

Recovery Strategy for the Pale-bellied Frost Lichen (*Physconia subpallida*) in Canada

Pale-bellied Frost Lichen



2015



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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk Public Registry¹.

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¹ <http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1>

RECOVERY STRATEGY FOR THE PALE-BELLIED FROST LICHEN (*Physconia subpallida*) IN CANADA

2015

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of Ontario has given permission to the Government of Canada to adopt the *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario* (Part 2) under Section 44 of the *Species at Risk Act*. Environment Canada has included an addition (Part 1) which completes the SARA requirements for this recovery strategy.

Environment Canada is adopting the provincial recovery strategy with the exception of section 2, Recovery. In place of section 2, Environment Canada is establishing its own population and distribution objective (based on the Government of Ontario's goal) and performance indicators, is adopting the government-led and government-supported actions of the *Pale-bellied Frost Lichen Ontario Government Response Statement*² (Part 3) as broad strategies and general approaches to meet the population and distribution objective, and is adopting the habitat regulated under Ontario's *Endangered Species Act, 2007* as critical habitat for the Pale-bellied Frost Lichen. In addition, Environment Canada has identified an additional site as critical habitat for the Pale-bellied Frost Lichen.

The federal Recovery Strategy for the Pale-bellied Frost Lichen (*Physconia subpallida*) in Canada consists of three parts:

Part 1 – Federal Addition to the *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario*, prepared by Environment Canada.

Part 2 - *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario*, prepared by C.L. Lewis for the Ontario Ministry of Natural Resources³.

Part 3 - *Pale-bellied Frost Lichen Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources.

²The Government Response Statement is the Ontario Government's policy response to the recovery strategy and summarizes the prioritized actions that the Ontario Government intends to take and support.

³ On June 26, 2014, the Ontario Ministry of Natural Resources became the Ontario Ministry of Natural Resources and Forestry.

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PART 2 - *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario*, prepared by C.L. Lewis for the Ontario Ministry of Natural Resources.

PART 3 - *Pale-bellied Frost Lichen Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources.

PART 1 - Federal Addition to the *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario*, prepared by Environment Canada

PREFACE

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)⁴ 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 and the Minister responsible for Parks Canada Agency are the competent ministers for the recovery of the Pale-bellied Frost Lichen and have prepared the federal component of this recovery strategy (Part 1), as per section 37 of SARA. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (sub-sections 41(1) or (2)). The Ontario Ministry of Natural Resources (now the Ontario Ministry of Natural Resources and Forestry) led the development of the attached recovery strategy for the Pale-bellied Frost Lichen (Part 2) in cooperation with Environment Canada.

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, the Parks Canada Agency or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Pale-bellied Frost 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, Parks Canada Agency 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.

⁴ <http://registrelep-sararegistry.gc.ca/default.asp?lang=en&n=6B319869-1#2>

ACKNOWLEDGEMENTS

The federal addition was prepared by Karolyne Pickett (Environment Canada, Canadian Wildlife Service – Ontario). Additional preparation and review of the document was completed by Tianna Burke (formerly of Environment Canada, Canadian Wildlife Service - Ontario), Rachel deCatanzaro and Lee Voisin (Environment Canada, Canadian Wildlife Service – Ontario). This federal addition benefited from input, review, and suggestions from the following individuals and organizations: Krista Holmes, Madeline Austen, Lesley Dunn, and Elizabeth Rezek (Environment Canada, Canadian Wildlife Service – Ontario); Wendy Dunford (Environment Canada, Canadian Wildlife Service – National Capital Region); Joanne Tuckwell and Sheldon Lambert (Parks Canada Agency); and Vivian Brownell, Amanda Fracz, Aileen Wheeldon, Eric Snyder, Amelia Argue, Jay Fitzsimmons, Brian Naylor, Jim Saunders, Michael J. Oldham, and Shaun Thompson (Ontario Ministry of Natural Resources and Forestry).

Acknowledgement and thanks is given to all other parties that provided advice and input used to help inform the development of this recovery strategy including various Aboriginal organizations and individuals, individual citizens, and stakeholders who provided input and/or participated in consultation meetings.

ADDITIONS AND MODIFICATIONS TO THE ADOPTED DOCUMENT

The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the Province of Ontario's *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario* (Part 2) and to provide updated or additional information.

Under SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Therefore, statements in the provincial recovery strategy referring to protection of the species' habitat may not directly correspond to federal requirements, and are not being adopted by Environment Canada as part of the federal recovery strategy. Whether particular measures or actions will result in protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.

1. Species Status Information

The global status of the Pale-bellied Frost Lichen has not yet been ranked (GNR)⁵ (NatureServe 2012). At the national scale, it is ranked Critically Imperiled⁶ in Canada (N1), and has not been ranked in the United States. At the sub-national level, it is ranked as Imperiled⁷ in Ontario (S2) (NHIC 2013). The species is listed as Endangered⁸ under the Ontario *Endangered Species Act, 2007* (ESA), and as Endangered on Schedule 1 of the federal SARA.

The Pale-bellied Frost Lichen is only found in north-eastern North America. In Canada, it is confirmed extant (i.e., still occurring) in 10 locations and extirpated from 4 locations in south-eastern Ontario. The Canadian population of the Pale-bellied Frost Lichen probably constitutes less than five percent of the species' global distribution⁹.

2. Recovery Feasibility

Based on the following four criteria outlined in the draft SARA Policies (Government of Canada 2009), there are unknowns regarding the feasibility of recovery of the Pale-bellied Frost Lichen. In keeping with the precautionary principle, a full recovery strategy has been prepared as would be done when recovery is determined to be feasible.

⁵ Global rank has not yet been assessed.

⁶ Critically Imperiled (G1/N1/S1): At very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors.

⁷ Imperiled (G2/N2/S2): At high risk of extirpation in the jurisdiction due to very restricted range, few populations or occurrences, very steep declines, severe threats, or other factors.

⁸ A species that is native to the wild in Ontario but is facing imminent extinction or extirpation.

⁹ Based on the range presented in Lewis (2011). The majority of samples that form the basis of the known range are from pre-1973.

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. Individuals capable of reproduction are currently present in Ontario, as evidenced by the occurrence of mature individuals at ten sites between 2007 and 2012. At the Calabogie Peak site in 2009, it was noted that 16 of 71 individuals were fertile (Lewis 2011).

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

Yes. The species occurs in intermediate-aged to old-growth deciduous forests with trees that are adapted to interior humidity and which provide a suitable substrate on which the Pale-bellied Frost Lichen can grow, such as thick-barked elm (*Ulmus* spp.), ash (*Fraxinus* spp.) or Hop-hornbeam (Ironwood) (*Ostrya virginiana*) trees (Lewis 2011). Currently, apparently suitable mature and old-growth forest habitats can still be found in Ontario including many areas that are not known to be occupied by the species (Lewis 2011). However, it is important to note that the quantity of suitable habitat has declined considerably over the past few centuries due to logging and other human activities, and many remaining forest stands throughout southern Ontario do not provide the suitable interior forest characteristics required by the Pale-bellied Frost Lichen (Landowner Resource Centre 2000). In addition, historically, the Pale-bellied Frost Lichen has largely been recorded on American Elm trees. With the spread of Dutch Elm Disease, many American Elm trees have been lost, reducing the quantity and quality of suitable trees available for the Pale-bellied Frost Lichen to grow on (Leadbitter et al. 2002). The spread of a relatively recent invasive insect species in Ontario, the Emerald Ash Borer (*Agilus planipennis*), also has the potential to cause reductions in the availability of suitable host trees for the Pale-bellied Frost Lichen, by impacting the health and numbers of native ash trees.

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

Unknown. The primary threats to the Pale-bellied Frost Lichen are removal of mature and old-growth deciduous forests in south-eastern Ontario, including the removal of host trees, and alterations to interior forest conditions preferred by the species (e.g., shade, lower wind speeds and high humidity levels). The removal of host trees can be avoided and the alterations to habitat can be mitigated through the implementation of appropriate forest management planning, policies and practices. In spite of this, there are still information gaps regarding the extent and severity of threats caused by both Dutch Elm Disease and Emerald Ash Borer to the host tree populations, and the ability to mitigate these threats.

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

Unknown. Management and protection of suitable old-growth forest habitat is imperative to the survival and recovery of this species. Forest management techniques needed to address the primary threats listed above already exist. Guidelines for protecting interior forest species in Southern Ontario have been developed and recommend that a 100 to 200 m distance from the forest edge be maintained to help in the protection of the interior microclimate (Environment Canada 2013). However, although there have been some guidelines and recovery techniques created, the loss of interior old-growth forests is still a major concern. Assuming that forest management techniques can be successfully implemented, there still remain unknowns concerning the potential impact of and ability to mitigate the threat of both Dutch Elm Disease and Emerald Ash Borer, and it is possible that this could pose a challenge to achieving the population and distribution objective.

Because the Pale-bellied Frost Lichen has only been recorded at 14 locations (4 of which are extirpated) in south-eastern Ontario to date, the species may have always been rare in the province, in which case, due to the species' naturally limited distribution in Canada, it will likely always be vulnerable to anthropogenic and natural stressors. However, the fact that seven of these occurrences were newly discovered within the last few years (NHIC 2013) demonstrates that the species occupies a wider distribution than previously thought, and may indicate that the species has, at least to some extent, been overlooked.

3. Population and Distribution

The *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario* reported the species as extirpated at four historical sites (Belleville, Brighton, Britannia and Ottawa) and extant at three locations in Ontario: the Calabogie Peak site in the County of Renfrew, the Billa Lake site in the County of Lanark, and the Arcol Road site in the County of Frontenac (Lewis 2011). Since the publication of the provincial recovery strategy, the species has been discovered at seven new locations: the Salmon River site and the Frontenac Provincial Park site (County of Frontenac); the Highland Grove site (County of Haliburton); the Moira River site and the Cassidy Block site (County of Hastings); the Peterborough County Forest site (County of Peterborough); and Main Duck Island (Prince Edward County) (NHIC 2013). The Main Duck Island location was found after the amendment of the provincial habitat regulation. These extirpated and extant locations have been included in Table 1.

Table 1: Currently known extirpated and extant locations of the Pale-bellied Frost Lichen in Canada¹⁰.

Location	County	Occurrence Status	Approximate number of individuals (thalli ¹¹) observed
Belleville	Hastings	Extirpated	0
Brighton	Northumberland	Extirpated	0
Britannia	Ottawa	Extirpated	0
Ottawa	Ottawa	Extirpated	0
Calabogie Peak	Renfrew	Extant	~76
Billa Lake	Lanark	Extant	~19
Arcol Road	Frontenac	Extant	~26
Salmon River*	Frontenac	Extant	~4
Frontenac Provincial Park*	Frontenac	Extant	1+ (?)
Highland Grove*	Haliburton	Extant	~4
Moira River*	Hastings	Extant	1
Cassidy Block*	Hastings	Extant	1
Peterborough County Forest*	Peterborough	Extant	2
Main Duck Island (Thousand Islands National Park)*	Prince Edward	Extant	~3

*Locations that were newly discovered since the publication of the provincial recovery strategy

4. Threats

Threats to the Pale-bellied Frost Lichen are described in Part 2 -*Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario*.

