PROPOSED

Species at Risk Act
Recovery Strategy Series
Adopted under Section 44 of SARA

Recovery Strategy for the Large Whorled Pogonia (*Isotria verticillata*) in Canada

Large Whorled Pogonia

2016

Government of Canada
Gouvernement du Canada
Canada

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For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

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RECOVERY STRATEGY FOR THE LARGE WHORLED POGONIA (*Isotria verticillata*) IN CANADA

2016

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 Large Whorled Pogonia (*Isotria verticillata*) in Ontario* (Part 2) and the *Large Whorled Pogonia – Ontario Government Response Statement*[2] (Part 3) under Section 44 of the *Species at Risk Act* (SARA). Environment Canada has included an federal addition (Part 1) which completes the SARA requirements for this recovery strategy.

The federal recovery strategy for the Large Whorled Pogonia in Canada consists of three parts:

Part 1 – Federal Addition to the *Recovery Strategy for the Large Whorled Pogonia (*Isotria verticillata*) in Ontario*, prepared by Environment Canada.

Part 2 – *Recovery Strategy for the Large Whorled Pogonia (*Isotria verticillata*) in Ontario*, prepared for the Ontario Ministry of Natural Resources[3].

Part 3 – *Large Whorled Pogonia – Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources.

[2] The 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 3 – *Large Whorled Pogonia – Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources.

Part 1 – Federal Addition to the *Recovery Strategy for the Large Whorled Pogonia (*Isotria verticillata*) 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 five years after the publication of the final document on the SAR Public Registry.

The Minister of the Environment is the competent minister under SARA for the Large Whorled Pogonia and has 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 Large Whorled Pogonia (Part 2) in cooperation with Environment Canada. The Province of Ontario also led the development of the attached Government response (Part 3), which is the Ontario Government's policy response to its provincial recovery strategy and summarizes the prioritized actions that the Ontario Government intends to take and support.

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

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

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When the recovery strategy identifies critical habitat, there may be future regulatory implications, depending on where the critical habitat is identified. SARA requires that critical habitat identified within federal protected areas be described in the *Canada Gazette*, after which prohibitions against its destruction will apply. For critical habitat located on federal lands outside of federal protected areas, the Minister of the Environment must either make a statement on existing legal protection or make an order so that the prohibition against

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

destruction of critical habitat applies. For critical habitat located on non-federal lands, if the Minister of the Environment forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, and not effectively protected by the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to extend the prohibition against destruction of critical habitat to that portion. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

Acknowledgements

The initial draft of the federal addition was prepared by Holly Bickerton (Consulting Ecologist, Ottawa). Assistance from Judith Jones (Winter Spider Eco-consulting) is gratefully acknowledged. Additional preparation and review of the document was completed by Angela McConnell, Lauren Strybos, Justine Mannion and Krista Holmes (Environment Canada, Canadian Wildlife Service – Ontario) and Lee Voisin (formerly Environment Canada, Canadian Wildlife Service – Ontario). Rachel DeCatanzaro, Lesley Dunn, Véronique Brondex (Environment Canada, Canadian Wildlife Service – Ontario), Vivian Brownell, Aileen Wheeldon, Alikhan Tamachi, Eric Snyder, Jay Fitzsimmons, Kim Taylor and Michael J. Oldham (Ontario Ministry of Natural Resources and Forestry) reviewed and provided comments and advice during the development of this document.

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, landowners, 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 Large Whorled Pogonia (*Isotria verticillata*) in Ontario* (Part 2) and to provide updates or additional information.

Environment Canada is adopting the provincial recovery strategy (Part 2) with the exception of section 2, Recovery. In place of section 2, Environment Canada has established its own population and distribution objectives that are consistent with the provincial recovery goal, and is adopting government-led and government-supported actions and the recovery goal of the *Large Whorled Pogonia – Ontario Government Response Statement*[5] (Part 3) as broad strategies and general approaches to meet the population and distribution objectives.

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.

[5] The 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.

1. COSEWIC* Species Assessment Information

Date of Assessment: November 2011

Common Name: Large Whorled Pogonia

Scientific Name: *Isotria verticillata*

COSEWIC Status: Endangered

Reason for Designation:
This orchid is known historically from only 3 sites in Ontario, but it has not been seen since 1996 despite searches at two of the three previously known sites. The species requires rich, deciduous or mixed, moist forest on sandy soil with abundant humus; this habitat continues to decline in quality due to trampling and exotic plants and earthworms. It is possible that this species may still be extant in Canada since many orchids are known to have long dormancy periods and often occur in very low numbers.

Canadian Occurrence: Ontario

COSEWIC Status History: Designated Endangered in April 1986. Status re-examined and confirmed Endangered in April 1998, May 2000, and in November 2011.

*COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

2. Species Status Information

The Large Whorled Pogonia (*Isotria verticillata*) is a perennial orchid that occurs widely across eastern North America from Michigan and southwestern Ontario, across New England to Maine, and south to Georgia and Texas (White 1998). The Large Whorled Pogonia has a global conservation rank of secure[6] (G5). In Canada and Ontario, the species is ranked as critically imperilled (N1 and S1 respectively). It is considered secure (N5) in the United States, although it is considered to be of conservation concern (S1-S3, or SX) in 18 of the 31 states in which it occurs (NatureServe 2014; Appendix A). In Canada, the Large Whorled Pogonia is listed as Endangered[7] on Schedule 1 of the federal *Species at Risk Act* (SARA). In Ontario, it is listed as Endangered[8] under the *Endangered Species Act*, *2007* (ESA 2007).

It has never been known to be common in Canada, reported from only four locations all in southwestern Ontario. Two of these locations are presumed extant, one is possibly

[6] Definitions of conservation ranks can be found in Appendix A.
[7] A wildlife species facing imminent extirpation or extinction in Canada.
[8] A species that lives in the wild in Ontario but is facing imminent extinction or extirpation.

extant, and one is considered to be extirpated, although the last recorded observation of the species in Canada was in 1996. Less than one percent of the species' global range occurs in Canada (Jones et al. 2012).

3. Recovery Feasibility Summary

Based on the following four criteria that Environment Canada uses to establish recovery feasibility, there are unknowns regarding the feasibility of recovery of the Large Whorled Pogonia. In keeping with the precautionary principle, a recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be feasible. This recovery strategy addresses the unknowns surrounding the feasibility of recovery.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

Unknown. Despite searches since then, the last observation of a single Large Whorled Pogonia in Canada occurred in 1996. This species can remain dormant underground for long periods of time, though the maximum dormancy period of this species remains unknown (Hill 2007). Presuming the three populations still exist, they are likely very small (i.e., fewer than 20 plants have been counted at each site over many years, with a majority of them vegetative[9]; Jones et al. 2012). Successful reproduction may also be limited, since elsewhere in its range, only a small percentage of the population normally flower in any given year (Hill 2007) and mature plants in this species typically produce few mature capsules (Mehrhoff 1983). Although orchids produce abundant small and mobile seeds, it is not clear whether recruitment would be sufficient to sustain the extremely small Canadian population. Large Whorled Pogonia is uncommon to rare in nearby American states (NatureServe 2014; Hill 2007) and it is unlikely that this species could be successfully introduced (or re-introduced) from other populations to suitable sites in Canada. Research into propagation techniques is underway in the U.S.; however, no examples of successful propagation from seed or by transplant have been reported (Brumback and Fyler 1996; Hill 2007; Wingham pers. comm. 2015). Propagation of many orchids from seed is difficult due to their requirement for specific mycorrhizal fungi and these relationships with Large Whorled Pogonia need to be better understood. It is also unclear whether propagated stock from other areas within the species' North American range would be adapted to local conditions.

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

Unknown. This orchid has been reported from only four areas in southwestern Ontario, and it is not known whether sufficient habitat exists within its Canadian range to support

[9] Not flowering or fruiting (i.e., existing only in a vegetative and non-reproductive condition rather than in a reproductive condition).

a viable population over the long-term. Large Whorled Pogonia prefers moist deciduous or mixed forest with sandy, acidic soils (pH between 4.2 and 5.1) and much of this habitat has been lost due to ongoing severe fragmentation and clearing of forests for development in southwestern Ontario (Jones et al. 2012). Like most other orchids, Large Whorled Pogonia also requires the presence of mycorrhizal fungi to provide nutrients throughout its life cycle (Hill 2007). The presence of suitable fungi is an essential component of suitable habitat; where they are absent, the orchid cannot be sustained. In general, the distribution and abundance of mycorrhizal fungi are poorly understood. The species of mycorrhizal fungi associated with Large Whorled Pogonia is currently unknown, however, samples obtained by the North American Orchid Conservation Center have found Large Whorled Pogonia to be associated with fungi in the genus *Tulasnella* (Wingham pers. comm. 2015).

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

Unknown. The primary observed threats to the species are habitat loss, fragmentation and isolation, and the risk of extirpation due to natural processes. Potential threats include atmospheric pollutants as well as exotic and invasive species, including non-native earthworms and possibly invasive plants such as Garlic Mustard (*Alliaria petiolata*) which may alter soil conditions and reduce the availability of the mycorrhizal fungi that the species requires to survive (Jones et al. 2012). While habitat loss and fragmentation can be mitigated to some extent through habitat protection, management and stewardship, other threats are very difficult to avoid or mitigate. For example, it can be difficult to predict natural processes such as flooding or wildfire. The three populations of Large Whorled Pogonia are isolated and small and a single flooding or fire event could remove an entire population. Control of invasive plant species may be possible through the application of Best Management Practices such as direct removal (e.g., through pulling, mowing or cutting), proper disposal and frequent monitoring following removal (Nature Conservancy of Canada 2007; Pridham and Anderson 2009; Anderson 2012; Anderson et al. 2013). While potential methods to control populations of non-native earthworms are being explored (Seamans et al. 2015), no known methods to mitigate the effect of atmospheric pollutants on symbiotic mycorrhizal fungi currently exist.

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

Unknown. Habitat protection methods such as land securement or stewardship could be employed to reduce the risk of loss of the privately owned occurrence. However, public and/or conservation ownership alone may not be sufficient to reduce threats at any of the known sites. It is not known whether this species requires or responds to any habitat management techniques, although there is evidence that release from canopy suppression may improve vigor in related orchid species such as the Small Whorled Pogonia (*I. medeoloides*) (Brumback et al. 2011). As described above, successful propagation of this species is not known. Little is known about the possible success of

direct seeding of mature capsules into suitable habitat; this would also require obtaining capsules from a source outside Canada.

In Canada, the Large Whorled Pogonia has a very restricted distribution and is at the northern edge of the species' range. As a result of this, and considering the lack of evidence to suggest that the Large Whorled Pogonia was ever common in Ontario (COSEWIC 2011), the species will likely continue to be considered 'at risk' in Canada despite applying available recovery techniques and maintaining existing populations.

4. Threats

In addition to the threats outlined in Part 2 - *Recovery Strategy for the Large Whorled Pogonia* (Isotria verticillata) *in Ontario*, a potential threat to the Large Whorled Pogonia is a decline in pollinator populations, as the Large Whorled Pogonia is pollinated primarily by bees[10] (Mehrhoff 1983). A number of factors are suspected to be contributing to the decline in insect pollinator populations globally and in Canada, including loss of habitat and food sources, diseases, viruses, pests, and pesticide exposure (Colla et al. 2012). Notably, there is growing evidence to suggest that pesticides, including neonicotinoids, may be having negative effects on pollinator populations due to their toxic properties and persistence in soil and water (van der Sluijs et al. 2013; Godfray et al. 2014; Pisa et al. 2015). Currently, the extent to which the decline in pollinator populations may impact the Large Whorled Pogonia is not known.

