



Bird's-foot Violet *(Viola pedata)* in Ontario

Ontario Recovery Strategy Series

Recovery strategy prepared under the Endangered Species Act, 2007

2013

Natural. Valued. Protected.

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the Endangered Species Act (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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DECLARATION

The recovery strategy for the Bird's-foot Violet was developed 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

Bird's-foot Violet (*Viola pedata*) is a distinctive and showy perennial violet. It ranges across much of the eastern United States and has been reported from 14 populations distributed across a broad area in southwestern Ontario. It is considered globally secure (G5) but critically imperilled (N1) in Canada. Bird's-foot Violet is designated as endangered under Ontario's *Endangered Species Act, 2007*.

Of the documented 14 populations, there are currently only five populations considered extant in Canada, occupying a much-reduced range in Brant and Norfolk counties. Only one of these five populations is found on public land managed for conservation. Although recent information is lacking, this large population is believed to be stable or increasing due to ongoing habitat management and protection. The remaining four populations are found entirely on private land, and face many threats. At three of these four sites, fewer than 10 plants remained when they were last observed.

Bird's-foot Violet favours dry, open, sandy sites throughout its range. At its five remaining sites in Ontario, it grows mainly in oak savanna (or ingrown savanna) on well-drained, sandy soils. The species has a strong preference for sites with an open canopy, bare soil and a thin organic layer or moss cover. Originally, such open habitat would have been maintained by fire. In the settled southern Ontario landscape, the long-term maintenance of oak savanna requires regular management, such as brush cutting or prescribed burning.

The predominant threat to this species in Ontario is fire suppression which results in shaded and unsuitable conditions. This threatens plants mainly at the sites on private lands. Other threats include habitat loss through conversion to homes and gardens, trampling and recreational pressure, erosion, and competition from invasive species. The small size and limited spatial extent of most populations further compounds the risks that these threats pose to Bird's-foot Violet.

The recovery goal for Bird's-foot Violet is to maintain or increase the current abundance, area of occupancy and range extent within Ontario, by managing habitat and restoring or re-introducing the species to suitable habitat within its known range. Protection and recovery objectives are to:

1. protect extant populations by working collaboratively with landowners;
2. manage extant populations to maintain suitable habitat conditions;
3. monitor populations and habitats regularly, particularly in response to management actions; and
4. if necessary to meet the recovery goal, re-establish and/or introduce populations in suitable habitat within the species' former range.

It is recommended that the area prescribed as habitat in a regulation for Bird's-foot Violet include the extent of the Ecological Land Classification (ELC) Ecosite polygon(s) (Lee et al. 1998) within which the species is found. If plants are close to the edge of a polygon, a minimum distance of 50 metres from the outer limit of the population is

recommended for regulation. The areas surrounding cultivated Bird's-foot Violet plants and those originating from outside Canada should be excluded from regulation. Habitat mapping of all populations and sub-populations of this species would inform the regulation process.

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1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Bird's-foot Violet

SCIENTIFIC NAME: *Viola pedata*

SARO List Classification: Endangered

SARO List History: Endangered (2005), Endangered – Not Regulated (2004)

COSEWIC Assessment History: Endangered (2002), Threatened (1990)

SARA Schedule 1: Endangered (January 12, 2005)

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

Bird's-foot Violet (*Viola pedata*) is a herbaceous perennial in the violet family (Violaceae). Its common name derives from its distinctive, deeply divided leaves that resemble the splayed toes of a bird. Each leaf is three-parted and each division is further divided into three to five segments. In spring and autumn, lilac-purple flowers appear individually on leafless stalks that arise directly from the base of the plant (with the plants therefore appearing “stemless”). The five petals of the flower may be all the same colour, or the upper two may be darker in colour than the lower three petals (COSEWIC 2002). An entirely white form (*V. pedata* f. *alba*) also exists and has been reported from Ontario populations (Kavanagh et al. 1990). Flowers are broader (up to three centimetres across) and flatter than in many other native violets (Voss and Reznicek 2012). The unusually divided leaf and broad, erect flower with various colour forms make this a relatively showy violet, which can be cultivated in rock gardens. Following pollination, small, copper-coloured seeds are contained in smooth green capsules (COSEWIC 2002).

Bird's-foot Violet is quite distinctive in flower and in its vegetative form and is not likely to be confused with other species. In the past, it has been confused with Prairie Violet (*V. pedatifida*), which is known in Ontario only from a single population near Brantford, and the more widespread Wood Violet (*V. palmata*) (Kavanagh et al. 1990). Detailed botanical descriptions can be found in Gleason and Cronquist (1991) and Voss and Reznicek (2012). Technical illustrations are shown in Holmgren (1998).

Species Biology

In Ontario, Bird's-foot Violet flowers in mid-May to mid-June, and again in late September to mid-October. Plants may flower profusely in ideal habitat conditions, with up to 80 or more flowers on large individuals (Kavanagh et al. 1990). Unlike most other violets native to Ontario, it does not produce cleistogamous¹ flowers and cannot self-fertilize (Kavanagh et al. 1990).

