Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Flooded Jellyskin Lichen (*Leptogium rivulare*) in Canada

Flooded Jellyskin Lichen

2013

Canada

Recommended citation:

Environment Canada. 2013. Recovery Strategy for the Flooded Jellyskin Lichen (*Leptogium rivulare*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. iv + 23 pp.

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 (SAR) Public Registry (www.sararegistry.gc.ca).

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Également disponible en français sous le titre
« Programme de rétablissement du leptoge des terrains inondés (*Leptogium rivulare*) au Canada »

ISBN 978-1-100-21189-3
Catalogue no. En3-4/147-2013E-PDF

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 within five years.

The Minister of the Environment is the competent minister for the recovery of the Flooded Jellyskin Lichen and has prepared this strategy, as per section 37 of SARA. It has been prepared in cooperation with the Ontario Ministry of Natural Resources and Manitoba Conservation.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Flooded Jellyskin Lichen 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 Environment Canada 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.

ACKNOWLEDGMENTS

The recovery strategy was developed by the following members of the Flooded Jellyskin Lichen Recovery Team: Shaun Thompson (chair) - Ontario Ministry of Natural Resources, Ron Bazin – Environment Canada, Canadian Wildlife Service - Prairie and Northern, Jason Greenall - Manitoba Conservation, Robert Lee - independent consultant, Chris Lewis - Niblett Environmental Associates, Angela McConnell - Environment Canada, Canadian Wildlife Service - Ontario and Eva Katic - National Capital Commission.

An earlier draft of the recovery strategy was developed by Dr. Robert F. Foster of Northern Bioscience and the Flooded Jellyskin Lichen recovery team.

In particular, Robert Lee is thanked for generously sharing his extensive expertise on the Flooded Jellyskin Lichen.

Erica Oberndorfer, Kathy St. Laurent, Christina Rohe, Madeline Austen, Lesley Dunn, Barbara Slezak and Angela Darwin (Environment Canada, Canadian Wildlife Service – Ontario) also reviewed and provided comments and advice during development of this document.

EXECUTIVE SUMMARY

The Flooded Jellyskin Lichen (*Leptogium rivulare*) is a small, leaf-like lichen characterized by smooth blue-grey lobes and abundant small brown reproductive disks (apothecia). It grows in seasonally flooded habitats, typically on the bark of deciduous trees and rocks along the margins of seasonal ponds and on rocks along shorelines and stream/riverbeds. It grows below the high watermark in a zone where most other lichens are excluded. The species is known to be historically rare throughout its North American and European range and until recently had only been recorded at a few locations in Ontario and Manitoba. In Canada, the majority of extant occurrences (based on population size) are from two locations in eastern Ontario (Stony Swamp, City of Ottawa and Peneshula Road, Lanark County), where the Flooded Jellyskin Lichen is found almost exclusively on trees along the margins of a few small seasonal ponds. There are 21 extant populations in Ontario and eight extant populations in Manitoba. Two historical records exist for northeastern Ontario but the population status at these locations is unknown. It is estimated that 100% of the Flooded Jellyskin Lichen's North American range occurs in Canada as no confirmed records in recent years exist in the United States.

The Flooded Jellyskin Lichen is designated as Threatened under both the federal *Species at Risk Act* (SARA) and Ontario's *Endangered Species Act, 2007* (ESA 2007). In Manitoba, the species is not yet designated under provincial species at risk legislation.

Threats identified to Canadian populations of the Flooded Jellyskin Lichen include, but are not limited to: invasive species such as Emerald Ash Borer (*Agrilis plannipennis*), slugs (*Arion subfuscus*), and Dutch elm disease, alteration of the water regime, development (housing, recreational and industrial), quarrying and mining, tree harvesting, recreational activities and pollution. This species is limited to a very narrow zone between the seasonal high and low watermarks and is therefore especially vulnerable to changes in the normal pattern of annual flooding. Removal or death of substrate trees or removal of substrate rocks could deprive the species of suitable habitat. The broad strategies to be taken to address the threats to the survival and recovery of the species are presented in the section on Strategic Direction for Recovery (Section 6.2).

Although there are unknowns regarding the feasibility of recovery, in keeping with the precautionary principle, a full recovery strategy has been prepared as would be done when recovery is determined to be feasible. The population and distribution objective is to maintain the size and distribution of currently known extant populations of the Flooded Jellyskin Lichen in Canada.

Critical habitat for the Flooded Jellyskin Lichen in Canada is identified in this recovery strategy. As additional information becomes available, critical habitat identification may be refined or sites meeting critical habitat criteria may be added.

One or more action plans for the Flooded Jellyskin Lichen will be posted on the Species at Risk Public Registry by December 2018.

RECOVERY FEASIBILITY SUMMARY

Based on the following four criteria outlined by the Government of Canada (2009), there are unknowns regarding the feasibility of recovery of the Flooded Jellyskin Lichen. Therefore, in keeping with the precautionary principle, a full recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be feasible. This recovery strategy addresses the unknowns surrounding the feasibility of recovery.

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.**

   Yes. Available individuals capable of reproduction currently exist in relatively few, small, scattered locations in Ontario and Manitoba; knowledge of species' abundance has improved with increased search effort and will likely continue to improve.

2. **Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.**

   Yes. Sufficient suitable habitat is available to support extant populations of the Flooded Jellyskin Lichen. Seasonally flooded ponds with ash (*Fraxinus* spp.) and other deciduous trees are not uncommon in the species' range, and might potentially support additional Flooded Jellyskin Lichen populations. There are also extensive areas of potentially suitable rocky shoreline habitat in the species' range, similar to the habitat found for the Manitoba populations.

3. **The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.**

   Unknown. Significant threats to the Flooded Jellyskin Lichen's habitat related to development, alteration of the water regime and recreational pressures can be avoided or mitigated through recovery actions. Other primary threats, such as invasive species, particularly Emerald Ash Borer (*Agrilus planipennis*), may be more difficult to avoid or mitigate.

4. **Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.**

   Unknown. There are some recovery techniques (e.g., habitat management) which would be effective in ensuring habitat remains suitable for this species; however, techniques to control the threat of invasive species may not be developed within a reasonable timeframe. Emerald Ash Borer was found within 2 km of extant populations in 2010. Control techniques using insecticides have met with varying degrees of success; controlling insect species that feed under the bark, such as Emerald Ash Borer, is difficult and it is unlikely that the beetle will ever be eradicated (Herms et al. 2009). Restrictions are in place that prohibit the movement of ash and elm material and firewood (CFIA 2010a) though Dutch elm disease continues to threaten the Flooded Jellyskin Lichen populations. It is also unlikely that Dutch elm disease will ever be eradicated.