5. Population and Distribution Objectives

The provincial *Recovery Strategy for the Large Whorled Pogonia* (Isotria verticillata) *in Ontario* (Part 2) contains the following recovery goal:

- The recovery goal is to recover and maintain long-term self-sustaining viable populations of Large Whorled Pogonia and its habitats within the current and historic range in southern Ontario.

The Government Response Statement for the Province of Ontario (Part 3) lists the following goal for the recovery of the Large Whorled Pogonia in Ontario:

- The government's goal for the recovery of Large Whorled Pogonia is to confirm its presence and maintain the persistence of the species' populations and habitats in southern Ontario.

Under SARA, population and distribution objectives for the species must be established. Consistent with the goal set out in the Government of Ontario's Government Response Statement, Environment Canada's population and distribution objective for the Large Whorled Pogonia in Canada is to:

[10] Known pollinators of the Large Whorled Pogonia include solitary bees of the *Andrenidae*, *Antrophoridae* and *Halictidae* families.

- Maintain the persistence of the species and suitable habitat conditions where populations exist.

This objective necessarily focuses on maintaining existing populations and habitats of Large Whorled Pogonia in Canada. One documented population of Large Whorled Pogonia is now considered extirpated and the other three known populations have declined heavily from the 1960s to the 1990s. Because the species has not been recently observed, its presence and abundance need to be confirmed at the three known locations, two of which are presumed to be extant and the third which is possibly extant. Large Whorled Pogonia can remain dormant underground for many years and therefore may persist undetected for long periods, possibly for decades.

The presence of Large Whorled Pogonia may be confirmed through activities such as regular surveys of the two presumed extant and one possibly extant sites. Sites have not been regularly surveyed in more than five years, and no plants have been observed in Canada since 1996. Like many other orchids, the species appears to be restricted by the presence of the specific mycorrhizal fungus required for establishment and growth. Therefore, suitable habitat for this species should be maintained where the species is known to occur, as well as adjacent areas of suitable habitat where mycorrhizal relationships are likely to persist, to allow for re-emergence of individuals. Where suitable habitat conditions are maintained, and provided that the fungal associate remains present, it is possible that Large Whorled Pogonia populations may increase locally, and colonize or recolonize areas of nearby suitable habitat. Maintaining suitable habitat will likely require the promotion of stewardship activities such as removing invasive species, maintaining suitable habitat conditions (e.g., semi-open or closed canopy, thick leaf litter layer, abundant humus), and reducing disturbance near occurrences.

Despite the extreme rarity of this orchid in Canada, population and distribution objectives do not currently include re-introduction or population augmentation of the Large Whorled Pogonia at presumed extant or possibly extant sites. This is for several reasons. First, because no individuals have been observed in Canada in almost two decades, and seeds or transplants would need to be sourced from populations in the northeastern United States. However, the species is also uncommon to rare in adjacent jurisdictions, and the suitability of these populations to Canadian sites is not known. Second, there is currently little evidence to suggest that re-introduction would be successful without more substantial research. Until more is known, the likelihood of successful re-introduction of the Large Whorled Pogonia in Canada is considered very low. However, many knowledge gaps relating to re-introduction are included in the provincial recovery strategy (Jones et al. 2012).

6. Broad Strategies and General Approaches to Meet Objectives

The government-led and government-supported action tables from the *Large Whorled Pogonia – Ontario Government Response Statement* (Part 3) are adopted as the broad strategies and general approaches to meet the population and distribution objectives. Environment Canada is not adopting the approaches identified in section 2.0 of the *Recovery Strategy for the Large Whorled Pogonia* (Isotria verticillata) *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 provincial recovery strategies under the Province of Ontario's ESA. Under the ESA, when a species becomes listed as endangered or threatened on the Species at Risk in Ontario List, it automatically receives general habitat protection. Although a description of the general habitat for Large Whorled Pogonia has not yet been developed, the species still receives general habitat protection under the ESA. In some cases, a habitat regulation may be developed that replaces the general habitat protection. A habitat regulation is a legal instrument that prescribes an area that will be protected[11] as the habitat of the species by the Province of Ontario. A habitat regulation has not been developed for Large Whorled Pogonia under the ESA; however, the provincial recovery strategy (Part 2) contains a recommendation on the area for consideration in developing a habitat regulation.

This federal recovery strategy identifies critical habitat for the Large Whorled Pogonia in Canada to the extent possible, based on this recommendation and on the best available information as of October 2014. Critical habitat is identified for two presumed extant populations of Large Whorled Pogonia in Ontario (see Figure 2 and Table 1). It is recognized that the critical habitat identified below may be insufficient to achieve the population and distribution objective for the species. Therefore, to confirm that the identified critical habitat is sufficient to meet the objective, a Schedule of Studies (section 7.2; Table 2) has been developed that outlines the activities required to obtain this information. If additional information supports the inclusion of areas beyond those

[11] Under the federal *Species at Risk Act* (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.

currently identified, critical habitat will be updated, either in a revised recovery strategy or an action plan.

The identification of critical habitat for the Large Whorled Pogonia is based on two criteria: habitat occupancy and habitat suitability.

7.1.1 Habitat Occupancy

This criterion refers to areas of suitable habitat where there is a reasonable degree of certainty of current use by the species.

Habitat is considered occupied when:

- One or more Large Whorled Pogonia has been observed in any single year since 1990.

The twenty-five year timeframe for the habitat occupancy criterion is reasonable due to the limited number of systematic surveys that have been conducted for this species. Application of a twenty-five year timeframe allows for the inclusion of data for two populations where habitat appears to be suitable, but surveys have not been conducted on a consistent annual basis. Therefore it is possible that the plants may have appeared and returned to dormancy without any documentation. When conditions are unfavourable, the plant may remain dormant for several years at a time; although the factors promoting emergence and flowering, and the maximum length of apparent dormancy are unknown (Jones et al. 2012). It has been suggested that the related plant species, Small Whorled Pogonia (*Isotria medeoloides*), may be capable of remaining dormant for up to 20 years (COSEWIC 2011).

Habitat occupancy is therefore presumed for Skunk's Misery and Backus Woods populations until the status is reassessed by the NHIC as extirpated. Habitat occupancy is possible for the Fowler's Pond population however, because the location has been exposed to prolonged flooding and it is unclear whether Large Whorled Pogonia and/or its mycorrhizal fungal associate can withstand prolonged submersion underwater. Additional surveys are required to confirm habitat occupancy and suitability at this location.

7.1.2 Habitat Suitability

Habitat suitability relates to areas possessing a specific set of biophysical attributes that support individuals of the species in carrying out essential aspects of their life cycle.

At presumed extant locations in Canada, Large Whorled Pogonia occurs in moist deciduous or mixed Carolinian forests of southwestern Ontario on sandy acidic soil (pH of between 4.2 and 5.1) with thick leaf litter and abundant humus (White 1998; Jones et al. 2012). Tree cover is variable, persisting in semi-open (between 25-60%) to closed (>60%) canopy conditions. The variability in cover and composition suggests the presence of Large Whorled Pogonia may be more dependent on site conditions, owing to its obligate association with soil mycorrhizae, which is required for successful seedling establishment and overall fitness throughout all life stages (COSEWIC 2011).

The biophysical attributes of suitable habitat for Large Whorled Pogonia include:

- Deciduous or Mixed forest[12];
    - Associated tree species may include but are not limited to Red Maple (*Acer rubrum*), White Oak (*Quercus alba*), Red Oak (*Quercus rubra*), and White Pine (*Pinus strobus*)
- Semi-open (25-60%) or closed (>60%) canopy;
- Moist, sandy, acidic soils with a pH range of between 4.0 and 5.5;
- Rich soils with an abundance of humus and duff (>10cm);
- Thick leaf litter layer; and,
- Presence of mycorrhizal fungal associate (i.e., *Tulasnella*).

Based on the best available information, suitable habitat for the Large Whorled Pogonia is currently defined as the extent of the biophysical attributes where the Large Whorled Pogonia presumably exists in Ontario, and any contiguous deciduous or mixed forest or swamp that occurs up to 100 m from that extent (see Figure 1). In addition to the suitable habitat, a critical function zone of 50 m (radial distance) is applied when the biophysical attributes around a plant extend for less than 50 m.

In Ontario, suitable habitat for Large Whorled Pogonia can be described using the Ecological Land Classification (ELC) framework for Ontario (Lee et al. 1998). The ELC framework provides a standardized approach to the interpretation and delineation of dynamic ecosystem boundaries. The ELC approach classifies habitats not only by vegetation community but also considers soil moisture conditions and topography, and as such encompasses the biophysical attributes of the habitat for Large Whorled Pogonia. In Ontario, ELC terminology and methods are familiar to many land managers and conservation practitioners who have adopted this tool as the standard approach for habitat classification in Ontario.

Within the ELC system in Ontario, the ecosite boundary best captures the extent of biophysical attributes required by the species. The ecosite includes the areas occupied by Large Whorled Pogonia and the surrounding areas that provide suitable habitat conditions to carry out essential life processes for the species and should allow for natural processes related to population dynamics and reproduction (e.g., dispersal and pollination) to occur.

In Canada, Large Whorled Pogonia is geographically restricted and is considered one of the rarest plants in the country. As habitat loss and degradation are considered the likely primary past and present threats to the species (White 1998, in Jones et al. 2012) and to other plants in the Carolinian forest (Jones et al. 2012), a habitat-based approach is important to preserve any remaining suitable habitat.

[12] ELC Ecosites may include but are not limited to FOD 6, FOD 9, FOM 6, or FOM 7.

In addition to the ecosite, the adjacent deciduous or mixed forest or swamp extending up to 100 m radial distance will maintain suitable conditions (e.g., moisture regime, light) that are favourable to Large Whorled Pogonia and perhaps, its mycorrhizal associate. Large Whorled Pogonia may associate with one or several species of the mycorrhizal soil fungi, but the specific mycorrhizal associate is not known (COSEWIC 2011; Jones et al. 2012). It is likely Large Whorled Pogonia distribution is restricted by the presence of the fungus. With the exception of the immediate area where Large Whorled Pogonia plants are growing, it is not possible to ensure the ELC ecosite captures the fungus, about which very little is known regarding its distribution and ecology in Canada. Including adjacent deciduous or mixed forest or swamp increases the likelihood of ensuring the fungus is captured within the extent of suitable habitat.

Furthermore, maintaining the adjacent forest or swamp will also promote ecosystem resilience to invasive species and will allow for potential seed dispersal into adjacent forest habitat. Although there is little information on patterns of seed dispersal for Large Whorled Pogonia (COSEWIC 2011; Jones et al. 2012), orchids produce large numbers of minute, wind-dispersed seeds that can be widely distributed (Dressler 1981), possibly over hundreds of metres (COSEWIC 2011; Jones et al. 2012). Even a small proportion of seeds can be sufficient for colonizing new areas, provided that the required conditions are met for their germination and growth; Large Whorled Pogonia has been known to crop up 100 m away, after having been absent for a few years (Jones et al. 2012).

