

# Report on the Progress of Management Plan Implementation for the Yellow Lampmussel (*Lampsilis cariosa*) in Canada for the Period 2010-2015

## Yellow Lampmussel



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## Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under Section 72 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the competent ministers are responsible for reporting on the implementation of the management plan for a species at risk, and on the progress towards meeting its objectives within five years of the date when the management plan was placed on the Species at Risk Public Registry and in every subsequent five-year period, until its objectives have been achieved or the status of the species changes to threatened or endangered under SARA.

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

The Minister of Fisheries and Oceans is the competent minister under SARA for the Yellow Lampmussel and has prepared this Progress Report.

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

## **Acknowledgements**

Fisheries and Oceans Canada (DFO) is grateful to those who participated in the development of the Report on the Progress of Management Plan Implementation for the Yellow Lampmussel (*Lampsilis cariosa*) in Canada for the Period 2010-2015. DFO is thankful to those individuals, groups, Aboriginal Organizations and government agencies, including the Governments of Nova Scotia and New Brunswick, who responded to the survey requesting input on activities undertaken or initiated during the reporting period in relation to, or in support of, the goals, objectives and strategies of the Yellow Lampmussel Management Plan. DFO would also like to express its appreciation to all individuals and organizations who have contributed to the conservation of the Yellow Lampmussel.

## Executive Summary

The Yellow Lampmussel (*Lampsilis cariosa*) is a freshwater bivalve mollusc that was listed as Special Concern under the *Species at Risk Act* (SARA) in 2005. The general prohibitions of SARA, which protect individuals of the species and their residence, do not apply to species of Special Concern and there is no requirement to identify or protect critical habitat. The “Management Plan for the Yellow Lampmussel (*Lampsilis cariosa*) in Canada” was finalized and published on the Species at Risk Public Registry in 2010 (DFO 2010a).

When the Management Plan was published, the Yellow Lampmussel was only known to exist at two locations in Canada: the Sydney River, Cape Breton, Nova Scotia and the lower Saint John River watershed below the Mactaquac Dam, New Brunswick. While there are no accurate abundance estimates for either population, both appear to be large and stable at present and are not under any immediate threat. Estimates of the populations in both of these locations are into the millions (Sabine et al. 2004; DFO 2010a; COSEWIC 2013). Also since the publication of the Management Plan, a new population was discovered in Pottle Lake, NS in 2012 (COSEWIC 2013).

The main threats to both populations of Yellow Lampmussel include changes to habitat and water quality and the potential introduction of non-native and invasive aquatic species. Specific threats to the Sydney River Yellow Lampmussel population include sedimentation resulting from shoreline activities and the use of garden or agricultural chemicals; the presence of invasive aquatic predators such as Chain Pickerel (*Esox niger*) and Smallmouth Bass (*Micropterus dolomieu*) that threaten their host fish species; the potential use of molluscicides (pesticides targeting molluscs, used to control snail and slug pests); the potential introduction of Zebra Mussels (*Dreissena polymorpha*); and predation by Muskrats (*Ondatra zibethicus*). Specific threats to the Saint John River Yellow Lampmussel population include riparian development and sedimentation resulting from poor forestry and agricultural practices; eutrophication and pollution due to run-off of agricultural chemicals and other inputs; the potential introduction of Zebra Mussels and the presence of the invasive aquatic predatory fish that may impact their host fish populations.

The goal of the Management Plan is to maintain the existing Yellow Lampmussel populations in Canada. The five objectives of the Plan are to:

- Maintain current quality and quantity of known Yellow Lampmussel habitat;
- Reduce direct threats to Yellow Lampmussel populations;
- Improve our understanding of Yellow Lampmussel populations in New Brunswick and Nova Scotia;
- Maintain existing host fish populations; and
- Increase public awareness and involvement in Yellow Lampmussel conservation efforts.

Between April 2010 and April 2015 (henceforth, “the reporting period”), progress was made in reducing potential threats to Yellow Lampmussel habitat and improving our understanding of Yellow Lampmussel populations. Studies were also initiated during the reporting period that will eventually improve our understanding of Yellow Lampmussel population size, population dynamics, and distribution in the Sydney Watershed. Several scheduled actions that were not started during the reporting period will be the focus of implementation work from 2015-2020 and will be reported on in the next 5 year Progress Report.

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# 1 Introduction

The Yellow Lampmussel (*Lampsilis cariosa*) is one of a number of freshwater mussel species endemic to North America. Freshwater mussels play a vital role in streams, rivers and lakes by filtering the water, providing food for other animals, and serving as an indicator of healthy freshwater ecosystems. In some parts of North America, freshwater mussels were once gathered for food and decorative use. They were also sought after for freshwater pearls and their shells were extensively used in the button making industry before plastics came into use (Farr 2008). Today many mussel species are in decline due to habitat degradation, impacts to their host fish and the introduction of the non-native Zebra Mussel (*Dreissena polymorpha*) (Mackie 1993). Efforts to conserve freshwater mussels also benefit freshwater ecosystems and those who depend on these ecosystems for their survival and enjoyment.

The Yellow Lampmussel is a freshwater bivalve mollusc that was listed as Special Concern under the *Species at Risk Act* (SARA) in 2005. The general prohibitions of SARA, which protect individuals of the species and their residence, do not apply to species of Special Concern and there is no requirement to identify or protect critical habitat. The “Management Plan for the Yellow Lampmussel (*Lampsilis cariosa*) in Canada” was finalized and published on the Species at Risk Public Registry in 2010 (DFO 2010a).

This report documents progress made towards implementing the actions and meeting the objectives outlined in the Management Plan between April 2010 and April 2015 (the reporting period). This Progress Report is one in a series of documents for the Yellow Lampmussel that are linked and should be considered together. Along with the Management Plan, these documents include the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report (COSEWIC 2004) and the COSEWIC status appraisal summary (COSEWIC 2013).

The stated goal of the Management Plan is to maintain the existing Yellow Lampmussel populations in Canada. Section 2 of this report summarizes key information on the challenges the species faces and the management objectives and threat mitigation strategies identified in the Management Plan. Section 3 reports on the various conservation activities undertaken during the reporting period and evaluates how these have contributed to the implementation of the Management Plan’s 26 conservation actions and five over-arching objectives. The final section of this report, Section 4, summarizes the progress made and the overall outcome of the conservation efforts during the reporting period.

## 2 Background

### 2.1 COSEWIC Assessment Summary

The COSEWIC Status Report ([COSEWIC 2004](#)) informed the listing of the Yellow Lampmussel in 2005, which led to the development and publication of the Yellow Lampmussel Management Plan in 2010. This information is also included in Section 1.1 of the Management Plan. In 2013, COSEWIC re-examined and confirmed the status of the Yellow Lampmussel as “Special Concern” ([COSEWIC 2013](#)).

**Assessment Summary – May 2004**

**Common name** Yellow lampmussel

**Scientific name** *Lampsilis cariosa*

**Status** Special Concern

**Reason for designation** Populations quite large and apparently stable in Canada but found only in Sydney River, Nova Scotia and Saint John River watershed, New Brunswick. Threats are currently very limited but there are long-term concerns related to the potential for introduction of zebra mussels into the Saint John River, and maintaining habitat quality of the sole population in the Sydney River.

**Occurrence** New Brunswick, Nova Scotia

**Status history** Designated Special Concern in May 2004. Assessment based on a new status report.

**Assessment Summary – November 2013**

**Common name**  
Yellow Lampmussel

**Scientific name**  
*Lampsilis cariosa*

**Status**  
Special Concern

**Reason for designation**  
Populations still occur in the Sydney River watershed, Nova Scotia, and in the Saint John River watershed, New Brunswick. In addition, a new site has been found at Pottle Lake in Nova Scotia. While cumulative threat impacts from non-native species of fish and from industrial pollution are high, there is uncertainty about the timing and possibility of invasion by Zebra Mussels and the impact of non-native species of fish on host fish for the Yellow Lampmussel.