Herbivory by gastropods¹² (whether native or non-native species) was suggested as a possible threat to the Pale-bellied Frost Lichen in the provincial recovery strategy. As noted in the provincial recovery strategy, while there has been no evidence of gastropod herbivory on the Pale-bellied Frost Lichen to date, gastropod herbivory on other lichen species including Flooded Jellyskin (*Leptogium rivulare*) has been observed in Ontario (Lee pers. Comm. 2010 in Lewis 2011). In addition to the evidence presented in the provincial recovery strategy (Part 2), in Nova Scotia, Cameron (2009) documented heavy herbivory by gastropods on the endangered Boreal Felt Lichen (*Erioderma pedicellatum*) in an area where most gastropods were non-native *Arion* sp. Research is

¹⁰ Based on observation records reported to the Ontario Conservation Data Centre (Natural Heritage Information Centre) as of October 2013.

¹¹ The undifferentiated vegetative bodies of algae, fungi, and lichens.

¹² Taxonomic group that includes slugs and snails.

underway in the Ottawa, Ontario area to study gastropod herbivory on lichen populations (see Lewis 2011).

As noted in the provincial recovery strategy, the spread of Dutch Elm Disease has resulted in the loss of American Elm trees, reducing the number of trees available for the Pale-bellied Frost Lichen to colonize on (Leadbitter et al. 2002). Recently, ash trees have also come under threat by the invasive Emerald Ash Borer insect. There is limited knowledge on the extent to which Dutch Elm Disease and Emerald Ash Borer threaten the Pale-bellied Frost Lichen.

Since the publication of the provincial recovery strategy, there has been some evidence that herbicides pose a threat to lichens in Ontario. Recent studies have found that lichens suffer mortality when exposed to herbicides such as triclopyr and glyphosate (McMullin et al. 2011; McMullin et al. 2013). There is limited information on the extent to which herbicides threaten the Pale-bellied Frost Lichen specifically.

5. Population and Distribution Objectives

The *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario* contains the following recovery goal:

- The recovery goal is to maintain the size and distribution of all extant and newly discovered populations of Pale-bellied Frost Lichen in Ontario, with hopes of population increases through habitat protection, and to fill in some of the identified knowledge gaps.

The Government Response Statement prepared by the province of Ontario states the following goal for the recovery of the Pale-bellied Frost Lichen in Ontario:

- The government's goal for the recovery of the Pale-bellied Frost Lichen is to ensure the persistence of the size and distribution of all existing populations of the species in Ontario and to allow for natural population growth through maintenance of suitable occupied and adjacent habitat.

Under SARA, a population and distribution objective for the species must be established. Environment Canada's population and distribution objective for the Pale-bellied Frost Lichen in Canada is to:

- Maintain the current abundance and distribution of all existing populations of the species in Ontario and to allow for natural population growth through maintenance of suitable occupied and adjacent habitat.

6. Broad Strategies and General Approaches to Meet Objectives

The government-led and government-supported actions tables from the *Pale-bellied Frost Lichen Ontario Government Response Statement* (Part 3) are adopted as the broad strategies and general approaches to meet the population and distribution objective. Environment Canada is not adopting the approaches identified in section 2 of the *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario* (Part 2).

7. Critical Habitat

7.1 Identification of the Species' Critical Habitat

Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. Under SARA, critical habitat is "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species".

Identification of critical habitat is not a component of the provincial recovery strategy under the Province of Ontario's ESA. However, following the completion of the provincial recovery strategy for this species, a provincial habitat regulation was developed for the Pale-bellied Frost Lichen, and came into force January 1, 2014¹³. A habitat regulation is a legal instrument that prescribes an area that will be protected¹⁴ as the habitat of this species by the Province of Ontario. The habitat regulation identifies the geographic area within which the habitat for the species is prescribed and the regulation may apply and explains how the boundaries of regulated habitat are determined (based on biophysical and other attributes). The regulation is dynamic and automatically in effect whenever the conditions described in the regulation are met.

Environment Canada adopts the description of the Pale-bellied Frost Lichen habitat under section 28.2 of Ontario Regulation 242/08¹⁵ made under the provincial ESA as the critical habitat in this federal recovery strategy. The area defined under Ontario's habitat regulation contains the biophysical attributes required by the Pale-bellied Frost Lichen to carry out its life processes. An additional location of critical habitat currently not included in the provincial habitat regulation is also identified in this section. To meet

¹³ A habitat regulation for Pale-bellied Frost lichen came into effect July 1, 2011; however, an amendment to that regulation came into effect January 1, 2014.

¹⁴ Under the federal SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.

¹⁵ http://www.e-laws.gov.on.ca/html/regis/english/elaws_regs_080242_e.htm#BK66

specific requirements of SARA, the biophysical attributes of critical habitat are further detailed below.

The areas prescribed under **Ontario regulation 242/08 – Pale-bellied Frost Lichen habitat** are described as follows:

28.2 (1) For the purpose of clause (a) of the definition of “habitat” in subsection 2 (1) of the Act [ESA], the areas described in subsection (2) that are located in the following geographic areas, parts of geographic areas and provincial park are prescribed as the habitat of Pale-bellied Frost Lichen:

- 1. Algonquin Provincial Park.*
- 2. The geographic areas of Haliburton, Hastings, Lanark, Lennox and Addington, Peterborough and Renfrew.*
- 3. The parts of the geographic area of Frontenac composed of the lower-tier municipalities of Central Frontenac, North Frontenac and South Frontenac.*
- 4. The parts of the geographic area of Leeds and Grenville composed of the lower-tier municipalities of Athens, Elizabethtown-Kitley, Merrickville-Wolford and Rideau Lakes.*
- 5. The parts of the geographic area of Nipissing composed of the lower-tier municipality of South Algonquin. O. Reg. 323/13, s. 12 (1).*

(2) Subsection (1) applies to the following areas:

- 1. The host tree on which the Pale-bellied Frost Lichen exists and the area within 50 metres of the trunk of the host tree.*
- 2. An area within 100 metres of Pale-bellied Frost Lichen that falls within a water body, watercourse or an area belonging to a community series identified under the land classification system for southern Ontario and that,
 - i. is suitable for natural colonization from an existing population of pale-bellied frost lichen, or*
 - ii. contributes to the maintenance of suitable microsite characteristics for Pale-bellied Frost Lichen to exist. O. Reg. 122/12, s. 4.**

The biophysical attributes of critical habitat include the characteristics described below.

Suitable host trees for the Pale-bellied Frost Lichen:

- Tree species of suitable bark pH, calcium content, and moisture holding capacity (including, but not limited to Hop-hornbeam (Ironwood), ash, and elm trees)

Areas suitable for natural colonization by the Pale-bellied Frost Lichen:

- Areas of deciduous forest, mixed forest, deciduous swamp, or mixed swamp as defined using the Ecological Land Classification (ELC) community series for Southern Ontario (Lee et al. 1998) (most commonly intermediate-aged to old-growth forest) which possess the following characteristics:
 - presence of suitable host trees (as defined above); AND
 - relatively high humidity; AND
 - moderate-to-high levels of shade

Areas that contribute to the maintenance of suitable microsite characteristics for the Pale-bellied Frost Lichen to exist:

- Any community series defined using the ELC for Southern Ontario which contributes to maintenance of shade, humidity levels, and air circulation. This may include community series which are:
 - part of a waterbody or watercourse; OR
 - forested; OR
 - contain other natural or semi-natural (cultural) vegetation

The Pale-bellied Frost Lichen is sensitive to edge effects and changes in microsite conditions (Lewis 2011). Protection of the area within 50 m of the trunk of a host tree would contribute to survival of the host tree (and therefore the lichen) through protection of the roots, trunk and crown. In addition, maintenance of habitat suitable for colonization by the Pale-bellied Frost Lichen within 100 m of Pale-bellied Frost Lichen would provide opportunities for dispersal and possible expansion of the population into adjacent areas, while maintenance of waterbodies and watercourses, as well as other naturally or semi-naturally vegetated areas within 100 m of Pale-bellied Frost Lichen would protect interior forest conditions and/or maintain features that create suitable microsite characteristics for growth of the Pale-bellied Frost Lichen. For the purposes of identifying critical habitat, boundaries are defined using the ELC for Southern Ontario (Lee et al. 1998) (OMNR 2012). The ELC framework provides a standardized approach to the interpretation and delineation of dynamic ecosystem boundaries and as such encompasses the biophysical attributes of the habitat for the Pale-bellied Frost Lichen.

Through this recovery strategy, the areas prescribed as habitat for the Pale-bellied Frost Lichen under section 28.2 of Ontario Regulation 242/08 become critical habitat identified under SARA. Since the regulation is dynamic and automatically in effect whenever the conditions described in the regulation are met, if any new locations of the

Pale-bellied Frost Lichen are confirmed within the geographic areas listed under subsection (1) of the regulation (see Figure 1), the habitat regulation under the ESA applies. Refer to the *Habitat Protection Summary for Pale-bellied Frost Lichen* (OMNR 2012) for further details on the provincial habitat regulation and its application. Should new occurrences of the Pale-bellied Frost Lichen be identified that meet the criteria above, the additional critical habitat will be identified in an updated recovery strategy or a subsequent action plan.

Based on the best available information for the Pale-bellied Frost Lichen, the provincial habitat regulation currently includes habitat required by nine of the ten currently known extant local populations in Canada. One additional population occurs on federal land (Main Duck Island in Thousand Islands National Park). For this population, critical habitat is identified using the the description of the Pale-bellied Frost Lichen habitat under section 28.2 of Ontario Regulation 242/08, subsection (2).

In applying the critical habitat criteria above to the best available data (as of April 2014), critical habitat is identified for the 12 sites and the 10 known local populations of the Pale-bellied Frost Lichen in Canada, totalling up to 311 ha¹⁶ (Figures 2 and 3; see also Table 1). The critical habitat identified is considered sufficient to meet the population and distribution objective for the Pale-bellied Frost Lichen. Areas that are in neither a natural nor semi-natural state (e.g., roads, housing developments, agricultural fields) do not meet the biophysical attributes described above and are therefore not a part of critical habitat.

Critical habitat for the Pale-bellied Frost Lichen is presented using a 1 x 1 km UTM grid. The 1 X 1 km UTM grid is part of a standardized grid system that indicates the general geographic areas containing critical habitat which can be used for land use planning and/or environmental assessment purposes. The areas of critical habitat within each grid square occur where the description of critical habitat is met. More detailed information on regulated habitat may be requested on a need-to-know basis from the Ontario Ministry of Natural Resources and Forestry. More detailed information on critical habitat may be requested on a need-to-know basis by contacting Environment Canada – Canadian Wildlife Service at RecoveryPlanning_Pl@ec.gc.ca.

¹⁶ This is the maximum extent of critical habitat based on a 100m buffer around Pale-bellied Frost Lichen. Actual critical habitat occurs only in those areas described in subsection 28.2(2)2 of the provincial habitat regulation that fall within the 100m buffer and therefore the actual area could be less than this and would require field verification to determine accurately.