A critical function zone in the form of a 50 m radial distance around the plant when it occurs less than 50 m from the suitable ELC ecosite boundary within which it is found, will ensure that microhabitat properties (e.g., essential light, moisture, temperature, humidity levels necessary for survival) are maintained. At present, it is not clear at what exact distance physical and/or biological processes begin to negatively affect Large Whorled Pogonia, but gradual changes along transects from the forest edge to interior have been identified for edaphic[13] factors such as soil moisture, air humidity, and solar radiation (Alignier and Deconchat 2013). Studies on micro-environmental gradients at habitat edges, including light, temperature, litter moisture (Matlack 1993), and of edge effects on plants in mixed hardwood forests, as evidenced by changes in plant community structure and composition (Fraver 1994), have shown that edge effects could be detected up to 50 m into habitat fragments, although other studies show that the magnitude and distance of edge effects will vary depending on the structure and composition of adjacent habitat types (Harper et al. 2005). Forman and Alexander (1998) and Forman et al. (2003) found that most roadside edge effects on plants resulting from construction and repeated traffic have their greatest impact within the first 30 to 50 m. Therefore, a 50 m distance from any Large Whorled Pogonia plant was chosen as a precautionary distance to ensure that microhabitat properties were maintained as part of the identification of critical habitat.

[13] Of, produced by, or influenced by the soil.

The area within the critical function zone may include both suitable and unsuitable habitat as Large Whorled Pogonia may be found near a transition area/zone between suitable and unsuitable habitat. As new information on species' habitat requirements and site-specific characteristics such as hydrology become available, these distances may be refined.

Maintained roadways or built-up features such as buildings do not possess the biophysical attributes of suitable habitat or assist in the maintenance of natural processes and are therefore not considered critical habitat.

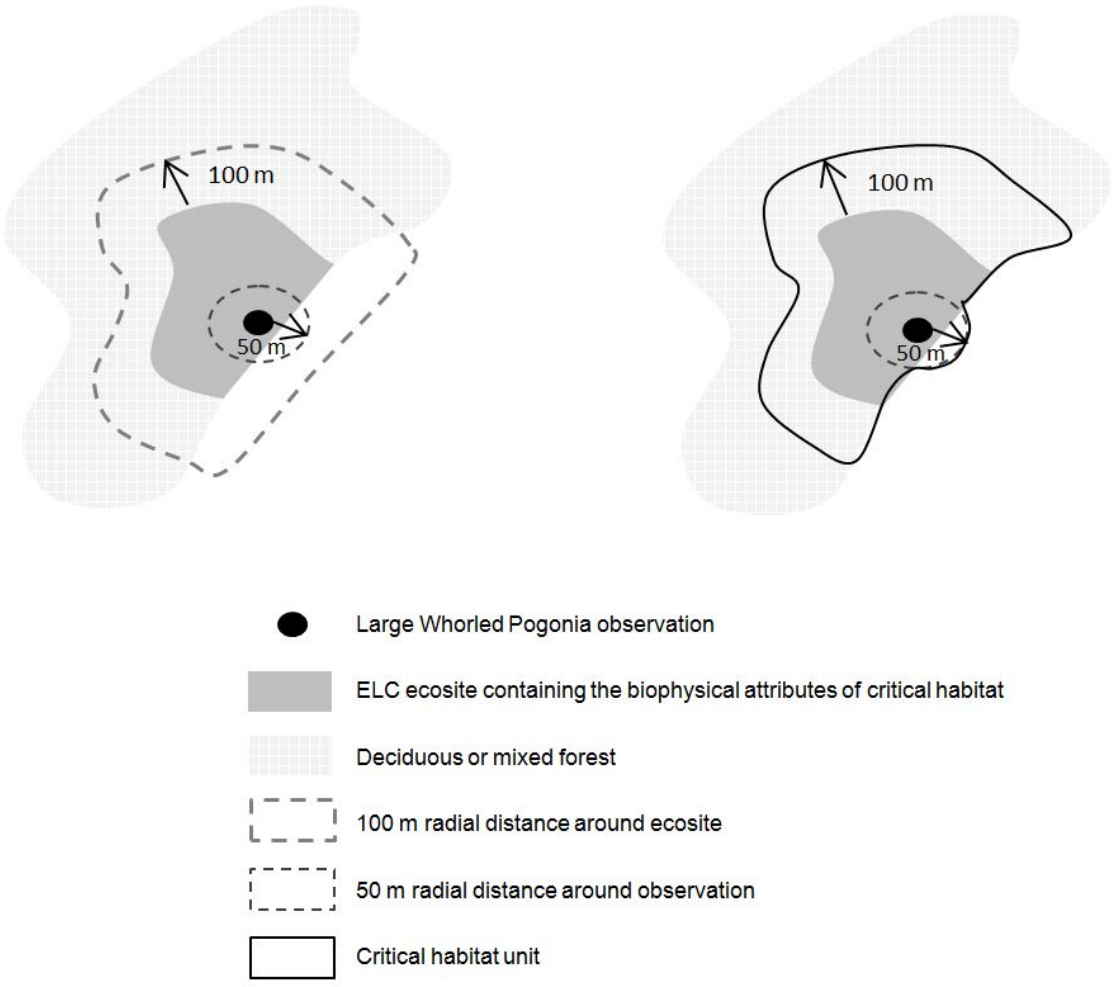

Figure 1: **Schematic of Critical Habitat Criteria for Large Whorled Pogonia.** The biophysical attributes of critical habitat are best captured by the extent of the ELC ecosite around a known observation of the Large Whorled Pogonia (that meets the habitat occupancy criteria) and any contiguous deciduous or mixed forest where it occurs up to 100 m from the ecosite. In addition, critical habitat also includes a critical function zone of 50 m (radial distance) around the plant.

7.1.3 Application of the Criteria to Identify Critical Habitat for Large Whorled Pogonia

Critical habitat for Large Whorled Pogonia is identified as the extent of suitable habitat (section 7.1.2) where the habitat occupancy criteria is met (section 7.1.1). In cases where the suitable habitat extends for less than 50 m around a Large Whorled Pogonia, a critical function zone capturing an area within a radial distance of 50 m is also included as critical habitat (see Figure 1).

In Ontario, as noted above, suitable habitat for Large Whorled Pogonia is most appropriately identified at the ecosite level. At the present time, ecosite descriptions and boundaries are not available to support the identification of critical habitat for all populations in Ontario. In the interim, where ELC ecosite boundaries are not available, the ELC community series level is identified as the area within which critical habitat is found. When ecosite boundaries are determined, the identification of critical habitat will be updated.

Application of the critical habitat criteria using the best available information has identified critical habitat for two populations of Large Whorled Pogonia in Canada (Figure 2, see also Table 1)[14]. The critical habitat identified is considered a partial identification of critical habitat and is insufficient to meet the population and distribution objective. Information on the status of the population at Fowler's Pond is required, as is determining the presence of suitable habitat at the site. A Schedule of Studies (section 7.2) has been developed to provide the information necessary to complete the identification of critical habitat that will be sufficient to meet the population and distribution objective.

Critical habitat for Large Whorled Pogonia is presented using a 1 x 1 km UTM grid squares (Table 1). The UTM grid squares presented in Figure 2 are 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. In addition to providing these benefits, the 1 x 1 km UTM grid respects provincial data-sharing agreements in Ontario. Critical habitat within each grid square occurs where the description of habitat occupancy (section 7.1.1) and habitat suitability (section 7.1.2) are met. More detailed information on critical habitat may be requested on a need-to-know basis by contacting Environment Canada – Canadian Wildlife Service at ec.planificationduretablissement-recoveryplanning.ec@canada.ca.

[14] This is the maximum extent of critical habitat based on suitable habitat boundaries that can be delineated from high resolution aerial photography (comparable to ELC Community Series) and/or a 50 m radial distance around the Large Whorled Pogonia. Actual critical habitat occurs only in those areas described in section 7.1 and therefore the actual area could be less than this and would require field verification to determine the precise amount.

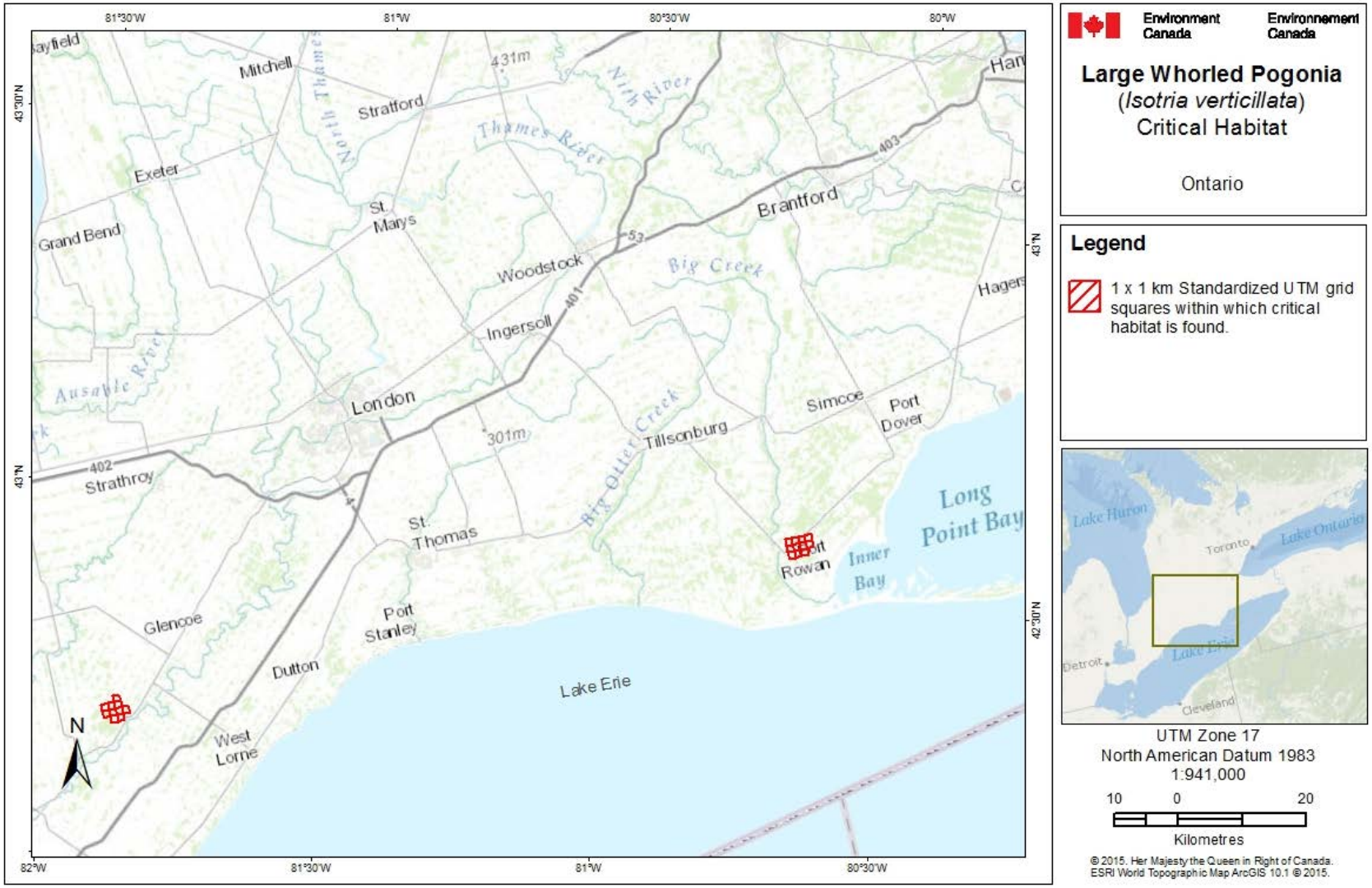

Figure 2. Grid Squares Identified as Containing Critical habitat for the Large Whorled Pogonia in Canada. Critical habitat for the Large Whorled Pogonia occurs within these 1 x 1 km standardized UTM grid squares (red squares), where the description of habitat occupancy (section 7.1.1) and habitat suitability (section 7.1.2) are met.