**Occurrence**  
New Brunswick, Nova Scotia

**Status history**  
Designated Special Concern in May 2004. Status re-examined and confirmed in November 2013.

## 2.2 Threats

Threats to the Yellow Lampmussel and its habitat are discussed in Section 1.5.2 and Appendices 3 and 4 of the Management Plan. These threats and the associated level of concern assigned to each area are summarized below in Tables 1 and 2.

**Table 1. Summary of the threats identified for the Yellow Lampmussel population in the Sydney River Watershed, Nova Scotia (DFO 2010a).**

Sydney River Watershed, Nova Scotia	
Threat	Description
<b>Level of Concern: Moderate</b>	
Changes to habitat and water quality	Residential and industrial development is increasing. Sedimentation (siltation) resulting from shoreline activities, such as construction and property maintenance, can alter the quality and extent of suitable benthic habitat for the Yellow Lampmussel. Sedimentation can interfere with feeding and reproduction or even result in smothering. Water quality could decline if less stringent best management practices are used for residential shoreline works and activities. Human use of garden or agricultural chemicals can lead to eutrophication. Localised sewage and septic tank inputs may also promote the growth of algae and aquatic plants and reduce oxygen levels, further degrading habitat and water quality. Transportation accidents and accidental discharge of pollutants could also impact water quality.
<b>Level of Concern: Moderate (Zebra Mussels); Low (Fish and other species)</b>	
Non-native and invasive species	If introduced, non-native and invasive species including fish, mussels and aquatic plants, could negatively impact the Yellow Lampmussel, its habitat and its host fish. The Management Plan discusses the potential impacts of several non-native and invasive species introductions on Yellow Lampmussels and their habitat. Several invasive species had been identified in the Management Plan as having been recently established, or with the potential for establishment. They were deemed a potential threat to the Yellow Lampmussel and the aquatic ecosystems on which they depend. Piscivorous predators such as Chain Pickerel ( <i>Esox niger</i> ), recently introduced to the Sydney River, may pose a significant threat to the Yellow Lampmussel's possible host fish species such as White Perch ( <i>Morone americana</i> ) and Banded Killifish ( <i>Fundulus diaphanus</i> ). The potential introduction of Zebra Mussels ( <i>Dreissena polymorpha</i> ) was considered of moderate concern to the Sydney River population. Zebra Mussels are known to smother native mussel communities (Mackie 1993).
<b>Level of Concern: Low</b>	
Breach of Sydney River Dam	A breach to the Sydney River Dam could alter habitat and water quality to the detriment of Yellow Lampmussel. Water levels would lower and saltwater intrusion would increase upstream. Given the current management and maintenance of the dam, the threat of a dam breach is considered unlikely.
Low water levels	A seasonal drop in water levels could result in elevated water temperatures and air exposure. These changes could cause stress, physiological changes and/or death to Yellow Lampmussels.
Use of molluscicides	Molluscicides are used to control snails that host a parasite causing "swimmers itch". Molluscicides are not species-specific and non-target organisms may be affected by their application. While their potential episodic use is a direct threat to Yellow Lampmussel and macroinvertebrate populations, there is no indication that they have ever been used in Blacketts Lake, nor are they likely to be approved provincially for future use.
<b>Level of Concern: Unknown</b>	
Muskrat predation	Muskraats ( <i>Ondatra zibethicus</i> ) are the main predators of adult Yellow Lampmussels in the Sydney River. Given that Muskrat and freshwater mussel populations co-exist in many areas, predation is likely a minor threat to the population (Neves and Odom 1989; Zahner-Meike and Hanson 2001).

**Table 2. Summary of the threats identified for the Yellow Lampmussel populations in the Saint John River Watershed, New Brunswick (DFO 2010a).**

Saint John River Watershed, New Brunswick	
Threat	Description
<b>Level of Concern: Moderate</b>	
Introduction of non-native, invasive Zebra Mussels	The potential introduction of Zebra Mussels has been identified as a serious threat to Yellow Lampmussel in the Saint John River. Zebra Mussels colonize other mussel species, preventing valve closure, which exposes them to environmental extremes and affects normal metabolic function (Mackie 1993). If accidentally introduced as fouling organisms on recreational fishing boats, anchors and gear from the St. Lawrence River or elsewhere, Zebra Mussels could establish and displace populations of Yellow Lampmussel.
Impacts of poor forestry, agriculture, and development practices	Riparian development and sedimentation in some areas of the Saint John River watershed may pose a threat to the Yellow Lampmussel and their habitat. Erosion following deforestation or resulting from poor agricultural practices may result in increased siltation that impairs filter-feeding and respiration by bivalves, and creates unstable bottoms, which are unsuitable Yellow Lampmussel habitat.
	Eutrophication due to run-off of agricultural chemicals and localized sewage may increase nutrient levels and lead to algae blooms and excessive aquatic plant growth. This alters the overall water quality and reduces oxygen levels that may affect mussels and their host fish. Agricultural pesticide and chemical run-off may also kill invertebrates and fish, and result in decreased vigour or death of resident bivalve populations as they accumulate toxic substances in their tissues.
<b>Level of Concern: Low - Moderate</b>	
Pollution due to household and industrial inputs	The Saint John River receives both point-source treated and untreated effluents. Increased nutrient levels can lead to algae blooms, excessive aquatic plant growth, and reduced oxygen levels. Chemical inputs can degrade water quality and may result in decreased vigour or death of resident bivalve populations as they accumulate toxic substances in their tissues.
<b>Level of Concern: Unknown</b>	
Non-native and invasive fish species	Muskellunge ( <i>Esox masquinongy</i> ), a predatory, non-native fish, is established in the Saint John River watershed. Muskellunge may adversely affect Yellow Lampmussel through impacts to fish abundance, including the host fish populations.
	Both Smallmouth Bass ( <i>Micropterus dolomieu</i> ) and Chain Pickerel, two non-native and invasive species, have been present in the Saint John River system since the 1800s. Although the Yellow Lampmussel may have adapted to the presence of these species in the watershed, anything that might enhance the populations of these non-native species would potentially be of concern.
Low water levels	Seasonal low water levels in late summer are a concern for Yellow Lampmussel on the Saint John River. Low water levels could result in elevated water temperatures and air exposure. These changes could cause stress, physiological changes and/or death to Yellow Lampmussels. There is little information available on the extent of this threat.

### 2.3 Conservation Objectives

The goal of the Management Plan is to maintain the existing Yellow Lampmussel populations in Canada (DFO 2010a). A numerical population goal could not be established at the time the Management Plan was published because there were no accurate abundance estimates for either the Nova Scotia or the New Brunswick populations. The following objectives and strategies were developed to support the overall goal of the Management Plan (Table 3). The objectives are the high-level targets that contribute to achieving the overall goal. The strategies are supporting plans which, when accomplished, contribute to meeting each objective.