Flowers are pollinated by long-tongued insects, primarily bumblebees (*Bombus* spp.) and certain butterflies (Kavanagh et al. 1990). Ripe seeds are forcefully ejected from mature capsules; in greenhouse conditions, these spread an average of 140 cm (and up to 510 cm) from the parent plant (Beattie and Lyons 1975). Ants are attracted to a lipid-rich structure on the seed, and may further transport *Viola* seeds an average distance of 75 cm to their nests (Culver and Beattie 1978). In addition to assisting with seed dispersal, this is thought to reduce seed predation and increase germination and seedling establishment. *Viola* seeds are eaten by birds, small mammals, caterpillar larvae, and occasionally ants (Beattie and Lyons 1975, Culver and Beattie 1978).

Bird's-foot Violet does not produce stolons or rhizomes, and therefore cannot reproduce vegetatively like many other violets (COSEWIC 2002). It has been suggested that plants require at least five years before reaching reproductive maturity (Molano-Flores 1999), although demographic studies could not be found. This showy species can be grown from seed (Cullina 2000), and a variety of cultivars is available commercially in Ontario. No information could be found about the longevity of seeds in soil.

Many members of the genus *Viola* in the United Kingdom have been found to have obligately symbiotic relationships with mycorrhizal fungi, which assist plants with the uptake of soil nutrients (Harley and Harley 1987). It is possible but not known whether North American species have similar associations.

Deer, cattle, rabbits and the caterpillars of several species of Fritillary (*Speyeria* spp.) have been reported as herbivores on the foliage of Bird's-foot Violet (Molano-Flores 1999) although this has not been documented as a threat at Ontario sites. In greenhouse conditions, seedlings and plants may be affected by other diseases (e.g., anthracnose, root rot) and pests (e.g., gall midges) (Molano-Flores 1999).

1.3 Distribution, Abundance and Population Trends

Distribution

Bird's-foot Violet occurs only in eastern North America from southern Ontario, New York and Minnesota, south to Georgia and Texas. In Canada, it has been documented only from 14 populations in southwestern Ontario, of which only five are believed to be

¹ Cleistogamous flowers are fertilized and set seed without opening (Voss and Reznicek 2012). Such flowers are common in the genus *Viola*; they are produced later in the season and are on shorter stalks, often close to the ground.

extant (Figure 1; Table 1; COSEWIC 2002; G. Buck, pers. comm. 2012; R. Gould, pers. comm. 2012). Nine extirpated populations have been documented.

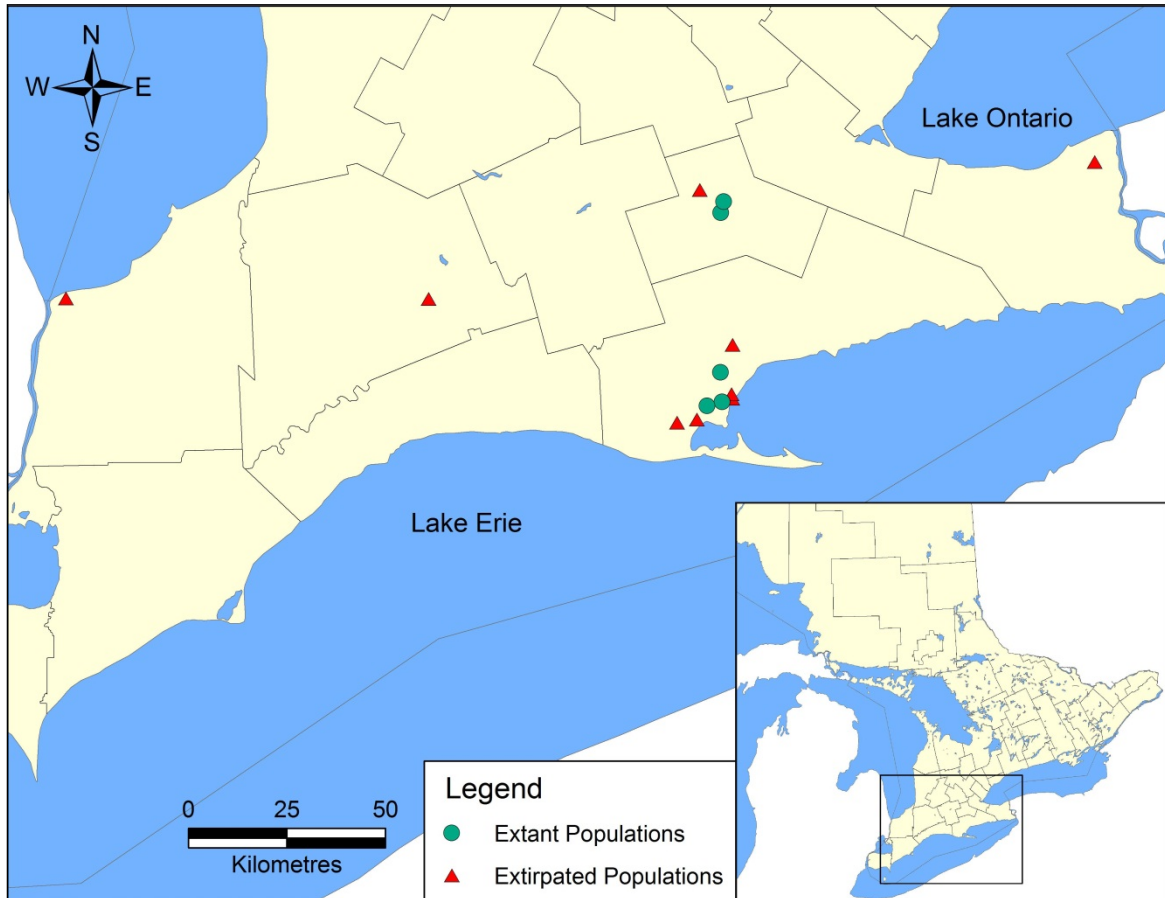


Figure 1. Extant and extirpated populations of Bird's-foot Violet in Ontario.

