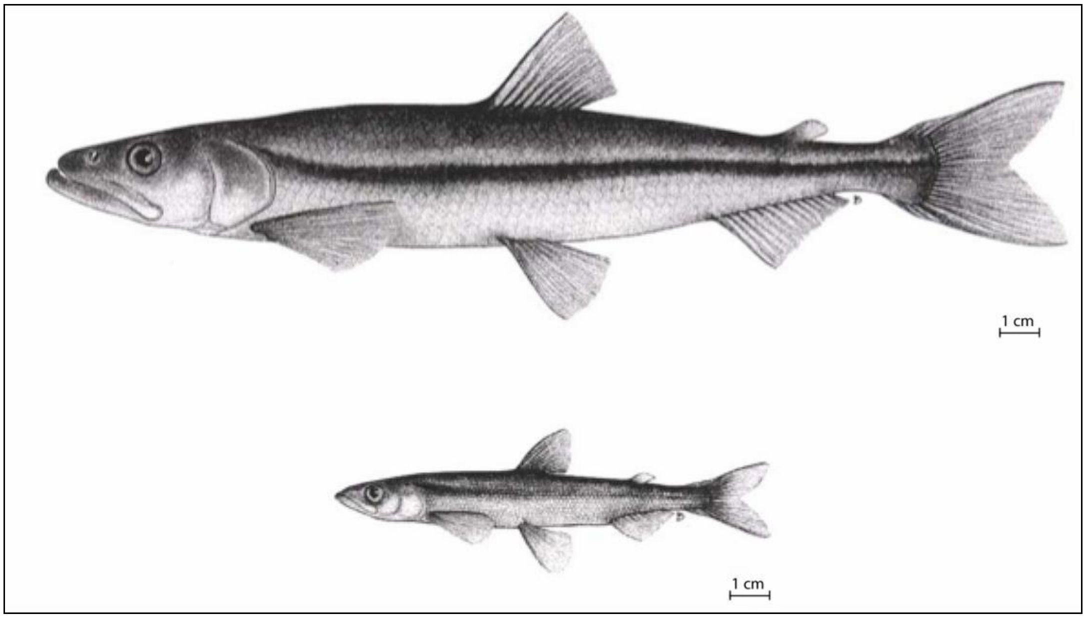


Figure 1. Line drawings of the large-bodied (top sketch) and small-bodied (bottom sketch) forms of Lake Utopia Rainbow Smelt. Both illustrations represent mature males. (Illustrations by Diana McPhail from Taylor 2001).

## 4.2 Population and Distribution

The LURS are naturally and historically limited to Lake Utopia and its tributaries in the Magaguadavic River watershed (DFO 2011) (Figure 2). Each population of the species pair currently demonstrates a stable number of populations (one) and locations (one), as well as a stable extent of occurrence (29 $km^2$) and a stable area of occupancy (6 $km^2$ based on a 1x1 km grid of the three spawning streams for each the SbP and LbP; 12 $km^2$ total for LURS) (COSEWIC 2008). Overall, the population distribution of LURS, albeit small and limited to a single lake, is considered stable (COSEWIC 2008).

Estimates of abundance for LURS-SbP are limited to those of daily spawner abundance and are most frequently on the order of tens of thousands (Curry et al. 2004, COSEWIC 2008; DFO 2011; Bradford et al. 2012). The LURS-SbP is currently considered a self-sustaining population (COSEWIC 2008; DFO 2011). The abundance of LURS-LbP and its ability to self-sustain cannot be assessed with the current data (DFO 2011).

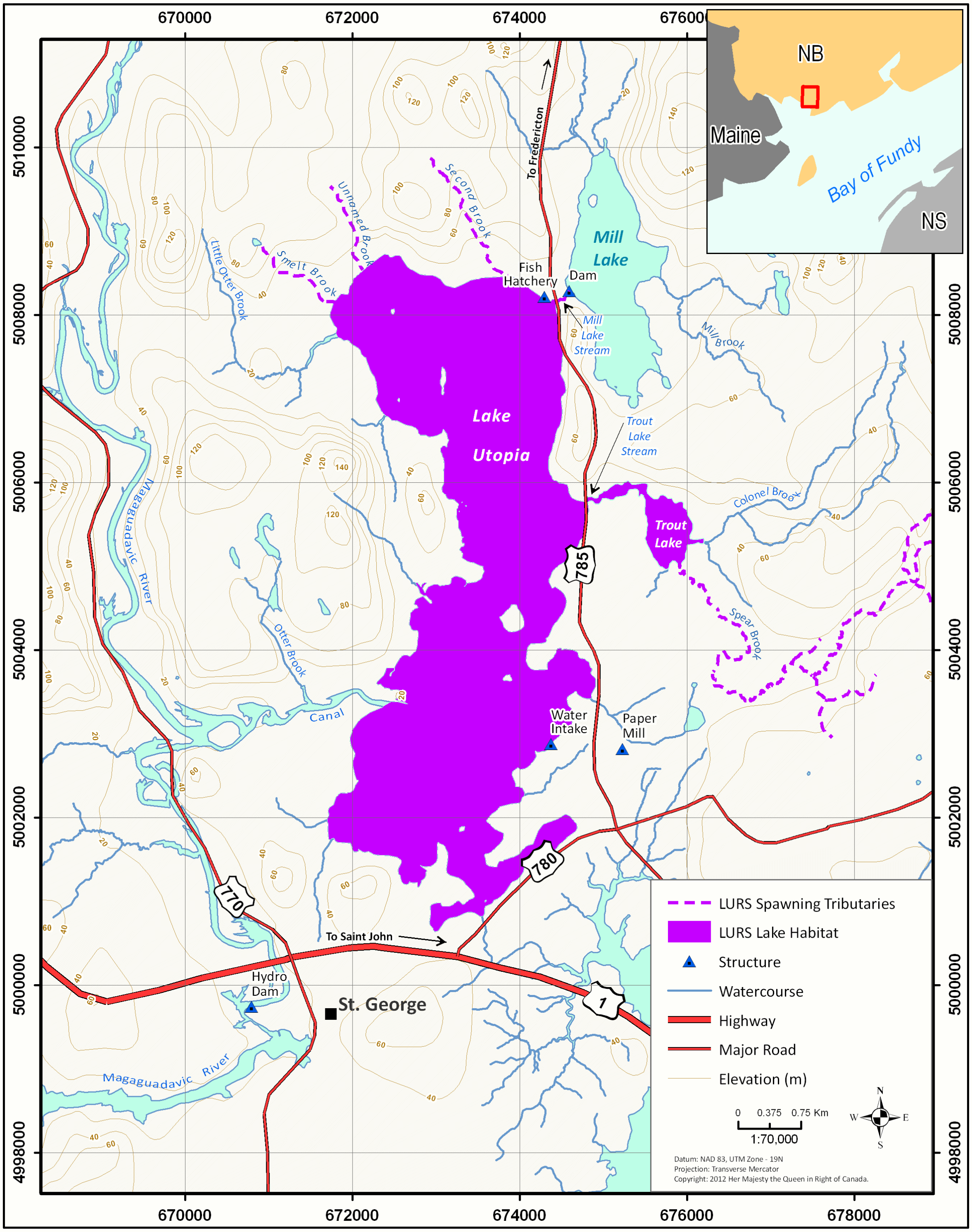


Figure 2. Lake Utopia is located in the Magaguadavic River watershed that flows into the Bay of Fundy in southwestern New Brunswick. Lake Utopia is connected to the lower Magaguadavic River via an outflow called The Canal. Spawning tributaries for the LURS are highlighted and industrial structures are also identified. (Datum: NAD83, UTM Zone 19N; Projection: Transverse Mercator; © 2011 Her Majesty the Queen in Right of Canada).

## 4.3 Needs of the Lake Utopia Rainbow Smelt

The sympatric species pair of Rainbow Smelt in Lake Utopia is a product of Lake Utopia and its tributaries and the conditions that have promoted and maintained their genetic divergence. Similarly, the conditions have also allowed for each population to persist in its own right.

Lake Utopia is a relatively small (surface area = 14 $km^2$), oligotrophic to mesotrophic coldwater lake that has ice-cover from mid-December to mid-April, and exhibits thermal stratification during the summer (Hanson 2003). Larvae can be found throughout the surface waters of Lake Utopia at night (Shaw 2006), and though adult Rainbow Smelt are known to be pelagic, schooling fish that feed primarily on zooplankton (Scott and Crossman 1973), little is known of the distribution of the two populations within Lake Utopia or the use of the lake at various life stages. Notably, LURS-LbP shows physical adaptations for a piscivorous diet, suggesting that the use of the lake by the LbP may be different from what would be expected from typical Rainbow Smelt adults in other lakes.

The current understanding of spawning habitat use (described below) is based on unpublished data from the New Brunswick Department of Natural Resources (NB DNR 2002, unpublished data) and research conducted by Curry et al. (2004). These data were used to inform the COSEWIC Assessment and Status Report (2008), RPA (DFO 2011) and helped to identify critical habitat.

LURS uses five tributaries of Lake Utopia; the SbP uses three streams and the LbP uses the remaining two (Figure 2). The three tributaries used by the SbP are located at the north end of Lake Utopia (Second Brook, Unnamed Brook, and Smelt Brook). The two spawning tributaries used by the LbP (Mill Lake Stream and Trout Lake Stream) are located on the northeast side of Lake Utopia, contain smaller lakes, and are larger and generally warmer than those used by the SbP. In the Trout Lake Stream tributary, which includes Trout Lake, LURS-LbP has been observed spawning both in Trout Lake Stream itself and in Spear Brook, a tributary of Trout Lake (Taylor 2001; Curry et al. 2004; DFO 2011; Bradford et al. 2012). The Mill Lake Stream tributary contains Mill Lake, although a dam prevents any upward fish passage into the lake. The LbP begins spawning activities earlier in the spring than the SbP and there is little overlap between the two spawning periods (Bradford et al. 2012).

New spawning stream monitoring efforts by the New Brunswick Aboriginal Peoples Council (NBAPC) began in spring 2013. During the 2013 spawning season, LURS-SbP were observed in Mill Lake Stream after spawning activity by the LbP appeared to be complete (IKANAWTIKET Environmental Incorporated, 2014). Numerous LURS-SbP were also observed in Mill Lake Stream by a DFO Conservation Officer in April, 2014 (MacDougall pers. comm. 2014). These observations suggest that LURS-SbP may be spawning in Mill lake Stream. Further investigation is required to validate these results and to determine if LURS-SbP consistently use Mill Lake Stream for spawning, For the purposes of this Recovery Strategy, LURS-SbP spawning habitat refers to Second

Brook, Unnamed Brook and Smelt Brook. Any further information on LURS-SbP spawning habitat will be considered and incorporated into future recovery documents.

Details describing the specific attributes of the lake or stream habitat used by LURS have been summarized in Bradford et al. (2012). The specific attributes that are essential to the species survival are, however, unknown. Until further information is available, the needs for LURS can only be generally described. These include the ecological conditions provided by Lake Utopia and the spawning tributaries, including the trophic status of the lake; the access to, and functionality of, the five spawning tributaries used by LURS; and, a biological community within the system conducive to the growth and survival of a sufficient number of reproductive adults. The stability of the conditions that support those ecological and life-history differences that work to maintain the reproductive isolation and consequent genetic diversity between the different forms of the sympatric species pair is also likely necessary (DFO 2011).

# 5. Threats

## 5.1 Threat Assessment

Table 1 lists threats to the LURS resulting from human activities. Threats were initially identified through the status assessment performed by COSEWIC (2008) and further identified and evaluated through the RPA undertaken by DFO (2011) and through Bradford et al. 2012. Threats have been grouped under four main categories of impact: direct mortality, impacts to habitat, water quantity, and water quality. To guide management priorities, each threat is summarized in Table 1 with respect to several criteria that assist in establishing the relative level of concern of the threats to the survival of the species. The level of concern for a threat in this section refers to the importance of managing the threat when working toward the achievement of the population objectives for survival. It considers all of the information provided in Table 1 for a particular threat (i.e. extent, occurrence, frequency, severity, causal certainty, and adequacy of existing mitigation). Unless otherwise indicated, the assessment of a criterion for a threat is the same for both the SbP and LbP. The threats under each general category of impact, their underlying causes, and the potential effects on the species are discussed in Subsection 2. Planned management of the threats will be discussed in the "Broad Strategies and General Approaches to Meet Population Objectives" section.