**Table 3. Yellow Lampmussel Management Plan objectives and strategies (DFO 2010a)**

Strategies
<b><u>Objective 1: Maintain current quality and quantity of known Yellow Lampmussel habitat</u></b>
<p>S1. Reduce threats to Yellow Lampmussel habitat</p> <ul style="list-style-type: none"> <li>a) Maintain current levels of water quality at all known sites</li> <li>b) Monitor water quality conditions at known sites</li> <li>c) Meet with, and disseminate information to, water quality and aquatic habitat regulators to ensure that they are informed about Yellow Lampmussel presence and its water quality needs and sensitivities</li> <li>d) Inform and encourage stakeholders to implement water quality best practices</li> <li>e) Prevent or reduce activities that result in shoreline degradation, habitat alteration, and sedimentation</li> <li>f) Determine risk posed by low-water levels in the Saint John River and Sydney River</li> <li>g) Enforce existing riparian zone protection regulations</li> </ul>
<b><u>Objective 2: Reduce direct threats to Yellow Lampmussel populations</u></b>
<p>S1. Determine level of risk and reduce direct threats to Yellow Lampmussel populations</p> <ul style="list-style-type: none"> <li>a) Discourage the use of molluscicides in Blacketts Lake</li> <li>b) Determine level of risk posed by Muskrat predators on Sydney River population</li> <li>c) Prevent the introduction of Zebra Mussels</li> </ul>
<b><u>Objective 3: Improve our understanding of Yellow Lampmussel populations in New Brunswick and Nova Scotia</u></b>
<p>S1. Gain a better understanding of Yellow Lampmussel population size, dynamics, and distribution</p> <ul style="list-style-type: none"> <li>a) Develop and implement a long-term monitoring protocol for all existing populations to gather abundance and trend information</li> <li>b) Develop and implement a survey protocol to look for new occurrences of Yellow Lampmussel in suitable habitat</li> <li>c) Gather information on habitat and biology which is necessary to assist activities in (a) and (b)</li> </ul> <p>S2. Gain a better understanding of the interactions between Yellow Lampmussel populations and other native fish species in the watershed</p> <ul style="list-style-type: none"> <li>a) Determine potential interactions with Atlantic Sturgeon (<i>Acipenser oxyrinchus</i>) and Shortnose Sturgeon (<i>Acipenser brevirostrum</i>) in the Saint John River</li> </ul>
<b><u>Objective 4: Maintain existing host fish populations</u></b>
<p>S1. Identify and gather information on host fish species in NB and NS</p> <p>S2. Assess and reduce potential threats to host fish populations, including potential negative impacts from non-native and invasive species</p>
<b><u>Objective 5: Increase public awareness and involvement in Yellow Lampmussel conservation efforts</u></b>
<p>S1. Encourage education and communication programs with stakeholders and general public that:</p> <ul style="list-style-type: none"> <li>a) Raise awareness of the presence of Yellow Lampmussel in the Saint John and Sydney rivers and conservation efforts under the <i>Species at Risk Act</i></li> <li>b) Raise awareness of the effects of non-native and invasive species on Yellow Lampmussel and other species at risk</li> <li>c) Raise the importance of maintaining biodiversity and the functional components of existing habitats for Yellow Lampmussel and other native species</li> <li>d) Raise awareness of existing federal and provincial regulations that protect Yellow Lampmussel habitat</li> <li>e) Raise awareness on issues pertaining to riparian zone degradation and the potential for sediment deposition in the lower Saint John River watershed</li> </ul> <p>S2. Adopt and/or develop tools and approaches that reduce the risk of non-native and invasive species introductions</p>

## 2.4 Performance Indicators

The Management Plan did not include performance indicators. The progress towards achieving the overall goal of the Management Plan will be informed by the progress made toward meeting the five objectives and more specifically toward implementing the actions identified in the

implementation schedules for the Yellow Lampmussel populations in the Sydney River, Nova Scotia (NS) and the Saint John River, New Brunswick (NB) as reported on in Table 4 and evaluated in Table 5 below.

### 3 Progress Toward Achieving Conservation Objectives

To develop this Progress Report, Fisheries and Oceans Canada (DFO) gathered information via a survey on research, monitoring, management, protection, outreach and communication activities that were undertaken during the reporting period and that support achieving the goal, objectives and strategies of the Yellow Lampmussel Management Plan.

#### 3.1 Activities Supporting Conservation Objectives

The conservation activities undertaken during the reporting period that support or contribute to meeting the objectives, strategies and actions of the Yellow Lampmussel Management Plan are presented in Table 4. Progress made toward completing the actions outlined in the implementation schedules of the Yellow Lampmussel Management Plan (DFO 2010a) are presented in Table 5. Some of the activities listed in these tables were undertaken specifically to advance the conservation of the Yellow Lampmussel, whereas others were undertaken for different or broader purposes, but still resulted in benefits to the Yellow Lampmussel.

#### List of acronyms used in Tables 4 and 5:

**AAFC** – Agriculture and Agri-Food Canada  
**AC CDC** – Atlantic Canada Conservation Data Centre  
**ACAP-CB** – Atlantic Coastal Action Program – Cape Breton  
**AFSAR** – Aboriginal Funds for Species at Risk  
**CABIN** – Canadian Aquatic Biomonitoring Network  
**CBRM** – Cape Breton Regional Municipality  
**CBU** – Cape Breton University  
**COSEWIC** – Committee on the Status of Endangered Wildlife in Canada  
**CRI** - Canadian Rivers Institute  
**DFO** – Fisheries and Oceans Canada  
**ECCC** – Environment and Climate Change Canada  
**FPP** – Fisheries Protection Program  
**GIS** – Geographic Information System  
**MNCC** – Maliseet Nation Conservation Council  
**MTRI** – Mersey Tobeatic Research Institute  
**NB** – New Brunswick  
**NBDELG** – New Brunswick Department of Environment and Local Government  
**NBDERD** – New Brunswick Department of Energy and Resource Development  
**NBEN** - New Brunswick Environmental Network  
**NCC** - Nature Conservancy Canada  
**NS** – Nova Scotia  
**NSDFA** – Nova Scotia Department of Fisheries and Aquaculture  
**NSDNR** – Nova Scotia Department of Natural Resources  
**NSE** – Nova Scotia Environment (Department of Environment)  
**NSERC** – Natural Sciences and Engineering Research Council of Canada  
**RFCPP** - Recreational Fisheries Conservation Partnerships Program  
**SJR** – Saint John River  
**SNS** – Shortnose Sturgeon  
**YLM** – Yellow Lampmussel

**Table 4. Report on conservation activities undertaken in support of the Yellow Lampmussel Management Plan. Corresponding Objective and Strategy numbers, as provided in Table 3, are denoted in the third column (e.g. O1; S1) and each associated Action or multiple Actions are denoted in column 4. The specific Action numbers refer to those outlined in Section 2.3 of the Management Plan. They are also listed sequentially in Table 5 below.**

Conservation Activity	Description and results	Obj. & strg.	Action (s)	Participants
AC CDC maintenance of geo-referenced location records	The AC CDC maintains geo-referenced location records of YLM occurrences (approximately 140 to date) in a biodiversity database. The database is used for various purposes, most significantly to inform federal and provincial Environmental Assessments and for the preparation of species assessments by COSEWIC. The record fields include location, observer, observation data and habitat description.  Reference: AC CDC 2015	O1; S1	1, 2	AC CDC
Source Water Protection Plan for Pottle Lake completed	Pottle Lake, the location of a newly discovered population of YLM (COSEWIC 2013), is a public water supply for North Sydney. The final version of the "Source Water Protection Plan for Pottle Lake" was approved by the Source Water Protection Committee in June 2012 and published in 2013. The Plan identifies potential risks to drinking water quality and quantity and includes source water protection and risk reduction strategies. It includes sections on inspection and enforcement, public education and best management practices, some of which, including restricted access to the lake and regular water quality testing, have already been implemented. The activities in this plan also serve to protect YLM habitat in Pottle Lake.  Reference: CBRM 2013	O1; S1	1, 2, 5, 6, 23, 24	CBRM
Launching of the Nova Scotia Museum's electronic publications program	The Nova Scotia Museum electronic publications program was launched in 2014. The goal of this initiative was to increase public access to preliminary results from research on Nova Scotia Museum collections or research carried out under a Museum program. Freshwater mussel distributional and ecological data is published and available online.  References: Davis 2007; Nova Scotia Museum Publications 2015	O1; S1	1, 2	Nova Scotia Museum
Sydney River Dam Operators made aware of YLM presence and habitat needs	Operators of the Sydney River Dam (which is managed by Nova Scotia Lands - a Provincial Crown corporation) were sent a list of the YLM management goal, objectives and strategies in January 2015. Operators are aware of YLM needs and inspect the dam and fish ladders yearly and make repairs as required.	O1, S1 O2, S1	3	Nova Scotia Lands