Table 1. Extant populations of Bird's-foot Violet in Ontario.

Location	Last observed	Population	Threats	Owner or Manager
Near Brantford	2001	~100 plants (4 sub-populations)	Housing development; fire suppression	Private
Golf Course Savanna, NW part of Brantford	1996	1996: 10 flowering plants 2006: Searched by R. Gould and D. Kirk, none observed.	Fire suppression	Private
Forestville	2001	1 plant	Fire suppression, small population size	Private
Turkey Point Provincial Park (including Turkey Point Tract of St. Williams Conservation Reserve)	~2011	TPPP: 2001: 6500 plants (in 8 sub-populations) ~2011: population estimated at 6500 or more	Trampling and recreational pressure	Ontario Parks
	~2011	St. Williams Conservation Reserve (Turkey Point Tract): 2001: 183 plants ~2011: 500 plants (estimate)	Invasive species, trampling, recreational pressure	OMNR
Vittoria	2005-2007	2001: 9 plants 2005-2007: 7-9 plants	Erosion, fire suppression, small population size	Private

Sources: COSEWIC (2002), R. Gould, pers. comm. 2012, NHIC (2012), A. Heagy, pers. comm. 2013.

Since the last COSEWIC status report (2002), one additional site has been discovered on property recently purchased by the Nature Conservancy of Canada. Bird's-foot Violet was discovered following a prescribed burn in a location where it had not previously been reported (G. Buck, pers. comm. 2012). The property on which this new population is found has now been regulated as part of Turkey Point Provincial Park and is likely to be considered a sub-population of the existing Element Occurrence at Turkey Point Provincial Park².

² To be considered as new Element Occurrences, plant populations must typically be separated from previously identified EOs by at least one kilometre (NatureServe 2012). In this document, a population is considered synonymous with an EO. Several sub-populations may be contained within one EO or population.

However, the total extent of suitable oak savanna habitat in Ontario is extremely limited and has been well surveyed, and this species is relatively distinctive. Together, these factors make it unlikely that new populations will be discovered.

Abundance and Population Trends

At the time of the 2002 COSEWIC status report, the total population of Bird's-foot Violet in Canada (i.e., in Ontario) was estimated at 6,800 plants, in five locations. This represented a significant population decline from 1990 estimate of 13,600 plants at three locations (Kavanagh et al. 1990). Although a more recent population estimate is not available, current information on each population is summarized below.

One Element Occurrence (EO) on public conservation lands in Ontario is considered stable. This EO consists of two main sub-populations within St. Williams Conservation Reserve (Turkey Point Tract) and at Turkey Point Provincial Park. Both of these sub-populations are probably increasing in size since the previous status report was completed in 2002 (R. Gould, pers. comm. 2012). Following prescribed burning in 2005 and again in 2010, the sub-population at the Turkey Point Tract within the St. Williams Conservation Reserve has increased in density and extent, with an estimated 500 plants observed in the last few years (R. Gould, pers. comm. 2012).

Similarly, continued fire re-introduction and use in the nearby sub-population at Turkey Point Provincial Park has resulted in an increase in the area occupied by Bird's-foot Violet, as well as its density and vigour. Although partial counts are made, a total census of this sub-population has not been made since 2001. The population is believed to equal or exceed the 2001 estimate of 6,500 plants (R. Gould, pers. comm. 2012).

The remaining four EOs, all on private property, are much more precarious. One formerly large Brantford population (3,300 plants in six sub-populations in 1987) had declined severely to about 100 plants in only four sub-populations by 2000. Two sub-populations were entirely lost to housing development. No access has been granted to these sites in recent years, so no further abundance information is available.

Another Brantford EO at a golf course has not reappeared despite several prescribed burns in suitable habitat, and is probably extirpated (G. Buck, pers. comm. 2012). Apart from burns at the golf course site, no management is known to have occurred at any of the Brantford sites. Oak savanna habitat at the golf course site is considered highly suitable for continued restoration and possible re-introduction (G. Buck, pers. comm. 2012).

The Forestville site has not been visited since 2001 (R. Gould, pers. comm. 2012, M. Gartshore, pers. comm. 2012), and it may be extirpated. Even in 2001, the oak savanna habitat at the site was becoming overgrown, and no management is known to have occurred since that time. However, based on experience at other sites, it is possible that the population could be recovered through site management such as prescribed burning, or perhaps even by using mechanical thinning techniques (R.

Gould, pers. comm. 2012). The resulting open habitat conditions would promote germination of seeds, assuming that they remain viable in the soil.