## 5.2 Description of Threats

The Lake Utopia watershed supports forestry, agriculture, a pulp mill, aquaculture, year-round and seasonal human settlement, recreational use (e.g. boating, all-terrain vehicle use, hunting and fishing), linear developments (e.g. roads, railways and transmission lines) and water storage for hydroelectric power generation. Lake Utopia and its tributaries are susceptible and vulnerable to Aquatic Invasive Species (AIS), which may arrive either through deliberate or accidental pathways (DFO 2011). The levels of concern for different activities posing a threat to LURS vary as does the certainty regarding their actual impacts. The cumulative and interactive effects of concurrent activities taking place are difficult to predict, however the collective product of their impacts potentially pose the most significant threat to LURS and its habitat.

### 5.2.1 Threats to Habitat

*Forestry and Land-Alteration Activities*

The Magaguadavic River watershed is currently subject to widespread and recurrent forestry activities and land alteration for other purposes like residential, urban and recreational developments. There is particular concern where these activities occur within the drainage basins of LURS spawning streams. Forestry activities include the harvesting of trees as well as other activities that may have short or long term effects on the environment (e.g. road construction). The provincial government (NB DELG on private land and NB DNR on crown land) regulates any harvesting that takes place within a 30m buffer zone along watercourses to ensure that water quality and aquatic habitat are not compromised (NB DNR 2004; NB DELG 2012). Given the essential role of the spawning habitat, further study of the current and potential impact of these activities on LURS spawning streams (e.g. stream temperature, soil compaction, surface run off, ease of access) and the effectiveness of current regulations and guidelines is warranted. This threat is likely of greater concern for the SbP because the SbP streams are both smaller and south-facing, which makes them more vulnerable to impacts relating to hydrology and temperature.

While forestry and development are currently and continuously taking place in the watershed, impacts to LURS habitat from these activities are not of the same immediate concern as impacts from localized activities taking place near spawning habitat. The watershed-level effects should be evaluated in more detail, with particular attention to their scope and existing mitigation. This also has been identified as a knowledge gap.

*Stream Blockages Associated with Man-Made Structures*

Spawning stream blockages from the build-up of debris at man-made structures such as culverts can also pose a threat to habitat by serving as a barrier to dispersal. This could limit the spawning habitat accessible during a given year to the habitat below the blockage or impede larval exit from above the blockage to the lake. These impacts are considered severe. With so few streams used by LURS for spawning, a critical life function, the loss of spawning function in just one stream would have a severe impact on both of the populations, particularly because such events are often recurrent. The only culvert crossing over LURS-SbP spawning habitat is a bridge over Second Brook that was designed to avoid stream blockage, and to date has done so adequately (See Appendix E, Figure 5). However, the culvert between Lake Utopia and Mill Lake Stream (one of the LbP spawning streams) is not considered a bridge-sized culvert and therefore, does not have biannual inspections. Any beaver dam debris or blockages would be removed only if backwatering could potentially impact highway structure. Therefore, this threat is considered a low-level concern for the SbP and high-level for the LbP, reflecting the susceptibility of the existing fish passage structure in Mill Lake Stream to blockages (DFO 2011).

*All Terrain Vehicles (ATVs) and Foot Traffic*

Traffic on foot or by ATVs has also been identified as a concern because of the potential to disrupt bottom habitat in the spawning streams. ATV use is common in the Lake Utopia area. The SbP streams are considered more vulnerable to traffic because they are smaller than the LbP streams and thus more conducive to crossing. Historically, only low levels of traffic have been observed in the area during the spawning season. However, evidence of ATV traffic was discovered as recently as spring 2011, when fresh tire marks were observed to intersect with a portion of one of the streams wherein hundreds of individuals of LURS-SbP were staging in preparation to spawn (MacDougall and Meyer pers. comm. 2011). This observation demonstrates the potential for ATV traffic in a critical location (the portion of the stream used for spawning), and at a critical time of year (while both adults and eggs are present). This activity has the potential to jeopardize both the attributes of the stream relied upon for spawning (e.g. the substrate via physical disturbance, or water quality via the release or transfer of pollutants into the stream), and the lives of up to thousands of individual LURSs. For this reason, ATV and foot traffic are considered both a threat to habitat and a source of direct mortality for LURS. Additionally, traffic is considered one of the sources of recreational inputs referred to under the threats to water quality.

The RPA concluded that ATV and foot traffic were low-level concerns for LURS given the information available at that time (DFO 2011). More recent observations, however, suggest that traffic could have a significant impact on LURS depending on its intensity, timing, and location. The traffic threat-level has therefore been re-evaluated considering that 1) the potential for the destruction of LURS spawning habitat and direct mortality of spawners and eggs when traffic occurs at the wrong time and place is great, 2) traffic-related impacts do not appear to be a regular occurrence, and 3) the recent observation of impacts was limited to one of the three LURS-SbP streams. As a result, and for the purpose of recovery planning based on the best available information, ATV and foot traffic is considered to be medium-level threat to habitat for LURS-SbP, and low-level threat to habitat for LURS-LbP.

### 5.2.2 Threats to Water Quantity

Two main industrial users have the potential to impact water quantity in Lake Utopia and the lower portions of its tributaries: the Lake Utopia Paper Mill (LUPM); and, the St. George Pulp and Paper (SGPP) hydroelectric facility located at First Falls (Figure 2) in the town of St. George.

Changes to water quantity in the streams can impact on several elements of stream function for LURS spawning, which may eliminate or reduce the productivity of one or more spawning streams. When water levels are too low, access to or exit from spawning sites can be impeded, while high water levels may result in backwatering, reducing the availability of oxygen to developing eggs in the head ponds of spawning streams. If fluctuations in Lake Utopia water levels are too severe, eggs may become vulnerable to excessive submergence or to desiccation as water levels change. These effects are considered severe given the implications to the populations' ability to propagate; without effective mitigation, activities resulting in these effects warrant a high-level of concern.

*Hydroelectric Facility Operations*

The re-developed SGPP hydroelectric facility at First Falls became operational in 2004. The dam at First Falls creates a head pond that includes Lake Utopia. Water levels in the head pond vary according to the operational practices of the hydroelectric facility, which are now guided by the "Fisheries Management Plan for the St. George Power Limited Partnership Facility" (the FMP) (St. George Power Limited Partnership 2012). One purpose of the FMP is to guide compliance with the fisheries protection provisions of the *Fisheries Act* through informed operational management and the implementation of best management practices. The FMP provides a platform for adaptive management such that operation of the facility may change as new information becomes available. The dam is thought to influence water levels mainly during low inflow conditions. A key issue of focus for the FMP is the maintenance of appropriate water levels in Lake Utopia between mid-March and mid-May to provide access to lake tributaries for LURS-SbP and LURS-LbP at spawning time. The FMP states as an objective the development of an operational monitoring program to estimate and demonstrate the success of best management practice implementation.

Lake Utopia and the associated tributaries serve important purposes for the LURS life cycle. As such, the threats to water levels for these two water bodies are assessed separately. With respect to the tributaries, monitoring of LURS-SbP spawning activity during the hydroelectric dam redevelopment in 2004 indicated that water levels did not result in impeded access to spawning sites that year. While the SGPP has developed several monitoring measures for fluctuating water levels (including management and mitigation measures outlined in the FMP noted above) and conditions have improved since the establishment of the FMP in 2004, concerns remain with respect to water level fluctuations, particularly during the spring spawning season. Changes to water levels in the stream at and following spawning times could have a severe impact on the survival of LURS. Therefore, there is a high level of concern regarding this threat.

With respect to Lake Utopia itself, although the SGPP hydroelectric facility operations also affect water levels, the severity of the impacts (i.e. the potential flushing of larvae from the lake) are considered to be low. Therefore under the facility's current operating regime, the level of concern for this threat is considered to be low.

*Water Withdrawal for Lake Utopia Paper Mill*

The LUPM also withdraws water from the lake for its industrial operation and the effects of this are not all clear. However, the facility has been in operation for decades without triggering concerns over lake or stream levels. Accordingly, the level of concern for this threat is considered to be low for both the lake and streams (Bradford et al. 2012).

### 5.2.3 Threats to Water Quality

Lake Utopia itself receives effluent water directly from a fish hatchery that resides along its banks. The watershed receives effluent or run-off water from additional sources including aquaculture, residential, and agriculture activities. Each of these sources, in addition to inputs from the Magaguadavic River via The Canal (Figure 2), increases the nutrient load and other contamination into the lake. Water quality monitoring from 1989 to 2002 indicated stable to declining levels of phosphorus and nitrogen, but showed a significant increase of Chlorophyll A, which was associated with an increase in frequency of algal blooms in the lake (Hanson 2003). The location of point sources of pollution and limitations to the flushing mechanisms of the lake may facilitate the build-up of nutrients (Hanson 2003), thereby creating the conditions for increased productivity, and resulting in less suitable conditions for LURS.

Eutrophication in Lake Utopia may have had significant implications to the survival of LURS in the past. If unmitigated, all effluent sources could drive eutrophication in the lake, alter water quality, and negatively affect LURS, thus warranting a high-level of concern. However, under the *Water Quality Regulations* of the New Brunswick *Clean Environment Act,* new operational limits for nutrient loading placed upon the hatcheries within and outside Lake Utopia appear to be effectively reducing the phosphorus levels associated with algal blooms. These operational limits continue to be under review and may be changed if ongoing water quality monitoring identifies a problem. Due to the apparent effectiveness of this mitigation, the cumulative effects of all effluent sources are considered to be a medium-level of concern.

Some mitigation is also in place for other effluent sources. For example, residential inputs are mitigated using regulations under the New Brunswick *Clean Environment Act*. Determining the relative severity of the threat posed to water quality by the various sources of effluent is difficult. The effectiveness of existing mitigation measures, and compliance with the mitigation itself, is uncertain in most cases. Therefore, the levels of concern for the individual threats to water quality are predominantly based on the location of their impact. Effluent from the hatchery inside Lake Utopia and recreational and residential inputs that can also affect the streams are considered to be of medium concern, while those sources from outside Lake Utopia are considered to be of low concern.

*Pesticide Contamination*

Pesticides from agricultural and silviculture activities are also identified as a threat because of the potential effects on fish health. This threat is also considered to be of low concern because measures in place through the New Brunswick *Pesticide Control Act* are considered to be adequate to mitigate the effects on species, particularly because the use of pesticides does not occur directly adjacent to the lake and spawning streams.

### 5.2.4 Threats Relating to Direct Mortality

The overall level of concern for several threats related to direct mortality is low (DFO 2011; Bradford et al. 2012). These are described below.

Three low-concern sources of direct mortality include lethal sampling for scientific research, entrainment at intakes for the paper mill and fish hatchery, and bycatch in the recreational angling fishery. Even if unmitigated, these threats are considered to be of low concern because the number of mortalities that could result from these activities is expected to be low. Incidents are not expected to be frequent, and LURS-SbP is considered sufficient to sustain some level of direct mortality without jeopardizing its survival. In addition, the management tools exist to further reduce mortality associated with these threats if necessary.

Other sources of direct mortality include predation by fish stocked for the recreational angling fishery and exposure to disease or parasites from hatchery effluent. If unmitigated, the severity of the threat from these sources could be high. However, stocking is kept at a rate designed to minimize the impact on smelt populations and the *Fish Health Protection Regulations* under the *Fisheries Act* are expected to mitigate these impacts. Recreational fishing for land-locked Atlantic Salmon and Brook Trout takes place in Lake Utopia. Although the fishery is enhanced by stocking in some years, stocking densities are designed to have minimal impact on their forage species within the lake, like Smelt. Fish hatcheries are regulated by federal and provincial legislation including the *Fish Health Protection Regulations* of the *Fisheries Act*, and the NB *Clean Environment Act* and *Aquaculture Act* that require measures to monitor and control disease within the facility and to minimize the risk of releasing contaminated effluent into the surrounding natural environment. This existing level of mitigation is considered effective in preventing the spread of parasites or disease to resident LURS.