Conservation Activity	Description and results	Obj. & strg.	Action (s)	Participants
NBDELG Watercourse and Wetland Alteration Technical Guidelines	<p>NBDELG produced a guidance document for developers and land owners considering projects near water, entitled: "Watercourse and Wetland Alteration Technical Guidelines". These guidelines were prepared to complement the NB <i>Watercourse and Wetland Alteration Regulation 90-80</i> under the <i>New Brunswick Clean Water Act</i> C-6.1, Acts of New Brunswick, 1989. The guidelines include information on safeguarding riparian habitat. Changes made to or near a watercourse may result in damage to the aquatic environment and could place fish and wildlife at risk, as well as diminish water quality. A permit must be obtained from the NBDELG for all watercourse and wetland alterations. Every permit application is carefully evaluated to ensure that the potential effects of a watercourse or wetland alteration are adequately considered at the design stage and they must comply with the habitat provisions of the <i>Fisheries Act</i>.</p> <p>Reference: NBDELG 2012</p>	O1, S1 O5, S1	1, 2, 4, 5, 6, 25	NBDELG
Booklet prepared on Beneficial Management Practices for Riparian Zones in Atlantic Canada	<p>An information booklet was produced by AAFC and the Island Nature Trust in 2010, entitled "Beneficial Management Practices for Riparian Zones in Atlantic Canada".</p> <p>Reference: AAFC and Island Nature Trust 2010</p>	O1, S1 O5, S1	1, 2, 4, 5, 6, 24, 25	AAFC; Island Nature Trust
ACAP-CB's CBRM Wastewater Management video produced and available online	<p>ACAP-CB produced a video accessible on their website entitled "The Solution to Water Pollution – Sydney – CBRM Wastewater Management" to encourage citizens to implement water quality best practices.</p> <p>Video: <a href="http://www.acapcb.ns.ca/#!videos/cukt">http://www.acapcb.ns.ca/#!videos/cukt</a></p>	O1, S1 O5, S1	5, 6, 24	ACAP-CB
Species at Risk in Nova Scotia, Identification and Information Guide 2 <sup>nd</sup> edition published	<p>MTRI developed a 2<sup>nd</sup> edition of the "Species at Risk in Nova Scotia, Identification and Information Guide". The guide includes basic information about YLM, its habitat, threats to its survival and ways for the public to help conserve this species.</p> <p>Reference: MTRI 2015</p>	O1, S1 O5, S1	5, 6, 24	MTRI
DFO Regulatory review of development projects in YLM habitat	<p>DFO's FPP reviewed projects and considered impacts on YLM and other species at risk and their habitat in their decision making and provision of advice to project proponents.</p>	O1, S1	1, 2, 5, 6	DFO

Conservation Activity	Description and results	Obj. & strg.	Action (s)	Participants
<p>NBDERD advice and recommendations to minimize forest harvesting impacts to YLM and its habitat</p>	<p>NBDERD was involved in the development of the YLM Management Plan and is aware of the YLM presence and its needs in NB. NBDERD received and reviewed proposals to harvest and conduct silviculture management on Crown lands, with the intention of managing forests to maintain biodiversity and protect riparian habitat according to policies set out in their two documents: “Biodiversity Strategy” and “Be... sustainable in this place, A balanced management approach for New Brunswick’s Crown Forest”.</p> <p>On Crown Lands, the NB <i>Crown Lands and Forests Act</i> also applies. The Crown Timber Licensees must adhere to the Forest Management Manual and other guidance documents, with the goal of managing habitat for the maintenance of fish and wildlife populations. The forest companies are also certified with a 1-week course to train them to operate as per the “Watercourse and Wetland Alteration (WAWA) Regulation Guidelines” for standard agreed-upon low-risk activities relating to forestry-related watercourse crossings and road construction. Anything outside those standards requires a standard WAWA permit and additional review.</p> <p>References: NBDERD 2016; M. Sabine pers. comm. 2016</p>	<p>O1, S1</p>	<p>1, 2, 5, 6</p>	<p>NBDERD</p>
<p>NSDNR advice and recommendations to minimize forest harvesting impacts to YLM and its habitat</p>	<p>NSDNR received and reviewed proposals to harvest and conduct silviculture management on Crown lands, including within the Blacketts Lake - Sydney River watershed. NSDNR also received requests from forestry organizations for information and recommendations regarding the conservation of various species that occur on private lands.</p> <p>In response to these requests, NSDNR provided recommendations to minimize soil disturbance, as well as comments on the value of the Blacketts Lake - Sydney River watershed to YLM. Their response also reminded landowners and operators to implement the “Forest Ecosystem Classification for Nova Scotia” to ensure that the forest harvesting and silviculture methods are site-appropriate, minimize impacts to soils and safeguard water quality.</p> <p>Reference: NSDNR 2016</p>	<p>O1; S1</p>	<p>1, 2, 5, 6</p>	<p>NSDNR</p>
<p>Booklet prepared: Greenprint, Towards a Sustainable New Brunswick</p>	<p>In 2010, the NBEN published a booklet entitled “Greenprint, Towards a Sustainable New Brunswick”. It was developed in consultation with industry and other stakeholders. It sets out goals and measures encouraging many sustainable actions for healthy natural ecosystems, including water quality best practices. In an ongoing effort to implement these goals and measures, a Watershed Network representing 30 groups from across the province, work together to share ideas and address common concerns about the ecological integrity of their respective watersheds, as well as the Province’s water resources.</p> <p>References: NBEN 2010; 2016</p>	<p>O1, S1 O5, S1</p>	<p>4, 5, 6, 25</p>	<p>NBEN</p>

Conservation Activity	Description and results	Obj. & strg.	Action (s)	Participants
NBDELG implements its regulations and policies to protect aquatic habitat	<p>NBDELG continues to implement its 1) Coastal Areas Protection Policy to maintain buffering capacity of coastal areas to protect inland areas from storm surge; and 2) <i>Watercourse and Wetland Alteration Regulation</i> under the <i>Clean Water Act</i> to minimize impact to waterbodies and prevent harm to the aquatic environment and ecosystem.</p> <p>Reference: NBDELG 2012</p>	O1, S1	1, 2	NBDELG
Distribution of YLM Management Plan within DFO and to NSDFA and NBDERD	<p>The YLM Management Plan was distributed within DFO and to NSDFA and NBDERD, which has contributed to increased awareness and actions reported in this document.</p>	O1, S1	1, 2, 5, 6, 8	DFO NSDFA NBDERD
NSDFA invasive species research	<p>NSDFA conducted research on the impact of invasive species on YLM host fish in Blacketts Lake.</p> <p>References: LeBlanc 2010; Mitchell et al. 2010; Campbell and LeBlanc. 2013; J. LeBlanc pers. comm. 2016</p>	O4, S1, S2	19, 20	NSDFA
NSDFA distributes information to anglers about how to prevent the spread of aquatic invasive species	<p>NSDFA includes an insert about invasive species in the Nova Scotia Angler's Handbook, which was distributed annually during the reporting period to recreational anglers in NS. It describes how fishers can take actions to prevent the spread of aquatic invasive species, such as predatory fish and Zebra Mussels.</p> <p>As well, when NSDFA meets with angler groups in Cape Breton as part of their regular outreach work, they promote YLM and freshwater mussel conservation issues, such as preventing the introduction of Zebra Mussels.</p> <p>References: NSDFA 2015a; J. LeBlanc, pers. comm. 2016</p>	O4, S2	9, 24, 26	NSDFA
NBDERD distributes information to anglers about how to prevent the spread of aquatic invasive species	<p>Annually, during the reporting period, the NB guide for angler's "Fish 2015: a part of our heritage" has included an insert with information on how anglers can take actions to prevent the spread of aquatic invasive species, such as predatory fish and Zebra Mussels.</p> <p>Reference: NBDERD 2015</p>	O4, S2	9, 25, 26	NBDERD
NS Live Fish Possession Regulations	<p>In November 2012, NS implemented <i>Live Fish Possession Regulations</i> under the under Section 81 of the <i>Fisheries and Coastal Resources Act</i> to help prevent the spread of aquatic invasive species through the illegal introduction (live possession and transport) of fish species into provincial waters. Outreach material, informing the public of these regulations, can be found on the NSDFA's website.</p> <p>Reference: NSDFA 2015b</p>	O4, S2	9	NSDFA