Table 1. Critical Habitat for the Large Whorled Pogonia in Ontario occurs within these 1 x 1 km Standardized UTM grid squares where criteria described in Section 7 are met.

Population	1 x 1 km Standardized UTM grid square ID[1]	Province/Territory	UTM Grid Square Coordinates[2]		Land Tenure[3]
			Easting	Northing	
Skunk's Misery	17TMH3255	Ontario	435000	4725000	Non-federal
	17TMH3254		435000	4724000	
	17TMH3253		435000	4723000	
	17TMH3263		436000	4723000	
	17TMH3252		435000	4722000	
	17TMH3244		434000	4724000	
	17TMH3243		434000	4723000	
	17TMH3242		434000	4722000	
	17TMH3234		433000	4724000	
	17TMH3233		433000	4723000	
Backus Woods	17TNH4235	Ontario	543000	4725000	Non-federal
	17TNH4234		543000	4724000	
	17TNH4225		542000	4725000	
	17TNH4224		542000	4724000	
	17TNH4223		542000	4723000	
	17TNH4215		541000	4725000	
	17TNH4214		541000	4724000	
	17TNH4213		541000	4723000	
	17TNH4205		540000	4725000	
	17TNH4204		540000	4724000	
	17TNH4203		540000	4723000	
					Total = 21 grid squares

[1]Based 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 2 digits represent the UTM Zone, the following 2 letters indicate the 100 x 100 km Standardized UTM grid, followed by 2 digits to represent the 10 x 10 km Standardized UTM grid. The last 2 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).

[2]The 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 unit. The coordinates may not fall within critical habitat and are provided as a general location only.

[3]Land tenure is provided as an approximation of the types of land ownership that exist at the critical habitat units 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 Schedule of Studies to Identify Critical Habitat

Table 2. Schedule of Studies to Identify Critical Habitat

Description of Activity	Rationale	Timeline
Determine population status and presence of suitable habitat (including presence of mycorrhizal fungal associate) for the Fowler's Pond population.	It is unclear if Large Whorled Pogonia plants and/or the mycorrhizal fungal associate can withstand prolonged submersion underwater. Population status and presence of suitable habitat is required to allow for additional critical habitat to be identified.	2016-2023

7.3 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 was degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single activity or multiple activities at one point in time or from the cumulative effects of one or more activities over time.

It should be noted that not all activities that occur in or near critical habitat are likely to cause its destruction. For example, use of existing roadways, access roads and recreational trails would not result in the destruction of critical habitat. 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 Critical Habitat of Large Whorled Pogonia

Description of Activity	Descriptions of Effect in Relation to Function Loss	Details of Effect
Complete removal of native vegetation component of critical habitat, (e.g., clearcut forest harvesting, shelterwood, partial harvest) for any purpose other than vegetation management specific to the Large Whorled Pogonia	Results in an increase in light penetration within the mature forest, reduction in soil moisture and maintenance of suitable soil conditions, reduction in summer air humidity, alteration of lighting and temperature regime, and an increase in the probability of propagules of invasive species being introduced on forestry equipment. Additionally, since Large Whorled Pogonia requires a wooded environment, this would ultimately result in the habitat no longer being suitable for the species.	When this activity occurs within the bounds of critical habitat, and/or adjacent to critical habitat where the species occurs less than 50 m from the edge of the ELC ecosite at any time of year, the effects are likely to be direct. The information available at this time is insufficient to develop a threshold for this activity.
Conversion of land to agriculture and construction of	Removal of vegetation converts habitat, directly alters the physical and biological properties of the	When this activity occurs within the bounds of critical habitat, and/or adjacent to critical habitat where the

Description of Activity	Descriptions of Effect in Relation to Function Loss	Details of Effect
houses, other structures or roads, including removal of vegetation and/or soils (e.g., residential or industrial development)	landscape and results in the direct loss of critical habitat upon which the species relies for basic survival, successful seed germination and seedling establishment. Ploughing or direct removal of soil/substrate would render the habitat unsuitable for Large Whorled Pogonia by disrupting and/or removing the biophysical attributes (especially soil mycorrhizae) required by the species.	species occurs less than 50 m from the edge of the ELC ecosite at any time of year, the effects will be direct, and is certain to result in the permanent destruction of critical habitat. It is not possible to develop thresholds for this activity.
Introduction of exotic species, especially plants or invertebrates (e.g. introduction of non-native plant seeds, plants, foreign soil or gravel, composting or dumping of garden waste, livestock grazing)	Exotic species may outcompete Large Whorled Pogonia for space and resources, and/or result in physical and chemical changes to habitat such that it is no longer suitable for the species.	When this activity occurs within or adjacent to critical habitat, at any time of year, the effects may be direct and/or cumulative. The introduction of an invasive species can lead to gradual destruction of critical habitat over time (i.e. cumulative impacts). The information available at this time does not allow for the development of thresholds.
Construction of trails	The construction of trails through critical habitat have the potential to increase visibility of this species, and increase the likelihood of foot, bicycle or ATV traffic within critical habitat, and in the immediate vicinity of plants by those wishing to view or photograph them. In addition to direct harm to plants, heavy use of trails can result in soil compaction, which has the potential to alter the leaf litter and/or habitat available for soil fungi. Disturbing native ground cover can also increase ability of invasive plants to colonize areas.	When this activity occurs within critical habitat, the effects may be direct and/or cumulative. Negative effects would occur if the activity were undertaken in any season. This activity may result in destruction of critical habitat because Large Whorled Pogonia is dependent upon soil mycorrhizae for growth and development, and there is evidence that the presence of soil mycorrhizae is negatively affected by soil compaction. The information available at this time is insufficient to develop a threshold for this activity.

8. Measuring Progress

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

- The species and suitable habitat conditions have been maintained where populations exist.

9. Statement on Action Plans

One or more action plans will be completed for the Large Whorled Pogonia and posted on the Species at Risk Public Registry by December 31, 2023.

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*[15]. 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 and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[16] (FSDS) goals and targets.

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

Several listed Species at Risk have been noted from the two presumed extant sites or the one possibly extant site where Large Whorled Pogonia occurs (e.g., Butler's Gartersnake, Eastern Hog-nosed Snake, Acadian Flycatcher, Eastern Flowering Dogwood). In general, its suitable habitat (dry sandy woods) is relatively rare in the heavily developed Carolinian zone. Conserving this habitat may assist in the protection of other provincially or regionally significant plant species.

The potential for this recovery strategy to inadvertently lead to adverse effects on other species was considered. Because no management activities are proposed for the habitat of Large Whorled Pogonia in Canada, and this orchid, presumed extant, is highly localized with no known co-occurring species at risk, the SEA concluded that this strategy will clearly benefit the environment and will not entail significant adverse effects.

[15] http://www.ceaa.gc.ca/default.asp?lang=E&n=B3186435-1
[16] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

References

Alignier, A. and M. Deconchat. 2013. Patterns of forest vegetation responses to edge effects as revealed by a continuous approach. Annals of Forest Science: 1-9.

Anderson, H. 2012. Invasive Garlic Mustard (*Alliaria petiolata*) Best Management Practices in Ontario. Ontario Invasive Plant Council. Peterborough, ON.

Anderson, H., R. Gagnon, F. Forsyth, R. Krick, E.Weisz, G. Bales and F. MacDonald. 2013. A Landowner's Guide to Managing and Controlling Invasive Plants in Ontario. Ontario Invasive Plant Council. Peterborough, ON.

Brumback, W. E., and C. W. Fyler. 1996. Small Whorled Pogonia (*Isotria medeoloides*) Transplant Project. Pages 445-452 in D. A. Falk, C. I. Millar, and M. Olwell, editors. Restoring Diversity: Strategies for Reintroduction of Endangered Plants. Island Press, Washington DC.

Brumback, W. E., S. Cairns, M. B. Sperduto, and C. W. Fyler. (2011). Response of an Isotria medeoloides population to canopy thinning. Northeastern Naturalist 18(2): 185-196.

Colla et al. 2012. Assessing declines of North American bumble bees (*Bombus* spp.) using museum specimens. Biodiversity Conservation 21:3585–3595.

COSEWIC. 2011. COSEWIC status appraisal summary on the Large Whorled Pogonia *Isotria verticillata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi pp.

Cutler, G.C., C.D. Scott-Dupree and D.M. Drexler. 2014. Honey bees, neonicotinoids, and bee incident reports: the Canadian situation. Pest Management Science 70(5): 779-783.

Dressler, R.L. 1981. The Orchids: Natural History and Classification. Harvard University Press, Cambridge.

Forman, R.T.T. and L. E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecology and Systematics 29:207-231.

Forman, R. T. T., D. Sperling, J. A. Bissonette, A. P Clevenger, C. D. Cutshall, V. H. Dale, L. Fahrig, R. France, C. R. Goldman, K. Heanue, J. A. Jones, F. J. Swanson, T. Turrentine, and T. C. Winter. 2003. Road Ecology: Science and Solutions. Island Press, Washington, D.C., USA.

Godfray, C. H., T. Blacquière, L.M. Field, R.S.Hails, G. Petrokofsky, S. G. Potts, N. E. Raine, A. J. Vanbergen and A. R. McLean. 2014. A restatement of the natural science

evidence base concerning neonicotinoid insecticides and insect pollinators. Proc. R. Soc. B 281:20140558.

Health Canada. 2014. Pollinator Health and Pesticides. Website: http://www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/pollinators-pollinisateurs/index-eng.php

Hill, S.R. 2007. Conservation Assessment for the Large Whorled Pogonia (*Isotria verticillata* (Mulh. ex Willd) Raf.) Illinois Natural History Survey technical report 2007(8), Champaign, Illinois. 46 pp.

Jones, J., J.V. Jalava and J.D. Ambrose. 2012. Recovery Strategy for the Large Whorled Pogonia (*Isotria verticillata*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 19 pp.

Lee, H. T., W.D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig, and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First approximation and its application. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

Matlack, G.R. 1993. Microenvironment variation within and among forest edge sites in the eastern United States. Biol. Conserv. 66(3): 185-194.

Mehrhoff, L.A. 1983. Pollination in the genus *Isotria* (Orchidaceae). American Journal of Botany. 70(10): 1444-1453.

NatureServe 2014. NatureServe Explorer: An online encyclopaedia of life. Version 7.1. NatureServe, Arlington, Virginia. Website: http://www.natureserve.org/explorer [Accessed: April 15, 2014].

Nature Conservancy of Canada (NCC). 2007. Control Methods for the Invasive Plant Garlic Mustard (*Alliaria petiolata*) within Ontario Natural Areas.V1.0. NCC – Southwestern Ontario Region, London, Ontario. 16 pp.

Pisa, L. W., V. Amaral-Rogers, L. P. Belzunces, J. M. Bonmatin, C. A. Downs, D. Goulson, D. P. Kreutzweiser, C. Krupke, M. Liess, M. McField, C. A. Morrissey, D. A. Noome, J. Settele, N. Simon-Delso, J. D. Stark, J. P. Van der Sluijs, H. Van Dyck and M. Wiemers. 2015. Effects of neonicotinoids and fipronil on non-target invertebrates. Environ Sci Pollut Res 22:68–102.