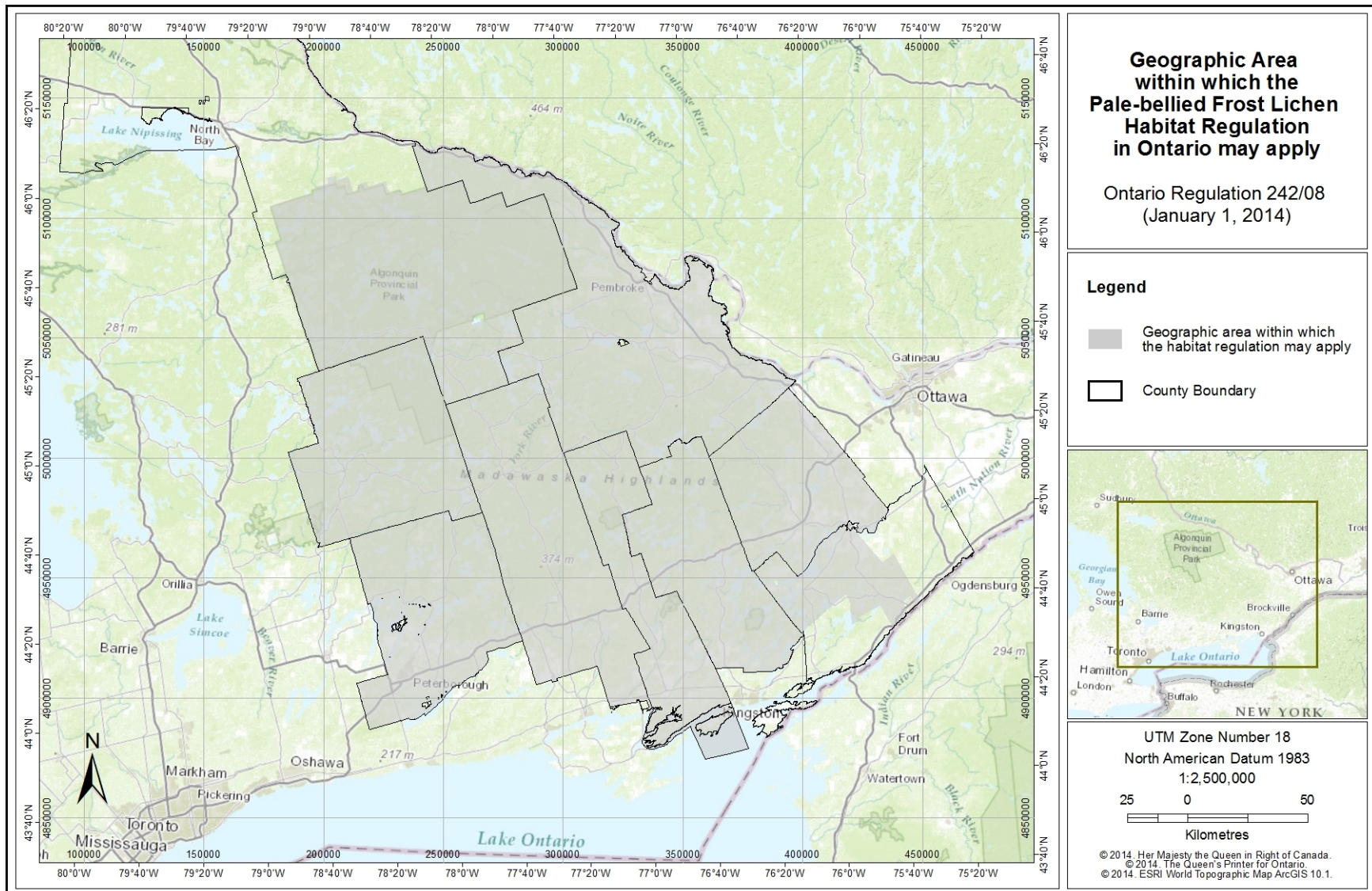


Figure 1. The geographic area within which the habitat regulation for the Pale-bellied Frost Lichen may apply, if the habitat meets the criteria described in section 28.2 of Ontario Regulation 242/08 under the provincial ESA.

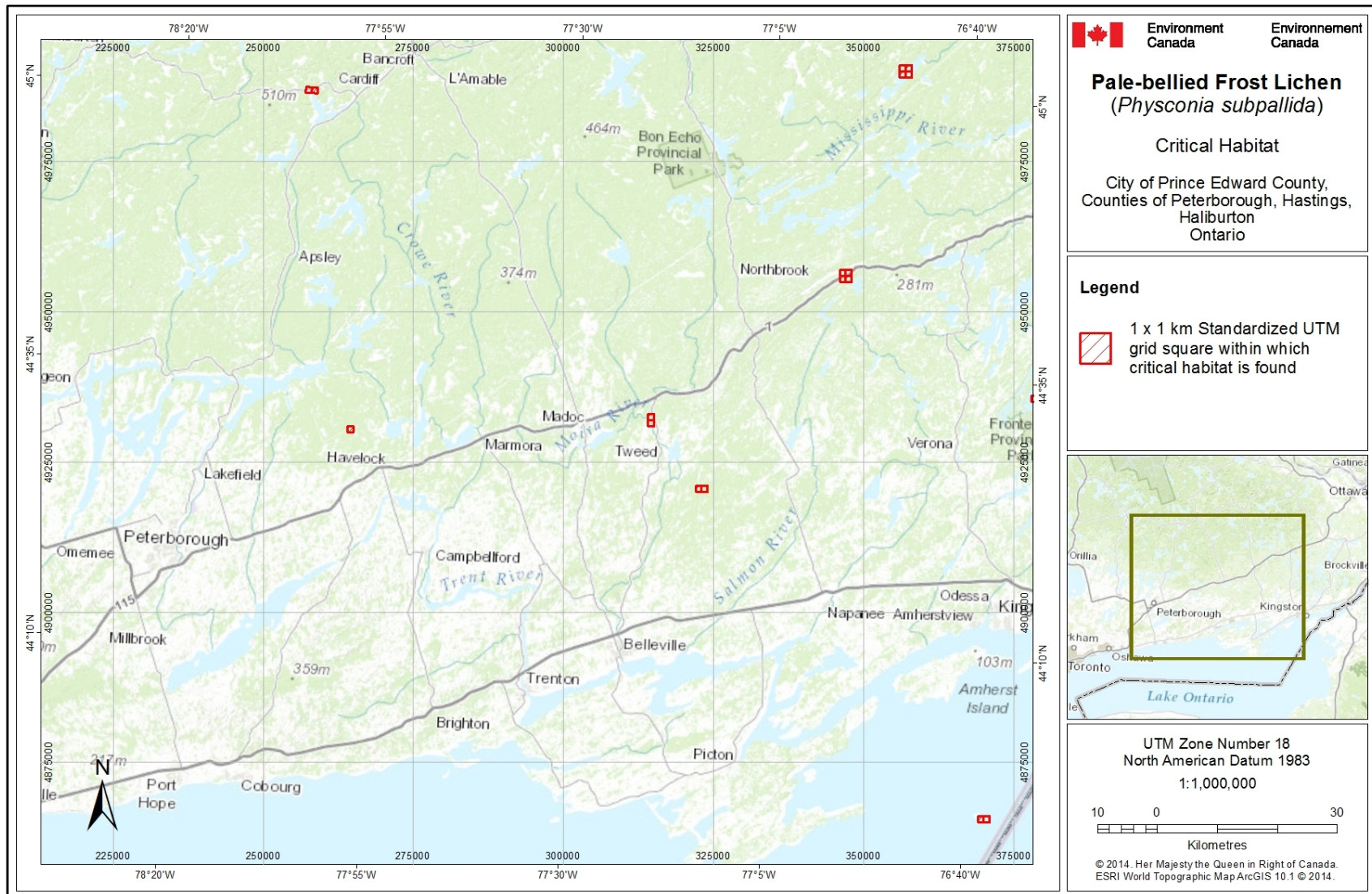


Figure 2. Grid squares that contain critical habitat for the Pale-bellied Frost Lichen in the city of Prince Edward County and the counties of Peterborough, Hastings, and Haliburton, Ontario, current to April 2014. Critical habitat for the Pale-bellied Frost Lichen occurs within these 1 x 1 km standardized UTM grid squares (red hatched outline), where the description of critical habitat is met.

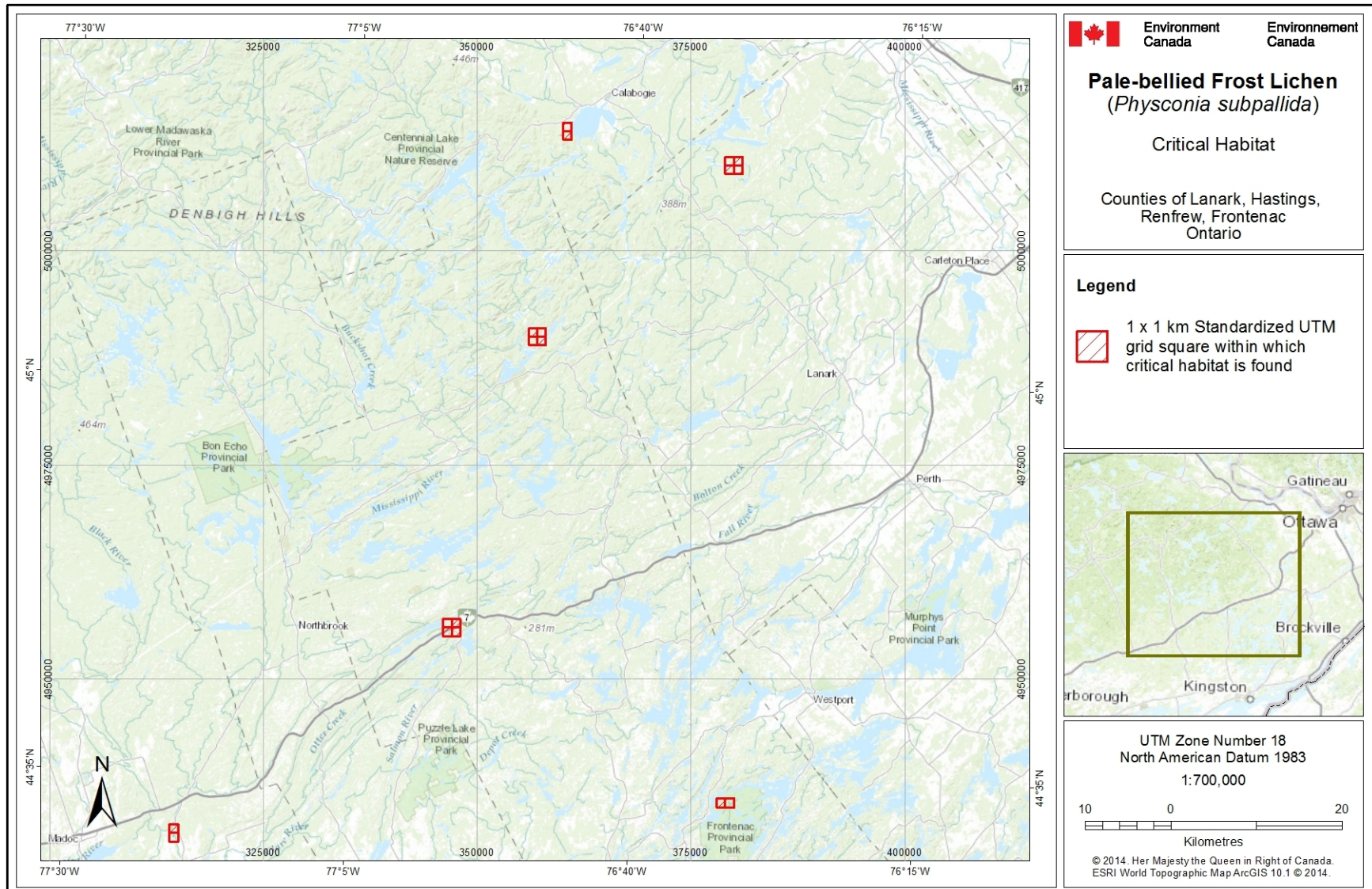


Figure 3. Grid squares that contain critical habitat for the Pale-bellied Frost Lichen in the counties of Lanark, Hastings, Renfrew and Frontenac, Ontario, current to April 2014. Critical habitat for the Pale-bellied Frost Lichen occurs within these 1 x 1 km standardized UTM grid squares (red hatched outline), where the description of critical habitat is met.