The population near Vittoria was visited between 2005 and 2007 and numbered around seven to nine plants (R. Gould, pers. comm. 2012). No management of this site has been undertaken, although suitable habitat is abundant and there is significant potential for restoration of the oak savanna, benefitting a number of other rare and at-risk species.

Nine of the fourteen documented populations are considered extirpated by the Ontario Natural Heritage Information Centre. These are: Sarnia (last observed in 1909), Paris (1900), London (1890), Niagara-on-the-Lake (1906), Simcoe (1905), St. Williams³ (1936), Normandale (1928), One mile north of Normandale (1960), and Backus Woods (1963) (NHIC 2012).

The majority of these old records have only vague locality data. One exception is the Backus Woods population, based on a 1963 collection. However, despite extensive searches in this area, including inventories by Steve Varga in 1985 and Bill Draper in 2011–2012, this population has not been rediscovered (COSEWIC 2002, W. Draper, pers. comm. 2012).

1.4 Habitat Needs

Throughout its range, Bird's-foot Violet favours dry, open, sandy sites, including savanna, prairies and slopes, and usually grows in association with oaks and/or pines (Kavanagh et al. 1990; Voss and Reznicek 2012). Habitat characteristics at the remaining Ontario populations have been well documented, although in some cases this information is now dated. Species inventories have been undertaken at most sites (Kavanagh et al. 1990), and a Masters' thesis has been completed to determine optimal microhabitat requirements at Ontario sites (Thompson 2006).

Bird's-foot Violet requires open conditions and benefits from fire. Plants at burned sites have shown to produce more flowers (Thompson 2006) and greater numbers of seeds (O'Dell 1996, cited in Thompson 2006) than plants at unburned sites. Compared with unburned sites, the effects of a burn on flower and fruit production have been observed even six years following a burn (Thompson 2006). Positive responses are likely due to the resultant removal of leaf litter, increase in bare soil cover and removal of tree, sub-canopy and shrub layers.

In Ontario, Bird's-foot Violet prefers oak savanna habitat, which may be dominated by Black Oak (*Quercus velutina*), White Oak (*Quercus alba*) and/or Red Oak (*Quercus rubra*). The sparse shrub layer, where present, typically contains species including Chokecherry (*Prunus virginiana*), Frost Grape (*Vitis riparia*), Staghorn Sumac (*Rhus*

³ This 1936 occurrence lies several kilometres to the west of the extant sub-population in the Turkey Point Tract of the St. Williams Conservation Reserve.

typhina), Wild Red Raspberry (*Rubus idaeus* ssp. *strigosus*), Gray Dogwood (*Cornus racemosa*) and Virginia Creeper (*Parthenocissus inserta*). Species often present in the understory typically include graminoids such as Little Bluestem (*Schizachyrium scoparium*), Kentucky Bluegrass (*Poa pratensis*), Hay Sedge (*Carex foenea*), Canada Bluegrass (*Poa compressa*) and Pennsylvania Sedge (*Carex pennsylvanica*). Common herbaceous plants include Hawkweeds (*Hieracium* spp.), Sheep Sorrel (*Rumex acetosella*), Field Pussytoes (*Antennaria neglecta*), Arrow-leaved Aster (*Symphotrichum urophyllum*), Canada Goldenrod (*Solidago canadensis*), Long-branched Frostweed (*Helianthemum canadense*), Plains Frostweed (*Helianthemum bicknellii*), Wild Strawberry (*Fragaria virginiana*), Wild Carrot (*Daucus carota*), Gray Goldenrod (*Solidago nemoralis*) and Bracken (*Pteridium aquilinum*) (Kavanagh et al. 1990). Virginia Goat's-rue (*Tephrosia virginiana*), also at-risk in Ontario, occurs with Bird's-foot Violet at several sites (Kavanagh et al. 1990; R. Gould, pers. comm. 2012).

Of associated species, Thompson (2006) found that the presence of Bird's-foot Violet was most strongly associated with Pilose Evening Primrose (*Oenothera pilosella*), Sheep Sorrel (*Rumex acetosella*) and Acuminate Panic Grass (*Panicum acuminatum*, now *Dichanthelium acuminatum*).

Detailed habitat and population information was collected at 180 microplots at three of the five Ontario populations (Thompson 2006). Biotic and abiotic factors including percentage of canopy opening, total vegetation cover and species composition, soil pH and nutrient profile, and soil cover (bare soil, litter, moss, etc.) were examined to determine which of these was most associated with the presence, vigour and reproductive capacity of the species. The study determined that plots associated with Bird's-foot Violet are most strongly associated with an open canopy (greater than 15% canopy openness, as measured by gap light analysis of canopy photos using specific software), bare soil or soil covered with a thin organic layer, and moss cover (for further information and methods, see Thompson 2006). This association is sufficiently strong that Thompson (2006) recommends habitat management (e.g., burning or mechanical thinning) if light levels reach less than 10% canopy openness.

The soils associated with Bird's-foot Violet consist of well-drained sandy loams and silty sands, which are dry through the late spring and summer (Kavanagh et al. 1990). No significant difference in soil pH could be found between similar microplots with and without Bird's-foot Violet (Thompson 2006). This species generally occurs in nutrient-poor soils but no clear patterns emerged in relation to the presence of soil nutrients at the microhabitat level (Thompson 2006).