Pridham, D. and Anderson, H. 2009. The Landowners Guide to Controlling Invasive Woodland Plants. Ontario Federation of Anglers and Hunters, Ontario Ministry of Natural Resources Invading Species Awareness Program and the Victoria Stewardship Council. 26 pp.

Seamans, T. W., B. F. Blackwell, G. E. Bernhardt, and D. A. Potter. 2015. Assessing Chemical Control of Earthworms at Airports. Wildlife Society Bulletin 39(2):434–442.

van der Sluijs, J.P., N. Simon-Delso, D. Goulson, L. Maxim, J. Bonmatin and L.P. Belzunces. 2013. Neonicotinoids, bee disorders and the sustainability of pollinator services. Current Opinion in Environmental Sustainability 2013(5):293–305.

White, D.J. 1998. Update COSEWIC Status Report on the Large Whorled Pogonia, *Isotria verticillata*. Committee on the Status of Endangered Wildlife in Canada.

Wingham, D. 2015. Senior Botanist, Smithsonian Environmental Research Center, North American Orchid Conservation Centre. Personal Communication.

Appendix A: Subnational Conservation Ranks of Large Whorled Pogonia (*Isotria verticillata*) in Canada and the United States

Large Whorled Pogonia (*Isotria verticillata*)				
Global (G) Rank	**National (N) Rank (Canada)**	**Sub-national (S) Rank (Canada)**	**National (N) Rank (United States)**	**Sub-national (S) Rank (United States)**
G5 (Secure: At very low risk of extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats).	N1	Ontario (S1)	N5	Alabama (S2), Arkansas (SNR), Connecticut (S3), Delaware (S3), District of Columbia (SNR), Florida (S1), Georgia (S3), Illinois (S1), Indiana (S3), Kentucky (S4S5), Louisiana (S3), Maine (SX), Maryland (SNR), Massachusetts (S3S4), Michigan (S2), Mississippi (S3), Missouri (S1S2), New Hampshire (S1), New Jersey (S4), New York (S3S4), North Carolina (S2S3), Ohio (SNR), Oklahoma (S1), Pennsylvania (SNR), Rhode Island (S3), South Carolina (SNR), Tennessee (SNR), Texas (S1), Vermont (S2), Virginia (S5), West Virginia (S5)

(NatureServe 2014)

Rank Definitions (NatureServe 2014)

S1/N1: Critically Imperilled - At very high risk of extirpation in the jurisdiction (i.e., N - nation, or S - state/province) due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.

S2: Imperilled - At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

S3: Vulnerable - At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats or other factors.

S4: Apparently Secure – At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences but with possible cause for some concern as a result of local recent declines, threats or other factors.

S5/N5/G5: Secure - At very low risk of extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.

SX: Extirpated - Adequate surveys by one or more experienced observers at times and under conditions appropriate for the species at the occurrence location, or other persuasive evidence, indicate that the species no longer exists there or that the habitat or environment of the occurrence has been destroyed to such an extent that it can no longer support the species.

SNR: Unranked – National or subnational conservation status not yet assessed.

Part 2 – *Recovery Strategy for the Large Whorled Pogonia (*Isotria verticillata*) in Ontario*, prepared for the Ontario Ministry of Natural Resources

Photo: Loyal A. Mehrhoff

Large Whorled Pogonia

(Isotria verticillata) in Ontario

Ontario Recovery Strategy Series

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

Natural. Valued. Protected.

Ministry of Natural Resources

Ontario

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 (ESA) 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, 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 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. 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 recovery strategy for the Large Whorled Pogonia has been prepared 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

The Large Whorled Pogonia (*Isotria verticillata*) is an orchid with a single yellowish-green flower above a whorl of leaves. The species requires mycorrhizal fungi in its roots for nourishment. The Large Whorled Pogonia can remain dormant, sometimes being absent for a number of years. The species is listed as endangered under the provincial *Endangered Species Act, 2007* and the federal *Species at Risk Act*.

Canadian locations of Large Whorled Pogonia are all in Carolinian woodland in southwestern Ontario. There are two populations presumed extant, one population possibly extant and one historical population last seen in 1879. The three populations declined steadily from the 1960s to the early 1990s. The last observation of the species in Canada was in 1996 despite some subsequent searches. However the maximum dormancy period for this species is unknown and sites have not been searched in consecutive years; therefore it is premature to presume the species is extirpated.

The habitat of Large Whorled Pogonia generally is moist, deciduous or mixed forest with a semi-open canopy on sandy acidic soil with thick leaf litter and abundant humus.

Human impacts on habitat (land clearing, incompatible forestry practices and trampling) have probably played a significant role in the decline of Large Whorled Pogonia in Canada. Other threats include the effects of fragmentation of woodlands and resulting isolation of small populations and natural processes such as flooding by beaver. As well, exotic earthworms and atmospheric pollutants are potential threats that may alter soil conditions and deleteriously affect the symbiotic mycorrhizal fungi that the orchid requires to survive. Invasive plant species may also be a potential threat.

Determining if any Canadian populations are extant is an urgent knowledge gap.

The recovery goal is to recover and maintain long-term, self-sustaining, viable populations of Large Whorled Pogonia and its habitats within the current and historic range in southern Ontario. Recovery for Large Whorled Pogonia will present a number of challenges. Propagation and re-introduction can be difficult to do with orchids because of the necessary mycorrhizal associations. The objectives toward achieving the recovery goal include the following.

- Determine current status of Large Whorled Pogonia populations in Ontario through inventory of the three known populations, historic reports and other potential habitat.
- Protect and manage habitat to maintain extant populations in Ontario through:
    a. appropriate management of public lands;
    b. appropriate land-use planning for private lands;
    c. stewardship on private lands;
    d. site securement; and
    e. site restoration and rehabilitation.

- Address knowledge gaps relating to the biology, ecology, habitat and threats of Large Whorled Pogonia in Ontario.
- Coordinate recovery activities with other plant species of the draft Carolinian Woodland Plants Recovery Strategy and work towards increasing the amount of high-quality interior moist forest habitat (to enhance the chances of natural dispersal and colonization of new sites).
- Develop educational and outreach materials for naturalists, orchid enthusiasts and the general public highlighting the significance, uniqueness and vulnerability of the species.
- Investigate the feasibility of reintroducing Large Whorled Pogonia to sites where it is deemed extirpated if suitable habitat remains, or to other suitable habitat.

The maximum length of dormancy for this species is not known, so as a precautionary principle a habitat prescription should be made for the populations presumed or possibly extant until their status can be clarified.

It is suggested that the area to be prescribed as habitat should be the Ecological Land Classification (ELC) vegetation type around the three documented populations plus any contiguous area of deciduous or mixed forest cover that has >10 cm of duff and humus and soil pH of 4.0 to 5.5. If the plants reappear in any given year and it becomes possible to fill knowledge gaps, these parameters can be further refined.

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1. BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Large Whorled Pogonia
SCIENTIFIC NAME: *Isotria verticillata*
SARO List Classification: Endangered
SARO List History: Endangered (2008), Endangered – Regulated (2004)
COSEWIC Assessment History: Endangered (2000)
SARA Schedule 1: Endangered
CONSERVATION STATUS RANKINGS: GRANK: G5 NRANK: N1 SRANK: S1

The glossary provides definitions for technical terms, including the abbreviations above.

1.2 Species Description and Biology

Species Description

Large Whorled Pogonia is an orchid with a single yellowish-green flower with narrow purplish sepals growing just above a whorl of five or six green leaves. The leaves measure approximately nine centimetres long by five centimetres wide. The sepals are much longer than the petals (White 1998) and the flower has a sweet, delicate fragrance. It can attain a maximum height of 30 cm and has a stem that is often purplish (White 1998). The fruit measures 25 mm by 7 mm (Environment Canada 2008).

Species Biology

Large Whorled Pogonia reproduces primarily through vegetative shoots. A single clone is capable of producing up to 300 individual shoots (ramets) (Mehrhoff and Homoya 2002). In Canada, the plants flower in late May or early June, and bees are the main pollinators (Mehrhoff, 1983). The fruit is a dry capsule with fine seeds which are dispersed by wind (Environment Canada 2008). Like many other orchids, Large Whorled Pogonia plants require mycorrhizal fungi for nourishment (Hill 2007). The relationship between orchids and their associated mycorrhizae is normally symbiotic, and one can usually not survive without the other.

This species may remain dormant during unfavourable conditions and can be absent for several years at a time if conditions required to produce flowers and seeds are not met.

A year or even several without flowering plants does not necessarily indicate that the species is extirpated (Hill 2007).

1.3 Distribution, Abundance and Population Trends

Large Whorled Pogonia (Figure 1) occurs in eastern North America, from New England, southwestern Ontario and Michigan south to Texas and Georgia (Klinkenberg 1986, White 1998). In Canada it is restricted to extreme southwestern Ontario (Middlesex, Oxford and Norfolk counties) (Figure 2). Less than one percent of its global range is in Canada.

Large Whorled Pogonia is globally ranked as G5 (secure), nationally in the United States as N5 (secure) and nationally in Canada as N1 (critically imperilled). In Ontario, it is ranked critically imperilled (S1). According to NatureServe (2009), the species is listed as:

- critically imperilled (S1) in Florida, Illinois, Missouri, New Hampshire, Oklahoma, and Texas;
- imperilled (S2) in Alabama, Delaware, Michigan, North Carolina, and Vermont;
- vulnerable (S3) in Connecticut, Georgia, Indiana, Louisiana, Massachusetts, Mississippi, New York, and Rhode Island;
- extirpated (SX) in Maine; and
- secure or Not Ranked (S4, S5, SNR) in Arkansas, District of Columbia, Kentucky, Maryland, New Jersey, Ohio, Pennsylvania, and South Carolina, Tennessee, Virginia, and West Virginia.

In Ontario, a total of four populations have been recorded. Two populations have not been seen since 1990 and 1996 but are still presumed extant. A third population was seriously affected by flooding but may possibly still have some portion extant. The fourth population is an historical record of a population last seen in 1879 (Table 1). For the three populations that may be extant, dramatic declines since the 1960s have been observed.

Due to the long dormancy periods possible for this species, these populations cannot yet be presumed extirpated, especially since they have not been searched for on a consistent, annual basis to see if the plants have appeared above ground. The related species Small Whorled Pogonia (*Isotria medioloides*) is known to be able to be dormant for up to 20 years but the Large Whorled Pogonia probably does not remain dormant for as long (Woodliffe pers. comm. 2009).