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1. COSEWIC* SPECIES ASSESSMENT INFORMATION

Date of Assessment: May 2004

Common Name (population): Flooded Jellyskin

Scientific Name: *Leptogium rivulare*

COSEWIC Status: Threatened

Reason for Designation: This is a globally rare species currently known in Canada from only four locations, all in Ontario and Manitoba. The species has very restricted habitat requirements, found primarily at the margins of seasonal (vernal) pools, where it grows on rocks and at the base of living deciduous trees between the seasonal high and low water marks. It is vulnerable to changes in normal patterns of annual flooding, as well as to death of host trees. Major threats to the largest populations include urban development and recreational activity.

Canadian Occurrence: Manitoba, Ontario

COSEWIC Status History: Designated Threatened in May 2004.

*COSEWIC – Committee on the Status of Endangered Wildlife in Canada

2. SPECIES STATUS INFORMATION

The global conservation rank for the Flooded Jellyskin Lichen (*Leptogium rivulare)* is vulnerable[1]-secure[2] (G3G5[3]); the rounded global conservation rank is apparently secure[4] (G4) (NatureServe 2010). In the United States, it is only known historically from two sites in Illinois and Vermont (Sierk 1964) and the national conservation status is currently unranked (NNR) (NatureServe 2010). In Canada, the national conservation status is also currently unranked (NNR), however, the Flooded Jellyskin Lichen is found in the provinces of Manitoba and Ontario and the subnational conservation rank for both provinces is critically imperilled[5] (S1) (NatureServe 2010).

[1] at moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors
[2] common; widespread and abundant
[3] a numeric range rank (e.g., G2G3, G1G3) is used to indicate the range of uncertainty about the exact status of a taxon or ecosystem type
[4] uncommon but not rare; some cause for long-term concern due to declines or other factors.
[5] extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the province

The Flooded Jellyskin Lichen is listed as Threatened[6] on Schedule 1 of the federal *Species at Risk Act* (SARA). In Ontario, the Flooded Jellyskin Lichen is listed as Threatened[7] under the provincial *Endangered Species Act*, *2007* (ESA 2007). In Manitoba, the species is not yet designated under provincial species at risk legislation.

At the time of the COSEWIC (2004) assessment, the Flooded Jellyskin Lichen appeared to be globally rare, with approximately 95% of the global population within Canada. Subsequently, new populations have been reported from the extensive wetlands of northern Russia, between the Baltic Sea and the Ural Mountains (J. Hermansson 2004, pers. comm.) as well as 25 new populations recently reported in Canada (CWS 2010; OMNR and CWS 2010). It is estimated that 100% of the Flooded Jellyskin Lichen's North American range occurs in Canada as no confirmed records in recent years exist in the United States (very old ca. 1850 specimens exist from Illinois and Vermont) (Sierk 1964; COSEWIC 2004).

3. SPECIES INFORMATION

3.1 Species Description

The Flooded Jellyskin Lichen is a small, grey or bluish-grey foliose[8] lichen found attached to the lower trunk of seasonally flooded trees or rocks in seasonal ponds and along lakeshores and waterways (COSEWIC 2004). Each individual is made up of irregular, narrow, paper-thin lobes that radiate out for 1-2 cm and may stick out slightly at the tips. These otherwise smooth lobes are dotted or speckled with rather minute, light reddish-brown apothecia (Sierk 1964). Sometimes there are so many of these spore-producing disks that the lichen takes on a light reddish-brown cast; however, when wet, the apothecia appear dull and grey. The elliptically-shaped spores are colourless and multicellular; spore dispersal may be air-borne or water-borne. All lichens are also capable of reproducing by fragmentation[9] (COSEWIC 2004).

Where many individuals grow together, they merge into a continuous mat. When wet, the lobes swell slightly, becoming somewhat jelly-like and transparent. The whole lichen then looks black and is hard to distinguish from other lichen species.

3.2 Population and Distribution

The Flooded Jellyskin Lichen occupies a wide range across northern Europe and North America but within that range it is sparsely distributed among relatively few, distant and very restricted locations (Goward et al. 1998). In Europe, it remains rare in the Scandinavian and Baltic states where it was first found more than 200 years ago (Jørgensen 1994). In Sweden, the species is extant at 18 locations and is considered extirpated in Finland (SSIC 2010; Rassi et al. 2010). It is also known to occur in Estonia, Belarus and the European portion of the Russian Federation

[6] a wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction
[7] a species that is at risk of becoming endangered in Ontario if limiting factors are not reversed
[8] of, relating to, or resembling a leaf
[9] a form of asexual reproduction where tiny lobes are formed for the purpose of propagation

(Dudoreva 2003; Pystina et al. 1998; Pystina 2001a; Pystina 2001b; Motieljūnaitė and Golubkov 2005; SSIC 2010). In the United States, it is known only historically from two sites in Illinois and Vermont (Sierk 1964). It was discovered in 2006 in Tanzania, but little is known of its status there (Alstrup and Christensen 2006).

At the time of the COSEWIC (2004) assessment, extant Flooded Jellyskin Lichen populations were known from only four Canadian locations (COSEWIC 2004); three extant populations in eastern Ontario and one extant population in northern Manitoba (discovered in 2003). There are two historical reports of the Flooded Jellyskin Lichen in Ontario; one near Wawa and one at Lake Temagami. Since the COSEWIC (2004) assessment, search efforts (see section 6.1) have led to the discovery of new populations in Canada in the provinces of Ontario and Manitoba; a total of 29 extant populations currently exist (Figure 1), based on a distance of more than 1 km between populations. This distance is generally used in recognizing separate occurrences/ populations in the COSEWIC, NatureServe and Natural Heritage Information Centre records for immobile and/or vascular plants. In Ontario, 18 new populations have been discovered along with confirmation of three of the previous extant populations. In Manitoba, seven new populations have been discovered along with confirmation of the one previous extant population.

An apothecial count is a direct measure of the reproductive effort of the lichen; however, counting apothecia can be time consuming and impractical. The number of apothecia has been shown to be correlated with the size of the individual lichen; thus measuring the size is an easy and useful estimate of fitness (Pringle et al. 2003). The total estimated size of the Canadian population of the Flooded Jellyskin Lichen is 70 m^2 of which greater than 95% occurs in Ontario (CWS and OMNR 2010, unpublished data). Population trends for the Flooded Jellyskin Lichen do not exist as most populations are newly discovered and others have not been regularly monitored.

Due to the poorly understood distribution in Canada, the recent range extensions likely represent the discovery of long-existing, remote populations, rather than changes in distribution.
In addition, it is unlikely that all populations of the Flooded Jellyskin Lichen that exist are known (COSEWIC 2004), and further search efforts are warranted in suitable habitats. The Flooded Jellyskin Lichen has not been reported for more than a century from its historical range in the northern United States, where there has been considerable habitat alteration. Similar disruption of habitat has occurred in southern Canada (through agricultural land clearing and associated silty runoff, and the use of lakes and rivers in early logging practices); if the lichen was ever more widely present in this area, it may have been lost. However, this cannot be demonstrated with any certainty as historical records are scant and indicate only the presence of the species, not its extent or abundance. Furthermore, the current extant populations have all been under observation for less than 10 years.