*Fishing Activities*

Three fisheries have previously posed a threat of direct mortality to LURS: the recreational smelt dip net fishery (currently closed), the Aboriginal Food, Social, and Ceremonial (FSC) smelt fishery, and the recreational angling fishery (currently closed). In all cases, the severity of the unmitigated threat to the LbP is unknown. This uncertainty exists because, unlike the SbP, there is no accurate population abundance estimate for LbP. Therefore the level of mortality that can be sustained by the LbP without jeopardizing either its survival, or its role in the survival of the SbP as we know it, cannot be predicted. Hence, fishing activities are considered a high-level concern for the LbP. Given that SbP abundance is considered sufficient to sustain some level of direct mortality without jeopardizing its survival, fishing activities are considered a low-level concern for the SbP. Mortality to both LURS populations resulting from the directed recreational dip net smelt fishery is mitigated through the closure of this fishery in Lake Utopia in spring 2011, effectively eliminating this threat.

More recently, fishery closures were expanded to angling when DFO issued an *Order Varying the Close Time for Fishing for Smelt in New Brunswick* in April 2013. This Order (2013-018) implemented a year-round closure of the smelt dip net and angling season in Lake Utopia. Seasons for other fishing methods (bag nets, box nets, gill nets and spears) are already closed pursuant to s. 88 of the *Maritime Provinces Fishery Regulations*.

Because neither Variation Order 2013-018 nor s. 88 of the *Maritime Provinces Fishery Regulations* apply to fishing and related activities carried out under the authority of a licence issued under the *Aboriginal Communal Fishing Licences Regulations*, the FSC fishery for smelt continues to be managed cooperatively with the New Brunswick Aboriginal People's Council (NBAPC). Adaptive management is applied to the FSC fishery whereby mitigation measures are reviewed and changed if appropriate to reflect the most up-to-date information on the populations and so that harvesting, if any, occurs only at levels sustainable to the populations.

*Aquatic Invasive Species*

Introduced, non-indigenous species present various levels of concern to LURS. Generally, introduced fish can affect and threaten native fish via predation (direct mortality), competition, displacement or community shift.

Smallmouth Bass (*Micropterus dolomieu*) have been established in Lake Utopia since 1942 (Smith 1942) with no apparent risk to the viability of LURS. This threat is therefore considered low concern (DFO 2011). The potential exists for the introduction and spread of Chain Pickerel (*Esox niger*) and Largemouth Bass (*Micropterus salmoides*) to Lake Utopia. The threat of invasion by Largemouth Bass is considered of low concern because the evidence of its presence in the system is limited to a single observation near the top of the St. George fishway in 2006 (Carr & Whoriskey, 2009).

Chain Pickerel was first observed in the Magaguadavic Lake in 2003 and has since spread and become naturalized to its headwater lakes (Carr & Whoriskey, 2009). Due to its presence in the Magaguadavic watershed, the invasive qualities of its spread, and the unknown severity of its impacts to LURS, its threat is of greater concern than that presented by Smallmouth or Largemouth Bass (DFO 2011; Bradford et al. 2012). The threat posed by Chain Pickerel differs between the SbP and the LbP, with the threat of direct mortality considered of medium concern to the SbP and of high concern to the LbP. In general, the LbP is more vulnerable to the effects of direct mortality by any means because they are less abundant, possibly at least by an order of magnitude (Curry et al. 2004; Bradford et al. 2012). The differing levels of concern also result in part because the LbP and Chain Pickerel share preferred foraging and spawning area characteristics. The likelihood that Chain Pickerel will compete with the LbP for resources and predate on larval, juvenile or adult LbP is therefore high. The SbP are also potential Chain Pickerel prey items, however their differing spawning and foraging habitat would limit their interaction. Interestingly, smaller-form Rainbow Smelts have been known to co-exist with Chain Pickerel in other water systems for many generations. No such examples exist for the large-bodied form (NB DNR; Bradford et al. 2011).

*ATV and Foot Traffic*

ATV traffic through spawning sites during the spring could result in some combination of adults, eggs and juveniles being killed, potentially in great numbers (Bradford et al. 2012). It is also likely that foot traffic from the now-closed recreational dip net smelt fishery was a source of direct mortality in the fished streams, particularly to eggs while fishing for spawning adults. Foot traffic during the spring from other sources like hiking and research continue to pose a threat of direct mortality. However, given that ATV and foot traffic are not frequent activities, this threat of direct mortality is considered to be a low level of concern (Bradford et al. 2012).

## 5.3 Other Considerations

*Climate Change*

Trends toward earlier ice-melt and later lake-ice formation, since 1961 and 1971 respectively, have been demonstrated for Lake Utopia (Duguay et al. 2006). The consequences of a shorter period of ice cover on the productive potential of the lake for both DUs are not known. The extent, or whether, the trends in ice-cover indicate a potential for change in the hydrological and temperature cycles of the tributaries used for spawning is not known.

*Conservation of Uniqueness*

The uniqueness of Rainbow Smelt in Lake Utopia relies on the co-existence of the two physically and genetically different forms of the species in a common environment. The loss of either form would render the remaining population no more unique than many other Rainbow Smelt populations in Canada. Therefore, any threat to the survival of one of the populations of LURS is considered a threat to the maintenance of the unique characteristics of the other and of the collective pair. Similarly, any threat to the reproductive isolation of the two populations from one another is also a threat to the unique characteristics of the species pair and each of its constituent populations.

Table 1: Threats Assessment

| **Threats** | **Level of Concern**[1] | **Location/ Extent** | **Occurrence** | **Frequency** | **Severity**[2] | **Causal Certainty**[3] | **Adequacy of Existing Mitigation**[4] |
|---|---|---|---|---|---|---|---|
| **Threats to Habitat** | | | | | | | |
| Forestry &/or Land-Alteration Activities Near Spawning Habitat | High (Small-bodied Population – SbP)<br>Low (Large-bodied Population – LbP) | Stream | Current | Recurrent | High (SbP)<br>Low (LbP) | High<br>Medium | Unknown |
| Forestry &/or Land-Alternation Activities Within the Watersheds | Low | Lake and Stream | Current | Continuous | Low | Medium | Unknown |
| Stream Blockages Associated with Man-made Structures | Low (SbP)<br>High (LbP) | Streams<br>Mill Lake Stream | Current | Recurrent | Low (SbP)<br>High (LbP) | High | Adequate (SbP)<br>Not Adequate (LbP) |
| ATV and Foot Traffic | Medium (SbP)<br>Low (LbP) | Stream | Current | Recurrent | High | High | Not Adequate (SbP)<br>Adequate (LbP) |
| **Threats to Water Quantity** | | | | | | | |
| Water Level Fluctuations to Stream (hydro-electric facility operations) | High | Stream | Current | Seasonal | High[5] | High | Unknown |
| Water Level Fluctuations to Lake (hydro-electric facility operations) | Low | Lake | Current | Seasonal | Low | Medium | Adequate |
| Water Withdrawal for Paper Mill | Low | Lake and Stream | Current | Continuous | Moderate | High | Adequate |
| **Threats to Water Quality** | | | | | | | |
| Hatchery Effluent (inside Lake Utopia) | Medium | Lake | Current | Continuous | High | High | Under Review |
| Residential and Recreational Inputs (non-point sources) | Medium | Lake and Stream | Current | Continuous | Moderate | Medium | Adequate |

| Threats | Level of Concern[1] | Location/ Extent | Occurrence | Frequency | Severity[2] | Causal Certainty[3] | Adequacy of Existing Mitigation[4] |
|---|---|---|---|---|---|---|---|
| Cumulative Effluent (all sources) | Medium | Lake | Current | Continuous | High | Medium | Under Review |
| Hatchery Effluent (outside Lake Utopia) | Low | Lake | Current | Continuous | Moderate | High | Under Review |
| Inputs from Magaguadavic River (non-point sources) | Low | Lake | Current | Seasonal/ Recurrent | Moderate | High | Unknown |
| Pesticide Contamination (Agriculture/Silviculture) | Low | Lake and Stream | Current | Seasonal | Low | Medium | Adequate |
| **Threats of Direct Mortality** | | | | | | | |
| Aquatic Invasive Species (Chain Pickerel — naturalized in the Magaguadavic system) | Medium (SbP)<br>High (LbP) | Lake<br>Lake and Stream | Anticipated | Continuous | Low (SbP)<br>High (LbP) | Medium (SbP)<br>Medium (LbP) | Unknown |
| Aquatic Invasive Species (Largemouth Bass — non-naturalized) | Low | Lake | Unknown | Continuous | Unknown | Low | Unknown |
| Aquatic Invasive Species (Smallmouth Bass — naturalized) | Low | Lake | Current | Continuous | Low | High | Adequate |
| Entrainment at Intakes for Paper Mill and Hatchery | Low | Lake | Current | Continuous | Low | High | Adequate |
| Directed Fisheries (Recreational Dip Net)[6] | Low | Stream | Historic[6] | Seasonal | Low (SbP)<br>Unknown (LbP) | High (SbP)<br>Low (LbP) | Adequate |
| Directed Fisheries (Aboriginal Food, Social, Ceremonial) | Low (SbP)<br>High (LbP) | Lake and Stream | Current | Seasonal | Low (SbP)<br>Unknown (LbP) | High (SbP)<br>Low (SbP) | Adequate (SbP)<br>Unknown (LbP) |

| **Threats** | **Level of Concern**[1] | **Location/ Extent** | **Occurrence** | **Frequency** | **Severity**[2] | **Causal Certainty**[3] | **Adequacy of Existing Mitigation**[4] |
|---|---|---|---|---|---|---|---|
| Bycatch in Recreational Angling Fishery | Low | Lake | Current | Seasonal | Low (SbP)<br>Unknown (LbP) | High (SbP)<br>Low (LbP) | Adequate[7] |
| Predation by Stocked Fish | Low | Lake | Current | Recurrent | High | High | Adequate |
| ATV and Foot Traffic | Low | Stream | Current | Seasonal | High | High | Not Adequate |
| Scientific Research | Low | Lake and Stream | Current | Recurrent | Low | High | Adequate |
| Hatchery Effluent (inside Lake Utopia – disease/parasites) | Low | Lake and Stream | Current | Continuous | High | High | Adequate |

¹***Level of Concern****: signifies that managing the threat is of (high, medium or low) concern for the survival of the species. This criterion considers the assessment of all the information in the table and the population objectives.*

2 ***Severity****: reflects the population-level effect if unmitigated (High: very large population-level effect, Moderate, Low, and Unknown).*

3 ***Causal certainty****: reflects the strength of the evidence that links the threat to population viability (High: there is substantial evidence for a causal link; Medium: there is some evidence for a causal link; Low: the threat has an unsubstantiated but plausible link).*

4 ***Adequacy of Existing Mitigation****: (Adequate: the mitigation in place is sufficient to mitigate the effects of the threat to an acceptable level given the current intensity of the threat; Not Adequate: the mitigation in place is insufficient or ineffective in reducing or maintaining the impact of the threat to an acceptable level; Unknown: a relationship between the mitigation in place (or lack thereof) and the source of the threat has not been established; Under Review: the relationship between the mitigation in place (or lack thereof) and the source of the threat is under review).*

5 *The severity of the effect to the LbP from high water levels at Mill Lake Stream is high, and for Trout Lake-Spear Brook, is unknown.*

6 *The directed dip net fishery in Lake Utopia was closed in the spring of 2011. The assessment of this threat is based on a closed dip net fishery.*

7 *No smelt caught as bycatch in the recreational angling fishery in Lake Utopia may be retained beginning April 1, 2013. The assessment of this threat is based on this change.*

# 6. Population and Distribution Objectives

While the cumulative impact of documented and potential threats to LURS is not entirely clear at this time, a single, small occurrence of two populations that represents a unique species pair is a precarious scenario, particularly when that pair depends on a small, single feature in a landscape subject to many anthropogenic activities and pressures.