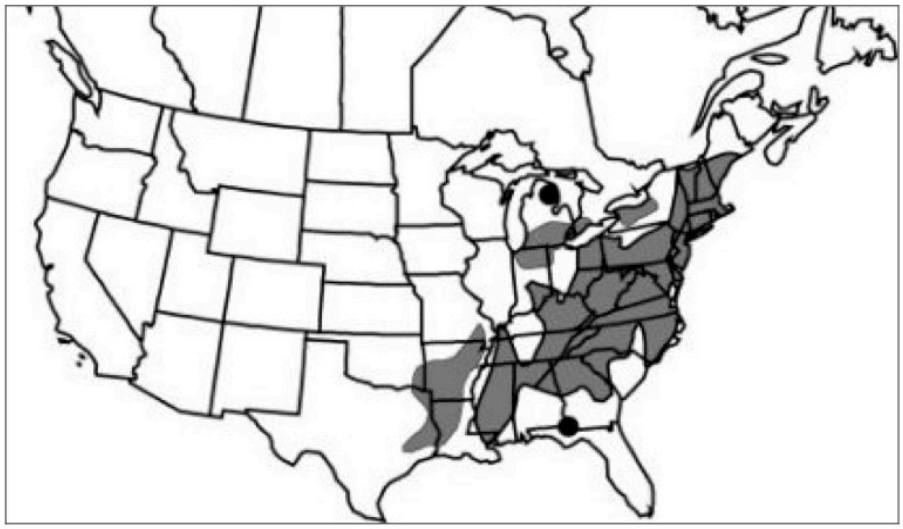

Figure 1. Global Distribution of Large Whorled Pogonia (shaded area and outlying dots) (FNA 2005)

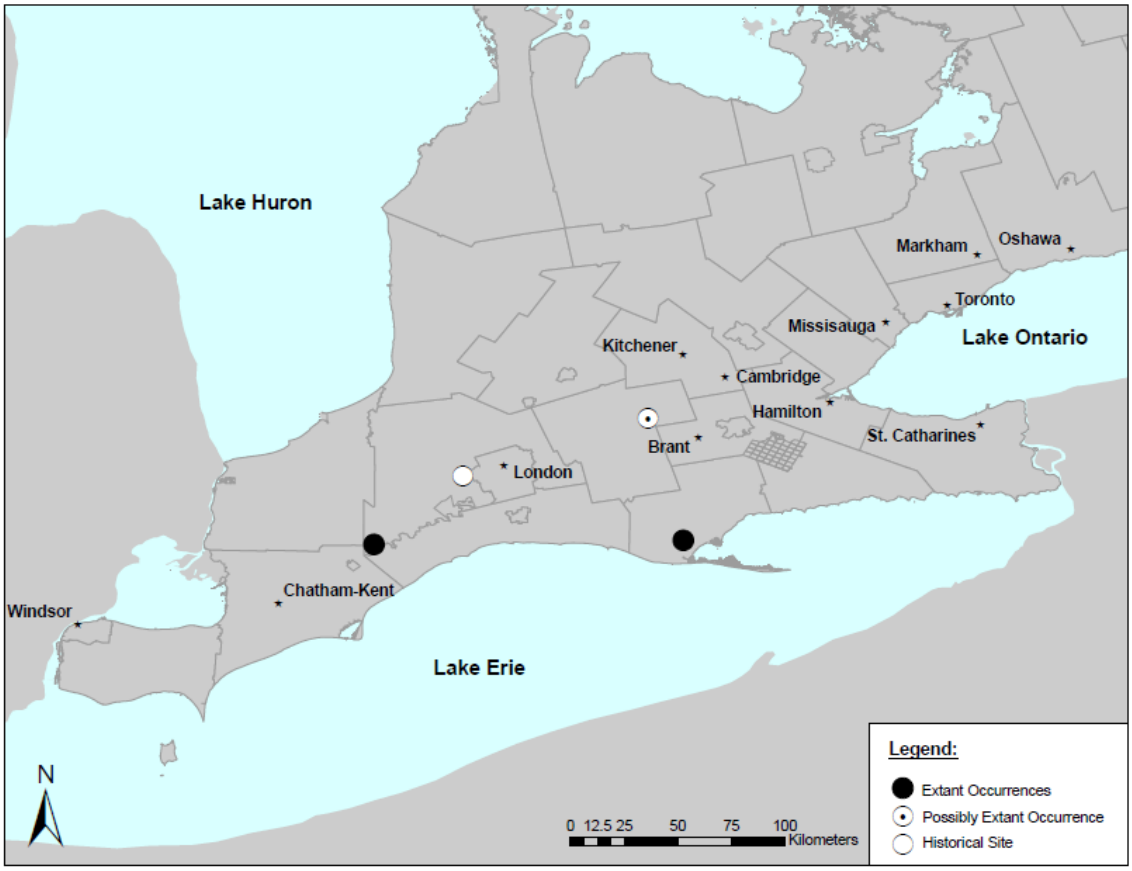

Figure 2. Distribution of Large Whorled Pogonia in Ontario. Black dots—populations presumed extant; grey dot—population possibly extant; white dot—historical site presumed extirpated.

Table 1. Populations of Large Whorled Pogonia with most recent observation data.

Location	Status	Last Observation	Year of Survey	Flowering Plants	Vegetative Plants	Notes
Middlesex County, Skunk's Misery	Unknown Presumed extant	1996	1989 1993 1996 1997	0 0 0 0	9 1 1 0	A maximum of nine plants observed since initial discovery in 1984; flowering plants never observed. Not found during 1997 search (White 1998). Private land.
Norfolk County, Backus Woods	Unknown Presumed extant	1990	1965 1966 1969 1971 1980 1982 1983 1984 1987 1989 1990 1997 2008	6 ? 6-8 12 2 0 0 0 0 0 0 0 0	24 43? ? 28 23 20 19 17 11 3 2 0 0	Rare; confined to a single colony. Not seen since 1990, despite the fact that the colony is easy to locate and several people have searched for it (White 1998). Owned by Nature Conservancy Canada. Suitable (but apparently unoccupied) habitat also present, so species may have been overlooked there.
Oxford County, Fowler's Pond	Unknown Possibly still extant	1990	1985 1986 1987 1989 1990 1996 1997	4 2 1 0 0 0 0	40 70 105 41 >20 0 0	Apparently eliminated by beaver flooding of nearby pond. Formerly Ontario's largest known population. Provincial Wildlife Area owned and managed by Ontario Ministry of Natural Resources.
Middlesex Co Komoka Swamp	Historical	1879				Documented in 1879 by W.E. Saunders. In 1941 he reported the species as absent in the London area after 1879 (Whiting and Catling 1986).

1.4 **Habitat Needs**

Large Whorled Pogonia generally requires moist deciduous or mixed forest with a semi-open canopy on sandy soil, a thick leaf litter and abundant humus (White 1998). In the United States the species is also found in seepage zones and successional bogs with *Sphagnum* and other species that prefer acidic soils. Other descriptions (Hill 2007; Michigan Natural Features Inventory 2007; House 1906) report the habitat as the drier parts of low oak and Red Maple (*Acer rubrum*) forest and in seasonally inundated, acidic hardwood swamps with hummocky ground. Acidic soils are essential, with the species being found in soils with a pH range of between 4.2 and 5.1 (FNA 2006).

At Backus Woods the species occurs in a closed-canopy, sandy, dry-mesic forest dominated by Red Maple with scattered White Oak (*Quercus alba*) and Red Oak (*Quercus rubra*). Dominant shrubs at the site include Maple-leaved Viburnum

(*Viburnum acerifolium*), Lowbush Blueberry (*Vaccinium angustifolium*) and Smooth Serviceberry (*Amelanchier laevis* ssp. *arborea*), while dominant herbs include Canada Mayflower (*Maianthemum canadense*), Indian Cucumber-root (*Medeola virginiana*), Starflower (*Trientalis borealis*), False Solomon's-seal (*Maianthemum racemosum*) and Lance-leaved Wild-licorice (*Galium lanceolatum*) (NHIC 2011).

1.5 **Limiting Factors**

The three populations of Large Whorled Pogonia are isolated and small, so the species is at risk of being destroyed by stochastic events such as major storms, drought or wildfire. A single event could remove an entire population. Loss of genetic diversity is another concern for species occurring in such small, geographically isolated populations.

Large Whorled Pogonia, like several other rare orchid species in Ontario, only grows above ground in years with conditions favourable to the production of flowers and seeds. The reproductive biology of this species is highly specialized and requires coinciding factors: favourable conditions for the plant to invest energy in producing flowers; insect pollinators to produce a seed set; wind dispersal of seeds; and contact of the seeds with a specific fungus species in order for germination to take place. These intricacies limit the species because if one factor is lacking it can affect the entire chain of events necessary for reproductive success and perpetuation of populations. In addition only a small percentage of the population normally flowers in any given year, and some years no flowers at all may be produced (Hill 2007).

Large Whorled Pogonia is normally pollinated by solitary bees of the Andrenidae, Anthophoridae and Halictidae families. These bees are wide-ranging and visit a large number of spring and early summer flowers (Mehrhoff, 1983). Large Whorled Pogonia is also self-compatible but does not frequently self-pollinate, unlike the related Small Whorled Pogonia. Thus, pollinators are required. In addition, the pollen in this species is a mass rather than a single pollinia, meaning that more than one insect may receive pollen from a single flower (Mehrhoff 1983). Despite this, field studies in North Carolina (Mehrhoff, 1983) found that only 21% of the plants studied received successful pollination. Furthermore, only six percent of flowers produced mature capsules, the majority either aborting or being destroyed by other factors. Even in experimentally hand-pollinated flowers, capsule loss was high. The Small Whorled Pogonia was found to have a pollination rate of 83% but despite a better pollination rate it is also a very rare species.

As noted above, the Large Whorled Pogonia requires soils with a pH between 4.2 and 5.1 and there is a general paucity of Carolinian forest habitat with suitably acidic substrate in Southwestern Ontario (White 1998).

1.6 **Threats to Survival and Recovery**

Observed Threats

Habitat Loss or Degradation

Habitat loss and degradation are likely the primary past and present threats to the Large Whorled Pogonia (White 1998) and to many of the other species at risk in the Carolinian woodlands. Clearing of forests for development may eliminate habitat altogether and cause local extinctions. Forest management and development can result in excessive drying of the humus layer that the species needs for survival.

Fragmentation and Isolation

The clearing of forests has created a fragmented landscape of isolated woodlots separated by great distances. This has resulted in reduced dispersal ability and increased genetic isolation for woodland plants.

Natural Processes

Because there are so few (if any) extant populations of Large Whorled Pogonia in Ontario, the species is at considerable risk of extirpation due to natural processes such as drought, flooding or wildfire. Opening of the forest canopy by windstorms may result in drying of the critical humus layer. Flooding by beaver has eliminated the habitat of the Fowler's Pond occurrence which was once the largest population in the province. More robust populations would normally be able to rebound from such impacts.

Trampling by Pedestrians

Trampling of habitat by people looking for this species may cause soil compaction, direct damage to plants and introduction of exotic or invasive plant species (below).

Potential Threats

Exotic and Invasive Species

Exotic earthworms reduce duff and humus layers as well as fungal diversity (Baxter et al. 1999; Muratake 2003, Bohlen et al. 2004). All of these are necessary for the survival of Large Whorled Pogonia, so the presence of exotic earthworms may be an important potential threat. The impacts on the greater forest ecosystems of eastern North America are still being studied (e.g., Hale et al. 2006) but the effects of exotic earthworms appear to be wide-spread and potentially devastating for understory forest communities.

Garlic Mustard (*Alliaria petiolata*) is an exotic invasive plant that produces chemicals in the soil that inhibit the growth of other plants and mycorrhizal fungi. The effects of Garlic Mustard on Large Whorled Pogonia have not been studied, but Garlic Mustard is present in most woodlots in southern Ontario and may be a potential threat. Other exotic or invasive plant species are also a potential threat as they can out-compete native plants for space and resources.