Table 2. Grid squares that contain critical habitat for the Pale-bellied Frost Lichen in Canada, current to April 2014. Critical habitat for the Pale-bellied Frost Lichen occurs within these 1 x 1 km standardized UTM grid squares where the description of critical habitat is met.

Critical Habitat Unit	1 x 1 km Standardized UTM Grid Square ID ¹	UTM Grid Square Coordinates ²		Critical Habitat Unit Area (ha) ³	Land Tenure ⁴
		Easting	Northing		
Cassidy Block	18UQ22_20 18UQ22_30	322000 323000	4920000 4920000	4	Non-federal Land
Peterborough County Forest	18TQ63_40	264000	4930000	4	Non-federal Land
Moirra River	18UQ13_41 18UQ13_42	314000 314000	4931000 4932000	4	Non-federal Land
Frontenac Provincial Park	18UQ73_85 18UP73_95	378000 379000	4935000 4935000	4	Non-federal Land
Salmon River	18UQ45_65 18UQ45_66 18UQ45_75 18UQ45_76	346000 346000 347000 347000	4955000 4956000 4955000 4956000	50	Non-federal Land
Highland Grove 1	17QK38_16	731000	4986000	4	Non-federal Land
Highland Grove 2	17QK38_06 17QK38_16	730000 731000	4986000 4986000	4	Non-federal Land
Arcol Road/Canonto Lake	18UQ58_69 18UQ58_79 18UQ59_60 18UQ59_70	356000 357000 356000 357000	4989000 4989000 4990000 4990000	105	Non-federal Land
Billa Lake (Darling Long Lake)	18UR70_99 18UR71_90 18UR80_09 18UR81_00	379000 379000 380000 380000	5009000 5010000 5009000 5010000	101	Non-federal Land
Calabogie 1	18UR61_04	360000	5014000	12	Non-federal Land
Calabogie 2	18UR61_03	360000	5013000	14	Non-federal Land
Main Duck Island	18UP66_95 18UP76_05	369000 370000	4865000 4865000	5	Other Federal Land
Total of 311 ha in 12 critical habitat units					

¹Based on the standard UTM Military Grid Reference System (see <http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098>), where the first two digits represent the UTM Zone, the following two letters indicate the 100 x 100 km standardized UTM grid, followed by two digits to represent the 10 x 10 km standardized UTM grid. The last two digits represent the 1 x 1 km standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology produced from the Breeding Bird Atlases of Canada (See <http://www.bsc-eoc.org/> for more information on breeding bird atlases).

²The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 1 x 1 km standardized UTM grid square containing all or a portion of the critical habitat. The coordinates may not fall within critical habitat and are provided as a general location only.

³The area presented is a maximum extent of the area that contains critical habitat (rounded up to the nearest 1 ha); therefore, the exact area of critical habitat may be significantly less and would require field verification.

⁴Land tenure is provided as an approximation of the types of land ownership that exist where critical habitat has been identified and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information.

7.2 Activities Likely to Result in the Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time (Government of Canada 2009). It should be noted that not all activities that occur in or near critical habitat are likely to cause its destruction.

Activities described in Table 3 include those likely to cause destruction of critical habitat for the species; however, destructive activities are not limited to those listed.

Table 3. Activities likely to destroy the critical habitat of the Pale-bellied Frost Lichen

Description of Activity	Description of effect in relation to function loss	Details of effect (including related threat, scope, and thresholds)
Clearing of forests (e.g., logging) or other natural features	<p>Felling a tree or removing bark on which the lichen is growing eliminates the living substrate which is necessary for the survival of the lichen.</p> <p>Felling of suitable, healthy host trees (e.g., elm, ash, Hop-hornbeam) located within 100 metres of a host tree reduces the amount of living substrate available for the species to disperse to.</p> <p>Removing canopy cover, through felling of trees located within 50 metres of a host tree or through significant clearing of forests (e.g., clear-cut logging) and/or other natural features (e.g., wetlands, vegetation) within 100 metres of a host tree alters the shade, wind and humidity conditions of the microhabitat required for the survival of the host trees.</p>	<p>Removal of the substrate on which the lichen is growing, either the bark on which the lichen is living or the host tree in its entirety, will directly result in the destruction of critical habitat. Effects of the removal of trees of a suitable host species upon which the lichen is not yet growing are predominantly cumulative; it would likely take repetitive occurrences to cause destruction of critical habitat. Clearing of forests or other natural features could have direct and cumulative effects; depending on their extent, a single occurrence of the activity could cause destruction of critical habitat. Clearing of forests and other natural features must occur within the bounds of critical habitat to cause its destruction. It could cause destruction of critical habitat at any time throughout the year. Although a threshold for tree harvesting could potentially be developed, it is not possible at this time due to the lack of studies on the degree of tolerance of the species to canopy cover removal.</p>
Activities that alter the hydrological regime (e.g.,	Humidity levels are a limiting factor for the species. Altering the water regime of a water body or watercourse located	If this activity occurs, it is likely to cause destruction of critical habitat. It does not have to occur within the bounds of critical

<p>alteration of surface and subsurface water flows and levels in rivers, lakes, and wetlands)</p>	<p>within 100 metres of a host tree can lower or increase the humidity conditions of the microhabitat such that the microhabitat is no longer suitable for the survival of individuals of the species.</p>	<p>habitat to cause its destruction. Effects of this activity are predominately cumulative and it is most likely to cause destruction of critical habitat if alteration results in consistently drier conditions within the forest interior either</p> <ul style="list-style-type: none"> • over an extended period of time, at any time throughout the year or; • seasonally <p>The information available at this time is insufficient to develop a threshold for this activity.</p>
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8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objective. Every five years, success of recovery strategy implementation will be measured against the following performance indicators:

1. The abundance and distribution of any extant populations located in Ontario are maintained.
2. Extant populations have the ability for natural population growth through maintenance of suitable occupied and adjacent habitat.

9. Statement on Action Plans

One or more action plans will be completed and posted on the Species at Risk Public Registry for the Pale-bellied Frost Lichen by December 2022.

10. 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](#)¹⁷. 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. Species that would benefit from these recovery planning efforts include interior forest birds and other flora and fauna that depend on interior forest such as: American

¹⁷ <http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1>

Ginseng (*Panax quinquefolius*), Butternut (*Juglans cinerea*), Cerulean Warbler (*Setophaga cerulea*), and Canada Warbler (*Cardellina canadensis*). 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 on non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below.

The potential effects on other species are discussed in section 2.3 of the provincial *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario* (Part 2), under the Supporting Narrative heading. This federal recovery strategy will clearly benefit the environment by promoting the recovery of the Pale-bellied Frost Lichen. Since the lichen requires mature to old-growth deciduous forests, any efforts to protect and appropriately manage the species' habitat will likely have positive impacts on other species of flora and fauna that require the same habitat. Retention and protection of remnant old-growth forests, as well as implementation of appropriate forest management plans on Crown and private lands in eastern Ontario will also contribute positively to deciduous forest-dwelling species. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. Because of the overall rarity of the species, any increase in abundance or range expansion is not likely to have significant impacts on other lichen species as a result of competition. Given that all lichens are dependent on an atmospheric supply of water and organic nutrients (Esseen and Renhorn 1998; Kivistö and Kuusinen 2000 cited in Lewis 2011), any improvement to environmental parameters beneficial to the species will likely benefit all lichen species in general. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the following sections of the provincial recovery document in particular: distribution, abundance and population trends (Part 2, section 1.3); threats to survival and recovery (Part 2, section 1.5); and the government-led and government-supported actions tables from the Pale-bellied Frost Lichen Ontario Government Response Statement (Part 3).

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PART 2 - *Recovery Strategy for the Pale-bellied Frost Lichen (Physconia subpallida) in Ontario*, prepared by C.L. Lewis for the Ontario Ministry of Natural Resources



Pale-bellied Frost Lichen

(Physconia subpallida) in Ontario

Ontario Recovery Strategy Series

Recovery strategy prepared under the *Endangered Species Act, 2007*

February 2011

Natural. Valued. Protected.

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the Endangered Species Act, 2007 (ESA, 2007) and the Accord for the Protection of Species at Risk in Canada.

What is recovery?

Recovery of species at risk is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

Under the ESA, 2007, a recovery strategy provides the best available scientific knowledge on what is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA, 2007 outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. There is a transition period of five years (until June 30, 2013) to develop recovery strategies for those species listed as endangered or threatened in the schedules of the ESA, 2007. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of Natural Resources Species at Risk webpage at: www.ontario.ca/speciesatrisk

RECOMMENDED CITATION

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Cette publication hautement spécialisée Recovery strategies prepared under the Endangered Species Act, 2007, n'est disponible qu'en anglais en vertu du Règlement 411/97 qui en exempte l'application de la Loi sur les services en français. Pour obtenir de l'aide en français, veuillez communiquer avec Pamela Wesley au ministère des Richesses naturelles au 705-755-5217.

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DECLARATION

The Ontario Ministry of Natural Resources has led the development of this recovery strategy for the Pale-bellied Frost Lichen in accordance with the requirements of the *Endangered Species Act, 2007* (ESA). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

The recovery strategy does not necessarily represent the views of all of the individuals who provided advice or contributed to its preparation, or the official positions of the organizations with which the individuals are associated.

The goals, objectives and recovery approaches identified in the strategy are based on the best available knowledge and are subject to revision as new information becomes available. Implementation of this strategy is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

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.

RESPONSIBLE JURISDICTIONS

Ontario Ministry of Natural Resources
Environment Canada – Canadian Wildlife Service, Ontario

EXECUTIVE SUMMARY

Pale-bellied Frost Lichen (*Physconia subpallida*) is an endangered macrolichen. This foliose lichen is most often found on Eastern Hop-hornbeam (*Ostrya virginiana*) in mature to old-growth, humid forests. Historic locations were recorded by John Macoun 100 years ago near Belleville, Brighton and Ottawa. Currently there are only three known remaining populations in Ontario of which none are considered as one of Macoun's historic records.

The recovery goal is to maintain the size and distribution of all extant and newly discovered populations of Pale-bellied Frost Lichen in Ontario, with hopes of population increases through habitat protection, and to fill in some of the identified knowledge gaps. The objectives of the recovery strategy are to:

1. Protect individuals and habitat at all known occurrences of Pale-bellied Frost Lichen.
2. Provide communication and outreach materials on Pale-bellied Frost Lichen and its recovery to relevant landowners, land managers, municipalities and planners to restrict habitat destruction at any of the known sites.
3. Inventory and map all known Pale-bellied Frost Lichen locations, populations and habitats by 2016 to provide quantitative baseline data for future monitoring, and initiate a monitoring program.
4. Conduct surveys for Pale-bellied Frost Lichen in suitable habitat.
5. Conduct research to address knowledge gaps for Pale-bellied Frost Lichen.

The recovery approaches recommended in this recovery strategy should be carried out in part or in whole by 2016.

These objectives can be achieved through research, inventory and monitoring, protection and management, as well as education and stewardship.

Edge effects, caused by forest disturbance have been shown to impact groups of common forest lichens up to a distance of 50 m. Relatively rare interior forest lichen species, reliant on old-growth forest characteristics and sensitive to microhabitat disturbance, like the Pale-bellied Frost Lichen, would potentially require greater distances to maintain their required habitats. Deep forest-interior species are found in areas that are greater than 200 m from the forest edge. It is recommended that the minimum area that should be prescribed as habitat in a habitat regulation include a 200 m radius surrounding each host tree, or colony of host trees.