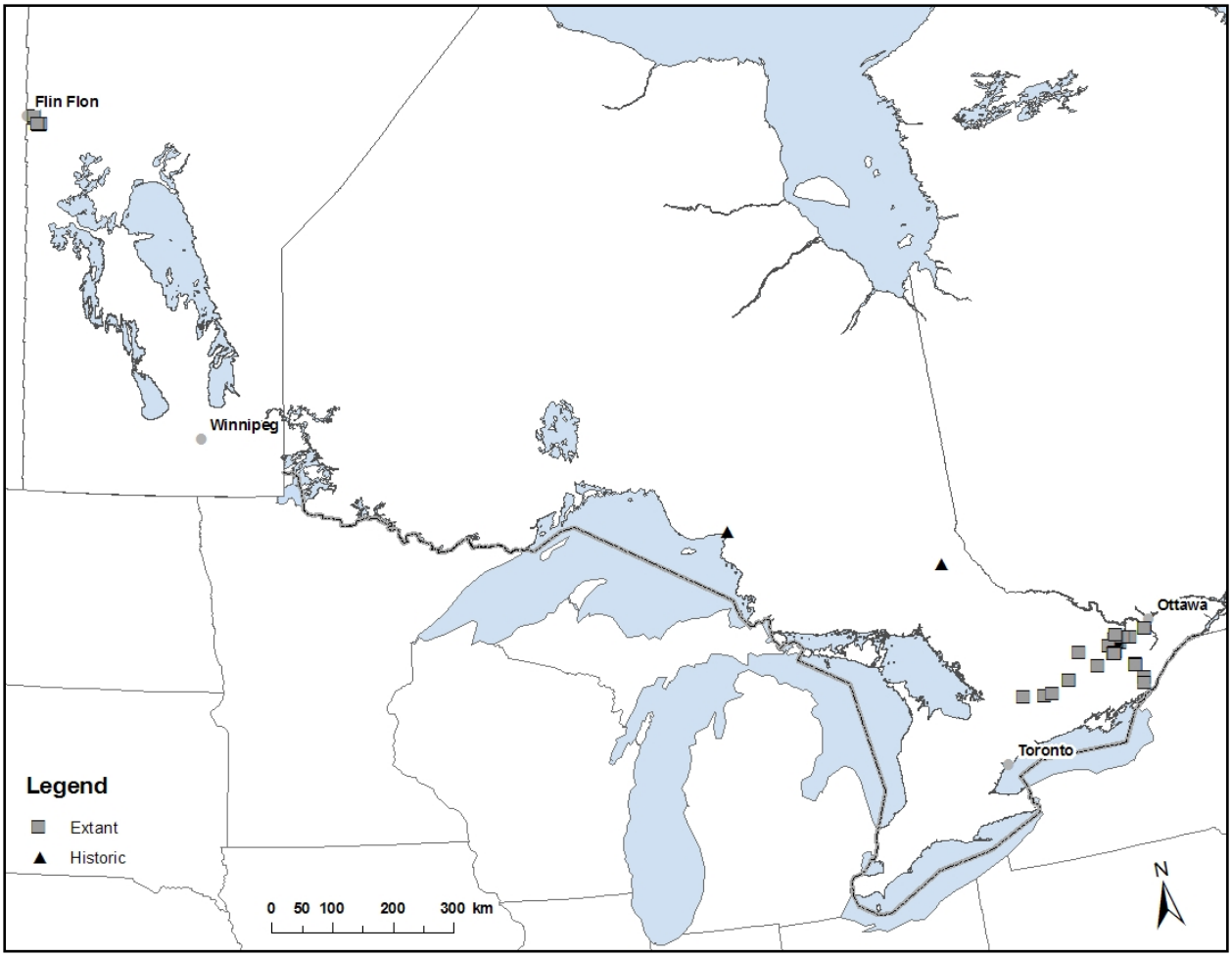

Figure 1. Distribution of the Flooded Jellyskin Lichen in Canada showing extant and historical records. *Note: the Manitoba populations and those in eastern Ontario contain many concentrated occurrences and therefore, at this scale, fewer squares than the 29 extant populations are visible due to overlapping.*

3.3 Needs of the Flooded Jellyskin Lichen

In Canada, most of the extant populations of the Flooded Jellyskin Lichen are in north temperate to boreal regions that are at least partly forested. Small, seasonal ponds with a fringe of flood-tolerant trees or shrubs, and rocky lakeshores and waterways support the lichen (COSEWIC 2004). Most seasonal ponds where the Flooded Jellyskin Lichen occur, including the two largest populations, are over top or very near calcareous parent or till material (i.e., marble or limestone); the pH of the floodwater should be well-buffered (COSEWIC 2004, C. Lewis 2010, pers. comm.)

Within the seasonal ponds only a few flood-tolerant tree species grow, notably Black Ash (*Fraxinus nigra*), Green Ash (*Fraxinus pennsylvanica*), Red Maple (*Acer rubrum*), American Elm (*Ulmus americana*), and Balsam Poplar (*Populus balsamifera*) (COSEWIC 2004). On such trees, the Flooded Jellyskin Lichen grows almost exclusively on the bark (not on exposed wood); hence the trees must be alive, or else serve as a substrate only until the bark

falls off (COSEWIC 2004). Most of the Flooded Jellyskin Lichen in Canada grows on Black Ash, which is the most abundant tree in its seasonal pond habitat in Ontario. The species has also been recorded on tree species such as Silver Maple (*Acer saccharinum*), Trembling Aspen (*Populus tremuloides*), Bur Oak (*Quercus macrocarpa*) and White Cedar (*Thuja occidentalis*), among others. To a lesser extent, the lichen grows on shrubs in the flood zone and has been observed on Red-osier Dogwood (*Cornus sericea*), alder (*Alnus* spp.), willow (*Salix* spp.) and Common Buttonbush (*Cephalanthus occidentalis*), among others (COSEWIC 2004). Its ability to quickly colonize new surfaces appears to occur only where the lichen is already locally abundant (COSEWIC 2004).

Where stones are colonized by the Flooded Jellyskin Lichen, the type of rock probably does not matter but the species' occurrence on granite has been noted (R. Lee, pers. obs.). Very little is known about the characteristics of the permanent lakeshores or waterways inhabited by the Flooded Jellyskin Lichen in Manitoba other than that a co-occurrence with *Dermatocarpon luridum* has been noted (R. Bazin 2010, pers. comm.).

Survival is dependent on periodic or occasional flooding coupled with subsequent prolonged exposure to the air, which results in a very limited habitat range (COSEWIC 2004). Flooding appears to be necessary for initial colonization and for reproduction; long-term persistence of the lichen would require minimum flood levels to fully immerse the lichens (i.e., flood levels that merely inundate the roots and base of the trunk would be inadequate) (C. Lewis 2010, pers. comm.). It can live for many years out of water, but probably cannot reproduce until flooded again. Because the Flooded Jellyskin Lichen grows below the high watermark, almost all other lichens are killed off, leaving only mosses as the Flooded Jellyskin Lichen's competitors. One exception is the Blue Jellyskin (*Leptogium cyanescens*) that may also be found below the high watermark and is thus likely a competitor.