Conservation Activity	Description and results	Obj. & strg.	Action (s)	Participants
Publication of the “Invasive Alien Species in Nova Scotia Identification and Information Guide”	<p>In 2012 the MRTI published an “Invasive Alien Species in Nova Scotia Identification and Information Guide”, encouraging the public to prevent the further introduction of Chain Pickerel, Smallmouth Bass and Zebra Mussels and providing information on numerous organizations working to control alien and invasive species in NS and Canada.</p> <p>Reference: MRTI 2012</p>	O4, S2 O5, S1, S2	9, 24, 26	MTRI
Public education about invasive species	<p>The Invasive Species Alliance of Nova Scotia promotes public education about the threat of invasive species, such as Zebra Mussels, on its website.</p> <p>Reference: Invasive Species Alliance of Nova Scotia 2016</p>	O4, S2 O5, S1, S2	9, 24, 26	Invasive Species Alliance of Nova Scotia
Multi-faceted YLM research project initiated at CBU	<p>A multi-faceted research project on YLM in NS was planned by CBU during the reporting period and has since been initiated. The results of this research will be reported on in the next 5 Year Progress Report. The various components of this research project are provided below.</p> <ul style="list-style-type: none"> <li>• Evaluate risks to YLM over time from seasonal low-water levels within monitoring sites established in Pottle Lake;</li> <li>• Estimates of the longevity of YLM shells sampled from midden sites located along the shores of Pottle Lake and Blacketts Lake;</li> <li>• Estimates of the age at sexual maturity of female YLM within the Pottle Lake population based on mantle lure display and age estimation via counts of external shell growth;</li> <li>• Estimation of glochidial release period and confirmation of period of gravidity for the population of YLM in Pottle Lake, as determined from field sampling. An attempt will be done to correlate mantle lure display and glochidial release period with changes in water temperature;</li> <li>• Development of protocols to identify potential YLM habitat and, using software such as Google Earth, mapping of suitable YLM habitat in the vicinity of the existing YLM populations in Blacketts Lake and Pottle Lake. The protocol will be used to conduct surveys to determine new occurrences of YLM;</li> <li>• Conduct surveys to determine new occurrences of the species in potential YLM habitat by examining the presence of shells in previously identified Muskrat midden sites, focusing on areas identified as potential YLM habitat;</li> <li>• Compare the maximum YLM shell length between midden sites and adjacent living YLM populations in Pottle Lake to determine whether midden shells are representative of the age/size of the living populations;</li> <li>• Establish protocols that will allow for monitoring of short-term and long-term fluctuations in size and distribution of the Pottle Lake YLM population;</li> <li>• Conduct surveys to establish baseline data that will allow for monitoring of short-term and long-term fluctuations in size and distribution of YLM populations;</li> <li>• Estimating the level of risk Muskrat predation poses to YLM populations in NS by</li> </ul>	O1, S1 O3, S1	10, 11, 15, 16, 17, 18, 21, 22, 23	CBU CBRM DFO

Conservation Activity	Description and results	Obj. & strg.	Action (s)	Participants
	<p>monitoring shell middens in Pottle Lake; and</p> <ul style="list-style-type: none"> <li>Monitoring threats to YLM habitat. Three YLM monitoring sites were established on Pottle Lake. Each site consists of a 30 m stretches of shoreline where YLM density and substrate data are collected. These stations will be monitored every two years to estimate trends in the population and habitat quality over time.</li> </ul> <p>References: K. White pers. comm. 2015, 2016;</p>			
<p>MAES ecological research and monitoring in YLM habitat</p>	<p>The Mactaquac Dam on the Saint John River is nearing the end of its life span (2030) and a decision on whether to renew it, remove it or maintain only an earthen dam and spillway is expected within the next 10 years.</p> <p>In 2013, NB Power engaged CRI and its partners to evaluate environmental parameters of the 20 km section of river (known YLM habitat) between the Mactaquac Generating Station (at the dam) and Fredericton, both before and after any alterations are made. This project, called The Mactaquac Aquatic Ecosystem Study (MAES), is also supported by UNB, NSERC, NB Wildlife Trust Fund, the NB Government, and ECCC. Phase I was initiated in 2014 and will continue through the 2017 field season. The results of this large-scale, multi-year project will help inform the impending decision.</p> <p>During the reporting period, as part of the MAES research, CRI collected baseline fish community data on diversity, abundance, and body condition, which may provide information on potential YLM host fish health and abundance. The CRI also studied the ecology of Muskellunge in the vicinity of the Mactaquac Dam, a predator on potential YLM host fish. These two studies will likely provide information on the possible effect that non-native, invasive species (e.g., Muskellunge, Smallmouth Bass, Chain Pickerel) are having on fish assemblages in YLM habitat.</p> <p>During the reporting period, MAES researchers planned a multi-year mussel survey with preliminary work initiated during the summer of 2015. Although MAES has a much broader focus than just YLM, it has the potential to also yield new information on YLM occurrences in the Saint John River watershed and information pertaining to YLM host fish. This work is underway and the results will be reported on in the next 5 Year Progress Report for the YLM.</p> <p>References: CRI 2015; T. Linnansaari pers. comm. 2016</p>	<p>O1, S1 O4, S2 O3, S1</p>	<p>13, 16, 20, 21, 23</p>	<p>CRI; UNB; NB Power; NBDERD; NSERC; NB Wildlife Trust Fund; ECCC</p>
<p>New occurrence record of Yellow Lampmussel in Pottle Lake</p>	<p>In 2012, live mussels were retrieved from Pottle Lake, NS by CBU staff and identified as YLM by researchers at CBU. This was not a specific survey, but an opportunistic event. This new occurrence of YLM was not recorded in the previous status report . The newly discovered Pottle Lake population is 10 km from the current Sydney River population.</p> <p>References: COSEWIC 2004, 2013; K. White pers. comm. 2016</p>	<p>O3, S1</p>	<p>16</p>	<p>CBU Nova Scotia Museum</p>

Conservation Activity	Description and results	Obj. & strg.	Action (s)	Participants
Examination of YLM shells in Muskrat middens	<p>Following the discovery of YLM in Pottle Lake in 2012, mussel shells were sampled from Muskrat midden sites along the shores of Pottle Lake (in October 2013) and Blacketts Lake (in October 2014). Although quantitative population estimates were not conducted at these two locations, relative abundance, shell size and sex of YLM shells found within midden sites were recorded. Preliminary results indicate that the relative abundances are quite different between the two lakes. CBU intends to publish this work, which will be included in the next YLM 5 Year Progress Report.</p> <p>Reference: K. White, pers. comm. 2015</p>	O3, S1	17, 22	CBU CBRM DFO
NSDFA surveys invasive fish species in Blacketts Lake	<p>NSDFA is conducting surveys in Blacketts Lake to determine the presence and abundance of invasive fish species Chain Pickerel and Smallmouth Bass, which likely prey on YLM host fish species. The initial work documented the presence of both invasive species in Blacketts Lake and nearby Gillis Lake (which is attached to Blacketts Lake) in June 2009. Since that time, research has focussed on documenting establishment and spread, reproductive success, population structure and anticipated impacts. The impacts of Chain Pickerel in this ecosystem could include (1) a simplified fish community, (2) a reduction in overall fish abundance, and (3) a truncated fish size distribution. Stable isotope analysis has shown that Smallmouth Bass and Chain Pickerel tend to occupy highest trophic positions in Blacketts Lake.</p> <p>References: LeBlanc 2010 ; Mitchell et al, 2010; Campbell and LeBlanc, 2013; J. LeBlanc pers. comm. 2016</p>	O4, S2	19, 20	NSDFA
Water and land use monitoring in Pottle Lake	<p>Due to the lake's status as the water supply for Sydney, CBRM conducts daily monitoring of the water chemistry of Pottle Lake. CBRM also monitors seasonal fluctuations in the water level and land use (e.g. illegal dump sites, development, etc.) within the Pottle Lake watershed.</p> <p>Reference: CBRM 2013</p>	O1, S1	1, 2, 5, 6, 23	CBRM
ACAP-CB stream restoration activities in Dutch Brook	<p>Although not specifically directed at YLM, ACAP-CB has conducted stream restoration activities throughout the CBRM, including rehabilitating Dutch Brook in 2014-2015, which flows into Blacketts Lake, known YLM habitat. This may allow YLM to spread into this restored stream. This work is supported by Adopt-A-Stream and DFO-RFCPP programs.</p> <p>References: ACAP-CB 2015; J. Tomie pers. comm. 2016</p>	O1, S1 O5, S1	5, 6, 24	ACAP-CB Adopt-A-Stream DFO-RFCPP