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Recovery Strategy for the Pale-bellied Frost Lichen in Canada

1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Pale-bellied Frost Lichen

SCIENTIFIC NAME: *Physconia subpallida*

SARO List Classification: Endangered

SARO List History: Endangered (2010)

COSEWIC Assessment History: Endangered (2009)

SARA Schedule 1: N/A

CONSERVATION STATUS RANKINGS:

GRANK: GNR

NRANK: N1

SRANK: S1

The glossary provides definitions for the abbreviations above.

1.2 Species Description and Biology

Species Description

Pale-bellied Frost Lichen is a relatively conspicuous circular/ rosette-forming foliose macrolichen. A dense covering of white pruina, which looks like frosting, on the upper surface provides a stark contrast to this species when compared to the relatively dark substrate on which it grows (e.g., hardwood bark). Rosettes can be as little as one to two cm in diameter, although thalli are more typically found growing in the three to four cm diameter range but have also been found as large as 8 to 11 cm (Esslinger 1994).

Two growth forms of Pale-bellied Frost Lichen have been identified. The two forms are separated by the variation in the central portions of the rosette. One form has a densely lobulate center with erect cylindrical lobules (Figures 1a and 1b), and the other is an apothecate form with flattened lobules protruding from the margins or edge of the apothecia (Figure 2). Although these two forms differ in central thalline characteristics they both have flat elongated lobes 1.0 to 2.5 (up to a maximum of 3.0) mm wide extending from the center to the outer edges (Esslinger 1994). Combination apothecate- to lobate- form specimens can also be found.



Figures 1a (left) and 1b (right). Pale-bellied Frost Lichen (centrally lobulate form - arrow).



Figure 2. Pale-bellied Frost Lichen (apothecate form - arrows)

There are several distinctive characters of this species to separate it from other eastern *Physconia* species: (1) absence of isidia and soredia, (2) presence of lobulate apothecia and/or lobules with pycnidia and (3) the pale undersurface with squarrose rhizines in distinct clusters (COSEWIC in press). A similar species, “Shaggy-fringed Lichen” or *Anaptychia palmulata*, can also have an entirely pale lower surface, at least in herbarium material, but has simple to bunched rhizines rather than to squarrose rhizines. *Anaptychia palmulata* also lacks the dense pruinose covering on the apothecia and lobes (Brodo et al. 2001, COSEWIC in press). Other species of *Physconia* can also be fertile (bearing apothecia) but are not commonly produced.

Species Biology

Pale-bellied Frost Lichen is typically found growing on substrates with a high pH, an ability to retain water, and in areas with high humidity levels. In Ontario these substrates have historically included the trunk bark of American Elm (*Ulmus americana*), and ash (*Fraxinus* spp.) and old rails. Extant Ontario populations seem to be limited to the trunks of Eastern Hop-hornbeam (*Ostrya virginiana*) (Figures 3a and 3b and 4a, 4b, and 4c), also known as Hop-hornbeam or Eastern Hop-hornbeam (COSEWIC in press).



Figure 3a and 3b. Typical growth location. Figure 3b is a close-up of the black box indicated in Figure 3a.



Figure 4a, 4b and 4c. Typical growth location. Figures 4b and 4c are close-ups of the black boxes indicated in Figure 4a.

Lichens are formed by the association of a fungal component and a photosynthesising component, usually alga. The photobiont is responsible for producing food for the organism through photosynthesis (Brodo et al. 2001). Lichens reproduce using a number of strategies including sexual reproduction, which is relatively complicated and risky since the mycobiont (fungus) spore must find the photosynthetic component somewhere in the wide expanses of nature, and fragmentation, where bits of the lichen (e.g., lobules, isidia) containing both symbiotic partners break off the parent thallus. The complexities and challenges of these various strategies are discussed in Nash (1996).

Pale-bellied Frost Lichen reproduces both sexually and asexually, assuming that the lobules can function as a means of asexual reproduction. However, the species lacks soredia or isidia, and it is possible that the larger lobules are not as easily dispersed as these smaller propagules (COSEWIC in press).

No data exist that clearly show how this species disperses but lichen in general have a variety of dispersal vectors including: wind and fauna (e.g., frogs, birds, insects, mammals).

1.3 Distribution, Abundance and Population Trends

Pale-bellied Frost Lichen is currently understood to be a North American endemic species occurring only in the United States and Canada. It is known, at least historically, from Massachusetts and New Hampshire west to southern Ontario, Michigan and eastern Iowa south to central Illinois, Ohio and Virginia. A disjunct population occurs in the Ozarks region of eastern Oklahoma and northwestern Arkansas (Figure 5). Throughout its range it is quite local with large distances between populations. The vast majority of collections are pre-1973 with only four samples collected since 1973 (COSEWIC in press).

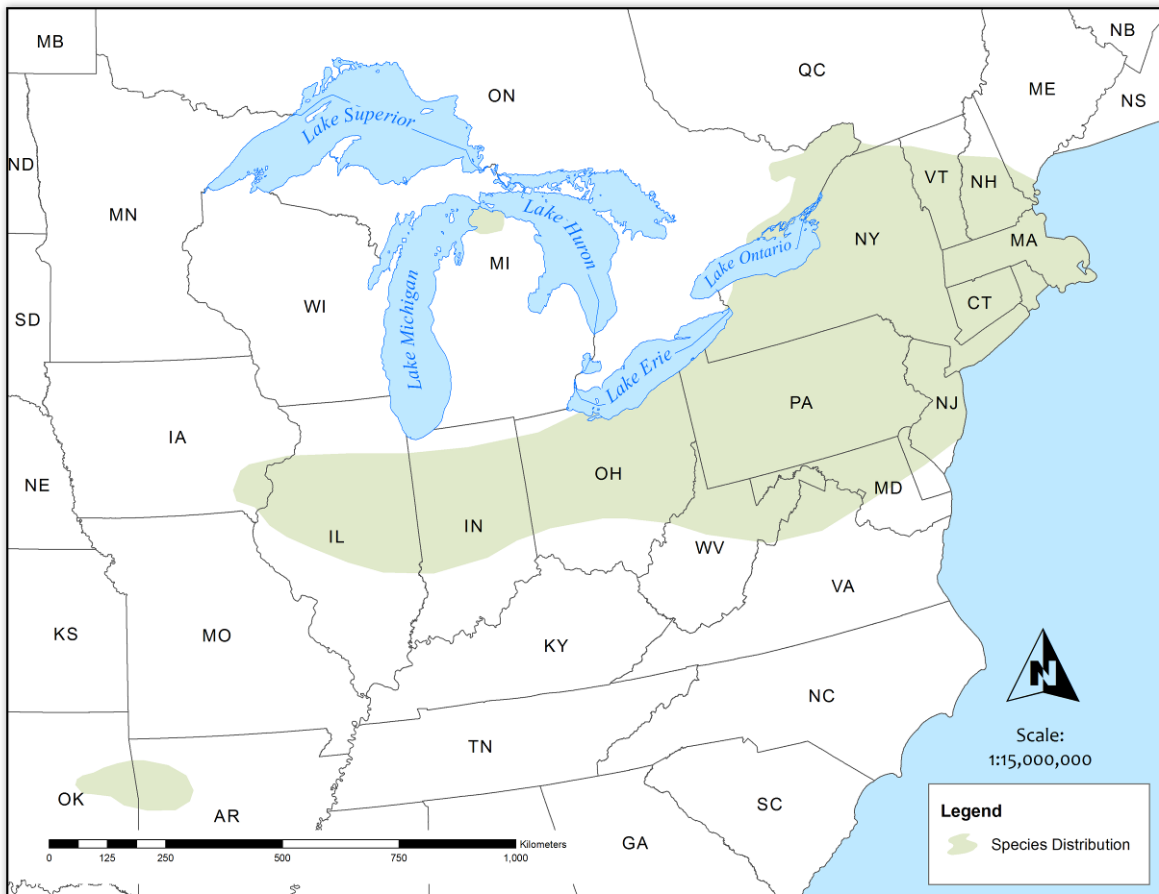


Figure 5. Distribution of Pale-bellied Frost Lichen in North America (based on COSEWIC in press)

In Canada it is known only from south-eastern Ontario: Four historic locations (Brighton, Belleville, Britannia, Ottawa) and three extant locations (Billa Lake, Lanark County; Arcol Road, Frontenac County; and Calabogie Peak, Renfrew County) (Figure 6). Surveys at historic locations and surrounding areas have not resulted in rediscovery; therefore, the Pale-bellied Frost Lichen is considered extirpated from those sites. The Billa Lake site was discovered in 2004 and the Arcol Road site was discovered in 2007.

The Calabogie Peak site was discovered in 2009, after the COSEWIC status report was completed. Even though detailed inventories and thalli counts have not been completed this new population is estimated to be the largest population of the three, with an estimated 71 individuals, 16 of which are fertile, almost doubling the entire population of the previous two localities.

Currently, the extant distribution in Ontario appears to be centered in the east portion of the province in Lanark, Renfrew and Frontenac Counties (Figure 6).

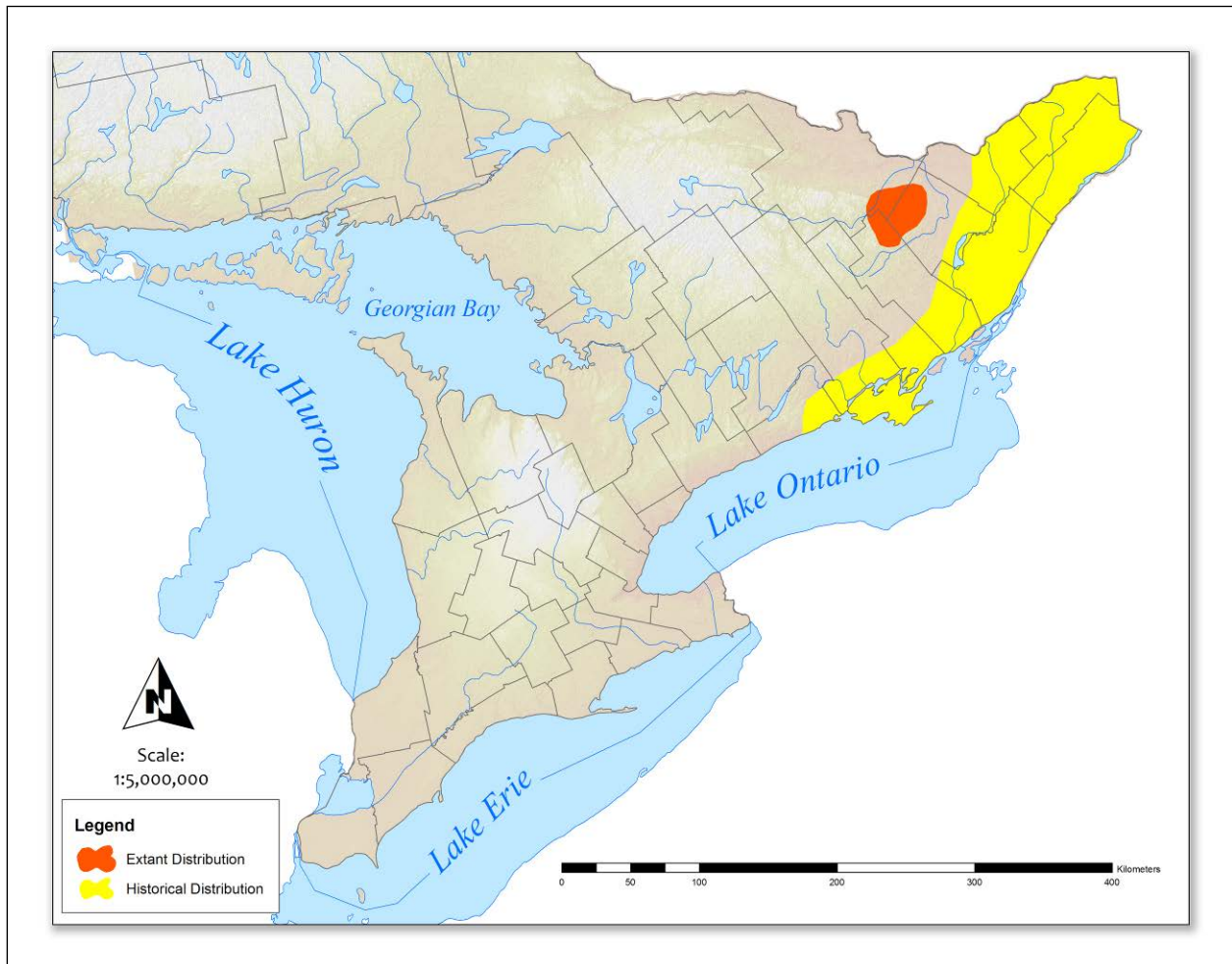


Figure 6. Historical and extant distribution of Pale-bellied Frost Lichen in Ontario (based on COSEWIC in press)