**BROAD RECOVERY GOAL**

Considering the rationale for the Threatened designations (COSEWIC 2008), the broad goal of the Recovery Strategy for LURS is to:

> *Maintain the current population distribution and abundance of the small-bodied and large-bodied populations of Lake Utopia Rainbow Smelt and the genetic diversity of the Lake Utopia Rainbow Smelt sympatric species pair.*

Essentially, the persistence of the LURS sympatric species pair, in the face of threats and the precarious nature of its unique, singular, and limited occurrence is what represents survival in this Recovery Strategy.

**POPULATION OBJECTIVES**

The broad recovery goal will be specifically addressed through the achievement of the following population genetic objective, which applies to the sympatric species pair, and population abundance and distribution objectives, which apply to each population separately.

**Genetic Objective:**

*Maintenance of the genetic diversity and genetic differentiation of LURS within the Lake Utopia system*.

**Abundance Objectives (Interim, 5-year):**

Small-Bodied Population: *100,000 spawning fish distributed among Second Brook, Unnamed Brook, and Smelt Brook during nights of peak spawning.*

Large-Bodied Population: *2,000 spawning fish in Mill Lake Stream during nights of peak spawning.*

**Distribution Objectives:**

Small-bodied Population: *Occupation of Lake Utopia year round and annual, synchronous occupation of Second Brook, Unnamed Brook and Smelt Brook for spawning, with no individual stream to be unoccupied for two consecutive years.*

Large-bodied Population: *Occupation of Lake Utopia year round and annual occupation of Mill Lake Stream for spawning.*

The population objectives aim to accommodate the effects of inter-annual variability of stream use resulting from natural factors associated with climate variability and variability in total spawner abundance. These population objectives will be re-evaluated with the mandatory five-year review toward progress of implementation of the Recovery Strategy and may be revised to take into account new information or changing conditions. The abundance objectives in particular, were designed for the interim since the broad recovery goal involves the maintenance of the current population abundances and more information is required to provide accurate estimates of these. In the meantime, the population abundance objectives are based on the best available information at this time. The distribution objective for LURS-LbP does not include the annual occupation of Trout Lake stream because the relative contribution of this spawning tributary to LURS-LbP productivity is not well understood at this time. Consideration will be given to including additional spawning streams in the LURS-LbP distribution objective as more information becomes available.

# 7. Broad Strategies and General Approaches to Meet Objectives

In the face of threats (discussed in the “Threats” section) that may impact the required conditions for LURS (discussed in the “Needs of the Lake Utopia Rainbow Smelt” section), broad strategies for recovery will center around isolating the specific characteristics of the system that are key requirements for the species and sympatric pair and using that information to develop specific mitigation to be incorporated into the existing regulatory framework and stewardship projects.

## 7.1 Broad Strategies for Recovery

Three broad strategies for recovery will collectively work toward the achievement of the broad recovery goal and the population objectives for LURS. These strategies address the threats and limitations identified for LURS and will be implemented by taking the general research and management approaches identified in the recovery planning table (Table 2).

The broad strategies for recovery are:

**1.** Conduct research and monitoring.

**2.** Protect the species and its habitat.

**3.** Promote, support and undertake stewardship and education activities.

Conducting research and monitoring will address knowledge gaps and support the implementation of effective mitigation required to achieve the population objectives of this Recovery Strategy. Protecting the species and its habitat using existing regulatory frameworks and management tools will mitigate the effects of threats and support survival. Stewardship and education activities will increase local awareness and engage local public, Aboriginal people and organizations, industry, and other stakeholders in the monitoring and mitigation of threats to LURS.

The recovery planning table below outlines the limitations and threats to LURS survival, the broad strategies for recovery, and the general research and management approaches that should be taken to work toward achieving the population objectives.

## 7.2 Strategic Direction for Recovery

Table 2. Recovery Planning

| Threat or Limitation | Broad Strategy for Recovery | Priority | General Description of Research and Management Approaches |
|---|---|---|---|
| <u>Limitation</u>:<br><br>Information gaps pertaining to the species, Lake Utopia and its tributaries, and the impact of current and potential threats. | Conduct research and monitoring | High | • Improve understanding of Lake Utopia Rainbow Smelt – Small-bodied Population (LURS-SbP) critical habitat (see Schedule of Studies).<br>• Characterize spatial and temporal habitat use of Lake Utopia at all life-stages by the Lake Utopia Rainbow Smelt (LURS) species pair.<br>• Examine the abundance and biological requirements for each population of LURS.<br>• Track progress toward achieving the population objectives for the species.<br>• Improve understanding of the hydrology and trophic status of Lake Utopia and its watershed.<br>• Identify and monitor indicators relating to water quantity and water quality of the lake and its tributaries.<br>• Evaluate the relationship between the identified threats to Lake Utopia and its tributaries and their effects on the parameters related to the achievement of the population objectives.<br>• Examine interactions between Smelt and potential invasive species by studying systems in which they coexist. |
| <u>Threats:</u><br><br>Habitat-related<br><br>Water Quantity<br><br>Water Quality<br><br>Direct Mortality | Protect the species and its habitat | High | • Evaluate the effectiveness of existing regulatory, policy, management, and voluntary instruments in promoting and protecting the conditions required to achieve the population objectives.<br>• Adapt and strengthen regulatory, policy, management and voluntary frameworks and tools to better protect LURS and LURS habitat when new information suggests it is required to meet the population objectives.<br>• Promote and enforce compliance with the regulations, best management practices, management plans and operational guidelines pertaining to activities having an impact on LURS or LURS habitat. |
| | Promote, support and undertake stewardship and education activities. | High | • Promote the use of best management practices.<br>• Implement targeted public awareness and education initiatives (e.g. landowners).<br>• Engage stakeholders and partners in selected monitoring and management activities.<br>• Promote and support stewardship programs. |

## 7.3 Narrative to Support the Recovery Planning Table

The three broad strategies identified are not mutually exclusive, nor must they occur in succession. When implemented together, they will work toward the achievement of the population objectives. For this reason, they are all considered to be high priority for implementation. For example, broad strategy 1 (Conduct research and monitoring) addresses knowledge gaps as a limitation to survival. The information and knowledge gained through carrying out this strategy will support the effective implementation of the second (Protect the species and its habitat) and third (Promote, support and undertake stewardship and education activities) broad strategies, which apply mitigation measures to address the threats identified for the species, either by using the existing regulatory framework and management tools in place or by public engagement, such as education, outreach, and stewardship. Likewise, some of the general approaches outlined for broad strategies 2 and 3 may provide the programs or tools for information gathering or monitoring that could feed into the general approaches of broad strategy 1.

Addressing information gaps that will help to guide the management approaches for the mitigation of threats are also pertinent to the further identification of critical habitat. They are addressed specifically in the “Schedule of Studies to Identify Critical Habitat” portion of this Recovery Strategy (Table 4). They do not appear again here in the recovery planning table, but it should be noted that the findings from the research activities outlined in the Schedule of Studies are also a key part of broad strategy 1 in informing management measures to be taken to mitigate threats (broad strategies 2 and 3). For example, the specific mitigation required to address threats to the survival of LURS in sympatry requires knowledge pertaining to the nature of, and threats to, the isolating mechanisms behind the genetic differentiation observed in the sympatric species pair. This knowledge will be gained through the research identified in the recovery planning table and in part through the Schedule of Studies.

# 8. Critical Habitat

Critical habitat for LURS-SbP has been identified as:

*The water column, substrate and LbP features of Lake Utopia in the Magaguadavic River watershed in Charlotte County, New Brunswick (total surface area 14km2), and part of the following tributaries of Lake Utopia: Smelt Brook, Unnamed Brook, and Second Brook (total combined length of 586 m).*

Figures 3 and 4 provide a geographic description of the identified critical habitat and a more detailed description is presented in Section 8.2.

The *Species at Risk Act (2002)* defines critical habitat as:

> "*the habitat that is necessary for the survival and 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*",

where habitat refers to:

> "…*spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend on directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced.*" [s. 2(1)]

In this document, it is necessary to specifically identify the critical habitat of the SARA-listed LURS-SbP for the purpose of its protection under SARA. For the LURS-SbP, critical habitat is identified to the extent possible, using the best available information, and provides the functions and features necessary to support the species' life-cycle processes. The area of critical habitat that is identified may be insufficient to fully achieve the population abundance, distribution, and genetic objectives for the LURS-SbP identified in Section 6 of this Recovery Strategy. As more information becomes available, critical habitat may be better described in terms of its functions, features, and biological attributes and/or expanded in terms of its spatial extent. The Schedule of Studies provided in Subsection 3 outlines the research required to address knowledge gaps that may allow for a more refined identification of critical habitat.

## 8.1 Information and Methods Used to Identify Critical Habitat of the LURS-SbP

The identification of critical habitat is supported by the information summarized in the RPA (DFO 2011), in particular, the results from several years of spawning stream surveys (NB DNR 2002, unpublished data; Curry et al. 2004;Bradford et al. 2012) as well as the observations by Shaw et al. (2006) of LURS in Lake Utopia. These studies identify the broad habitat feature types that support LURS-SbP life functions but do not describe what attributes of these habitat features ensure their functionality to LURS. Also, while studies by Taylor & Bentzen (1993) and Bradbury et al. (2011) have described the genetic relationship between the SbP and LbP, hypotheses regarding the drivers of that relationship and how they relate to habitat remain to be tested.

Critical habitat of the LURS-SbP was identified using the Area of Occurrence Approach. Therefore, critical habitat is comprised of the entire area within the identified boundaries that supports the function(s) and feature(s) necessary for the survival of LURS-SbP.

The LURS-SbP is limited in occurrence and distribution to Lake Utopia and several of its tributaries, and therefore broadly depends on these features to carry out all of its life functions. Guided by the definition of habitat for an aquatic species at risk, LURS-SbP habitat consists of Lake Utopia and its tributaries. The methods used to identify the critical habitat within Lake Utopia and the tributaries of Lake Utopia are described separately below.

***Stream Critical Habitat***

Critical habitat in the tributaries of Lake Utopia was defined by identifying the extent of habitat naturally accessible to the species within each spawning stream that is required to meet the population objectives of this Recovery Strategy.

The LURS-SbP has been observed spawning consistently in high abundance in only three of the 17 available tributaries (Smelt Brook, Unnamed Brook and Second Brook) (Taylor & Bentzen 1993; Curry et al. 2004), suggesting that suitable LURS-SbP spawning habitat may be limited (Taylor 2001; Bradford et al. 2012).

The LURS-SbP relies on these tributaries for staging, spawning, migrating, and rearing. If any of the three spawning streams used by the SbP are destroyed, its distribution objective (i.e. the "*annual, synchronous occupation of Second Brook, Unnamed Brook and Smelt Brook for spawning…*") would not be met. Destruction may also lead reproductive adults to select an alternate spawning tributary. This could be problematic if the selected tributary is at or near carrying capacity, has inappropriate conditions, or is already occupied by spawning LbP. If the spawning tributary is already occupied by the LbP, one population may out-compete the other, or there could be resulting hybrid offspring. Each of these outcomes would put the abundance objective for the SbP at risk. Furthermore, the specific consequences of losing either of the populations' spawning streams for the achievement of the genetic objective (i.e. "*Maintenance of the genetic diversity and genetic differentiation of LURS within Lake Utopia")* are unknown. Research on the mechanisms of genetic differentiation between the two populations is required to determine the role of separate spawning habitat in the achievement of the population objectives for either the SbP or LbP. This research topic is included in the Schedule of Studies and the results may lead to a refined description of the identified critical habitat. Using the information currently available, the three spawning streams used by the SbP are identified as critical habitat.