Conservation Activity	Description and results	Obj. & strg.	Action (s)	Participants
ACAP-CB habitat protection activities around Blacketts Lake	<p>ACAP-CB delivered Nova Scotia Environment's Environmental Home Assessment Program to residents surrounding Blacketts Lake (YLM habitat) who used a private water supply and septic system. The education included best practices for maintaining septic, well, and oil tanks, a \$100 voucher for septic tank pump-out and a septic repair grant with additional eligibility criteria.</p> <p>References: ACAP-CB 2015; J. Tomie pers. comm. 2016</p>	O1, S1 O5, S1	5, 6, 24	ACAP-CB NSE
CABIN sampling at Dutch Brook	<p>In 2015, ACAP-CB began conducting CABIN sampling at Dutch Brook, which flows into Blacketts Lake. CABIN is an aquatic biomonitoring program for assessing the health of fresh water ecosystems in Canada. CABIN is based on the network approach that promotes inter-agency collaboration and data-sharing to achieve consistent and comparable reporting on fresh water quality and aquatic ecosystem conditions in Canada. This work is underway and the results will be reported on in the next 5 Year Progress Report for the YLM.</p> <p>References: ACAP- CB 2015; CABIN 2015</p>	O1, S1 O5, S1	5, 6, 23, 24	ACAP-CB CABIN
Planning for YLM identification and survey techniques workshops	<p>Planning was initiated during the reporting period for the delivery of training workshops to be delivered by the NB Museum in January 2016 (outside the reporting period). These workshops are intended to help build capacity among local Aboriginal communities to carry out future mussel survey work in the Saint John River, in particular surveying for the YLM and Brook Floater (<i>Alasmidonta varicose</i>), which will contribute to Actions 16, 17 and 21 in the future. At the workshops, information will be presented on the YLM including basic mussel biology, commonly co-occurring species, and general survey techniques. The objective is to provide sufficient experience for participants to distinguish between mussel species and to gain an appreciation for the techniques used to conduct surveys in freshwater aquatic habitats.</p> <p>Reference: D. McAlpine pers. comm. 2015</p>	O3, S1 O5, S1	25	NB Museum DFO Aboriginal Organizations
YLM Aboriginal Traditional Knowledge study	<p>With support from the AFSAR program, the MNCC conducted a survey in 2011-2012 to collect Aboriginal Traditional Knowledge on YLM from six Maliseet First Nations communities. Traditional knowledge about the species, including information on traditional uses and cultural significance of the species, was gathered. A report on the study was completed.</p> <p>Reference: MNCC 2012</p>	O5, S1	25	MNCC DFO-AFSAR

Conservation Activity	Description and results	Obj. & strg.	Action (s)	Participants
Surveys of Recreational Fishing in Canada	<p>The 2010 and 2015 Surveys of Recreational Fishing in Canada (5-year national survey coordinated by DFO) were sent to a sample of anglers in each jurisdiction of Canada. The survey asks a series of questions on Aquatic Invasive Species, which serve to educate anglers on the issues and concerns regarding invasive species. These surveys were sent to anglers in both NB and NS.</p> <p>References: DFO 2010b; M. Sabine pers. comm. 2016</p>	O5, S1	9, 26	NSDFA NBDERD DFO
Web article about preventing the spread of Zebra Mussels	<p>In August 2014, NCC posted an article on their website about actions the public can take to prevent the spread of Zebra Mussels, entitled "Pack your bags, Zebra Mussels!"</p> <p>Reference: Cherka 2014</p>	O5, S1	9, 26	NCC

## 3.2 Summary of Progress

Table 5 provides a summary of the progress made toward completing the objectives of the Management Plan and the actions outlined in its implementation schedules. Each action has been assigned one of four statuses:

- **Incomplete (I):** *The action has not been completed and little to no progress has been made toward its completion.*
- **Underway (U):** *The action has not been completed, but there has been moderate to significant progress made toward its completion.*
- **Completed (C):** *The action has been completed and no further efforts are required.*
- **Completed, ongoing (C/O):** *The action has been completed, but efforts will continue until such time as the conservation objective has been achieved (i.e. the action will be reported against in the next five-year progress report).*
- **Not Applicable (N/A)**

**Table 5: Summary and evaluation of progress made toward completing the actions outlined in the implementation schedules of the Yellow Lampmussel Management Plan (DFO 2010a). Actions are organized into 5 categories (Protection, Management, Research, Monitoring and assessment, and Outreach and communication). These groupings correspond to Section 2.3 of the Management Plan.**

Status NB	Status NS	Comments	Next steps/recommendations
<b>Protection</b>			
Action 1. Inform water quality regulators about YLM presence, needs and sensitivities			
U	U	CBRM, NSE and NBDELG have been informed of the YLM management goal, objectives and strategies. Information about YLM presence can be acquired through the AC CDC and the YLM Management Plan is publically available on SAR Public Registry. As well, in NS, freshwater mussel distribution and ecological data is publically available online via the Nova Scotia Museum, and in the "Species at Risk in Nova Scotia Identification and Information Guide, 2 <sup>nd</sup> edition" (MTRI 2015).	On-going outreach to regulators is encouraged. DFO will send the YLM Management Plan, and an email reminder with a link to the YLM Management Plan (on 5-year cycle) to all water quality regulators in NB and NS.
Action 2. Inform aquatic habitat regulators about YLM presence and its habitat needs			
U	U	DFO sectors responsible for aquatic habitat regulations are aware of YLM presence and its habitat needs.  Comments for Action 1 apply here as well.	On-going outreach to regulators is encouraged. DFO will send the YLM Management Plan, and an email reminder with a link to the YLM Management Plan (on 5-year cycle) to all aquatic habitat regulators in NB and NS.
Action 3. Inform operators of Sydney River Dam about YLM presence and habitat needs			
N/A	U	Operators of the Sydney Dam (which is managed by Nova Scotia Lands) are aware of the YLM Management Plan goal, objectives and strategies. They inspect the dam and fish ladders yearly and make repairs as required.	Ongoing and more comprehensive outreach with the operators would be valuable to provide updates as new information becomes available.
Action 4. Inform stakeholders and the general public to raise awareness on issues pertaining to riparian zone degradation in the lower Saint John River			
C/O	N/A	Materials are available to inform stakeholders and the public of riparian zone degradation in NB. The NB Watercourse and Wetland Alteration Technical Guidelines (NBDELG 2012) describe the importance of riparian habitat and provide guidance to those planning a watercourse or wetland alteration or reviewing a proposed alteration.  Other public outreach information serves to provide awareness of riparian zone issues in Atlantic Canada: "Beneficial Management Practices for Riparian Zones in Atlantic Canada" (AAFC and Island Nature Trust 2010).	Other mechanisms to raise awareness of riparian zone degradation among stakeholders and the public specifically in the lower Saint John River should be considered and implemented.

Status NB	Status NS	Comments	Next steps/recommendations
<b>Management</b>			
Action 5. Encourage stakeholders to implement water quality best practices			
C/O	C/O	<p>In NS and NB, the Provincial Ministry of Natural Resources reviews forest harvesting plans and provides recommendations to minimize impacts to soils and water quality</p> <p>In NS and NB, various outreach materials and plans have been prepared by groups to encourage citizens to implement water quality best practices:</p> <p>In NS, a web-accessible video was produced: “The Solution to Water Pollution – Sydney – CBRM Wastewater Management” to encourage citizens to implement water quality best practices. Video: <a href="http://www.acapcb.ns.ca/#!videos/cukt">http://www.acapcb.ns.ca/#!videos/cukt</a></p> <p>In NB, the booklet “Greenprint, Towards a Sustainable New Brunswick” (NBEN 2010) encourages many sustainable actions for healthy natural ecosystems, including water quality best practices. The Watershed Network represents 30 groups from across NB that work together to share ideas and address common concerns about the ecological integrity of their respective watersheds, as well as NB’s water resources.</p> <p>Comments for Action 25 apply here as well.</p>	Efforts to encourage stakeholders to implement water quality best practices should be ongoing.
Action 6. Encourage stakeholders to implement best practices to reduce impacts to aquatic habitat			
C/O	C/O	<p>As a federal regulator in NS and NB, DFO’s FPP reviews projects and considers impacts to YLM and other species at risk and their habitat. FPP provides advice to proponents on how to minimize impacts on water quality.</p> <p>Comments for Actions 5 and 25 apply here as well.</p>	Efforts to encourage stakeholders to implement best practices to reduce impacts to aquatic habitat should continue.
Action 7. Contact NSE to discourage use of molluscicides in Blacketts Lake			
N/A	C/O	NSE was contacted during the reporting period regarding the potential use of molluscicides. They received no requests for using molluscicides on Blacketts Lake during the reporting period.	Although there may currently be no public interest in using molluscicides, efforts to discourage their use should continue.
Action 8. Inform jurisdictions involved in fish management about YLM and needs of host fish			