Pollution
Air- and precipitation-borne pollution, leading to soil acidification and nutrient loading (increases in available nitrogen) has been shown to alter the diversity and species composition of forest mycorrhizal fungi (Arnolds 1991; Peter et al. 2001). Pollution may therefore be a potential threat to Large Whorled Pogonia if it reduces the availability of the mycorrhizal fungi required by the orchid.

1.7 Knowledge Gaps

Knowledge gaps may limit the successful recovery of Large Whorled Pogonia.

Knowledge gaps that require field work are:

- current status of population and habitat conditions at the historical site;
- current status of extant populations (if any);
- whether other areas of suitable habitat exist that could support the species; and
- detailed standardized (ecological land classification or ELC) documentation and mapping of the forest communities of the extant occurrences to guide habitat protection.

To mitigate or eliminate threats, a better understanding is needed of:

- the specific mycorrhizal associations required by Large Whorled Pogonia;
- the impacts of air and water-borne nutrient loading on the species;
- the impacts of exotic earthworms, including which species are of most concern; and
- the ecological requirements of pollinators needed by Large Whorled Pogonia.

Data on the biological and ecological needs of the species is needed to guide site management, stewardship and potential reintroduction efforts.

1.8 Recovery Actions Completed or Underway

Recovery of Large Whorled Pogonia is being planned as part of work on the Carolinian woodlands ecosystem to improve the integrity of the landscape where a number of species at risk occur. So far, no actions have been taken specifically for Large Whorled Pogonia; however such actions could be incorporated as a part of ecosystem recovery planning which is currently underway.

All three populations of Large Whorled Pogonia were surveyed regularly until the late 1990s. The Backus Woods site had recently been acquired by the Nature Conservancy of Canada (NCC) and will have management planning with NCC's adjacent properties at that site (Crosthwaite pers. comm. 2011). Fowler's Pond is managed as a Provincial

Wildlife Area by the Ontario Ministry of Natural Resources. No recent management planning has been done for this site. A third site, Skunk's Misery, is owned by a church congregation that knows of this species and supports conservation activity.

2. RECOVERY

2.1 Recovery Goal

The recovery goal is to recover and maintain long-term self-sustaining viable populations of Large Whorled Pogonia and its habitats within the current and historic range in southern Ontario.

2.2 Protection and Recovery Objectives

Table 2. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Determine current status of Large Whorled Pogonia populations in Ontario through inventory of the three known populations, historic reports and other potential habitat.
2	Protect and manage habitat to maintain extant populations in Ontario through: a) appropriate management of public lands; b) appropriate land-use planning for private lands; c) stewardship on private lands; d) securing sites ; and e) site restoration and rehabilitation.
3	Address knowledge gaps relating to the biology, ecology, habitat and threats of Large Whorled Pogonia in Ontario.
4	Coordinate recovery activities with other plant species of the draft Carolinian Woodland Plants Recovery Strategy and work towards increasing the amount of high-quality interior moist forest habitat (to enhance the chances of natural dispersal and colonization of new sites).
5	Develop educational and outreach materials for naturalists, orchid enthusiasts and the general public highlighting the significance, uniqueness and vulnerability of the species.
6	Investigate the feasibility of reintroducing Large Whorled Pogonia to sites where it is deemed extirpated if suitable habitat remains or to other suitable habitat.

2.3 **Approaches to Recovery**

Table 3. Approaches to recovery of Large Whorled Pogonia in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
1. Determine current status of Large Whorled Pogonia populations in Ontario through inventory of the three recently extant populations, historic reports and other potential habitat.				
Critical	Short-term	Inventory, Monitoring and Assessment	**1.1** Conduct population counts of extant populations (if any); characterize habitat (including ELC mapping); rigorously assess threats present, especially exotic earthworms and Garlic Mustard.	• Any or all threats. By gaining insight into causes of declines, specific problems can then be addressed.
Critical	Short-term	Inventory, Monitoring and Assessment	**1.2** Inventory sites of historic reports	• Any or all threats. By gaining insight into causes of declines, specific problems can then be addressed.
Necessary	On-going	Inventory, Monitoring and Assessment	**1.3** Identify and survey additional sites with suitable habitat.	• Any or all threats. By gaining insight into causes of declines, specific problems can then be addressed.
2. Protect and manage habitat to maintain extant populations in Ontario through: a) appropriate management of public lands; b) appropriate land-use planning and stewardship for private lands; c) securing sites; and d) site restoration and rehabilitation.				
Critical	Short-term	Management	**2.1** Minimize beaver impacts at Fowler's Ponds through dam management.	• Natural Processes
Critical	Short-term	Management	**2.2** Post signs at public land occurrences indicating habitat sensitivity.	• Trampling
Critical	Short-term	Management	**2.3** Examine current land use and management practices and identify any positive and/or negative impacts.	• Habitat Degradation; Potential to address other threats

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Necessary	On-going	Communications	**2.4** Discuss Skunk's Misery site and other potential habitat areas on private land with municipal planners.	• Habitat loss
Necessary	Short-term	Stewardship; Management	**2.5** Develop species-specific management recommendations and provide to landowners and land managers.	• Habitat loss; Habitat degradation; Other threats
Necessary	Short-term	Management	**2.6** Review and update existing management plans for public lands to ensure they include considerations for protection of the species.	• Habitat Degradation
Beneficial	Long-term	Protection	**2.7** Secure key sites through easements or purchase.	• Habitat loss; Potential to address other threats;
3. Address knowledge gaps relating to the biology, ecology, habitat and threats of Large Whorled Pogonia in Ontario.				
Critical	Short-term	Research	**3.1** Engage academic community to participate in researching knowledge gaps.	• Any or all threats
Critical	Short-term	Research	**3.2** Investigate causes of extirpation from historic sites.	• Any or all threats
Critical	Short-term	Research	**3.3** Conduct population viability analysis.	• Fragmentation and isolation; any other threats.
Necessary	On-going	Research	**3.4** Research mycorrhizal relationships of the species.	• Habitat degradation
Necessary	On-going	Research	**3.5** Research impacts of air pollution (e.g., NO_2) on the species.	• Pollution
Necessary	On-going	Research	**3.6** Research pollination and long range dispersal mechanisms.	• Fragmentation and Isolation
Beneficial	Long-term	Research	**3.7** Based on 3.4, investigate ways to propagate Large Whorled Pogonia for reintroduction.	• Any or all threats by being able to counteract declines

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
4. Coordinate recovery activities with other plant species of the Carolinian Woodland Plants Recovery Strategy and work towards increasing the amount of high-quality interior moist forest habitat (to enhance the chances of natural dispersal and colonization of new sites).				
Critical	Short-term	Inventory, Monitoring and Assessment	**4.1** Develop monitoring protocol for Large Whorled Pogonia.	• Any or all threats. By gaining insight into causes of declines specific problems can then be addressed.
Critical	Short-term	Inventory, Monitoring and Assessment	**4.2** Apply monitoring protocol in association with monitoring other priority species of the overall draft Carolinian Woodlands Recovery Strategy.	• Any or all threats. By gaining insight into causes of declines specific problems can then be addressed.
5. Conduct outreach to naturalists, orchid enthusiasts and the public on the significance, uniqueness and vulnerability of the species.				
Beneficial	Long-term	Education & Outreach	**5.1** Educate orchid enthusiasts and naturalists on the impacts of visiting and trampling populations and of collecting.	• Trampling
Beneficial	Long-term	Education & Outreach	**5.2** Establishing a working relationship with orchid enthusiasts to facilitate propagation and appropriate repatriation if feasible.	• Any or all threats by increasing population size and thus resilience to extirpation
6. Pending research results (3.4, 3.7) investigate the feasibility of reintroducing Large Whorled Pogonia to suitable historic sites.				
Beneficial	Long-term	Management	**6.1** Based on assessments of threats, studies of the species' biology and ecology and population viability analysis, determine the feasibility and necessity of reintroduction.	• Any or all threats by increasing population size and thus resilience to extirpation
Beneficial	Long-term	Management	**6.2** Reintroduce species to historic or other suitable sites if deemed feasible.	• Any or all threats by increasing population size and thus resilience to extirpation

Narrative to Support Approaches to Recovery

The first step is to obtain up-to-date information on the status of the species. Because the species has the ability to remain dormant, gathering the necessary data may require visiting the sites several years in a row. Information is urgently needed on population size and demographic structure, habitat characteristics and condition, and threats in order to prioritize recovery activities. The two sites presumed to be extant have not been formally surveyed in over five years, and the historic Middlesex site should also be thoroughly searched. The presence or absence of exotic earthworms and sampling of the duff should be undertaken in concert with inventory. Once the status of the species is verified, recovery steps can proceed.

There is extant habitat that appears to match that of known sites, both on the Norfolk and the Bothwell sand plains. Colonization of new sites should be possible where suitable habitat conditions including appropriate fungal species are present. However, in general, very little forest habitat with acidic soils remains in extreme southwestern Ontario and much of it may in fact be negatively impacted by earthworm activity or other unknown factors. Landscape-level habitat restoration efforts, conducted in association with other Carolinian woodland species at risk, are needed. Habitat restoration will be a long process, but some progress should be evident within one decade. Locally, buffering of existing sites will increase the amount of interior forest. At a landscape level, efforts to re-establish more extensive and better-connected forests will aid in recovery of this and many other imperiled species of the Carolinian woodlands.

Recovery may require establishing new populations through reintroduction. Little is known about the species regeneration in situ, other than its need for mycorrhizal associations for nutrition. Because of these associations, propagating native orchids for potential restoration planting is often very difficult. Attempts to grow and transplant Large Whorled Pogonia have met with little success so far (ROM, 2009), and thus the protocol requires further study. Therefore, reintroduction of the Large Whorled Pogonia is probably best delayed until the knowledge gap on mycorrhizal relationships is better understood.

Many of the recovery steps suggested in this strategy should be accomplished in coordination with steps being planned for other Carolinian woodland species at risk in existing and developing parallel strategies. Examples of multi-species steps could include development of Beneficial Management Practices for woodlands, municipal natural heritage systems mapping and protection legislation, activities of conservation authorities and working with stewardship councils.

2.4 **Performance Measures**

- All sites have been searched in five consecutive years and presence or absence of the species as well as basic information on habitat characteristics and visible threats has been documented by fall 2016. (Steps 1.1, 1.2, 1.3)

- Management of sites on public lands has been reviewed with appropriate agencies, including need for dam regulation and signage where appropriate by fall 2016. (Steps 2.1, 2.2, 2.3)

- As a precautionary measure, during the time in which the status of the species is being confirmed, there is no increase in anthropogenic disturbance in the habitat, such as from logging or development (as determined from data in #1). Other threats, such as those from exotic species and air pollution, will be addressed pending research outcomes.

- The Skunk's Misery site and potential habitat sites are discussed with land managers, planners, and landowners (Step 2.4) beginning in 2014 and management planning has been updated (steps 2.5, 2.6) by 2016.

- Other recovery steps, especially monitoring, doing a population viability analysis and addressing knowledge gaps, will be undertaken pending the outcome of the inventory to determine the status of the species.

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 authors will be one of many sources considered by the Minister when developing the habitat regulation for this species.

In establishing the area to be prescribed as habitat in a regulation, two factors need to be considered.

First, in the time that Large Whorled Pogonia has been documented in Ontario, the species has been known to occur in several different ELC vegetation types. It has also been observed to be absent for a few years and then to crop up 100 m away in a different ELC vegetation type (Woodliffe pers. comm. 2009). Therefore, ELC type is not a hard and fast defining characteristic of habitat but rather is a broad guide to suitability.