Lichens are a composite of a fungus and an organism capable of producing food by photosynthesis; the relationship between the fungus and photosynthetic partner is called symbiosis (Brodo et al. 2001). The Flooded Jellyskin Lichen's photosynthetic symbiont (photobiont[10] for short) is a cyanobacterium; cyanobacterial lichens are most often shade- and moisture-loving (COSEWIC 2004). Lichens with a cyanobacterium as a photobiont require alkaline environments and are most abundant in continuously moist forest ecosystems (Green et al. 1993; Sillett and Antoine 2004). Cyanobacterial lichens are also notoriously sensitive to the effects on water chemistry of air pollution, particularly sulphur dioxide (Ferry et al. 1973) as it lowers the pH of the surrounding water, making it more acidic.

The Flooded Jellyskin Lichen's spores are believed to be released into the water body and float on its surface. This facilitates abundant spread within a single wetland, but isolates each population, unless there is an outflow of floodwater, or the passage of passive vectors between wetlands. Ducks and semi-aquatic mammals regularly move between wetlands, at both short and long ranges, but the lichen's failure to have dispersed more extensively suggests that this is not likely very effective (COSEWIC 2004). Most of the currently known extant sites are seasonal ponds that do not have outflows or are hydrologically-disjunct lakes, the exception being some of the Manitoba sites which are hydrologically-linked lakes.

[10] a photosynthetic partner of a symbiotic pair, such as the algal component of the fungal-algal association in lichens

4. THREATS

4.1 Threat Assessment

Table 1. Threat Assessment Table

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Exotic, Invasive or Introduced Species/Genome*						
Emerald Ash Borer (*Agrilus planipennis*)	High	Localized (ON)	Anticipated	Continuous	High	Medium
Dusky Slug (*Arion subfuscus*)	High	Localized (ON)	Current	Seasonal	Unknown	Low
Dutch elm disease	Medium	Widespread (ON)	Historic/ Current	Continuous	High	High
Black algae (*Lyngbya wollei*)	Low**	Localized (MB)	Anticipated	Seasonal	Unknown	Low
Changes in Ecological Dynamics or Natural Processes*						
Alteration of the water regime	High	Widespread (ON and MB)	Current	Continuous	High	High
Habitat Loss or Degradation*						
Industrial, recreational and housing development	High	Localized (ON and MB)	Current	Recurrent	High	High
Quarrying/mining	High	Localized (MB)	Anticipated	Recurrent	High	Medium
Biological Resource Use*						
Tree harvesting (e.g., forestry and firewood collection)	High	Widespread (ON)	Current	Continuous	High	High
Disturbance or Harm*						
Incidental harm	Medium	Localized (ON)	Current	Continuous	Moderate	High

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Pollution*						
Water pollution	Medium	Widespread (ON and MB)	Anticipated	Continuous	Moderate	Medium
Air pollution	Low**	Localized (ON and MB)	Historic/ Anticipated	Continuous	Moderate	Medium
Natural Processes or Activities*						
Interspecific competition (moss, algae, other lichens)	Low**	Widespread (ON and MB)	Current	Seasonal	Unknown	Low
Ice scarring	Low**	Localized (ON)	Current	Seasonal	High	Medium
Forest fire	Low**	Widespread (ON)	Anticipated	Seasonal	Moderate	Medium

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

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

[3] *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g., expert opinion; Low: the threat is assumed or plausible).*

** Threats are listed in decreasing level of significance.*
*** Threats with a low Level of Concern are listed and described but may not be specifically addressed in the recovery approaches.*

4.2 Description of Threats

Threats are listed in order of decreasing level of concern from Table 3.

Emerald Ash Borer
Invasive species, such as Emerald Ash Borer (*Agrilus planipennis*), can result in loss of crucial substrate for the Flooded Jellyskin Lichen in Ontario. Two species of substrate trees, Black Ash and Green Ash, have been killed in great numbers in Michigan by Emerald Ash Borer (COSEWIC 2004). This beetle has been found in Canada, near Ottawa, Ontario, within 2 km of the largest extant population of the Flooded Jellyskin Lichen and in additional counties near other Flooded Jellyskin Lichen populations (Ash Rescue Coalition 2003; CFIA 2010b; CFIA 2010c). Emerald Ash Borer is considered the greatest and most imminent threat facing most of the Flooded Jellyskin Lichen populations in Canada (R. Lee 2010a, pers. comm.).

Dusky Slug

The Dusky Slug (*Arion subfuscus*), an introduced slug from Europe that preferentially feeds on the reproductive structures (apothecia) of lichen species including the Flooded Jellyskin Lichen, has been documented at locations where the bulk of the known populations in Ontario occur and appears to be increasing in abundance and distribution (R. Lee 2010b, pers. comm.). Small populations of the Flooded Jellyskin Lichen could be readily eliminated but the impact to larger populations is unknown. The non-native slug appears to have displaced a locally occurring slug at a couple of sites and may have significant impacts on the conservation of this lichen (R. Lee 2010b, pers. comm.).

Alteration of the Water Regime

The Flooded Jellyskin Lichen's survival is dependent on periodic or occasional flooding coupled with subsequent prolonged exposure to the air (COSEWIC 2004). Maintenance of this hydrological cycle is critical to the species' long-term persistence as flooding appears to be necessary for initial colonization, reproduction and dispersal; conversely, permanent flooding may eliminate populations. Alteration to the water regime through water level regulation (dams), draining wetlands, urban and agricultural development and road building (COSEWIC 2004) is a potential threat to all populations. These activities can directly result in lowered water levels and may affect water levels by diverting and redirecting surface water flow. At the Stony Swamp site, the potential for adjacent land-use activities to negatively impact the hydrological regimes of the seasonal ponds is high due to development outside of the National Capital Commission's boundaries (E. Katic, pers. comm. 2011). Furthermore, even small changes to upstream water levels have the potential to impact hydrologically-linked populations and subpopulations.

Industrial, Recreational and Housing Development

Habitat loss or degradation are key threats to the Flooded Jellyskin Lichen populations, particularly in Darling Township in Ontario as private properties become subdivided and developed (COSEWIC 2004). The cutting of trees or removal of rocks due to industrial development (e.g., quarry activities, hydroelectric infrastructure construction, mining, road construction), recreational development (e.g., cutting trails), and surveying activities (e.g., cutting a sight line) would result in loss of crucial substrate for the Flooded Jellyskin Lichen. Cottage construction at lakes in Manitoba could impact the Flooded Jellyskin Lichen populations along the shoreline.