The spatial extent of critical habitat within the streams was refined to the habitat that is considered naturally accessible to the SbP. Observations of the distribution of egg mats and barriers to LURS dispersal were considered. The presence of egg mats in a stream indicates that the stream or portion of the stream possesses the features and attributes necessary to support the species, particularly the essential life functions of migration, spawning, and rearing. In some cases, the distribution of egg mats was observed to be everywhere on the stream bed until abruptly terminated at the first barrier to dispersal. This suggests that access to additional habitat is the limiting factor to the amount of habitat within a stream that is used, rather than the presence of specific biophysical attributes that LURS-SbP discriminately selects (e.g. Appendix E, Figure 2). Stream habitat was considered naturally accessible to LURS-SbP even if upstream from barriers to dispersal that are considered temporary in nature, such as a fallen log, or the build-up of debris (i.e. soft barriers to dispersal (e.g. Appendix E, Figure 3)). Stream habitat was not considered naturally accessible upstream from an identified hard barrier to dispersal, i.e. those barriers created by conditions not expected to change over time, such as the presence of a boulder or a waterfall (e.g. Appendix E, Figure 1, 2, 4, and 6).

The biophysical attributes of LURS-SbP critical habitat features are described to the extent possible in Subsection 8.2.2. Research to address knowledge gaps relating to these and determine their functionality to LURS-SbP has been listed in the Schedule of Studies.

***Lake Critical Habitat***

As their name indicates, LURS are found only in Lake Utopia and its tributaries. Aside from the critical life functions that are supported in their entirety by the streams during the yearly spawning season and the weeks that follow (i.e. spawning, rearing), all other life functions, including foraging and development, are supported year-round by Lake Utopia itself. The continued capacity of Lake Utopia to support these functions is therefore also critical to the survival of LURS-SbP. Indeed, larvae can be found throughout the surface waters of Lake Utopia at night (Shaw 2006), and larger individuals of Rainbow Smelt are known to occupy the deeper, cooler waters of the lakes they inhabit (Scott and Crossman 1973). The details regarding the use of Lake Utopia by the different life stages and body forms of LURS, and the specific attributes essential for its life functions are unknown. Research pertaining to this topic is included in the Schedule of Studies and may inform future refinement of the identified critical habitat. In the meantime, all of Lake Utopia is considered critical habitat for LURS-SbP.

***LURS- LbP as a Feature of LURS-SbP Critical Habitat***

The LURS-LbP is identified as an important feature of SbP critical habitat for two reasons. First, achieving the LURS-SbP population genetic objective to maintain the genetic relationship between the pair inherently relies on the survival of both populations. Also, as its sympatric counterpart, the LbP plays an essential role in the SbP's survival as we know it. This is because the removal of one member of a sympatric pair is expected to always somehow influence the other member, whether through a change to population size (likely an increase) and/or through a shift in the distribution of physical and ecological traits (Hendry pers. comm. 2011).

For example, if character displacement had been keeping two sympatric populations distinct, upon removal of one member of the pair, the characteristics of the remaining member might evolve to an intermediate form (Hendry pers. comm. 2011), which is exemplified by the current Enos Lake Stickleback hybrid swarm that evolved from the sympatric benthic and limnetic forms after the ecology of Enos Lake was disrupted by invasive species (COSEWIC 2012). For LURS-SbP, this could mean a less extreme adaptation to microphagy (eating small prey), driving changes to morphological features such as an increase in body size, fewer gill rakers, and smaller eyes (Bentzen pers. comm. 2011). Alternatively, if gene flow between two populations had been holding them together, the characteristics of the remaining member may become more extreme (Hendry, personal communication). For LURS-SbP, this could mean a more extreme adaptation to microphagy, driving changes such as even smaller body-size, more gill rakers, and larger eyes, particularly if the SbP abundance increases and the mean size of zooplankton prey is driven downward (Bentzen pers. comm. 2011).

The habitat used by the LbP for spawning is also important to the SbP, albeit indirectly. Affecting the ability of the LbP to spawn in its spawning streams, either by impeding access, or reducing functionality, will lead them to seek other areas for spawning. If no other habitat in Lake Utopia is suitable for LbP, their abundance and survival will be jeopardized, which will put the SbP at risk of the evolutionary changes discussed above. If a great enough number of LbP chose to spawn in SbP critical habitat, this could have a number of direct negative consequences for SbP such as increased predation on the SbP (by the LbP), a reduction in suitable spawning habitat (if outcompeted by the LbP), and/or increased hybridization between the forms (Bentzen pers. comm. 2011).

Without the survival of the LbP and its habitat, some kind of change to the SbP is considered inevitable. Determining precisely how the LURS-SbP population abundance, distribution, and genetics would be affected requires a better understanding of the isolating mechanisms driving the differentiation of the two populations (a topic addressed in the Schedule of Studies). It is nonetheless predictable that the SbP will be affected, and that these effects may not be readily observed in the short term (i.e. rather, many generations). For this reason, the LURS-LbP itself is considered a feature of the SbP's critical habitat, such that activities affecting the LbP to the extent that it can no longer play its role in the survival of the SbP, may constitute the destruction of critical habitat. Likewise, although the spawning habitat of the LbP cannot be directly protected as critical habitat of the SbP, activities taking place in LbP habitat affecting the LbP to that same extent may also constitute destruction of the LURS-SbP critical habitat.

## 8.2 Areas of Identified Critical Habitat

Critical habitat for LURS-SbP is described in this Recovery Strategy to the extent possible, using the best information currently available. Following the area of occurrence approach, critical habitat for LURS-SbP has been identified as:

> *The water column, substrate and LbP features of Lake Utopia in the Magaguadavic River watershed in Charlotte County, New Brunswick (total surface area 14km$^2$), and part of the following tributaries of Lake Utopia: Smelt Brook, Unnamed Brook, and Second Brook (total combined length of 586 m).*

The critical habitat represents all habitat requirements to meet the objectives for the SbP outlined in this Recovery Strategy.

### 8.2.1 Geophysical Description

Critical habitat for LURS-SbP is identified as:

*Lake Utopia, located in New Brunswick, Canada, including the water column and all substrate features from the high water mark to the lake bed;*

*and,*

*Smelt Brook, Unnamed Brook, and Second Brook, all located at the north end of Lake Utopia within the herein described geographic extent including the water column and all substrate features from the high water mark to the stream bed.*

The following areas constitute LURS-SbP critical habitat:

- **Lake Utopia –** The entire lake, located at 45˚10'N, 66˚47'W (approximate centre point).
- **Smelt Brook** – The approximately 161 meters from the brook's mouth to the collection of small boulders, approximately 0.5 meters in diameter (Appendix E, Figure 1) located at 45˚12'24"N, 66˚48'55"W.
- **Unnamed Brook** – The approximately 100 meters from the brook's mouth to the large boulder with coniferous trees growing on top (Appendix E, Figure 2) located at 45˚12'36"N, 66˚48'33"W.
- **Second Brook** – The approximately 330 meters from the brook's mouth to the bridge (Appendix E, Figure 5) located at 45˚12'37"N, 66˚47'22"W.

Existing anthropogenic features, such as docks, structures associated with water discharge or withdrawal, culverts, or dams and their associated structures that occur in the specified geographic boundaries are excluded from LURS-SbP critical habitat because they do not contribute to the specified biophysical functions necessary for the species' survival.

The locations of LURS-SbP critical habitat are shown in Figure 3. The descriptions and coordinates of the geographical extents of critical habitat within each stream are shown in Figure 4.

The total surface area of critical habitat for LURS-SbP in Lake Utopia is approximately 14 $km^2$ (Taylor 2001). The total combined length of critical habitat for LURS-SbP in the spawning streams is approximately 586 meters.

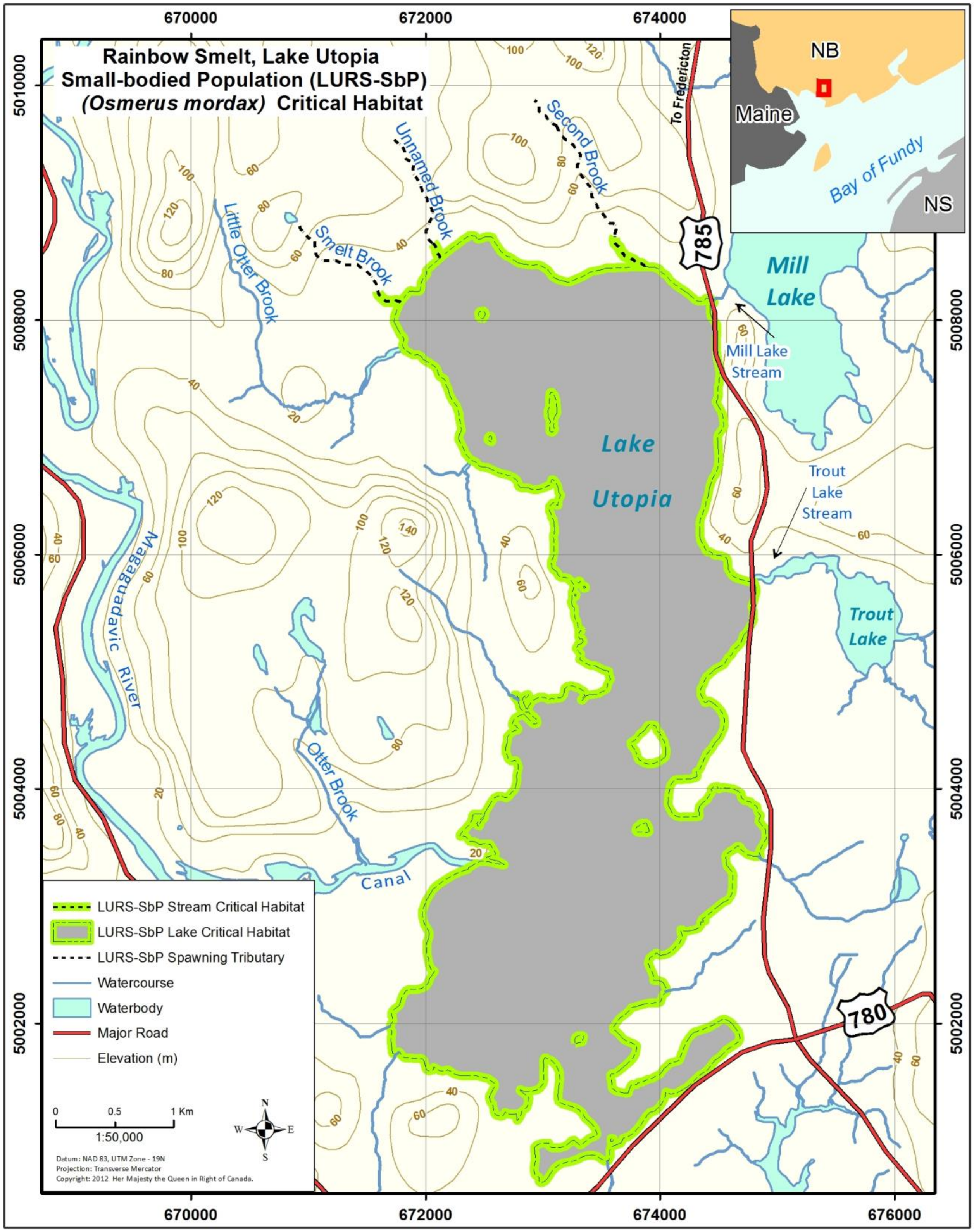


Figure 3. Areas of critical habitat identified for Lake Utopia Rainbow Smelt – Small-bodied Population (LURS-SbP). The extent of critical habitat located within the spawning streams is depicted with greater detail in Figure 4. The inset map shows the general location of LURS-SbP critical habitat within the Bay of Fundy area.