Status NB	Status NS	Comments	Next steps/recommendations
C/O	C/O	The YLM Management Plan was distributed within DFO Maritimes Region and to NSDFA and NBDERD, which has contributed to increased awareness and the actions reported in this document.	New (e.g. DFO Gulf Region) and ongoing outreach with jurisdictions involved in fish management in YLM habitat is encouraged to provide updates as new information becomes available.
<b>Action 9. Support existing programs that reduce the risk of non-native and invasive species introductions</b>			
C/O	C/O	<p>Both NB and NS have annually provided information to anglers on how to reduce the spread of aquatic invasive species.</p> <p>The new NS Live Fish Possession Regulations and associated outreach materials help prevent the spread of aquatic invasive species through the illegal introduction (live possession and transport) of fish species into provincial waters.</p> <p>Educational outreach materials have been prepared and distributed by several Environmental Non-Government Organizations.</p>	Ongoing efforts should be made to reduce the risk of non-native and invasive species introductions.
<b>Research</b>			
<b>Action 10. Initiate studies to evaluate risk from seasonal low-water levels in YLM habitat</b>			
I	U	A study to evaluate the risk to YLM from seasonal low-water levels was planned for Pottle Lake, NS, by CBU and will be reported on in the next 5 Year Progress Report.	Complete the planned studies and evaluate the results. Based on this information, recommend actions to reduce risk.
<b>Action 11. Initiate research to determine longevity, age at sexual maturity, timing of fertilization and glochidial release, and period of gravidity</b>			
I	U	Research to address this action was planned by CBU and will be reported on in the next 5 Year Progress Report.	Complete the planned research in NS and evaluate and share the results. Use the results to conserve and manage YLM and its habitat.
<b>Action 12. Initiate research to determine additional host fish species and potential predators to these host fish species</b>			

Status NB	Status NS	Comments	Next steps/recommendations
I	I	This research was not planned or initiated during the reporting period.	Initiate the planning, development of protocols for this research and conduct the research to identify and/or confirm YLM host fish species in NB and NS.
<b>Action 13. Determine the effect of non-native and invasive species (e.g., Muskellunge, Smallmouth Bass, Chain Pickerel) on fish assemblage in the Saint John River.</b>			
U	N/A	In NB, CRI studied the ecology of Muskellunge in the vicinity of the Mactaquac Dam. CRI also initiated work to gather baseline fish community data as part of ecological monitoring of a 20km stretch of known YLM habitat in the Saint John River, which will provide information on the possible effect of invasive fish species on native fish assemblages. The contribution of this work toward completing this action cannot, however, be evaluated until host fish species for NB are confirmed.	Continue this research and evaluate and share the results. Use the results to conserve and manage YLM host fish.
<b>Action 14. Determine potential interactions with Atlantic and Shortnose Sturgeon</b>			
I	N/A	No work was undertaken to complete this action during the reporting period.	Initiate work to complete Action 14.
<b>Monitoring and assessment</b>			
<b>Action 15. Identify suitable habitat for surveys of potential new occurrences</b>			
I	U	Suitable habitat to survey in NB and NS for new occurrences was not identified during the reporting period, however in NS, CBU initiated the development of protocols to identify potential YLM habitat.	Complete protocol for identifying suitable habitat for YLM, review characteristics of provincial waterbodies and identify suitable habitat for surveys of potential new occurrences of YLM in NS and NB.
<b>Action 16. Conduct surveys for potential new occurrences in previously identified suitable habitat</b>			
I	I	<p>Surveys were not conducted during the reporting period, however plans have been initiated to undertake surveys in previously identified suitable habitat in NS in the future. However, a new occurrence of YLM was opportunistically found in Pottle Lake, NS in 2012.</p> <p>In NB, while mussel surveys are planned for the 20 KM stretch of the Saint John River as part of the MAES research, and potential mussel surveys may be conducted as part of salmon stream survey work, these areas were not previously identified as suitable habitat for YLM in a systematic survey of the characteristics of the provinces' water bodies.</p>	Undertake the planned surveys in NS and evaluate and share the results. Plan and conduct surveys in NB. Use results to conserve and manage YLM and its habitat.

Status NB	Status NS	Comments	Next steps/recommendations
Action 17. Conduct surveys to determine more precise YLM population estimates			
I	U	<p>Surveys to determine precise population estimates were not conducted for either population. In NS, however, relative abundance, shell size and sex were recorded for YLM sampled from Muskrat middens in Pottle Lake and Blacketts Lake. Preliminary results indicate that the relative abundances are quite different between the two lakes.</p>	<p>Surveys to determine more precise YLM population estimates in NB and NS should be conducted. The NS relative abundance data should be analyzed and the results shared. All results should be used to conserve and manage YLM and its habitat.</p>
Action 18. Conduct surveys to determine short-term fluctuations in size and distribution of population			
I	U	<p>Surveys to determine short term fluctuation in size and distribution of the population were not conducted during the reporting period, however work was planned that will contribute toward the completion of this action by the end of the next 5-year reporting period.</p> <p>In NS, research was initiated at CBU to establish baseline data against which monitoring data can be compared to determine short and long term fluctuations in the size and distribution of YLM in Pottle Lake (see Action 17 above).</p> <p>In NB, CRI is developing a mussel survey monitoring protocol and has planned multi-year mussel survey work, but only along a 20km stretch of the Saint John River.</p>	<p>Conduct surveys to determine more precise YLM population estimates. Analyse data to determine relative abundance, and share results. Use results to conserve and manage YLM and its habitat.</p>
Action 19. Initiate surveys to determine abundance and health of host fish populations			
U	I	<p>Host fish surveys were not initiated during the reporting period in NS.</p> <p>In NB, CRI initiated work to gather baseline fish community data as part of ecological monitoring of a 20km stretch of known YLM habitat in the Saint John River. The contribution of this work toward completing this action cannot, however, be evaluated until host fish species for NB are confirmed.</p>	<p>Confirm host fish for YLM in NB. Initiate and conduct work to complete Action 19 in NB and NS.</p>
Action 20. Initiate surveys to determine threats to host fish populations			
C/O	C/O	<p>NSDFA has studied invasive Chain Pickerel and Smallmouth Bass in Blacketts Lake. These invasive species likely prey on YLM host fish species.</p> <p>In NB, work related to the threat of invasive species on host fish was initiated and is reported on in Action 13.</p>	<p>Confirm host fish for YLM in NB. Broaden research to include other known YLM habitat. Continue research and report on results. Use the results to conserve and manage YLM host fish.</p>
Action 21. Develop and implement a monitoring protocol to monitor YLM population dynamics at 5-10 yr. intervals			