Second, the maximum length of dormancy for this species is not known. The locations of this species have not been searched on a consistent annual basis so it is possible that the plants may have appeared and returned to dormancy without any documentation. Given this, a precautionary principle should be applied and a habitat prescription should be made for the populations presumed or possibly extant until their status is clarified.

It is suggested that the boundary of habitat will best be determined in the field and will require completion of recovery step 1.1 first. However, it is suggested that the area to be prescribed as habitat should be the ELC vegetation type around the three documented populations and any additional contiguous forest where conditions are suitable.

For example, this prescription would describe the ELC vegetation type polygon (probably variations of Red Maple-Red Oak deciduous forest) plus any contiguous forested area (of any type) that has more than10 cm of duff and humus and soil pH of 4.0 to 5.5. If the plants reappear in any given year and it becomes possible to fill knowledge gaps, these parameters can be further refined.

GLOSSARY

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 imperiled
2 = imperiled
3 = vulnerable
4 = apparently secure
5 = secure

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

Endangered (under COSEWIC and SARA): A wildlife species facing imminent extirpation or extinction.

Endangered (under COSSARO): A species that lives in the wild in Ontario but is facing imminent extinction or extirpation.

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.

REFERENCES

Anderson, A. B.1990. Improved germination and growth of rare native Ontario orchid species, p. 65-73., *in*: G.M. Allen, P.F.J. Eagles & S.D. Price, Conserving Carolinian Canada. University of Waterloo Press, Waterloo.

Arnolds, E. 1991. Decline of ectomycorrhizal fungi in Europe. *Agriculture, ecosystems and environment*, **35**: 209–244.

Baxter, J.W., S.T.A. Pickett, M. M. Carreiro, & J. Dighton. 1999. Ectomycorrhizal diversity and community structure in oak forest stands exposed to contrasting anthropogenic impacts. Canadian Journal of Botany. **77**: 771–782.

Bohlen, P.J., S. Scheu, C.M. Hale,M.A. McLean, S. Migge, P.M. Groffman and D. Parkinson, 2004. *Non-native invasive earthworms as agents of change in northern temperate forests.* Frontiers in Ecology and the Environment. **2(8)**: 427-435.

Crosthwaite, Jill, personal communication. 2011. Assistant Conservation Biologist, Nature Conservancy Canada, Guelph, Ontario.

Environment Canada. 2008. Species at Risk web page on Large Flowered Pogonia: http://www.speciesatrisk.gc.ca/search/speciesDetails_e.cfm?SpeciesID=183 Accessed March 4, 2009.

Flora of North America. 2005, 2006. Accessed November 23, 2006: http://efloras.org/florataxon.aspx?flora_id=1&taxon_id=220006872

Hale, C. M., L. E. Frelich, P. B. Reich. 2006. Changes in cold-temperate hardwood forest understory plant communities in response to invasion by European earthworms. Ecology 87(7): 1637-1649.

Hill, S.R. 2007. Conservation Assessment for the Large Whorled Pogonia (*Isotria verticillata* (Mulh. ex Willd) Raf.) Illinois Natural History Survey technical report 2007(8), Champaign, IL 46 pp. Accessed February 27, 2011. https://www.ideals.illinois.edu/bitstream/handle/2142/9938/inhsv02007i00008_opt.pdf?sequence=2.

House, H.D. 1906. Observations upon *Pogonia* (*Isotria*) *verticillata*. Rhodora (7) 84; 19-20.

Klinkenberg, R. 1986. Status Report on the Large Whorled Pogonia, *Isotria verticillata*, in Canada. Committee on the Status of Endangered Wildlife in Canada. 48 pp.

Mehrhoff, L.A. 1983. Pollination in the genus Isotria (Orchidaceae). American Journal of Botany. 70(10): 1444-1453

Mehrhoff, L. A. and M. A. Homoya. 2002. *Isotria* Rafinesque, Med. Repos., hexade 2, 5: 357. 1808. Pp. 511-513. *In* Flora of North America North of Mexico. Volume 26

Magnoliophyta: Liliidae: Liliales and Orchidales. New York: Oxford University Press. 723 pp. Available on line at http://www.efloras.org accessed February 28, 2011.

Michigan Natural Features Inventory. 2007. Rare Species Explorer (Web Application). Available online at http://web4.msue.msu.edu/mnfi/explorer (Accessed Mar 3, 2009).

Muratake, S. 2003. Effects of Exotic Earthworms on Northern Hardwood Forests in North America. *Restoration and Reclamation Review*. **8**:8.1; 1-11. (horticulture.coafes.umn.edu/vd/h5015/03papers/muratake.pdf)

NatureServe, 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.5. NatureServe, Arlington, Virginia. Accessed: February 26, 2009 http://www.natureserve.org/explorer.

NHIC (Natural Heritage Information Centre), 2011. Species Lists, Element Occurrence and Natural Areas databases and publications. Natural Heritage Information Centre, Ontario Ministry of Natural Resources, Peterborough, Ontario. Electronic databases; accessed March, 2009 and February 27, 2011.

Peter, M., F. Ayer and S. Egli. 2001. Nitrogen addition in a Norway spruce stand altered macromycete sporocarp production and below-ground ectomycorrhizal species composition. New Phytologist, 149 (2), 311-325.

Royal Ontario Museum (ROM), 2009. Species at Risk: Large Whorled Pogonia. http://www.rom.on.ca/ontario/risk.php?doc_type=fact&id=12&lang=en accessed March 4, 2009.

White, D.J. 1998. Update COSEWIC Status Report on the Large Whorled Pogonia, *Isotria verticillata*. Committee on the Status of Endangered Wildlife in Canada.

Whiting, E.R. and P.M. Catling. 1986. Orchids of Ontario. CanaColl Foundation, Ottawa, xii, 169 pp. + maps.

Woodliffe, Allen, personal communication. 2009. Aylmer District Ecologist, Ontario Ministry of Natural Resources, Chatham, Ontario.

RECOVERY STRATEGY DEVELOPMENT TEAM MEMBERS

Table 4. Recovery strategy development team members

NAME	AFFILIATION and LOCATION
The recovery strategy was developed by Jarmo Jalava, Judith Jones and John Ambrose under the direction of the following Recovery Team members:	
Dawn Bazely	York University
Jane Bowles	University of Western Ontario
Barb Boysen	Ontario Ministry of Natural Resources
Dawn Burke	Ontario Ministry of Natural Resources
Peter Carson	Private consultant
Ken Elliott	Ontario Ministry of Natural Resources
Mary Gartshore	Private consultant
Karen Hartley	Ontario Ministry of Natural Resources
Steve Hounsell	Ontario Power Generation
Donald Kirk	Ontario Ministry of Natural Resources
Daniel Kraus	Nature Conservancy of Canada
Nikki May	Carolinian Canada
Gordon Nelson	Conservation organization (NGO)
Michael Peppard	Conservation organization (NGO)
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Part 3 – *Large Whorled Pogonia – Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources

Ministry of Natural Resources

Natural. Valued. Protected.

Large Whorled Pogonia

Ontario Government Response Statement

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 Large Whorled Pogonia (Isotria verticillata) was published on June 15, 2012 (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/STDPROD_092936.html).

The response statement is the government's policy response to the scientific advice provided in the recovery strategy. All recommendations provided in the recovery strategy were considered and this response statement identifies those that are considered to be appropriate and necessary for the protection and recovery of the species. In addition to the strategy, the response statement is based on input from stakeholders, other jurisdictions, Aboriginal communities and members of the public. It 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.

The Large Whorled Pogonia is an orchid with a single yellowish-green flower that grows above a whorl of green leaves and can attain a height of 30 centimetres. It lives in moist, deciduous or mixed forests and obtains nutrients through soil fungi.

Ontario

MOVING FORWARD TO PROTECT AND RECOVER THE LARGE WHORLED POGONIA

The Large Whorled Pogonia is listed as an endangered species under the ESA, which protects both the plant 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.

The Large Whorled Pogonia is in the Carolinian forests in southwestern Ontario. This species can remain dormant underground for many years and therefore may persist undetected for long periods, possibly for decades. Although the last recorded observation of the Large Whorled Pogonia in Ontario was in 1996, the species is presumed to still exist at two locations and possibly exist at a third. It is presumed extirpated at a fourth location where it was last seen in 1879. Determining if any Canadian populations are still in existence (but currently dormant) is a knowledge gap in urgent need of filling for the recovery of this species. Habitat degradation due to land clearing, incompatible forestry practices, and trampling has likely played a significant role in the decline of this species. Other threats include flooding, the effects of atmospheric pollutants, and invasive plant species.

The Large Whorled Pogonia has been assessed as a globally secure species that has never been known to be common in Ontario, although historical surveys may have been limited. Propagation of the species in the wild has had limited success, which may in part be due to the specific mycorrhizal fungal associations required with the roots in the soil. Research into propagation techniques is underway in the U.S. Since it is uncertain whether Large Whorled Pogonia currently exists in Ontario, the main focus of recovery efforts is on confirming its presence and maintaining it at the existing locations.

The government's goal for the recovery of Large Whorled Pogonia is to confirm its presence and maintain the persistence of the species' populations and habitats in southern Ontario.

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 Large Whorled Pogonia, the government will directly undertake the following actions:

- Develop a survey protocol to be used by proponents and partners to survey for the presence of Large Whorled Pogonia.
- Educate other agencies and authorities involved in planning and environmental assessment processes on the protection requirements under the ESA.

- Encourage the submission of Large Whorled Pogonia 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 Large Whorled Pogonia and its habitat through the ESA.
- Support conservation, agency, municipal, industry partners and Aboriginal communities to undertake activities to protect and recover the Large Whorled Pogonia. Support will be provided where appropriate through funding, agreements, permits (including conditions) and advisory services.
- Establish and communicate annual priority actions for government support 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 Large Whorled Pogonia. 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.

Focus Area:	**Inventory and Monitoring**
Objective:	Confirm the existence of Large Whorled Pogonia populations and determine their extent and abundance.
	Actions:
	1. **(HIGH)** Conduct surveys for Large Whorled Pogonia at the sites where it may currently exist and, if found, document information about the population levels and demographics, its habitat, and any threats that may be present. Surveys may need to be carried out over a number of consecutive years, given dormancy periods, to determine if the species is still present.
	2. Conduct surveys at locations with potentially suitable habitat to determine if Large Whorled Pogonia is present.
Focus Area:	**Protection and Management**
Objective:	Protect and manage habitat to maintain existing populations in Ontario.
	Actions:
	3. Encourage stewardship activities to reduce threats to the species and its habitat at the sites where it may currently exist by maintaining suitable habitat conditions, removing invasive species, and reducing pedestrian traffic near occurrences.

Focus Area:	**Awareness**
Objective:	Increase awareness about the significance, uniqueness and vulnerability of the Large Whorled Pogonia.
	Actions:
	4. Provide information to orchid enthusiasts and other key stakeholders regarding the risks to Large Whorled Pogonia from inadvertent trampling and collecting.

IMPLEMENTING ACTIONS

Financial support for the implementation of actions may be available through the Species at Risk Stewardship Fund, Species at Risk Research Fund for Ontario, 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 Large Whorled Pogonia.

ACKNOWLEDGEMENT

We would like to thank all those who participated in the development of the "Recovery Strategy for the Large Whorled Pogonia (*Isotria verticillata*) 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
1-800-667-1940
TTY 1-866-686-6072
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ontario.ca/mnr