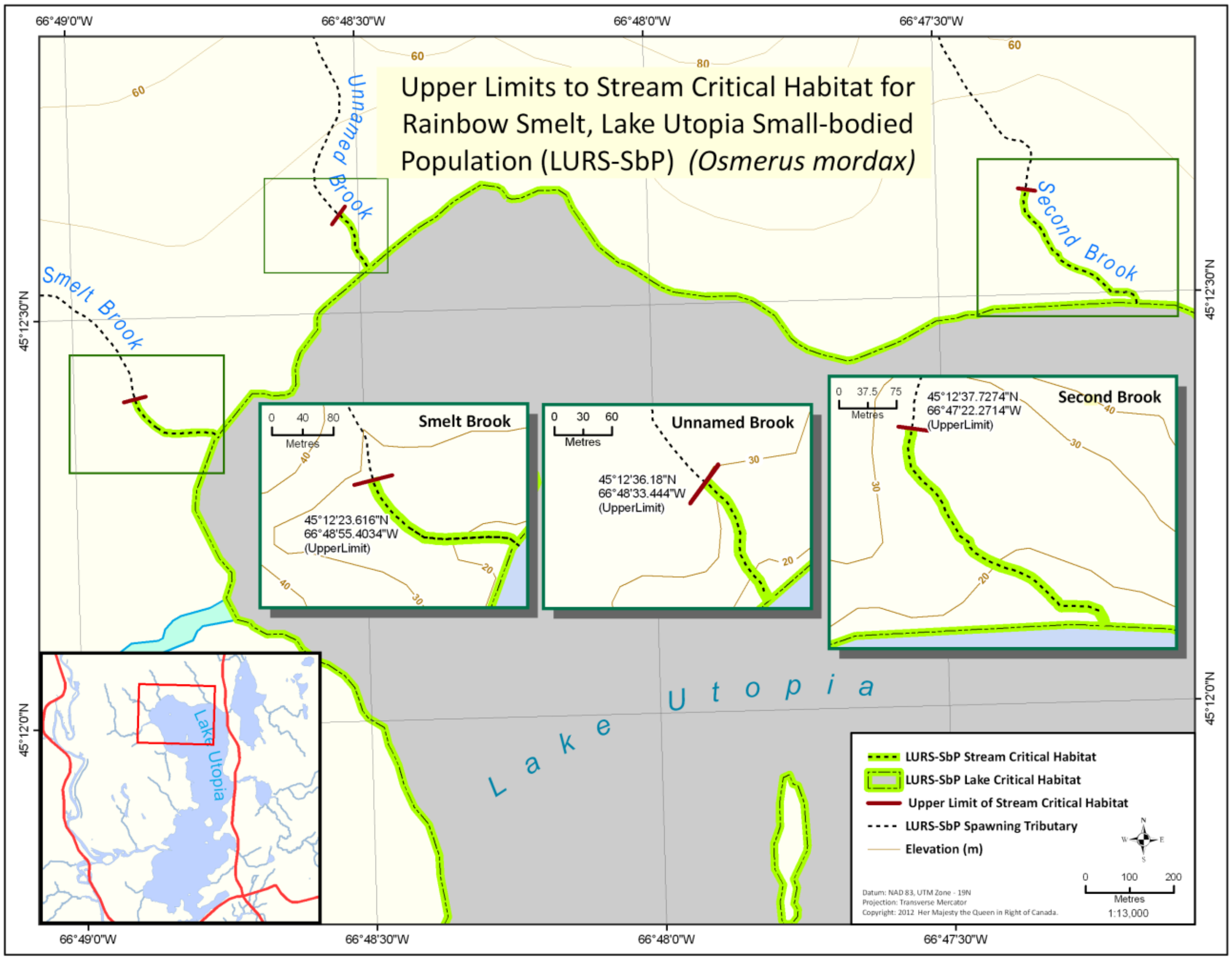


Figure 4. Areas identified as stream critical habitat for Lake Utopia Rainbow Smelt (Small-bodied Population). A portion of each of Smelt Brook, Unnamed Brook, and Second Brook are highlighted to emphasize the length of the linear extent of critical habitat within the stream. The width in each stream that constitutes critical habitat is not represented on this map. The inset map shows the general location of the identified critical habitat within Lake Utopia. For a larger scale context of the location of critical habitat, including the lake critical habitat, refer to Figure 3.

According to the advice of the RPA (DFO 2011), Lake Utopia and the above-identified streams represent the locations supporting the life functions of LURS-SbP. The geographical reach within these areas are considered by the Minister of Fisheries and Oceans as necessary for the survival of LURS-SbP.

### 8.2.2 Biophysical Functions, Features and Attributes of Critical Habitat

Table 3 summarizes the functions, features and attributes for each life-stage of LURS-SbP based on the best available knowledge. The attributes listed describe what is currently known about the features of LURS-SbP critical habitat. The values provided do not necessarily represent specific quantitative limits or thresholds with respect to the listed attributes, with the exception of the distances to hard barrier to dispersal for

LURS-SbP spawning streams. The specific attributes that are essential to the survival of LURS-SbP are currently unknown. If the features described in Table 3 are present and capable of supporting the associated function(s), the feature is considered critical habitat for LURS-SbP, even if it becomes known that the associated attributes or their values are different than those indicated in Table 3.

Further defining critical habitat may involve providing qualifiers related to biophysical attributes within the geospatial extent of the critical habitat identified in this Recovery Strategy. The Schedule of Studies needed to support the complete identification of critical habitat includes research pertaining to the biophysical attributes that influence the functionality of the habitat features used by the LURS species pair, evaluating additional or alternative tributaries that may be used for critical life functions, and isolating mechanisms supporting the genetic diversity observed among the two populations. Further examination of the relationship between the biophysical features of the Lake Utopia system and the life functions they support will be an important component to this research, and ultimately to the complete identification of critical habitat.

Table 3. Summary of functions, features and attributes of the Lake Utopia Rainbow Smelt, Small-Bodied Population critical habitat. Sources: Bradford et al. 2012; Curry et al. 2004; Taylor 2001; Collet et al. 1999.

| Life Stage | Function(s) | Feature(s) | Attributes |
|---|---|---|---|
| Eggs | Nursery | Bottom substrate (under flowing water) of:<br>• Second Brook<br>• Unnamed Brook<br>• Smelt Brook | • Substrate type: any secure substrate such as sand, gravel, rock, aquatic vegetation, and wood debris<br>• Stream width (range): 1–2m<br>• Water flow rate: <10cm/s<br>• Water temperature (range) (mid-April to mid-late-May): 4–9˚C<br>• Water level: depths of spawning brooks range from 0.3–2 m; should remain sufficient for successful completion of spawning, egg incubation and larval migration |
| Juveniles | Rearing (including developing and growing) | Water column and substrate features of:<br>• Second Brook<br>• Unnamed Brook<br>• Smelt Brook | |
| | | Water column and substrate features of Lake Utopia | • Mesotrophic to Oligotrophic (morphoedaphic index: 0.94)<br>• Thermally stratified in summer months (thermocline from 10m to 15–16m)<br>• Maximum depth: 25.6m<br>• Average depth: 11.1m<br>• August (1996) water temperature at surface: 22.3˚C; at ~26m depth: 7.9˚C<br>• August (1996) dissolved oxygen concentration at surface: 11.1mg/L; at ~26m depth: 6.4mg/L<br>• pH typically ranges from 7.0 at surface to 6.4 at 25m depth |
| Adults | Feeding<br><br>Rearing (including developing, growing, and maturing)<br><br>Maintenance of the sympatry of Rainbow Smelt in Lake Utopia | Water column and substrate features of Lake Utopia | See above Lake Utopia attributes |
| | Migrating Spawning (including staging) | Water column and substrate features of:<br>• Second Brook<br>• Unnamed Brook<br>• Smelt Brook | • Substrate type: any secure substrate such as sand, gravel, rock, aquatic vegetation, and wood debris<br>• Free access to spawning streams at spawning times (mid-March to late May)<br>• See stream attributes above<br>• Distance to Lake Utopia Rainbow Smelt – Small-bodied Population (LURS-SbP) hard barrier to dispersal: ≥330m (Second Brook), ≥100m (Unnamed Brook), ≥161m (Smelt Brook) |
| Adults and Juveniles | Maintenance of the sympatry of Rainbow Smelt in Lake Utopia | Lake Utopia Rainbow Smelt – Large-bodied Population (LURS-LbP) | • LURS-LbP abundance levels sufficient to continue to play a role in the ecological and evolutionary processes driving the existence of LURS-SbP in Lake Utopia |

## 8.3 Schedule of Studies to Identify Critical Habitat

This Recovery Strategy includes a description of critical habitat for LURS-SbP to the extent possible, based on the best available information. Additional information relating to habitat use by the LURS species pair is required to identify and/or refine additional critical habitat necessary to support the achievement of the population objectives for the LURS-SbP outlined in this Recovery Strategy and this will be addressed through the Schedule of Studies provided below (Table 4).

Additional areas of critical habitat or refined descriptions of critical habitat will be published in subsequent amended recovery strategies or action plans.

Table 4. Schedule of Studies

| Description of Activity | Rationale | Timeline |
|---|---|---|
| Research to understand the specific attributes of the critical habitat features that provide for the Lake Utopia Rainbow Smelt (LURS) life functions in both tributary and lake habitat, and the mechanisms through which these life functions are provided. | A refined understanding of the relationship between the functions, features and attributes of the identified critical habitat is needed to protect critical habitat. | 2015-2019 |
| Research to identify whether there are other suitable spawning locations available and in consistent use (e.g. other tributaries including Mill Lake Stream, lake shoreline), | This research is needed to ensure that all of the critical habitat needed to achieve the recovery objectives is identified and protected. | 2015-2019 |
| Research to understand the isolating mechanisms behind the genetic differentiation observed in the LURS species pair. | Understanding whether (and if so, which) geospatial or biophysical attributes are needed to maintain the genetic diversity of the LURS species pair is required to protect critical habitat and could result in a refined description of critical habitat features and attributes. | 2015-2019 |

## 8.4 Examples of Activities Likely to Result in the Destruction of Critical Habitat

The critical habitat for LURS-SbP will be legally protected through the application of s. 58(1) of the *Species at Risk Act*, which prohibits the destruction of any part of the critical habitat of aquatic species listed as Endangered or Threatened, and of any part of the critical habitat of aquatic species listed as extirpated if a recovery strategy has recommended their reintroduction into the wild in Canada. Therefore, the following examples of activities likely to destroy critical habitat are provided in Table 5.

Table 5 provides examples of activities that could result in destruction to critical habitat, either permanently or temporarily. However, the activities described in this table are neither exhaustive nor exclusive and their inclusion has been guided by the relevant general threats to habitat described in Section 5 of this Recovery Strategy. The absence of a specific human activity from the table does not preclude or restrict the Department's ability to regulate that activity pursuant to SARA. Furthermore, the inclusion of an activity does not result in its automatic prohibition since it is destruction of critical habitat that is prohibited.

Since habitat use is often temporal in nature, determining whether an activity results in destruction of critical habitat will be evaluated on a case-by-case basis. The determination will depend on the extent in time and space, intensity, and specific nature of the activity as well as whether the features and functions of critical habitat are rendered unavailable when needed by LURS-SbP. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species and would jeopardize survival or recovery of the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects resulting from one or more activities over time.

More information is required about the specific attributes required by LURS-SbP within each of the critical habitat features. For the time being, the table includes information that is generally true for fish and fish habitat. Information more specific to LURS-SbP may be added pending the results of the Schedule of Studies.

Under SARA, critical habitat must be legally protected within 180 days of being identified in a recovery strategy or action plan. For the LURS-SbP critical habitat, it is anticipated that this will be accomplished through a SARA Critical Habitat Order made under s. 58(4) and (5), which will invoke the prohibition in s. 58(1) against the destruction of the identified critical habitat.