1.4 Habitat Needs

Pale bellied-Frost Lichen requires mature to old-growth deciduous forests with tree species of suitable bark pH, calcium content, and moisture holding capacity, usually thick barked Eastern Hop-hornbeam. The site requires high levels of fog or high relative humidity with moderate to high levels of shade (Figure 7). The three Ontario extant sites appear to have a suppressed or sparsely-vegetated relatively open under story

that potentially allows for air circulation (Figure 8). Host trees are most typically found on or just over the crest of a northwest, north or northeast facing forested slope with a moderate (25 to 45 degree) grade (Figures 3a, 4a, and 8) (COSEWIC in press).

High levels of humidity in forest stands are a function of several factors often working in unison. Forests with northern and eastern aspects (NW, N, NE and E) are often cooler and wetter compared to southern and western aspects (SE, S, SW and W) (Oliver and Larson, 1996). Increased levels of shade reduce evaporation rates by shielding the area from the sun's rays. The relationship of proximity to an available source of water (e.g., creek, river or lake) and required humidity levels is unknown but undoubtedly a close proximity contributes to the intensity and duration of the low altitude humidity (i.e., fog) of the three extant sites (Brodo pers. comm., Author's personal observations).

Old trees, specifically those species identified as suitable substrates, have thick rough bark allowing for increase water holding capacity and retention. The pH of the substrate is also very important (Brodo 1974).



Figure 7. A typical example of crown/canopy closure at a Pale-bellied Frost Lichen forest stand.



Figure 8. A typical example of the understory composition at a Pale-bellied Frost Lichen site.

1.5 Threats to Survival and Recovery

Most of southern Ontario's old-growth forests were destroyed by logging, forest fire or settlement between the mid 1700's and the early 1900's (Landowner Resource Center 1999). Many of the remaining forest stands in southern Ontario do not provide suitable habitat for Pale-bellied Frost Lichen since they lack interior forest characteristics. Further, many of the remaining stands lack old, thick barked elm, ash or ironwood trees that provide Pale-bellied Frost Lichen with suitable substrates to grow on (Landowner Resource Center 2000). Interior forest characteristics differ from forest edges by being cooler, less windy, humid, and exhibit ecological integrity and stability (Landowner Resource Center 2000). See the supporting narrative for an explanation of ecological integrity and stability.

Since, lichens are poikilohydric organisms (not able to regulate their uptake or loss of water) they are dependant on an atmospheric supply of water and organic nutrients from precipitation, dew, or fog(humidity) and as such, lichens are particularly sensitive to micro-climatic changes (Esseen and Renhorn, 1998, Kivistö and Kuusinen 2000). Well documented edge effects, including changes in microclimates, such as: increased wind speeds, higher radiation, larger variations in temperature, and lower humidity

levels have implications to lichen diversity especially those species dependant on interior forest habitats (Esseen and Renhorn 1998, Kivistö and Kuusinen 2000, Rheault *et al* 2003). Lichens of old-growth forests are particularly sensitive to forest fragmentation (Kivistö and Kuusinen 2000, Rheault *et al.* 2003). A study by Jørgensen (1978) showed that an old-growth dependant threatened foliose lichen Boreal Felt Lichen (*Erioderma pedicellatum*) or vanished from a single location in Sweden due to alterations to its required microclimatic conditions following a cutting of the surrounding forest.

It is difficult to determine the exact distance required for maintenance of the existing microclimates at each site, because the distance may differ for each site based on factors such as: topography, forest condition, tree age and health, soil properties, such as drainage, texture, and texture, etc. (Environment Canada 2007). That being said, edge effects have been shown to have a measurable impact on common forest lichen species up to a distance of 50m with rarer lichen species especially adapted to humid, shaded microclimates requiring more (Kivistö and Kuusinen 2000, Rheault *et al.* 2003).

Guidelines for protecting interior forest species in Southern Ontario have recommended 100 to 200 m distances from the forest edge be maintained to protect against alteration to interior microclimate characteristics (Environment Canada 2006).

The loss of interior old-growth forests, with interior microclimates, has undoubtedly resulted in the loss of forest stands available to Pale-bellied Frost Lichen. The elimination of these forests has reduced the number of forest stands that have the required high humidity and old, thick barked elm, ash or Eastern Hop-hornbeam trees.

Loss and degradation of suitable habitat continues to threaten the persistence of Pale-bellied Frost Lichen because of changes to forest structure caused by site alteration (e.g., logging operations, forest fires, urban development and aggregate extraction)."

Sulphur dioxide (SO₂) deposition has been frequently linked to reduced lichen species diversity and abundance in an ecosystem (LeBlanc and De Sloover 1970, Nash 1996, Brodo *et al.* 2001). High levels of deposition result in the suppression of photosynthesis and respiration in lichens. Effects of high levels of SO₂ are first seen in the loss of SO₂ sensitive species from an ecosystem. Pale-bellied Frost Lichen is considered relatively sensitive to SO₂ (COSEWIC in press). Although mean annual SO₂ deposition levels have decreased in the past 30 years, the elevated deposition levels prior to 1971 have undoubtedly led to the decline of Pale-bellied Frost lichen and other rare and sensitive lichen species, and have left a lasting effect on the ecosystem, resulting in a time-lagged recovery of forest ecosystems and their floral and fauna components (COSEWIC in press).

If the current climate warming trend continues, the resulting elevation of mean seasonal temperatures could result in changes to evaporation rates, relative humidity levels, and the frequency and duration of fog events that are expected to have negative impacts on

Pale-bellied Frost Lichen. It has been suggested that humidity levels lower than 50 percent may have a negative impact on Pale-bellied Frost Lichen (COSEWIC in press).

Historically Pale-bellied Frost Lichen was most often recorded growing on elm bark. The loss of American Elm trees as a result of the Dutch Elm Disease (Leadbitter et al. 2002) has reduced the amount of available substrate for Pale-bellied Frost Lichen colonization, and may provide one explanation for why the extant populations of Pale-bellied Frost Lichen now appear to be limited to growing on Eastern Hop-hornbeam bark in remnant old-growth forests.

A number of lichen species are subject to herbivory by snails and slugs (Gastropods). While no evidence has been given of snail and slug herbivory on Pale-bellied Frost Lichen, it has been documented for other lichen species in Norway, on Lungwort (*Lobaria pulmonaria*) (Vatne et al. 2010) and in Ontario on Flooded Jellyskin (*Leptogium rivulare*) (Rob Lee pers. comm. 2010). Gastropod herbivory has been shown to increase over calcareous soils (Vatne et al. 2010). Research being conducted by the lichenologist Rob Lee in the Ottawa area, studying the effects of the feeding habits of relatively recent invasions and population boom, of non-native slugs (*Arion sp.*), has concluded that the impacts of these slug species are a legitimate cause for concern to lichen populations where these slugs are known to exist.

The outer bark of Eastern Hop-hornbeam is loosely attached and easily sloughs off as the tree ages. Physical removal of the bark, during forestry operations or recreational activities (e.g., hiking, skiing, and/or biking), could result in the removal of bark with Pale-bellied Frost Lichen growing on it. Repetitive bark removal, with the lichen directly on it at any of the sites, could severely reduce or eliminate the population. Repetitive removal of lichenized or non-lichenized bark from the host trees, or suitable habitat trees, could result in the trees becoming susceptible to disease; reduce the likelihood of colonization/population expansion, or potentially resulting in tree mortality.

Alterations to hydrological regimes may also have an impact to Pale-bellied Frost Lichen sites. A reduction in duration or intensity of hydrological periods could result in reduced humidity levels rendering the site unsuitable for retention or colonization.

1.6 Knowledge Gaps

Given the small and inconspicuous nature of the species, the knowledge required in finding and identifying it, and the relatively small (but growing) number of persons in Ontario who make a practice of recording lichen occurrences, it is not surprising that there are major gaps in our knowledge of the distribution of the Pale-bellied Frost Lichen, even within the three forests where it is known to be extant.

Historical accounts of Pale-bellied Frost lichen, especially in Ontario, provide little specific information. Vague collection labels make relocating historic sites and inferring historical habitat needs a challenge (e.g., “Brighton” or “Belleville”, “on trunks and rocks”

or “on old rails and trees”),). Therefore, the habitat requirements have been determined by examining the three extant locations, although they represent a relatively small sample size.

Even though historic information is not clear, a relatively large amount of suitable habitat has been surveyed over the past century by qualified lichenologists, yielding only a few new locations. The complete distribution pattern of the species in Ontario, and the reasons for this pattern, are therefore important knowledge gaps. Additional inventory work might find more locations, but the species is clearly not widespread in Ontario, suggesting a habitat specialization that is not clearly understood.

Thus, the specific biology and ecology of the Pale-bellied Frost Lichen is not well understood. Knowledge gaps include: detailed information on its lifespan, growth rate, life history, physiology, dispersal, genetic diversity, population dynamics, minimum viable population size, reaction to translocation in suitable habitats, reaction to ecological disturbance (e.g., various timber harvest methods and intensity), and sensitivity to air pollutants and acid deposition. Dispersal is of particular interest as the species is found in a limited number of locations. The potential role of succession, competition from mosses and other lichens, and susceptibility to herbivores (i.e., snails and slugs) are also knowledge gaps.

1.7 Recovery Actions Completed or Underway

To date several recovery activities specifically related to Pale-bellied Frost Lichen have been undertaken; all of which have focused on inventory, monitoring and outreach.

Several species-at-risk biologists working for the Ministry of Natural Resources (MNR) have been given presentations on rare lichens found in their district, or adjacent districts, with an emphasis on Pale-bellied Frost Lichen. The biologists were provided with photographs of the species and descriptions of the locations and habitat (by Lewis and Lee in 2009-2010 - Bancroft, Kemptonville and Pembroke Districts).

The Calabogie Mountain site is on private land. The landowners were notified, by a private consultant in 2009, that Pale-bellied Frost Lichen is located on their property.

Since the preparation of the COSEWIC status report (In press) in 2007, additional surveys in southern Ontario have been completed by qualified lichenologists (i.e., Rob Lee, Irwin Brodo and Chris Lewis).

In 2010, Lewis and Lee provided the MNR Natural Heritage Information Center (NHIC) with updated (i.e., 2007-2010) element occurrence (EO) data of all three extant sites in Ontario.