In an analysis of suitable habitat, Thompson (2006) found that much of the habitat in and near Turkey Point Provincial Park would probably support Bird's-foot Violet, but it may be prevented from colonizing other sites due to its limited dispersal distances. The detailed habitat requirements in this study could be used to evaluate potential sites for restoration or population augmentation.

At Turkey Point Provincial Park, the large Bird's-foot Violet sub-population occurs within the following ELC vegetation communities (see Lee et al. 1998 and Lee 2008):

- Dry Red Oak Deciduous Savanna (SVDM3-1)
- Dry-Fresh Black Oak Deciduous Savanna (SVDM3-23)
- Dry-Fresh Oak-Maple Deciduous Savanna (SVDM3-26) (Chambers 2010).

However, the largest single sub-population at Turkey Point PP occurs within a linear hydro corridor that is too narrow to be mapped as an ELC polygon. Although anthropogenic in origin, this area consists of low herbaceous growth on drought-prone soils, and several prairie indicator species are present along the corridor length (R. Gould, pers. comm. 2012). Small patches of Bird's-foot Violet also occur in areas considered as Parkland (CGL-2) and in openings or at the margins of coniferous plantations, many of which are in the process of being restored to native savanna communities.

At the Turkey Point Tract of the St. Williams Conservation Reserve, Bird's-foot Violet is found along the margins of narrow bicycle trails and in oak openings within a Dry-Fresh Black Oak Deciduous Forest (FOD1-3) (Draper et al. 2002). Currently classified as forest, this area is considered by the authors to be "ingrown oak savanna." Although this community is not recognized within the ELC for southern Ontario (Lee et al. 1998), the authors broadly define it as a plant community on drought-prone soils with one or more conservative indicator plants associated with tallgrass prairie and savanna in Ontario. Areas of ingrown savanna were identified in this report in order to suggest sites within the reserve that were likely to have been oak savanna at the time of European settlement and which may be restored to this state.

No ELC mapping is known from the privately-owned sites where Bird's-foot Violet is found. At three of these sites where no management is known to have occurred, it is possible that occupied habitat would now be considered deciduous forest (or "ingrown savanna"), and that several of the associated understory species listed above are no longer present. Bird's-foot Violet may persist for some time in small isolated patches of degraded habitat, although experience has demonstrated that populations may rebound quickly when appropriate management is undertaken (R. Gould, pers. comm. 2012).

1.5 Limiting Factors

The main limiting factor for Bird's-foot Violet is its highly specific habitat requirements, combined with the lack of available suitable habitat in Ontario. The fact that suitable habitat must be actively maintained to sustain this species further limits its persistence and spread.

The reproduction of Bird's-foot Violet is limited by its inability to self-pollinate, reproduce vegetatively and disperse widely. However, the species is quite common in areas of

suitable habitat in the United States (where it is ranked N5, or secure), suggesting that these biological characteristics do not inherently limit the population across its range.

At least three populations are extremely small in number (10 or fewer plants), and occur over very limited areas, increasing the risk of their extirpation by both the anthropogenic threats below and by natural events. Given the highly restricted seed dispersal distances, these small populations are geographically isolated and are unlikely to be naturally re-established. Inbreeding depression may also limit small populations, although this has not been demonstrated.

1.6 Threats to Survival and Recovery

Fire Suppression

In the past, natural and human-caused fires shaped and maintained oak savanna habitat in southern Ontario (Rodger 1998). Because Bird's-foot Violet's oak savanna habitat now requires regular management (e.g., through prescribed burning or thinning) to maintain the open conditions favoured for growth and reproduction, an absence of management will eventually result in the habitat becoming unsuitable. The remaining types of natural disturbance that create open conditions (e.g., storms, severe drought, insect outbreaks) are insufficient to maintain the conditions required at specific sites. Fire suppression across southern Ontario, combined with an absence of habitat management, probably represents the single largest threat facing the species in Ontario. All four privately owned occurrences are at significant risk of loss as habitat becomes increasingly unsuitable for this species.

Habitat Loss

Historically, the conversion of oak savanna habitat to agricultural land has been the single largest cause of the decline in abundance and extent of Bird's-foot Violet in Ontario (Thompson 2006). Although it remains a serious threat, it is probably now of secondary importance to fire suppression. Within the last two decades, housing and associated landscaping have further eliminated a large percentage of plants and their habitat in Brantford (COSEWIC 2002; Kavanagh et al. 1990). Four of the five known extant Ontario occurrences are privately owned (wholly or in part), and two of these four (Brantford Golf Course Savanna and Forestville) may already be extirpated.

Trampling and Recreational Pressure

Kavanagh et al. (1990) noted that this species appears sensitive to trampling, although Bird's-foot Violet is tolerant to some disturbance and can grow well alongside trails where more light is available. Individual Bird's-foot Violet plants sometimes appear within recreation areas (e.g., playgrounds, lawns, picnic areas) at Turkey Point Provincial Park, and areas where Bird's-foot Violet is present are sometimes mown (M. Gartshore, pers. comm. 2012). Trampling and maintenance of these sites (e.g., mowing) may threaten small numbers of individuals (COSEWIC 2002), although this threat is probably minor, considering the large populations now present in the area (R. Gould, pers. comm. 2012).