Quarrying/Mining

Site alteration and impacts to the hydrological regime from quarrying and mining activities (including sand/gravel pits) can threaten the Flooded Jellyskin Lichen and its habitat. Many existing populations occur on limestone and marble bedrock which are important industry resources. Substrate trees at the Darling Long Lake site have been removed by personal sandpit operations (COSEWIC 2004).

Tree Harvesting

In Ontario, forest management operations that remove trees within or along the edge of pools, or alter hydrological processes within pools, could potentially affect habitat for the Flooded Jellyskin Lichen (OMNR 2010). Road construction associated with forestry activities can impact hydrological regimes required by the species. Physical damage to substrate trees could occur as a result of mechanical activities associated with forestry operations.

The cutting or loss of trees due to firewood collection would result in loss of crucial substrate for the Flooded Jellyskin Lichen in Ontario. In some ponds, the species has been found on as few as two trees; hence, even removal or destruction of trees on a small scale, could have a significant impact on the Flooded Jellyskin Lichen populations (COSEWIC 2004).

Dutch Elm Disease

Another of this lichen's substrate trees, American Elm, has already been decimated by Dutch elm disease. The Flooded Jellyskin Lichen continues to be lost from the effects of Dutch elm disease. Elm trees in Ontario, with the Flooded Jellyskin Lichen growing on them, were observed dying in both 2009 and 2010; bark along with the lichen has fallen off the dead trees (R. Lee 2010a, pers. comm.).

Incidental Harm

Unintentional or deliberate removal or damage (e.g., vandalism) to Flooded Jellyskin Lichen individuals or their substrate could pose a threat to this species. Increased trail use of an unauthorized trail, established nearby a newly developed subdivision, threaten the Flooded Jellyskin Lichen population near Ottawa (COSEWIC 2004).

Water Pollution

Water pollution is both a potential broad-scale and local threat to the Flooded Jellyskin Lichen, their forested habitat, and the hydrological regimes that support them. Elevated sediment loading (e.g., as a result of agricultural runoff, mining waste) to rivers and lakes, to an extent that it leaves tree trunks and rocks in the floodplain coated in silt when the water subsides, would be harmful to the Flooded Jellyskin Lichen (COSEWIC 2004). Point-source water pollution (e.g., hydrocarbon leaks, train derailments near waterways) could also pose a threat to the Flooded Jellyskin Lichen populations.

Black Algae

Black Alga (*Lyngbya wollei*) was first noted at lakes in Manitoba in the 1990s (Government of Manitoba 2007). This exotic alga is sticky, enhancing its ability to spread by easily adhering to dispersal agents (e.g., boats) and enabling it to coat/cover rocky shorelines. The establishment of this alga in areas with Flooded Jellyskin Lichen populations could become problematic (R. Bazin 2010, pers. comm.).

Air Pollution

Cyanobacterial lichens, such as the Flooded Jellyskin Lichen, are notoriously sensitive to the impacts of air pollution, particularly pollution due to sulphur dioxide (COSEWIC 2004). Sulphur dioxide alters the water chemistry properties required by the Flooded Jellyskin Lichen by decreasing the pH. Declining air quality at the site near Ottawa, Ontario due to urban development may threaten the Flooded Jellyskin Lichen population in this area (COSEWIC 2004). In addition, mining activities in Flin Flon, Manitoba have historically affected the air quality and may have impacted the Flooded Jellyskin Lichen in this area; however, recent changes to the industrial processing infrastructure at this location (including the closing of a copper smelter in 2010) have greatly reduced industrial emissions of sulphur dioxide (Hudbay 2011).

Interspecific Competition

Resource competition from mosses, algae and other lichen species are potential threats to the Flooded Jellyskin Lichen and may contribute to a synergistic effect with other threats.

Ice Scarring

Populations of the Flooded Jellyskin Lichen that exist in seasonal pond habitat in Ontario appear to be affected by ice-scarring. In both 2004 and 2006, the normally vernal (i.e., springtime) ponds were filled by autumnal rains just before freeze-up. Heavy ice, 10 to 20 cm thick, formed around the tree trunks. During the winter, the water slowly sank into the earth, and the unsupported ice settled, scraping the bark free of both mosses and lichens. On trees in deeper water, 90% of the lichen was lost; in the shallows, none. The ultimate effect is unknown, because both the Flooded Jellyskin Lichen and the shaggy mosses that it competes with were removed.

Forest Fire

The loss of trees due to forest fires would result in the loss of crucial substrate trees for the Flooded Jellyskin Lichen in Ontario.

5. POPULATION AND DISTRIBUTION OBJECTIVES

The population and distribution objective is to maintain the size and distribution of currently known extant Flooded Jellyskin Lichen populations in Canada. The Flooded Jellyskin Lichen's distribution in Canada appears restricted, as it appears to have been historically, with widely scattered occurrences. Recent discoveries of new populations in Ontario and Manitoba suggest the Flooded Jellyskin Lichen could be much more widespread than currently known. The species does not appear to have undergone a significant population decline. New populations will likely continue to be discovered with increased search effort.

6. BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Currently Underway

A Recovery Team for the Flooded Jellyskin Lichen has been in place since the fall of 2006 with representatives from the federal government, the provinces of Manitoba and Ontario, the National Capital Commission, and consultants having experience with the species.

Since the COSEWIC status report was written in 2004, increased search effort has resulted in several recent discoveries of Flooded Jellyskin Lichen populations in Canada. In Ontario, apparently suitable habitats were surveyed near extant sites in the Ottawa area and at over 20 sites south and east of Ottawa (R. Lee 2010b, pers. comm.). These surveys resulted in the discovery of two new populations in Darling Township. Several extant sites were also revisited to record seasonal water levels. Spot checks at another 20 sites east and west of Ottawa revealed no Flooded Jellyskin Lichen. Surveys performed in 2010 by the Canadian Wildlife Service (CWS), Ontario's Ministry of Natural Resources (OMNR) and consultants resulted in the discovery of 16 new populations in Ontario (CWS and OMNR 2010, unpublished data).

In 2006, surveys for the Flooded Jellyskin Lichen were conducted by CWS personnel at the extant Manitoba site and surrounding areas; the Flooded Jellyskin Lichen was not found. The small island on Payuk Lake where it was discovered in 2003 was searched intensively. Nearby Neso, Twin, and Whitefish lakes were also surveyed, as well as parts of Athapapuskow and Naosap Lakes. The lack of success in finding any Flooded Jellyskin Lichen may be in part due to 2006 water levels that appeared to be higher than in 2003, as well as the difficulties associated in locating such a small, non-descript lichen within rocky crevices along extensive shorelines.

Surveys were performed again in Manitoba in 2010 by CWS personnel; seven new populations of the Flooded Jellyskin Lichen were discovered at sites around Payuk Lake, Neso Lake, Twin Lake and Whitefish Lake and confirmation of the previous extant population at Payuk Lake occurred (CWS 2010, unpublished data). Water levels in 2010 were much lower than in 2006 when the last survey was performed (R. Bazin 2010, pers. comm.). All populations, eight in total, from Manitoba were found on rocks along the lakeshores.