A few websites featuring Pale-bellied Frost Lichen are now available on the Internet, including national and provincial species at risk websites and a few private websites providing education to the general public (2009).

2.0 RECOVERY

2.1 Recovery Goal

Pale-bellied Frost Lichen has never been overly abundant in Ontario. The recovery goal is to maintain the size and distribution of all extant and newly discovered populations of Pale-bellied Frost Lichen in Ontario, with hopes of population increases through habitat protection, and to fill in some of the identified knowledge gaps.

2.2 Protection and Recovery Objectives

The protection and recovery objectives are listed in order of priority in Table 1 below.

Table 1. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Protect individuals and habitat at all known occurrences of Pale-bellied Frost Lichen. Incorporate specific protection into relevant municipal Official Plans, forestry management plans, and/or future development plans.
2	Provide communication and outreach to the landowners, municipalities, and planners.
3	Inventory and map all known Pale-bellied Frost Lichen locations, populations and habitats by 2015 to provide a quantitative baseline for future monitoring and initiate a monitoring program.
4	Conduct additional inventory for Pale-bellied Frost Lichen in suitable habitats.
5	Conduct research to address knowledge gaps for Pale-bellied Frost Lichen.

2.3 Approaches to Recovery

Table 2. Approaches to recovery of the Pale-bellied Frost Lichen in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
1. Protect individuals and habitat at all known occurrences of Pale-bellied Frost Lichen. Incorporate specific protection into relevant municipal Official Plans, forestry management plans, and/or future development plans.				
Critical	Short-term	Protection	1.1 Develop and enforce a habitat regulation for Pale-bellied Frost Lichen under the ESA.	▪ Habitat loss or degradation
Critical	Short-term	Protection	1.2 Review Crown forest management plans in or near areas occupied by Pale-bellied Frost Lichen populations occur to ensure species and habitat protection.	▪ Habitat loss or degradation
Critical	Short-term	Protection	1.3 In or near areas occupied by Pale-bellied Frost Lichen populations, review current management plans and practices, municipal official plans, and development proposals, to ensure species and habitat protection.	▪ Habitat loss or degradation
Beneficial	Long-term	Protection, Outreach, Stewardship	1.4 Develop stewardship/management plans for lands with known populations.	▪ Habitat loss or degradation
2. Provide communication and outreach to the landowners, municipalities, and planners.				
Necessary	Short-term	Communications and or Stewardship	2.1 Communicate with crown and private land managers. <ul style="list-style-type: none"> - Review zoning and development plans. - Provide relevant recovery and protection information. - Discuss management and recovery options. - Provide species descriptions and habitat requirements. - Provide identification training workshops. 	▪ Habitat loss or degradation

Recovery Strategy for the Pale-bellied Frost Lichen in Canada

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
3. Inventory and map all known Pale-bellied Frost Lichen locations, populations and habitats by 2015 to provide a quantitative baseline for future monitoring and initiate a monitoring program.				
Critical	Short-term	Inventory, Monitoring and Assessment	3.1 Conduct detailed mapping and quantitative census of known populations. <ul style="list-style-type: none"> - Conduct GIS based mapping at all known sites. - Accurately quantify the amount of Pale-bellied Frost Lichen at each site. - Carry out detailed inventories of associated lichen and other habitat indicator species.. 	<ul style="list-style-type: none"> ▪ Lack of detailed census and site mapping ▪ Lack of information on suitable habitat ▪ Lack of information about extent of suitable habitat
Beneficial	Short-term	Monitoring and Assessment	3.2 Implement a long-term monitoring program to assess population trends.	<ul style="list-style-type: none"> ▪ Provide information on response to degradation of habitat ▪ Provide information on response to climate change ▪ Provide information on response to sulphur dioxide deposition ▪ Provide information on response to gastropod herbivory ▪ Provide information on growth rates, population viability and dispersal

Recovery Strategy for the Pale-bellied Frost Lichen in Canada

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
4. Conduct additional inventory for Pale-bellied Frost Lichen in suitable habitats.				
Necessary	ongoing	Inventory	4.1 Conduct surveys for Pale-bellied Frost Lichen prioritized by un-verified historic locations, other sites adjacent to the currently known forest stands, and other suitable forests. All suitable sites resulting in no new Pale-bellied Frost Lichen being found should also be documented, providing a record of search effort. Report any new occurrences to NHIC.	<ul style="list-style-type: none"> Unknown distribution
5. Conduct research to address knowledge gaps for Pale-bellied Frost Lichen.				
Critical	Long-term	Research	5.1 Investigate the sensitivity of Pale-bellied Frost Lichen to various habitat features to determine which are important for survival and to prioritize threats (e.g., pH, Ca, humidity).	<ul style="list-style-type: none"> Help to understand habitat requirements and life history
Necessary	Long-term	Research	5.2 Determine forest age and stand characteristics (e.g., canopy closure, humidity, substrate availability) at each known site.	<ul style="list-style-type: none"> Help to understand habitat requirements and life history
Necessary	Long-term	Research	5.3 Identify the potential role of succession, competition from mosses and other lichens, and susceptibility to herbivores (i.e., snails and slugs).	<ul style="list-style-type: none"> Help to understand habitat requirements and life history

Supporting Narrative

The proposed approaches to recovery procedures emphasize habitat protection. Pale-bellied Frost Lichen is largely dependant on forest stands that have maintained ecological integrity and continuity (both temporal and spatial). In this instance maintenance of ecological integrity and stability refers to a forest ecosystem that is not subject to anthropogenic disturbances; with anthropogenic disturbances being identified as a human-induced discrete events in time or space that unnaturally change the physical (biotic or abiotic) conditions of that ecosystem. While some forest organisms are resilient to forest disturbance, and some natural disturbances are normal (e.g., wind throws, forest fires), Pale-bellied Frost Lichen is reliant on established stable ecosystems and is sensitive to disturbance. As such, it is recommended that the protection of suitable forest stands, by prohibiting anthropogenic disturbance, is implemented to maintain suitable habitat for this species.

Other species that could benefit from the habitat protection for Pale-bellied Frost Lichen habitat protection under the ESA could include: American Ginseng (*Panax quinquefolius*), Butternut (*Juglans cinerea*), interior forest birds and other flora and fauna dependant on interior forests.

The recommended measures should permit natural forest succession processes to proceed unimpeded by human activity. Implementation of the recovery strategy could yield positive environmental benefits due to retention of remnant old-growth forests, improved understanding of the ecology of lichens and lichen communities in southern Ontario, and the recovery of Pale-bellied Frost Lichen.

Recovery of Pale-bellied Frost Lichen would depend upon appropriate habitat management at both the site and landscape level. The required habitat would first have to be identified and mapped at the site level and protected by a combination of management actions, stewardship initiatives and legal tools. Any shortcomings would need to be addressed appropriately.

All Ontario landowners and land managers with extant populations of Pale-bellied Frost Lichen are aware of the presence of the species due to previous survey efforts. Continued cooperation of landowners and land managers of existing, expanding or newly discovered populations is essential to this species' recovery. Stewardship efforts could include developing voluntary stewardship agreements, increasing landowner awareness of the federal government's Ecological Gifts Program (EGP) and Habitat Stewardship Program (HSP), conservation easements and other stewardship programs.

A reliable, repeatable and long-term monitoring protocol should be developed and implemented to measure the abundance and distribution of Pale-bellied Frost Lichen at extant sites. Baseline data should be established for accurate comparisons and trend establishment. A protocol is also required for monitoring anthropogenic and natural threats to Pale-bellied Frost Lichen populations and habitat in order to assess the effectiveness of management actions. Landscape and site-level habitat variables, such

as the stand age, humidity levels, canopy closure, etc. should be monitored to help understand the species' biology and guide recovery.

Surveys in suitable habitat adjacent to known sites should be conducted in conjunction with monitoring of existing populations to determine if there is any successful dispersal.

Education should raise the profile of Pale-bellied Frost Lichen and its old-growth habitat to garner support for its protection on public lands. Training workshops should teach landowners, managers and other interested stakeholders survey techniques for identifying Pale-bellied Frost Lichen and potential habitat that will support its protection and potentially the identification of new populations. Public education should also be used to increase awareness of very broad-scale threats such as acid rain and climate change that may indirectly affect Pale-bellied Frost Lichen.

A research program should be developed, prioritized and initiated to address information gaps in order to guide recovery actions, particularly with respect to dispersal, population dynamics and habitat requirements. Once more is known about its ecology, the potential for translocation of Pale-bellied Frost Lichen into unoccupied suitable habitat should be evaluated. Even though attempts to translocate the Golden hair lichen (*Teloschistes flavicans*), a threatened lichen species in the United Kingdom, into what was thought to be suitable habitat, have not been very successful research into translocation of Pale-bellied Frost lichen may prove to be a viable option.

2.4 Performance Measures

Success of the recovery goal and objectives should be measured through demographic data on Pale-bellied Frost Lichen populations, habitat attributes and involvement of landowners and land managers in recovery efforts. Recovery can be considered successful if the following performance measures have been met:

Recovery Objective 1:

- Protection of Pale-bellied Frost Lichen and its habitat at known sites is incorporated into all relevant planning documents and management plans.
- Stewardship agreements are in place for all known sites on private lands.
- All occupied habitat is identified, mapped and protected.

Recovery Objective 2:

- Education materials, a communication strategy and training have been developed and delivered to landowners, land managers, the public and other stakeholders for all known sites.

Recovery Objective 3:

- Establishment of a qualitative population census baseline.
- Surveys at any newly discovered and historical sites have been conducted, with any new populations incorporated into recovery efforts, and all surveyed areas

documented. All new distribution data submitted to the Ontario Natural Heritage Information Centre in a timely manner.

- Using knowledge of habitat requirements implement targeted surveys for Pale-bellied Frost Lichen.
- GIS modelling could be implemented to focus the search effort

Recovery Objective 4:

- Using knowledge of habitat requirements implement targeted surveys for Pale-bellied Frost Lichen.

Recovery Objective 5:

- Research into Pale-bellied Frost Lichen biology and ecology, particularly relating to dispersal, population dynamics and habitat requirements, has been initiated and results have been incorporated into recovery efforts.
- Based upon the findings of other research, the feasibility of introduction of Pale-bellied Frost Lichen into unoccupied suitable habitat has been evaluated.
- A prioritized list of outstanding research topics has been developed.

2.5 Area for Consideration in Developing a Habitat Regulation

Under the ESA, a recovery strategy must include a recommendation to the Minister of Natural Resources on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below by the author will be one of many sources considered by the Minister when developing the habitat regulation for this species.

Due to the limited known distribution of the Pale-bellied Frost Lichen in Ontario, and until such time as it can be determined if, in fact, the species is restricted to just the three known forest stands, it is recommended that the area prescribed as habitat in the habitat regulation include only the locations where the species is known to occur.

Each location is described below:

1. “Billa Lake”/Darling Long Lake: Old-growth forests located at the east end of Darling Long Lake on the south shore Lot 18, 19 Con 7 Darling Township;
2. Arcol Road: Forest on Arcol Road, 1.5 to 2.7 km north from intersection of North Shore Estates Lane on the north shore of Canonto Lake Lot 19, 20 South Canonto Township; and
3. “Calabogie Peak” 5.4 km West of the Town of Calabogie: Old-growth forest 40 m southwest of the terminus/cul-de-sac of Mary Joanne Drive extending 1000 m southeast along the slope ridge to a point 130 m northwest of the intersection of Beaches Lane and Barrett Chutes Road. Con 3 Lots 16, 17, 18, 19 and Con 2 Lots 17, 18, 19 Blithfield Township.