Table 5. Examples of activities with the potential to result in the destruction of critical habitat of Lake Utopia Rainbow Smelt – Small-bodied Population.

| Activity | Effect-Pathway | Function Affected | Feature Affected | Attribute Affected |
|---|---|---|---|---|
| ***Riparian* vegetation removal**<br><br>e.g., urbanization, forestry, agriculture | Loss of riparian vegetation causing:<br><br>- Alteration of water temperatures and cycles.<br><br>- Loss of organic matter input into the aquatic system.<br><br>Release of sediment causing:<br><br>- Sediment deposit in spawning substrate resulting in the inhibition of the flow of oxygen-rich water to eggs and larvae during incubation. | spawning, nursery, rearing, migration | Water column and substrate of: Second Brook, Unnamed Brook and Smelt Brook | Water temperature, stream width, water level, water flow rate, substrate type, and other water quality* attributes |
| | | | Water column of Lake Utopia | Trophic status, dissolved oxygen concentration, water quality, |
| **Stream realignment, infilling and dredging**<br><br>e.g., urbanization, transportation | Loss of established stream bed, nearshore lake bottom, water column, and riparian zone. | Spawning, nursery, rearing, migration | Water column and substrate of: Second Brook, Unnamed Brook and Smelt Brook | Substrate type, stream width, water flow rate, water level, water quality, distance to Lake Utopia Rainbow Smelt – Small-bodied Population (LURS-SbP) hard barrier to dispersal |
| | | | Water column and substrate features of Lake Utopia (nearshore) | Substrate type, water quality |
| **Manipulation of water levels in Lake Utopia**<br><br>e.g., water withdrawals from the paper mill, hydroelectric power generation | Excessive water extraction or water level manipulation can reduce the water level in the lake, which contributes to decreased flushing rate in the lake, hypoxia, drying of spawning areas, and impeded access to spawning areas.<br><br>Storing water results in increased water levels in the lake, changes in stream flow patterns and excessively submerges spawning habitat. | Spawning, migration, and nursery. | Water column of: Second Brook, Unnamed Brook and Smelt Brook | Water levels (lower portion), water flow, free access to spawning streams |
| | | | Water column of Lake Utopia | Water depth |

| Activity | Effect-Pathway | Function Affected | Feature Affected | Attribute Affected |
|---|---|---|---|---|
| **Man-made barriers**<br><br>e.g., dams, unmaintained or improperly installed culverts | Habitat fragmentation, i.e., reduced amount of accessible spawning habitat.<br><br>Alteration to water flow, depth and substrate. | Spawning, migration, and nursery. | Water column and substrate of: Second Brook, Unnamed Brook and Smelt Brook | Water flow, water level, water depth, stream width, water temperature, substrate type distance to LURS-SbP hard barrier to dispersal |
| **Fording or wet crossings**<br><br>e.g., ATV crossing through stream | Disrupts benthic habitat in spawning streams.<br><br>Introduction of sediments or contaminants. | Spawning, migration, and nursery. | Water column and substrate of: Second Brook, Unnamed Brook and Smelt Brook | Water flow, water quality, substrate type |
| **Migration or release of contaminants,** directly or via water entering the lake from the Magaguadavic River<br><br>e.g. pesticides, petroleum hydrocarbons, nutrients | Degradation of water quality, contamination of food organisms, and algal blooms with possible Cryptosporidium outbreaks. | Spawning, migration, nursery, and rearing. | Water column of: Second Brook, Unnamed Brook and Smelt Brook | Water quality |
| | | | Water column of lake Utopia | pH, dissolved oxygen, water quality |
| **Impacts affecting Lake Utopia Rainbow Smelt – Large-bodied Population (LURS-LbP) availability**<br><br>e.g. harvesting, lethal sampling, or LURS-LbP habitat destruction (via pathways described above) | In time, changes in population abundance, distribution, morphology, ecology, or genetics of LURS-SbP due to impacts affecting the availability of LURS-LbP to the extent that the LbP can no longer maintain its role in the ecological and evolutionary processes driving the existence of two ecologically, morphologically, and genetically distinct populations of Rainbow Smelt in Lake Utopia. | Maintenance of sympatry of Rainbow Smelt in Lake Utopia. | Lake Utopia Rainbow Smelt – LbP | LURS-LbP abundance levels sufficient to continue to play a role in the ecological and evolutionary processes driving the existence of LURS-SbP in Lake Utopia. |

* Water quality is a measure of the condition of the water, including physical, chemical and biological properties, relative to the requirements of a species. It encompasses a broad range of attributes, such as temperature, pH and dissolved oxygen, as well as other attributes that have not been specially studied in regard to LURS but nonetheless are likely to affect the quality of LURS habitat features such as the concentration of contaminants and organic matter.

# 9. Measuring Progress

SARA requires the competent Minister to report on the implementation of the recovery strategy for a species at risk, and on the progress towards meeting its objectives. Reporting is required within five years after the recovery strategy is posted on the Public Registry and at subsequent five-year periods thereafter until the population and distribution objectives for the species at risk have been achieved or the species' survival or recovery is no longer feasible.

The performance measures presented below will define and measure progress toward achieving the population objectives. Each population objective is provided below along with 1–2 indicators to measure progress.

**Genetic Objective:** *Maintenance of the genetic diversity and genetic differentiation of LURS within Lake Utopia.*

Performance Measures:

1) Genetic discreteness between LURS-SbP and LURS-LbP as indicated by a $F_{ST}$ value of no less than 0.030 estimated from the genetic variation at the microsatellite loci used in Bradbury et al. (2011).

2) No increasing trend in the frequency of hybrids among at least three observations.

Two performance measures will be used for the genetic objective because of the challenges of detecting a trend in the short term for a phenomenon that is typically only detectable over the long term (i.e. genetic differentiation). Therefore, a second indicator will be used that, i) evaluates the trend for a measure for which change is easily detectable in the short term (i.e. frequency of hybrids); and, ii) can be an early warning sign if the conditions that support the isolating mechanisms that maintain the genetic diversity and genetic differentiation of LURS in Lake Utopia are not being maintained.

**SbP Abundance Objective** (Interim): *100,000 spawning fish distributed among Second Brook, Unnamed Brook, and Smelt Brook during nights of peak spawning.*

Performance Measure:

3) The average of the yearly means of the 5 highest daily summations of the spawner abundance of all spawning streams over the spawning period is no less than 100,000 individuals.

**SbP Distribution Objective:** *Occupation of Lake Utopia year round and the annual, synchronous occupation under natural conditions of the three spawning streams, with no individual stream to be unoccupied for two consecutive years.*

Performance Measures:

4) All three existing spawning streams were used by LURS-SbP for spawning.

5) None of the existing spawning streams went more than one year without being used by LURS-SbP for spawning.

Two performance measures are used for the population distribution objective to separately evaluate: i) whether each of the existing spawning streams continues to be used by LURS-SbP (i.e. the distribution of spawning has not changed); and, ii) whether all the streams are being used consistently enough that collectively their use could be considered synchronous.

**LbP Abundance Objective** (Interim, 5-year): 2*,000 spawning fish distributed in Mill Lake Stream during nights of peak spawning*.

Performance Measure:

6) The average of the yearly means of the five highest daily summations of the spawner abundance in Mill Lake Stream over the spawning period is no less than 2,000 individuals.

**LbP Distribution Objective:** *Occupation of Lake Utopia year round and annual occupancy of Mill Lake Stream for spawning.*

Performance Measure:

7) Mill Lake Stream was used each year by LURS-LbP for spawning.

# 10. Activities Permitted by the Recovery Strategy

SARA prohibits killing, harming, harassing, capturing and taking an individual or individuals of a wildlife species that is listed as an Extirpated species, an Endangered species, or a Threatened species, as well as possessing, collecting, buying, selling and trading of such an individual or any of its parts or derivatives. Furthermore, the Act also prohibits the damage or destruction of such a species' residence and the destruction of its critical habitat.

However, as set out in s. 83(4) of SARA, a person can engage in an otherwise prohibited activity if the activity is permitted by a recovery strategy and the person is authorized under an Act of Parliament to engage in that activity. Nonetheless, a recovery strategy cannot allow activities that would jeopardize survival or recovery. To do so would be contrary to the purposes of SARA set out in s. 6 and defeat the purpose of producing such a document.

Human activities that may contribute to mortality or harm to LURS were reviewed and evaluated at the 2010 RPA and are summarized in the Science Advisory Report (DFO 2011). Alternatives to the activity and possible mitigation measures were also presented.

The results of the RPA were used to guide the development of the following list of activities permitted by this Recovery Strategy in accordance with s. 83(4) of SARA. An explanation for their eligibility, the supporting information that led to that determination and any conditions that apply are also included.

The activities listed below could have an impact on either population of LURS. However, because the prohibitions of SARA apply only to species listed on Schedule 1 under the Act, only the impacts to the SARA-listed SbP are currently prohibited. Therefore, the exemption from the prohibitions of SARA provided by s. 83(4) to the activities listed below is only currently relevant for the LURS-SbP. If the LURS-LbP becomes listed, the SARA prohibitions will apply immediately to the LbP as well. The activities permitted by the Recovery Strategy would be reviewed at that time, and amended if necessary to apply to the LbP.

For the impacts of an activity to qualify for an exemption under s. 83(4), the activities themselves must be authorized under another Act of Parliament. The legislation under which an authorization is required, and provided, is indicated for each activity listed below.

The following authorized activities, as described below, qualify for the SARA s. 83(4) exemption for impacts to LURS-SbP that would otherwise be prohibited by SARA.

1. Scientific conservation and recovery activities led by DFO and authorized by license under s. 52 and s. 56 of the *Fishery (General) Regulations* and s. 4 of the *Fisheries Act* including:

    a) DFO authorized sampling by methods including but not limited to, dip nets, electrofishing, angling, fyke nets and seine nets, in support of DFO authorized research, assessment of status, or to determine the presence or absence of the species.

    b) The collection and release of individuals of LURS-SbP and their retention and use in support of DFO authorized recovery efforts and conservation research.

The lethal sampling of LURS-SbP for research purposes was identified as a threat of direct mortality; however, given the low number of individuals sacrificed and that LURS-SbP abundance is considered sufficient to sustain some level of direct mortality without jeopardizing its survival or recovery, the advice from the RPA concluded that the overall level of concern for this threat was low. Management approaches in this Recovery Strategy include conducting research on the species for which there is no reasonable alternative that would achieve the same objective.

A completed SARA s. 83(4) Exemption Report shall be completed annually by DFO Science on a date to be determined and submitted to the DFO Species at Risk Management Division, irrespective of whether exempted activities took place. The Report will take account of the previous fiscal year and shall include:

I. A list of all activities requiring use of the exemption and the license number for the associated authorization under another Act of Parliament (if applicable);

II. A record of interactions with LURS-SbP that occurred while conducting exempted activities; and,

III. An assessment on the overall impact of the exempted activities on the LURS populations, including a statement on the cumulative impacts of ongoing or concurrent use the exemption on their survival.

2. Electrofishing authorized by license under s. 52 of the *Fishery (General) Regulations*, conducted by qualified individuals for the purposes of i) enforcement (e.g. to gather evidence of suspected habitat destruction); ii) environmental emergencies; or, iii) fish rescue associated with approvals granted by DFO.

Electrofishing for the purposes described above is directed by DFO to mitigate the effects of authorized activities and will generally have a greater benefit to the species than detriment. Electrofishing can result in death to individuals. However, the probability of this is low and because LURS-SbP abundance is considered sufficient to sustain some level of direct mortality without jeopardizing its survival or recovery, this activity is not expected to jeopardize the survival or recovery of the LURS-SbP.

The allowance of activities 1 & 2 applies only if all feasible measures are taken to minimize the impact of the activity on LURS-SbP and its habitat. This includes but is not limited to:

a) Using the lowest effective voltage while electrofishing;

b) Minimizing the handling of live individuals;

c) Release of individuals as quickly as possible;

d) Lethally sampling only the minimum number of individuals required for retention and analysis, and;

e) Undertaking the activity in a manner that would cause the least disturbance to habitat.

3. Fishing activities for species other than smelt authorized under the *Maritimes Provinces Fishery Regulations* (MPFR), or the *Aboriginal Communal Fishing Licenses Regulations* (ACFLR) made pursuant to the *Fisheries Act* as follows: authorized recreational, commercial, and Aboriginal fishing activities that may incidentally kill, harm, harass, or capture LURS-SbP in the following locations: Lake Utopia and all its tributaries and any other place where LURS-SbP may be intercepted or introduced.