Utility Corridor Management

Most plants in the large Turkey Point Provincial Park population occur along a hydro corridor (R. Gould, pers. comm. 2012). Regular vegetation clearance has likely helped these plants to persist and thrive. However, it is possible that there are negative impacts associated with maintenance of the hydro corridor. Careful assessment and monitoring of management practices would clarify the severity of this threat.

Erosion

The Vittoria site lies at the top of a sandy oak knoll, adjacent to a steep road cut. Although progressing slowly, erosion is considered a threat to this very small population and is exacerbated by a local practice of digging sand out of the side of the bottom of the embankment, undermining the savanna at the top (R. Gould, pers. comm. 2012).

Invasive and Aggressive Species

The dry sand plain habitat favoured by Bird's-foot Violet excludes many of the common invasive plant species in Ontario. However, in St. Williams' Conservation Reserve, Garlic Mustard has the potential to affect Bird's-foot Violet populations (White 2012), presumably through competition for resources and habitat alteration. Spotted Knapweed (*Centaurea maculosa*) is also present near the St. Williams and Turkey Point Provincial Park sites. Other species native to Ontario, including Poison Ivy (*Toxicodendron radicans*), Black Cherry (*Prunus serotina*), and Staghorn Sumac (*Rhus typhina*) can become dominant in areas following fire and may shade out Bird's-foot Violet (R. Gould, pers. comm. 2012, K. Breault, pers. comm. 2012).

1.7 Knowledge Gaps

Population and Habitat Status

The single most important knowledge gap for Bird's-foot Violet in Ontario is a lack of information on the population status and abundance at the privately owned sites (which include several populations, some with multiple landowners). In recent years, access has not been granted to visit several privately owned sub-populations. An assessment of the current severity of threats (e.g., canopy shading and erosion, as well as the presence of invasive species and an assessment of their risk to populations) is also urgently needed. The minimum viable population of Bird's-foot Violet is not known, but would be helpful information given the critically low population abundance at some Ontario sites.

Managed sites on public land would also benefit from increased, regular, standard monitoring and documentation of their population and extent, especially in response to management actions.

Seed Ecology

Nothing is known of seed bank characteristics such as longevity. Because reproduction in Bird's-foot Violet is entirely dependent on seeds, this information could benefit

restoration efforts at historical and overgrown sites and inform the development of a habitat regulation.

Management and Restoration Techniques

Bird's-foot Violet has responded positively to prescribed fire at Turkey Point Provincial Park and St. Williams Conservation Reserve (R. Gould, pers. comm. 2012). However, documentation of the response of Bird's-foot Violet to prescribed fire is lacking. More detailed study of the species' response to a variety of management methods (fire, mechanical thinning, mowing) would help to provide information to managers about optimal fire frequency, temperature and other conditions. The success of assisting seed dispersal (i.e., spreading seeds into the immediate area to increase the likelihood of germination) is not known. There is little experience in propagating and transplanting this species in Ontario (M. Gartshore, pers. comm. 2012, G. Buck, pers. comm. 2012).

1.8 Recovery Actions Completed or Underway

Due to the completion of ecological research on this species in Ontario (Thompson 2006), many ecological parameters that could assist in restoration and re-introduction are well understood.

The Turkey Point Provincial Park population has been managed to restore oak savanna since the early 1990s. The Park Management Plan (OMNR 1989) supports oak savanna restoration and the use of prescribed burning as a management tool. A vegetation management plan has been developed for Turkey Point Provincial Park, in which a primary objective is to maintain representations of oak savanna and prairie, with their associated rare species (OMNR 1987). In this plan, park vegetation is described and a number of management options are given in phases. Most areas occupied by Bird's-foot Violet have now undergone multiple burns, and the species has responded positively (R. Gould, pers. comm. 2012).

Prescribed burning has also been used as a management tool at the Turkey Point Tract within the St. Williams Conservation Reserve, with burns completed in 2005 and 2010 (R. Gould, pers. comm. 2012). The St. Williams Conservation Reserve, which also includes the Nursery Tract, has recently (2008) been regulated as a provincial Conservation Reserve. The area is now under management by the Ontario Ministry of Natural Resources, in co-operation with the St. Williams Conservation Reserve Community Council (SWCRCC) non-profit organization. Management of the reserve is guided by a conservation-oriented management plan to protect, maintain and restore natural communities, including oak savanna (OMNR 2005). A detailed Life Science Inventory has been completed, in which areas of the reserve which originally supported oak savanna have been identified (Draper et al. 2002). An Operations Plan (OMNR 2009) identifies specific approaches, identifies and maps priority areas for restoration, and outlines management techniques for oak savanna and other habitats within the reserve. Finally, a detailed species-at-risk survey has been completed for the reserve

(White 2010). The SWCRCC works closely with the OMNR to implement the Operations Plan.

Since 2008, the SWCRCC has undertaken many stewardship and communication activities to protect species-at-risk habitat in the reserve including installing signage to delineate the authorized recreational trail system, closing unauthorized trails through species-at-risk habitats, undertaking species-at-risk surveys in selected priority management areas, and undertaking vegetation management activities to convert conifer plantations to oak savannah habitat to benefit species at risk. In 2011, the Council produced and distributed a printed bookmark featuring information on the Bird's-foot Violet and its conservation needs. This species is also one of more than 30 species at risk highlighted on the SWCRCC's website.