Other recent lichen studies in North America have been reported in the literature, which, although they were not focused on the Flooded Jellyskin Lichen, were carried out in apparently suitable habitat. A very rare foliose lichen, *Phaeophyscia leana* (Tuck.) Essl., was rediscovered after more than a century, growing on the periodically inundated bases of trees in Illinois and Ohio floodplains (Wilhelm et al. 2000; Gillespie and Methven 2002). These states are within the historic (1800s) range of the Flooded Jellyskin Lichen, yet intensive searching yielded no records. In northern Alberta, lichen communities at inundation-induced trimlines[11] on outcrops in the Peace-Athabasca delta were intensively studied at 16 sites, again yielding no records of the Flooded Jellyskin Lichen (Timoney and Marsh 2004). The location is 700 km beyond the lichen's known range, but due to the presence of suitable habitat it was considered a good location to search for this species.

The province of Ontario has developed a Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales (OMNR 2010) to be implemented on crown lands under the *Crown Forest Sustainability Act, 1994*. Included in this guide is a section which prescribes a 30 m reserve around high watermark for ponds populated with the Flooded Jellyskin Lichen and similar treatment for adjacent ponds. The prescription was implemented at a number of crown land forest operational blocks in 2010.

Several Ontario Ministry of Natural Resources (OMNR) staff have been trained to identify the Flooded Jellyskin Lichen in the field and some to confirm its identity under microscope. Broader awareness within OMNR field staff, and transfer of this knowledge to others, including consultants and people within the forest industry, resulted in several of the new findings in 2010. Preliminary efforts to educate the naturalist community and general public about the significance of the Flooded Jellyskin Lichen have been initiated. Webpages featuring the Flooded Jellyskin Lichen are now available through links from national and provincial species at risk websites.

[11] lichen trimlines are relatively level and distinct transition zones found on bedrock-lined shores. They occur as a result of disturbance to the rock lichen community, typically due to high water events.

6.2 Strategic Direction for Recovery

Table 2. Recovery Planning Table

Threat or Limitation	Priority	Broad Strategy to Recovery	General Description of Research and Management Approaches
Alteration of the water regime; Industrial, recreation and housing development; Quarrying/mining; Tree harvesting; Incidental harm; Water pollution	High	Protect, conserve and manage habitat	• Enforce existing laws and regulations, and develop habitat management techniques to ensure appropriate water levels and water quality are maintained as required by the Flooded Jellyskin Lichen for survival, colonization, reproduction and dispersal • Promote appropriate routing of recreational trail systems to deter access and potential vandalism to the lichens and their substrate, particularly at the Ottawa sites • Engage and provide information to landowners, industry and public and private land managers to develop appropriate land and forest management planning and protection • Employ methods to encourage and facilitate habitat improvements, stewardship and protection
All threats	High	Monitor and assess populations and habitat	• Establish long-term monitoring protocols to document population trends, threats and habitat quality • Continue search efforts in suitable habitats across Ontario and Manitoba in order to better understand distribution, ecology and number of populations
Emerald Ash Borer; Introduced slug; Dutch elm disease; Black Algae	High	Assess and manage invasive species' impacts	• Monitor and reduce threats from invasive species, particularly Emerald Ash Borer, where applicable
All threats	Medium	Education and Outreach	• Provide information on species and habitat identification to landowners, industry and public and private land managers
Knowledge gaps relating to population dynamics, invasive species, distribution and habitat	Medium	Conduct research	• Examples of research unknowns: Population and reproduction dynamics including dispersal methods and capability; impacts of and control methods for invasive species (introduced slug, Emerald Ash Borer, Dutch elm disease and Black Algae); species distribution and abundance in Canada; habitat characteristics and requirements (hydrology, geology, water chemistry, moisture levels)

7. CRITICAL HABITAT

7.1 Identification of the Species' Critical Habitat

Critical habitat is fully identified in this recovery strategy for all extant populations of the Flooded Jellyskin Lichen in Canada based on the best available data (up to December 2010). Additional critical habitat may be identified across the range as new information becomes available for the Flooded Jellyskin Lichen.

The identification of critical habitat for the Flooded Jellyskin Lichen is based on suitable habitat, described as seasonal ponds, seasonally flooded stream/riverbeds, or rocky shorelines, for all extant populations of the Flooded Jellyskin Lichen.

7.1.1 Suitable Habitat

In Canada, populations of the Flooded Jellyskin Lichen occur only in Ontario and Manitoba and are found in three main habitat types, which comprise suitable habitat:

1. Seasonal Ponds (Ontario)

Nearly all the Flooded Jellyskin Lichen occurrences in Ontario are on the base of periodically inundated deciduous trees, usually around the margins of seasonal ponds that fill with meltwater each spring (COSEWIC 2004). These seasonal ponds flood each spring for 3 to 12 weeks, to a depth of up to 2 m (COSEWIC 2004) and may also flood some years in late autumn (R. Lee 2010a, pers. comm.). The Flooded Jellyskin Lichen is found primarily on the tree trunk between the seasonal high and low watermarks but may also be found on shrubs and rocks within this zone. Tree species include Black Ash, Red Maple, Silver Maple, Green Ash, American Elm and other tree species tolerant of substantial flooding. Shrub species include Red-osier Dogwood, Frost Grape (*Vitis riparia*), willow, alder, Northern Highbush Blueberry (*Vaccinium corymbosum*), Common Buttonbrush and other shrubs that may be found between the seasonal high and low watermark. Within a seasonal pond, the Flooded Jellyskin Lichen can be found on a few to hundreds of trees, shrubs and/or rocks. As such, it is not feasible to identify every tree, shrub and/or rock within a pond that supports the Flooded Jellyskin Lichen. Additionally, dispersal within ponds appears to be excellent (COSEWIC 2004) indicating the likelihood of colonization on other trees within the pond is high.

Suitable habitat for the Flooded Jellyskin Lichen related to seasonal ponds is identified as the area encompassed by the high watermark of seasonal ponds known to support an extant population of the Flooded Jellyskin Lichen (which includes the seasonal water column and terrestrial features) plus a 30 m distance beyond the high watermark. The high watermark refers to the highest level reached by the water that has been maintained for enough time as to leave marks on trees (as seen by the visible change in bark colour and/or the demarcation between fungi, lichen, algae and mosses associated with seasonal flooded or non-flooded environments). A 30 m horizontal distance beyond the high watermark is recommended in *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales* (OMNR 2010) and is necessary to help maintain the hydrology of the area, the critical microclimate conditions and the integrity of the vegetation community supporting lichen substrates.