   These activities are subject to the following conditions:

   a) The fishing activities are conducted in accordance with the relevant provisions of the MPFR, or the ACFLR made pursuant to the *Fisheries Act*, including any applicable licensing requirements.

   b) All efforts must be taken to enhance the survival of incidentally captured LURS-SbP in these fisheries. The following additional conditions therefore apply to these fishing activities:

      I. Incidentally caught LURS-SbP must be returned immediately to the place from which they were taken in a manner that causes them the least harm;

      II. Best angling practices must be used, such as those described in the section titled “Attention: Tips on Releasing Fish” in the summary provided with the New Brunswick Angling License and found at http://www2.gnb.ca/content/dam/gnb/Departments/nr-rn/pdf/en/Fish/Fish.pdf;

      III. Incidental capture information (e.g. location, date, time, fish condition at capture and at release) must be reported to the local DFO, Conservation and Protection St. George detachment at (506) 755-5000 or 1-800-565-1633.

This exemption does not, under any circumstances, allow the retention of any live or dead individuals of LURS-SbP or their parts.

This activity is permitted in this Recovery Strategy because, although the bycatch of LURS-SbP while angling for other species was identified as a threat of direct mortality to the species, the RPA advice concluded that the level of concern for this threat is low. The basis for this determination was that only low levels of mortality are expected to result from these activities and that LURS-SbP abundance is considered sufficient to sustain some level of direct mortality without jeopardizing its survival or recovery at this time.

4. Fishing activities directed toward smelt authorized under the ACFLR made pursuant to the *Fisheries Act* and conducted in accordance with the provisions of the ACFLR, including any applicable license requirements, which result in the

capture, killing, and possession of individuals of LURS-SbP in the following locations: Lake Utopia and all its tributaries and any other place where LURS-SbP may be intercepted or introduced.

The above exemption is subject to the following:

a) The conditions and requirements of licenses authorizing the directed fishing activities are reviewed annually and modified if necessary as new information becomes available, such that only retention-levels that will not jeopardize the survival or recovery of the species pair will be authorized.

b) This activity is permitted in this Recovery Strategy because, although it is a source of direct mortality to LURS-SbP, population abundance is currently sufficient to sustain some directed fishing toward smelt in Lake Utopia and its tributaries without jeopardizing the survival or recovery of the LURS-SbP.

Allowing the activities listed in this section to occur will not jeopardize the survival or recovery of the LURS-SbP and in some cases, will assist in the more efficient completion of activities that contribute to achievement of the population objectives of the Recovery Strategy.

Other new or existing activities considered likely to result in an impact to LURS-SbP that are prohibited by SARA may be permitted by the Minister of Fisheries and Oceans Canada under a s. 73 permit or agreement if the conditions set out in the provisions of SARA are met. SARA s. 73 permit applications can be downloaded on the DFO Species at Risk website at http://www.dfo-mpo.gc.ca/species-especes/permits-permis/permits-eng.htm.

Although the impacts of the above-listed activities on LURS-LbP are neither prohibited by, nor exempted by SARA, conducting the activities may nonetheless require authorization under other Acts of Parliament.

Recovery strategy implementation must be reviewed within five years and every five years thereafter. A review of any new information will be undertaken at that time to ensure that the activities permitted by the recovery strategy are still considered to not jeopardize the survival or recovery of the species.

# 11. Statement on Action Plans

It is required that one or more action plans for this species will be developed. These outline actions to be taken to implement the broad strategies and research and management approaches to work toward the broad recovery goal and population objectives identified in this Recovery Strategy. An action plan will be completed within five years of posting the final Recovery Strategy.

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# Appendix A: Effects on the Environment and Other Species

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 planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats.

This Recovery Strategy will clearly benefit the environment by promoting the survival of Lake Utopia Rainbow Smelt. Other aquatic organisms in the Lake Utopia system may also benefit from the measures taken to mitigate threats to LURS, especially those threats to water quality, water quantity, and habitat. The potential for the strategy to inadvertently lead to adverse effects on other species was considered, and it is considered unlikely that the implementation of this recovery strategy will entail any significant adverse effects.

# Appendix B: Record of Cooperation and Consultation

Rainbow Smelt (*Osmerus mordax*) are found in fresh and salt water along the North American coast. In New Brunswick, anadromous populations occur in most coastal streams, and lake populations have been detected within approximately 50 inland water bodies, including Lake Utopia. The Rainbow Smelt found in Lake Utopia and its tributaries consist of two reproductively isolated populations that are considered to be a sympatric species pair. The Lake Utopia Rainbow Smelt (LURS) populations are under the federal jurisdiction of DFO. Lake Utopia is located entirely within the province of New Brunswick in the Magaguadavic River watershed that flows into the Bay of Fundy. The Lake Utopia watershed supports forestry, agriculture, a pulp mill, aquaculture, human settlements, recreational use, linear developments and water storage for hydroelectric power generation. As a result of all these different activities, broad engagement and consultations were sought in the development of the recovery strategy.

The LURS Conservation and Recovery Team assisted in the development of the Recovery Strategy between 2002 and 2004. Once development began, DFO Maritimes Region began a more formal engagement process with experts and representatives from multiple levels of government as well as stakeholder groups and Aboriginal peoples from New Brunswick. Specific members of the Recovery Team and their affiliations can be found in Appendix C of this Recovery Strategy. Input on this strategy was sought from all members of the Recovery Team.

In addition, the scientific elements of the strategy, namely the recovery feasibility, and Sections 5, (threats), 8 (critical habitat), and 10 (activities permitted by the recovery strategy) were informed through a full peer review organized by the Canadian Science Advisory Secretariat.

The strategy was also reviewed by DFO representatives in National Capital Regions and relevant provincial government representatives from Nova Scotia and New Brunswick. All comments received during this level of review were considered.

The final draft document was also circulated to relevant First Nations and Aboriginal communities to provide an opportunity for any additional input into this strategy. All comments received during this review were considered for incorporation into the document.

# Appendix C: Conservation and Recovery Team Membership (2002-2004)

Members listed have a pertinent interest, knowledge or expertise associated with LURS-SbP, represent a stakeholder organization, industry or government agency, or have participated in at least one meeting during the 2002-2004 period.

| **Name** | **Affiliation** |
|---|---|
| Paul Bentzen | Dalhousie University, Biology |
| Rod Bradford | DFO - Science |
| Sarah Cheney | DFO - Fisheries & Aquaculture Management |
| Kathryn Collet | Dept. Natural Resources - Fish and Wildlife Branch |
| Peter Cronin | Dept. Natural Resources - Fish and Wildlife Branch |
| Rod Currie | New Brunswick Wildlife Federation |
| Steve Currie | Dept. Natural Resources – Region 3 |
| Allen Curry | University of New Brunswick, Cooperative Fish and Wildlife Unit |
| Susan Farquharson | Eastern Charlotte Waterways |
| Russell Ferguson | Heritage Salmon Company |
| John Gilbert | J.D. Irving Limited |
| Robert MacDougall | DFO – Habitat Protection and Sustainable Development |
| Arran McPherson (Chair) | DFO - Species at Risk Coordination Office |
| Kirsten Querbach | DFO - Species at Risk Coordination Office |
| Kim Robichaud-LeBlanc | DFO - Species at Risk Coordination Office |
| Murray Rudd | DFO - Policy & Economics |
| Mary Sabine | Dept. Natural Resources - Fish and Wildlife Branch |
| Pam Seymour | Dept. Natural Resources - Region 3 |
| Kent Smedbol | DFO - Science |
| Maureen Toner | Dept. Natural Resources - Fish and Wildlife Branch |

# Appendix D: Glossary

***anadromous*** – migrating from the sea to fresh water to spawn

***aquatic invasive species*** (AIS) – a non-native species, whose introduction will likely cause (or has already caused) damage to the host ecosystem, existing species therein, the economy or human well-being.

***area of occurrence*** – the area of occurrence approach identifies the area essential at any life stage to the survival of existing populations.

***bycatch*** – any fish other than those targeted as a catch, unintentionally caught during fishing

***LURS-SbP critical habitat*** – meeting the definition of critical habitat as per the *Species at Risk Act* (SARA) s. 2(1), i.e. the habitat necessary for the survival or recovery of LURS-SbP, a listed wildlife species under SARA, identified as critical habitat in the Recovery Strategy for the species.

***designatable unit*** (DU) – Species, subspecies, variety, or geographically or genetically distinct population that may be assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), where such units are both discrete and evolutionarily significant.

***endemic*** – being unique to a particular geographic location, such as a specific island, habitat type, nation or other defined zone. To be endemic to a place or area means that it is found only in that part of the world and nowhere else

***eutrophication*** – the process by which the addition of excess nutrients to a body of water increases biological productivity resulting in less light penetration and decreased oxygen supply

***extent of occurrence*** – the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species, excluding cases of vagrancy

***genetic divergence*** – the process in which two or more populations of an ancestral species accumulate independent genetic changes through time, often after the populations have become reproductively isolated for some period of time

***gill rakers*** – bony or cartilaginous, finger-like projections off the gill arch which function in filter-feeders in retaining prey

***hard barrier to dispersal*** – object or condition that is not expected to change over time, which prevents the movement of an organism from one area of potentially suitable habitat to another

***hybridization*** – the process whereby individuals of one genetic stock breed with individuals of another genetic stock (e.g. another species), resulting in hybrid offspring that have lost the pure genetic characteristics of the original stock

***listed wildlife species*** – a species, subspecies, variety or geographically or genetically distinct population of animal, plant, or other organism, other than a bacterium or virus, that is wild by nature and native to Canada and is listed on Schedule 1 of the *Species at Risk Act*.

***mesotrophic*** – is a state of lake productivity characterized by moderate levels of nutrients, moderate growth and intermediate levels of oxygen

***microphagy*** – feeding on relatively minute particles or on very small prey.

***morphological*** – the visible, physical characteristics of an organism

***naturalized*** – A population is said to be naturalized to an area if its reproduction is sufficient to maintain it within that area

***oligotrophic*** – an unproductive, nutrient poor lake that typically has very clear water and high dissolved oxygen content

***pelagic*** – associated with surface or middle depths of a body of water

***piscivorous*** – fish-eating

***population abundance*** – the number or amount of individuals in a population

***reproductive isolation*** – a condition in which interbreeding between populations is prevented by intrinsic factors of the species themselves

***riparian*** – relating to the interface between land and a natural course of water

***self-sustaining population*** – a population that persists naturally

***soft barrier to dispersal*** – object or condition that is considered to be temporary in nature, which prevents the movement of an organism from one area of potentially suitable habitat to another

***sympatric*** – living in the same territory without interbreeding

***thermal stratification*** – the layering of warmer waters over colder waters that can occur in lakes because, as surface waters are warmed, they become less dense than the underlying colder waters

***trophic status*** – the level of growth or productivity of a lake as measured by phosphorus content, algae abundance, and depth of light penetration

***zooplankton*** – microscopic or barely visible aquatic animal organisms floating, drifting, or weakly mobile in a body of water

# Appendix E: Habitat Images

Figure 1. The collection of small boulders in Smelt Brook representing the upper limit of critical habitat in this spawning stream (N45.20656, W066.81539).

Figure 2. The natural barrier to Lake Utopia Rainbow Smelt, Small-bodied Population dispersal representing the upper limit of critical habitat in Unnamed Brook (N45.21005, W066.80929).

Figure 3. The observed upstream limit to Lake Utopia Rainbow Smelt, Small-bodied Population (LURS-SbP) egg distribution in Second Brook in 2011. The log embedded diagonally in the stream resulted in sheet flow which impeded access to habitat lying upstream. This is an example of a ‘soft’ natural barrier to LUR-SbP dispersal, which if not present in future years, LURS-SbP may disperse beyond.

Figure 4. The probable 'hard' barrier to Lake Utopia Rainbow Smelt, Small-bodied Population dispersal located upstream from the current 'soft' barrier in Second Brook shown in Figure 3. This feature would likely serve as a velocity barrier to the species. The bridge located approximately 14m upstream shown in Figure 5 is identified as the location of the upper limit of critical habitat because of its proximity to this feature and the relative ease of its identification in the field.

Figure 5. The bridge that represents the upper limit of critical habitat in Second Brook (N45.21048, W066.78952), approximately 14 linear meters beyond the potential ‘hard’ barrier shown in Figure 4.

Figure 6. The small waterfall representing the upper limit of spawning habitat for Lake Utopia Rainbow Smelt, Large-bodied Population in Mill Lake Stream (45˚12’21”N, 66˚46’38”W).