The SWRCC is currently working with ecological consultants to develop a comprehensive species at risk management plan for the entire reserve. The preliminary draft of this plan summarized the specific management needs of the various species at risk found in forested habitats in the reserve, including Bird's-foot Violet (White 2012). Planning is underway for future prescribed burns in priority oak savanna habitats at the Turkey Point Tract, including that in the vicinity of the Bird's-foot Violet population.

Habitat management of oak savanna has been undertaken at the Golf Course Savanna occurrence in Brantford. Bird's-foot Violet has been documented at this site but has not reappeared (G. Buck, pers. comm. 2012). Stewardship of other areas of oak savanna on private lands within the range of Bird's-foot Violet has been underway for several years, and considerable expertise in habitat management (e.g., prescribed burning, brush cutting, seed collection and restoration planting) exists in southwestern Ontario. A recovery plan for tallgrass communities in southern Ontario (Rodger 1998) continues to provide a planning framework for restoration and recovery activities (K. Breault, pers. comm. 2012).

2.0 RECOVERY

2.1 Recovery Goal

The recovery goal for Bird's-foot Violet is to maintain or increase the current abundance, area of occupancy and range within Ontario by managing habitat and restoring or re-introducing the species to suitable habitat within its known range.

2.2 Protection and Recovery Objectives

Table 2. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Protect extant populations by working collaboratively with landowners.
2	Manage extant populations to maintain suitable habitat conditions.
3	Monitor populations and habitats regularly, particularly in response to management actions.
4	If necessary to meet the recovery goal, re-establish and/or introduce populations in suitable habitat within the species' former range.

2.3 Approaches to Recovery

Table 3. Approaches to recovery of the Bird's-foot Violet in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
1.0 Protect extant populations by working collaboratively with landowners				
Critical	Short-term and Ongoing	Communications, Protection, Management	1.1 Identify and contact current private landowners to evaluate (or re-evaluate) interest in the protection and management of Bird's-foot Violet. Build collaborative relationships with private property owners (a long-term initiative).	<ul style="list-style-type: none"> • Habitat loss • Fire suppression
Critical	Long-term	Communications, Protection	1.2 Working with landowners, investigate and undertake additional methods of long-term stewardship and protection of each site; e.g.: <ul style="list-style-type: none"> – secure Species at Risk stewardship funding and/or Conservation Land Tax Incentive Program tax incentives; – participate in local conservation stewardship programs; – protect land through securement, easements or acquisition; – develop, field-test, and distribute concise Best Management Practice documents (BMPs) for appropriate management of Bird's-foot Violet (oak savanna) habitat; and – if necessary, develop habitat mapping guidelines so that Bird's-foot Violet habitat is eligible for the CLTIP program. 	<ul style="list-style-type: none"> • Habitat loss • Fire suppression • Utility corridor management • Invasive and aggressive species • Trampling and recreational pressure
2.0 Manage extant populations to maintain suitable habitat conditions				
Critical	Short-term	Management, Stewardship	2.1 Engage with landowners or land managers to identify management needs for each population; develop (or maintain) an oak savanna habitat management plan for extant sites.	<ul style="list-style-type: none"> • Population status • All threats

Recovery Strategy for the Bird's-foot Violet in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Critical	Short-term	Communication, Education and Outreach	2.2 Develop and field-test best management practices for oak savanna, e.g., Tallgrass Prairie and Savanna Prescribed Fire Decision Support System (North-South Environmental 2003) and other resources (e.g., Tallgrass Ontario, local stewardship councils).	<ul style="list-style-type: none"> • Habitat loss • Fire suppression
Critical	Ongoing	Management, Communication and Education	2.3 Manage extant sites on public lands according to habitat management plan(s) and monitor results following management action. <ul style="list-style-type: none"> – Continue management at Turkey Point Provincial Park and St. Williams Conservation Reserve in accordance with existing plans. – Ensure that management plans are kept current, and are informed by the best available science. – Increase awareness among park staff (e.g., seasonal operations staff) and visitors of Bird's-foot Violet habitat, and of best management practices in these areas. 	<ul style="list-style-type: none"> • Habitat loss • Fire suppression, Trampling and recreational pressure
Necessary	Long-term	Research Monitoring	2.4 Undertake detailed studies and monitoring to determine the success of a variety of management techniques on Bird's-foot Violet response, including: <ul style="list-style-type: none"> – prescribed burn (e.g., optimal frequency, season, fire intensity and burning prescriptions); – mechanical thinning of canopy; – mowing; and – assisted seed dispersal. 	<ul style="list-style-type: none"> • Fire suppression • Management and restoration techniques
Necessary	Long-term	Management, Restoration	2.5 If necessary to meet recovery goal, augment existing populations. <ul style="list-style-type: none"> – Working with OMNR, collect seed from Ontario populations to provide a local source for restoration if required, and to guard against the risk of population loss. – Assist seed dispersal at extant populations into areas of apparently suitable habitat. – Monitor, document, and share results 	<ul style="list-style-type: none"> • All threats • Management and restoration techniques