2. Seasonally Flooded Stream/Riverbeds (Ontario)

The Indian Creek and Mississippi River Island populations in Ontario are both found in the seasonally inundated rocky streambeds of what are high-energy watercourses in the spring (R. Lee 2010a, pers. comm.). The Indian Creek population consists of a few individuals on rocks and trees in a rocky riverbed that is covered by water only during spring flooding (R. Lee 2010c, pers. comm.). Although found only on a few rocks or trees, dispersal of spores to downstream areas may result in colonization on other rocks which would aid in maintaining these small populations.

Suitable habitat for the Flooded Jellyskin Lichen in seasonally flooded stream/riverbeds is identified as rock surfaces and treed areas within the floodplain up to a distance of 30 m downstream and upstream of extant occurrences of the Flooded Jellyskin Lichen. The floodplain refers to the areas immediately adjacent to the stream/riverbed that typically flood each year. The 30 m horizontal distance is a precautionary distance given the difficulty detecting the species and its often small area of occupancy. It is necessary to help maintain the hydrology of the stream/river, the critical microclimate conditions and the integrity of the vegetation community supporting lichen substrates. In addition, dispersal distances and mechanisms are largely unknown but it is thought to be limited and occur by water. This suggests that nearby trees and rock surfaces have a higher potential for colonization, either in the future or may already occupied but undetected.

3. Rocky Shorelines (Manitoba)

In Manitoba, the Flooded Jellyskin Lichen is found in cracks of rocks as well as on the flat surface of rocks along rocky shorelines of permanent lakes (CWS 2010, unpublished data). In many cases, sites are in fairly sheltered areas of calm water protected from predominant winds and resulting wave action. Sites are frequently small patches found in one area although at some sites, the Flooded Jellyskin Lichen is found at several spots up to approximately 6 m apart. Tree surfaces are not expected to be colonized by the Flooded Jellyskin Lichen along rocky shorelines in Manitoba; tree substrates available are largely softwood species (e.g., spruce) while the Flooded Jellyskin Lichen occurs predominantly on hardwood species (e.g., ash, maple and elm).

Suitable habitat for the Flooded Jellyskin Lichen along rocky shorelines of permanent waterbodies is identified as rock surfaces within the 30 m horizontal radius of extant occurrences of the Flooded Jellyskin Lichen. The 30 m horizontal radius is a precautionary distance given the difficulty detecting the species and its often small area of occupancy. Dispersal distances and mechanisms are largely unknown but it is thought to be limited and occur by water. This suggests that nearby rock surfaces have a higher potential for colonization, either in the future or may already be occupied but undetected.

7.1.2 Application of the Flooded Jellyskin Lichen Critical Habitat Criteria

Critical habitat is identified in this recovery strategy as sites containing suitable habitat (see Section 7.1.1) for all extant populations of the Flooded Jellyskin Lichen. Unsuitable habitat features such as existing anthropogenic features (e.g., existing infrastructure, including roads, trails, docks and buildings) within a site are not necessary for the survival or recovery of the species and are therefore not critical habitat. Rocks used in the construction of docks are part of the critical habitat.

In Manitoba, application of the critical habitat criteria to available data (up to December 2010) identifies 15 sites containing critical habitat at the eight extant populations (Appendix B).

In Ontario, application of the critical habitat criteria to available data (up to December 2010) identifies 40 sites containing critical habitat at the 21 extant populations (Appendix B).

7.2 Activities Likely to Result in the Destruction of Critical Habitat

Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat was degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single activity or multiple activities at one point in time or from the cumulative effects of one or more activities over time (Government of Canada 2009).

Due to the extremely small restricted populations, the Flooded Jellyskin Lichen is vulnerable to destruction of critical habitat. Activities that may result in the destruction of critical habitat include but are not limited to:

- Activities that result in the alteration of hydrological cycles such as upstream water regulation (e.g., dams), groundwater depletion, road construction and housing development. These activities may inhibit the required water level fluctuations that subsequently impairs the reproduction cycle and dispersal ability for the Flooded Jellyskin Lichen and alters critical habitat characteristics to the extent that habitat becomes unsuitable.
- Activities that result in decreased water quality including water pollution (e.g., agricultural runoff, mining waste) and air pollution that would coat suitable growing surfaces in silt when the water subsides and alter required water chemistry characteristics to the extent that habitat becomes unsuitable and can no longer support the species.
- Activities (e.g., logging, infilling for road construction, aggregate extraction, mining, agricultural development, residential/recreational development) that remove the trees and/or rocks would result in the destruction of critical habitat for the Flooded Jellyskin Lichen.
- Cutting of individual trees for firewood, new recreational trails and surveying sight lines would result in the destruction of critical habitat for the Flooded Jellyskin Lichen in Ontario through the removal of substrate trees.

- Activities that promote the spread of invasive or exotic species (e.g., transportation of infected elm or ash wood or Black Algae into the Flooded Jellyskin Lichen's habitat) would result in a reduction of critical habitat for the Flooded Jellyskin Lichen through the loss of substrate trees and coating of rock surfaces.

8. MEASURING PROGRESS

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives. Specific progress towards implementing the recovery strategy will be measured against indicators outlined in subsequent action plans.

Performance indicators:

- the size of the Flooded Jellyskin Lichen populations (surface area covered by the species) has not decreased, and
- the distribution of the Flooded Jellyskin Lichen has not decreased.

9. STATEMENT ON ACTION PLANS

One or more action plans for the Flooded Jellyskin Lichen will be posted on the Species at Risk (SAR) Public Registry by December 2018.

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APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

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

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The 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. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

It is very likely that recovery efforts for the Flooded Jellyskin Lichen will have positive effects on other species with similar habitat requirements. In particular, the protection of seasonal pond critical habitat could benefit other species at risk including the Eastern Ribbonsnake (*Thamnophis sauritus*) as well as seasonal pond dependent species such as Wood Frogs (*Rana sylvatica*) and Spotted Salamanders (*Ambystoma maculatum*). Seasonal ponds are of increasing public interest and conservation concern in Ontario and with many other jurisdictions (e.g., Parks Canada Agency 2006). Protection of critical habitat for the Flooded Jellyskin Lichen in lakeshore and stream/riverbed environments would likely have a beneficial impact on other species as well, such as the co-occurring Silverskin Lichen (*Dermatocarpon luridum*).