Status NB	Status NS	Comments	Next steps/recommendations
I	U	<p>Population dynamics were not monitored during the reporting period, however, work was either planned or initiated in both NS and NB to support such work in the future.</p> <p>Research at CBU will establish baseline data against which future monitoring data can be compared to evaluate fluctuations in the size and distribution of YLM population.</p> <p>CRI is developing a monitoring protocol and has planned multi-year mussel survey work.</p>	<p>Collect baseline data. Develop protocol for monitoring population dynamics. Undertake monitoring of population dynamics at 5-10 year intervals.</p>
Action 22. Monitor level of risk posed by Muskrat predation on Sydney River YLM population (monitoring shell middens)			
N/A	C/O	<p>CBU initiated this research in Pottle Lake during the reporting period and plans to continue with long term monitoring.</p>	<p>Complete research to estimate the level of risk posted by Muskrat predation in Pottle Lake. Analyze and share results. Use information to conserve and manage YLM and their habitat. Repeat this for the Blacketts Lake population.</p>
Action 23. Initiate monitoring programs to assess threats to YLM habitat at 5-10 yr. intervals			
U	U	<p>While monitoring programs to specifically assess threats to YLM habitat at 5-10 yr. intervals were not initiated, work that contributes to this action was undertaken or initiated, including:</p> <ul style="list-style-type: none"> <li>• Daily water chemistry monitoring and ongoing land use monitoring in Pottle Lake, NS.</li> <li>• Initiated monitoring of shoreline habitats in Pottle Lake every 2 years to estimate trends in the population and habitat quality over time.</li> <li>• Ecological monitoring of a 20km stretch of known YLM habitat in the Saint John River, NB was initiated to establish baseline conditions prior to any alternations to the Mactaquac Dam.</li> </ul>	<p>Continue current monitoring programs. Broaden monitoring in NS and NB to include other YLM habitat. Develop monitoring programs that address the highest threats (NB: Forestry and agricultural practices; NS: Residential and industrial development).</p>
<b>Outreach and communication</b>			

Status NB	Status NS	Comments	Next steps/recommendations
Action 24. Support existing education programs and stewardship initiatives led by ACAP-CB			
N/A	C/O	ACAP-CB has undertaken a number of activities that contribute to protecting and restoring YLM habitat, including stream restoration, pollution prevention, and public outreach.	Continue to support stewardship initiatives that benefit YLM and its habitat. Encourage monitoring in Dutch Brook to determine if YLM have become established. Evaluate results of CABIN monitoring. Use resulting information to conserve and manage YLM and its habitat.
Action 25. Encourage and support development and implementation of education, outreach and stewardship initiatives in SJR watershed			
C/O	N/A	<p>The MNCC received support to undertake a Traditional Ecological Knowledge survey on YLM in 2011-2012. This work was completed and a report was published. There is, however, an ongoing need for education, outreach and stewardship initiatives. Planning for mussel identification training workshops aimed at building survey capacity among Aboriginal communities was undertaken during the reporting period. Details on these workshops and their outcomes will be reported on in the next 5-year progress report.</p> <p>Comments for Action 5 and 6 apply here as well.</p>	Support for new and similar initiatives should continue.
Action 26. Provide information on Zebra Mussels and other invasive species to stakeholders and residents			
C/O	C/O	Several initiatives have been undertaken or are underway that provide information about Zebra Mussels to anglers in NB and NS. Other more general public education initiatives in NS and nation-wide have included information about how to prevent the spread of Zebra Mussels.	Continue to reach a broader audience with outreach efforts.

## 4 Concluding Statement

The information presented in Tables 4 and 5 provides many examples of how, and to what extent, the Yellow Lampmussel Management Plan has been implemented by DFO, the Provinces of NB and NS and other partners during the reporting period (April 2010 – April 2015). Actions were undertaken in support of all five of the Objectives outlined in the Management Plan, though some of these actions were only recently initiated.

Actions in both the Saint John and Sydney watersheds aimed at maintaining the current quality and quantity of known Yellow Lampmussel habitat (**Objective 1**) have been initiated, although those related to water quality were more general and not directed specifically at protecting the Yellow Lampmussel. In NS, management decisions and project reviews by DFO and NSDNR have included consideration of Yellow Lampmussel and its habitat as well as maintaining water quality. Access is restricted to Pottle Lake, the location of a new population of Yellow Lampmussel, and there is a regular water quality testing program in place. In 2010, the “Beneficial Management Practices for Riparian Zones in Atlantic Canada” was published (AAFC and Island Nature Trust 2010). If followed, it will assist efforts to protect and restore riparian habitat on which the Yellow Lampmussel depends. In NB, the development of the “Watercourse and Wetland Alteration Technical Guidelines” (NBDELG 2012) complements existing regulations, helping stakeholders interpret and abide by them, which will provide increased protection of NB wetlands and riparian areas, including Yellow Lampmussel habitat.

Some progress was made to reduce direct threats to Yellow Lampmussel populations (**Objective 2**). Environmental regulators are aware of the status of the Yellow Lampmussel as a species of Special Concern. Furthermore, in the interest of maintaining water quality, use of molluscicides in Blacketts Lake is not being requested by residents and is not being considered by habitat managers or regulators. A multi-faceted research study was initiated by CBU that aims to estimate the level of risk posed by Muskrat predation on Yellow Lampmussel populations in NS. In 2015, both the NS and NB Angler’s Handbooks contained information on preventing the spread of aquatic invasive species such as Zebra Mussels. While Zebra Mussels have not yet been introduced to the Sydney or Saint John River watersheds, this continues to be a serious potential threat to the Yellow Lampmussel and other native freshwater mussels.

Our understanding of Yellow Lampmussel populations was improved during the reporting period (**Objective 3**). Long term monitoring programs were initiated in the Sydney River Watershed and are planned for a short stretch of the Saint John River between the Mactaquac Dam and the city of Fredericton, NB. The finding of a new population in Pottle Lake, approximately 10 km from the existing population in Blacketts Lake, is significant because it extends the restricted range of the Yellow Lampmussel within NS. CBU’s ongoing research will address several of the actions aimed at gaining a better understanding of Yellow Lampmussel population size, dynamics and distribution.

Actions aimed at maintaining the existing host fish populations (**Objective 4**) consisted mainly of outreach efforts to inform anglers of the importance of Yellow Lampmussel host fish and the potential impact of invasive species of fish such as Smallmouth Bass and Chain Pickerel. Research on these alien, invasive fish species is currently being conducted in both watersheds. There is, however, a need to initiate research to confirm the suspected YLM’s host fish species, as well as the existence of additional host fish species.

Projects to increase public awareness and involvement in Yellow Lampmussel conservation efforts (**Objective 5**) got underway during the reporting period. Planning was initiated for the delivery of training workshops to interested Aboriginal groups in order to help build capacity to carry out future freshwater mussel survey work in the Saint John River watershed. A number of publications and pamphlets were produced aimed at raising awareness of species at risk, invasive species including how to avoid their spread, and freshwater habitat conservation.

Several initiatives now in the planning stages may further contribute towards the Management Plan's goal of maintaining the existing Yellow Lampmussel populations in Canada.

In NB, CRI is leading MAES, a large multidisciplinary study to support a decision on the future of the Mactaquac Generating Station. MAES is divided into three main project themes under which fall a number of individual studies. Two of the studies, under the "whole river ecosystem" theme, aim to collect baseline benthic macroinvertebrate community data, as well as baseline fish community data. This research is expected to produce information relevant to the Yellow Lampmussel, their host fish species and invasive species that may threaten them.

In NS, the NS Museum and the NSDFA plan to compile and publish distributional data on freshwater fishes of NS. The NS Museum plans to develop outreach tools on invasive species in NS habitats, as well as compile data on Yellow Lampmussel distribution collected through opportunistic sampling. These initiatives, and any others undertaken over the next five years, will be reported on more fully in the next 5 Year Progress Report.

While much has already been accomplished, and more good work is planned, priority should be given to the following actions for which progress is still needed:

- Conduct research on host fish species (Actions 12, 13, 19, 20);
- Identify suitable habitat and conduct surveys for potential new occurrences of Yellow Lampmussel (Action 15, 16); and
- Evaluate risk to Yellow Lampmussels from seasonal low-water levels (Action 10).

Although there is no information to indicate that the state of the Yellow Lampmussel populations in the Sydney and Saint John River watersheds has changed substantially from the last surveys, the size of the two populations remains unknown (COSEWIC 2013). Research to address this, and the establishment of protocols and periodic monitoring, is therefore also a high priority (Actions 17, 18, 21, and 23).

Progress has been made overall toward implementing the Yellow Lampmussel Management Plan during the first five-year reporting period. The objectives and strategies in the Management Plan remain relevant and the goal remains achievable. There exists a strong foundation for continued research and successful management of this species over the next five years.

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