Edge effects caused by forest disturbance have been shown to impact groups of common forest lichens up to a distance of 50 m (Esseen and Renhorn 1998, Rheault et al. 2003). Relatively rare interior forest lichen species that are reliant on old-growth forest characteristics and sensitive to microhabitat disturbance, like the Pale-bellied Frost Lichen, would potentially require greater distances to maintain their required habitats (Environment Canada 2007).

The Canadian Wildlife Service (2006) has shown that deep forest-interior species, species that are most sensitive to edge effects, are only found to inhabit areas that are at least 200 m from the forest edge. An initial buffer of 100 m could be used to protect the habitat from edge effects while a second 100 m buffer would maintain deep interior forest suitable for edge intolerant species.

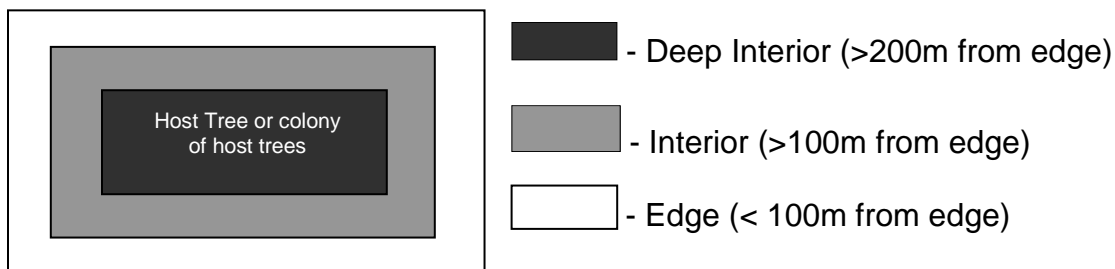


Figure 9. Schematic of habitat regulation recommendation for Pale-bellied Frost Lichen.

Based on these findings it is recommended that the minimum area that should be prescribed as habitat in a habitat regulation for Pale-bellied Frost Lichen, include a 200 m radius surrounding each host tree, or colony of host trees.

GLOSSARY*

Anthropogenic: effects, processes, or materials are those that are derived from human activities, as opposed to those occurring in biophysical environments without human influence.

Apothecium (pl. Apothecia): Disk shape or cup-shaped fruiting bodies of a lichen containing spore-filled sacs (asci)

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee responsible for assessing and classifying species at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO): The committee established under section 3 of the *Endangered Species Act, 2007* that is responsible for assessing and classifying species at risk in Ontario.

Conservation status rank: A rank assigned to a species or ecological community that primarily conveys the degree of rarity of the species or community at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by the letter G, N or S reflecting the appropriate geographic scale of the assessment. The numbers mean the following:

- 1 = critically imperilled
- 2 = imperilled
- 3 = vulnerable
- 4 = apparently secure
- 5 = secure
- NR = not yet ranked

Ecological Unit: Populations of organisms considered together with their physical environment and the interacting process amongst them.

***Endangered Species Act, 2007* (ESA):** The provincial legislation that provides protection to species at risk in Ontario.

Foliose Lichen: A type of lichen characterised by a dorsiventral leaf-like thallus with the lower surface largely free from the substrate, at least in part, and the upper surface different in some way from the lower surface.

Isidia: small growths on the upper cortex functioning as vegetative propagules, always covered with a cortex, can take on several forms (i.e. cylindrical, granular, globose, etc.).

Lobule (Lobulate): In reference to isidia resembling small lobes, or in reference to foliose lichen that have small lobes.

Macrolichen: Lichen species that are not crustose.

Propagule: a structure for reproductive dispersal, either sexual (e.g. ascospore) or asexual (vegetative; e.g. soredium).

Pruina: A fine, white, powder-like covering on the upper cortex or on the disk of apothecia.

Squarrose: branching at right angles (e.g. the short side branches of certain rhizines).

Species at Risk Act (SARA): The federal legislation that provides protection to species at risk in Canada. This act establishes Schedule 1 as the legal list of wildlife species at risk to which the SARA provisions apply. Schedules 2 and 3 contain lists of species that at the time the act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

Species at Risk in Ontario (SARO) List: The regulation made under section 7 of the *Endangered Species Act, 2007* that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

Soredium (pl. soredia): a vegetative dispersal unit consisting of a few algal cells surrounded by hyphae but not covered with a cortex.

Thallus (Thalli): the vegetative body of a lichen, consisting of both fungus and an alga.

** For additional technical lichen term definitions refer to Brodo et al. 2001.*

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**PART 3 - *Pale-bellied Frost Lichen* Ontario Government
Response Statement, prepared by the Ontario Ministry of
Natural Resources**

Pale-bellied Frost Lichen

Ontario Government Response Statement



Photo: Chris Lewis

PROTECTING AND RECOVERING SPECIES AT RISK IN ONTARIO

Species at risk recovery is a key part of protecting Ontario's biodiversity. Biodiversity – the variety of living organisms on Earth – provides us with clean air and water, food, fibre, medicine and other resources that we need to survive.

The *Endangered Species Act, 2007* (ESA) is the Government of Ontario's legislative commitment to protecting and recovering species at risk and their habitats. As soon as a species is listed as extirpated, endangered or threatened under the ESA, it is automatically protected from harm or harassment. Also, immediately upon listing, the habitats of endangered and threatened species are protected from damage or destruction.

Under the ESA, the Ministry of Natural Resources (the Ministry) must ensure that a recovery strategy is prepared for each species that is listed as endangered or threatened. A recovery strategy provides science-based advice to government on what is required to achieve recovery of a species.

GOVERNMENT RESPONSE STATEMENTS

Within nine months after a recovery strategy is prepared, the ESA requires the Ministry to publish a statement summarizing the government's intended actions and priorities in response to the recovery strategy. The recovery strategy for Pale-bellied Frost Lichen was completed on February 18, 2011 (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/STDPROD_075652.html).

The response statement is the government's policy response to the scientific advice provided in the recovery strategy. In addition to the strategy, input on the response statement was requested from stakeholders, other jurisdictions, Aboriginal communities and members of the public. The statement reflects the best available traditional, local and scientific knowledge at this time and may be adapted if new information becomes available. In implementing the actions in the response statement, the ESA allows the Ministry to determine what is feasible, taking into account social and economic factors.

Pale-bellied Frost Lichen is a macrolichen that was named for its pale underside and its bright white crust-like growth, which resembles a dusting of frost, present on its upper surface. It is found growing on trees.

MOVING FORWARD TO PROTECT AND RECOVER PALE-BELLIED FROST LICHEN

The Pale-bellied Frost Lichen is listed as an endangered species under the ESA, which protects both the species and its habitat. The ESA prohibits harm or harassment of the species and damage or destruction of its habitat without authorization. Such authorization would require that conditions established by the Ministry be met.

In Ontario, the Pale-bellied Frost Lichen is currently known in only four locations in Frontenac, Lanark and Renfrew counties and has never been overly abundant in the province. The primary threats to the species are loss and degradation of suitable interior forest habitat and sulphur dioxide deposition.

The government's goal for the recovery of the Pale-bellied Frost Lichen is to ensure the persistence of the size and distribution of all existing populations of the species in Ontario and to allow for natural population growth through maintenance of suitable occupied and adjacent habitat.

Protecting and recovering species at risk is a shared responsibility. No single agency or organization has the knowledge, authority or financial resources to protect and recover all of Ontario's species at risk. Successful recovery requires inter-governmental co-operation and the involvement of many individuals, organizations and communities.

In developing the government response statement, the Ministry considered what actions are feasible for the government to lead directly and what actions are feasible for the government to support its conservation partners to undertake.

GOVERNMENT-LED ACTIONS

To help protect and recover the Pale-bellied Frost Lichen, the government will directly undertake the following actions:

- Educate other agencies and authorities involved in planning and environmental assessment processes on the protection requirements under the ESA.
- Encourage the submission of Pale-bellied Frost Lichen observation data to the Ministry's central repository at the Natural Heritage Information Centre.
- Undertake communications and outreach to increase public awareness of species at risk in Ontario.
- Protect the Pale-bellied Frost Lichen and its habitat through the ESA. Develop and enforce a regulation identifying the specific habitat of the species.

- Support conservation, agency, municipal and industry partners to undertake activities to protect and recover the Pale-bellied Frost Lichen. Support will be provided through funding, agreements, permits (including conditions) and advisory services.
- Establish and communicate annual priority actions for government support across multiple species in order to encourage collaboration and reduce duplication of efforts.

GOVERNMENT-SUPPORTED ACTIONS

The government endorses the following actions as being necessary for the protection and recovery of the Pale-bellied Frost Lichen. Actions identified as “high” will be given priority consideration for funding or for authorizations under the ESA. The government will focus its support on these high-priority actions over the next five years.

<p>Focus Area: Protection and Management Objective: Protect individuals and habitat at all known locations of Pale-bellied Frost Lichen.</p>	<p>Actions:</p> <ol style="list-style-type: none"> 1. (HIGH) Review management practices in or near areas occupied by Pale-bellied Frost Lichen populations and refine and implement approaches as necessary to ensure species and habitat protection.
<p>Focus Area: Inventory and Monitoring Objective: Determine the distribution, abundance, and population trends of Pale-bellied Frost Lichen.</p>	<p>Actions:</p> <ol style="list-style-type: none"> 2. (HIGH) Conduct quantitative census of known populations of Pale-bellied Frost Lichen. 3. Implement a long-term monitoring program to assess population trends. 4. Conduct surveys to find Pale-bellied Frost Lichen at sites adjacent to the currently occupied forest stands, at historic locations and in suitable habitat within the species range.
<p>Focus Area: Research Objective: Conduct research to address knowledge gaps for Pale-bellied Frost Lichen.</p>	<p>Actions:</p> <ol style="list-style-type: none"> 5. Determine forest stand characteristics at each site and the sensitivity of Pale-bellied Frost Lichen to these habitat features to assess which are the most important for survival. 6. Identify the potential significance of threats including succession, competition from mosses and other lichens, and susceptibility to herbivores (e.g. snails and slugs).
<p>Focus Area: Awareness Objective: Increase awareness of landowners, municipalities, and planners through communication and outreach.</p>	<p>Actions:</p> <ol style="list-style-type: none"> 7. Increase the awareness of landowners, municipalities, and planners of the protection of Pale-bellied Frost Lichen and its habitat.

IMPLEMENTING ACTIONS

Financial support for the implementation of actions may be available through the Species at Risk Stewardship Fund, Species at Risk Farm Incentive Program or Community Fisheries and Wildlife Involvement Program. Conservation partners are encouraged to discuss project proposals related to the actions in this response statement with the Ministry. The Ministry can also advise if any authorizations under the ESA or other legislation may be required to undertake the project.

Implementation of the actions may be subject to changing priorities across the multitude of species at risk, available resources and the capacity of partners to undertake recovery activities. Where appropriate, the implementation of actions for multiple species will be co-ordinated across government response statements.

REVIEWING PROGRESS

The ESA requires the Ministry to conduct a review of progress towards protecting and recovering a species not later than five years from the publication of this response statement. The review will help identify if adjustments are needed to achieve the protection and recovery of the Pale-bellied Frost Lichen.

ACKNOWLEDGEMENT

We would like to thank all those who participated in the development of the "Recovery Strategy for the Pale-bellied Frost Lichen in Ontario" for their dedication to protecting and recovering species at risk.

For additional information:

Visit the species at risk website at
ontario.ca/speciesatrisk

Contact your MNR district office

Contact the Natural Resources Information Centre

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