APPENDIX B: LOCATION OF CRITICAL HABITAT

Sites Identified as Containing Critical Habitat for the Flooded Jellyskin Lichen in Canada

Province	Nearest Town or County	Location / Population	Site Name	Habitat	Coordinates representing the site[1]		Land Tenure
					Longitude	Latitude	
MB	Flin Flon	Neso Lake East	Neso Lake East 1	rocky shoreline	-101.5421	54.6517	Non-federal
MB	Flin Flon		Neso Lake East 2	rocky shoreline	-101.5421	54.6517	Non-federal
MB	Flin Flon	Neso Lake West	Neso Lake West 1	rocky shoreline	-101.5725	54.6420	Non-federal
MB	Flin Flon		Neso Lake West 2	rocky shoreline	-101.5725	54.6420	Non-federal
MB	Flin Flon	Payuk Lake East	Payuk Lake East 1	rocky shoreline	-101.5260	54.6430	Non-federal
MB	Flin Flon		Payuk Lake East 2	rocky shoreline	-101.5260	54.6430	Non-federal
MB	Flin Flon		Payuk Lake East 3	rocky shoreline	-101.5260	54.6430	Non-federal
MB	Flin Flon		Payuk Lake East 4	rocky shoreline	-101.5260	54.6430	Non-federal
MB	Flin Flon		Payuk Lake East 5	rocky shoreline	-101.5260	54.6430	Non-federal
MB	Flin Flon	Payuk Lake South	Payuk Lake South	rocky shoreline	-101.5255	54.6340	Non-federal
MB	Flin Flon	Payuk Lake West	Payuk Lake West	rocky shoreline	-101.5570	54.6424	Non-federal
MB	Flin Flon	Twin Lake	Twin Lake	rocky shoreline	-101.4796	54.6440	Non-federal
MB	Flin Flon	Whitefish Lake North	Whitefish Lake North 1	rocky shoreline	-101.6730	54.7567	Non-federal
MB	Flin Flon		Whitefish Lake North 2	rocky shoreline	-101.6730	54.7567	Non-federal
MB	Flin Flon	Whitefish Lake South	Whitefish Lake South	rocky shoreline	-101.6712	54.7298	Non-federal
ON	Ottawa	Stony Swamp	Stony Swamp Ponds 1, 2, 3 and 4	seasonal pond	-75.8546	45.3033	Federal (NCC*)
ON	Ottawa		Stony Swamp Pond 5	seasonal pond	-75.8546	45.3033	Federal (NCC*)
ON	Lanark	Tatlock	Tatlock	seasonal pond	-76.4635	45.1711	Non-federal
ON	Lanark	Billa Lake	Billa Lake, Darling Township Pond 1	seasonal pond	-76.5278	45.1973	Non-federal
ON	Lanark		Billa Lake, Darling Township Pond 2	seasonal pond	-76.5278	45.1973	Non-federal
ON	Lanark	Mississippi River Island	Mississippi River Island	seasonally flooded stream/riverbed	-76.2100	45.2191	Non-federal
ON	Lanark	Indian Creek	Indian Creek	seasonally flooded stream/riverbed	-76.3507	45.2445	Non-federal

ON	Lanark	Darling Long Lake Halfway Pond	Darling Long Lake Halfway Pond - Original	seasonal pond	-76.5415	45.2331	Non-federal
ON	Lanark		Darling Long Lake Halfway Pond - 1st addition	seasonal pond	-76.5545	45.2419	Non-federal
ON	Lanark		Darling Long Lake Halfway Pond - 2nd additional, Ponds A and B	seasonal pond	-76.5417	45.2421	Non-federal
ON	Lanark	Peneshula Rd	Peneshula Rd - Darling Township, Private Pond 1 (Pond #18)	seasonal pond	-76.5297	45.2693	Non-federal
ON	Lanark		Peneshula Rd - Darling Township, Private Pond 2 (Pond #19)	seasonal pond	-76.5297	45.2693	Non-federal
ON	Lanark		Peneshula Rd - Peter's Pond (Pond #21)	seasonal pond	-76.5168	45.2604	Non-federal
ON	Lanark		Peneshula Rd - Sand Pit Pond (Pond #22)	seasonal pond	-76.5295	45.2603	Non-federal
ON	Lanark		Peneshula Rd - Dave's Deep Pool (Pond #23)	seasonal pond	-76.5295	45.2603	Non-federal
ON	Lanark		Peneshula Rd - Straddling Pond (Pond #24)	seasonal pond	-76.5297	45.2693	Non-federal
ON	Lanark		Peneshula Rd - Northern Spur Pond (Pond #26)	seasonal pond	-76.5295	45.2603	Non-federal
ON	Lanark	Block 509	Block 509 - Pond 1	seasonal pond	-76.6126	45.0431	Non-federal
ON	Lanark		Block 509 - Pond 2	seasonal pond	-76.6126	45.0431	Non-federal
ON	Lanark	Block 306	Block 306 - Pond 1	seasonal pond	-76.7176	45.1586	Non-federal
ON	Lanark	Block 503	Block 503 - Pond 1	seasonal pond	-76.6377	45.0337	Non-federal
ON	Lanark		Block 503 - Pond 2	seasonal pond	-76.6374	45.0247	Non-federal
ON	Lanark		Block 503 - Ponds 3 and 4	seasonal pond	-76.6374	45.0247	Non-federal
ON	Lanark	Park Lake	Park Lake - Pond 1	seasonal pond	-76.6245	45.0159	Non-federal
ON	Lanark		Park Lake - Pond 2	seasonal pond	-76.6245	45.0159	Non-federal
ON	Lanark	Windy Point Road	Windy Point Road 1	seasonal pond	-76.5177	45.2964	Non-federal
ON	Lanark		Windy Point Road 2	seasonal pond	-76.5052	45.3056	Non-federal
ON	Lanark	Murphy's Point Provincial Park	Murphy’s Point 1	seasonal pond	-76.2260	44.7778	Non-federal
ON	Lanark		Murphy’s Point 2	seasonal pond	-76.2260	44.7778	Non-federal
ON	Lanark		Murphy’s Point 3	seasonal pond	-76.2262	44.7868	Non-federal
ON	Lanark		Murphy’s Point 4	seasonal pond	-76.2260	44.7778	Non-federal

ON	Lanark		Murphy's Point 5	seasonal pond	-76.2260	44.7778	Non-federal
ON	Leeds and Grenville	Redhorse Lake	Redhorse Lake	seasonal pond	-76.0954	44.5541	Non-federal
ON	Leeds and Grenville	Lost Bay	Lost Bay	seasonal pond	-76.1188	44.4638	Non-federal
ON	Hastings	Lake Township	Lake Township - Ponds 1, 2 and 3	seasonal pond	-77.7292	44.7608	Non-federal
ON	Lennox and Addington	Dickey Lake	Dickey Lake	seasonal pond	-77.3918	45.1554	Non-federal
ON	Kawartha Lakes	Coboconk	Coboconk	seasonal pond	-78.7932	44.6460	Non-federal
ON	Peterborough	Church Lake	Church Lake	seasonal pond	-78.1768	44.6145	Non-federal
ON	Peterborough	Rigby Quarry	Rigby Quarry	seasonal pond	-78.3417	44.5914	Non-federal
ON	Frontenac	Blue Lake	Blue Lake	seasonal pond	-77.0513	44.8830	Non-federal

[1] The listed coordinates represent the southwest corner of the 1 km Universal Transverse Mercator (UTM) Military Grid Reference System square containing the critical habitat site centroid (see http://maps.nrcan.gc.ca/topo101/mil_ref_e.php for more information on the reference system). The coordinates may not fall within critical habitat and are provided as a general location only.

**NCC – National Capital Commission*