Recovery Strategy for the Bird's-foot Violet in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
3.0 Monitor populations and habitats regularly, particularly in response to management actions				
Critical	Short-term	Inventory, Monitoring and Assessment	3.1 Conduct surveys of all populations, including: <ul style="list-style-type: none"> – total population census; – accurate GPS mapping of habitat extent and ELC vegetation communities; – measurement of canopy openness (see Thompson 2006); and – assessment of threats and identification of habitat management needs. 	<ul style="list-style-type: none"> • Population and habitat status • All threats
Necessary	Long-term	Inventory, Monitoring and Assessment	3.2 Develop and implement a standard monitoring program for all accessible populations, to be conducted every three to five years), including the population and threat assessment tasks above.	<ul style="list-style-type: none"> • Population and habitat status • All threats
4.0 If necessary to meet recovery goal, re-establish and/or introduce populations in suitable habitat within the species' former range				
Necessary/Beneficial ⁴	Long-term	Management, Stewardship	4.1 Identify potential areas for re-introduction and establishment of Bird's-foot Violet based on (e.g.): <ul style="list-style-type: none"> – presence of a historically documented population; – landowner/land manager commitment; – conservation ownership and management;and – habitat suitability and restoration potential. 	<ul style="list-style-type: none"> • Habitat loss and degradation • Small population size
Necessary/Beneficial ³	Long-term	Management, Stewardship	4.2 Collaboratively with landowners and managers, develop and implement site restoration and management plan(s).	<ul style="list-style-type: none"> • Habitat loss and degradation • Small population size

⁴ These approaches will be beneficial under any circumstances, but will become necessary to meet the recovery goal, should extant populations be lost.

Recovery Strategy for the Bird's-foot Violet in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Necessary	Long-term	Research	<p>4.3 Undertake applied research to determine:</p> <ul style="list-style-type: none"> - seed bank dynamics and longevity; and - the success of techniques such as assisting seed dispersal, and cultivation methods. 	<ul style="list-style-type: none"> • Management and restoration techniques • Seed ecology

Narrative to Support Approaches to Recovery

Bird's-foot Violet is in critical condition in Ontario. Although it has always been rare in the province, the extent and quality of its oak savanna habitat are now so severely reduced that even maintaining current populations (i.e., abundance, area of occupancy, and range extent) is likely the best scenario that can be achieved. Even this outcome will require a significant and increased commitment by government agencies, non-governmental partners and private citizens.

The extant population on conservation lands (Turkey Point Provincial Park and St. Williams Conservation Reserve) appears to be stable to increasing in population, and is responding well to current management approaches. For these areas, which are in public ownership and regarded as secure, continued management is required according to existing management plans (e.g., OMNR 2005, OMNR 2009). More rigorous monitoring and detailed study of Bird's-foot Violet populations at these locations would lead to a better understanding of the response of this species to different management techniques. A high level of adaptive management that links monitoring, management and research at these sites will benefit all other populations in Ontario, and is considered fundamental to recovery success.

The approaches identified in Table 3 are intended primarily to reduce the real and immediate risk of extirpation of the four populations on private property. One of these populations may already be extirpated. Without a rapid and targeted effort, the three other populations (near Brantford, Vittoria and Forestville) could well be extirpated in the near-term. Current ownership should be determined, and private landowners contacted to discuss the possibility of habitat management. It is recommended that ownership information be kept current, so that new owners may be approached within one or two field seasons.

It will be critical to identify and obtain financial support for the restoration of Bird's-foot Violet and oak savanna habitat on privately owned lands (Brantford, Vittoria and Forestville). The most successful management technique is likely to be prescribed burning, although the high cost of conducting burns almost always requires external funding. Ensuring that existing stewardship funding sources prioritize recovery actions for Bird's-foot Violet habitat restoration is also critical. Unfortunately, other successful conservation incentive programs do not currently apply to habitat conservation for Bird's-foot Violet. For example, the highly successful Norfolk County Alternative Land Use Services (ALUS) pilot program provides funding to farmers only for habitat creation, rather than for long-term protection or management of existing habitat.

Other financial incentives should also be examined to assist in conservation on private lands. The Conservation Land Tax Incentive Program (CLTIP) frequently does not provide significant financial incentives for agricultural landowners (K. Breault, pers. comm. 2012). CLTIP may provide a reasonable incentive for urban and suburban landowners, although habitat mapping guidelines must be developed before this can occur (F. McKay, pers. comm. 2012). Examining and identifying funding sources and other incentives for habitat stewardship on private lands would greatly assist in gaining

the support of private landowners. Securement of these sites through easements or acquisition by land trusts should also be explored.

In the event that private landowners are not interested in species management or other conservation initiatives including easements or acquisition, and no management is known to have occurred, it is reasonable to assume that these populations will be lost. Unless habitat has been converted to other uses, opportunities for restoration should continue to be sought, even if no plants are visible: habitat management probably led to the re-establishment of the James property population, now regulated as part of Turkey Point Provincial Park (G. Buck, pers. comm. 2012).

Without recovery efforts, it is possible that the original distribution of 14 documented populations that ranged across southern Ontario from Lambton County to London and Niagara-on-the-Lake may dwindle to only one population in a small area of Norfolk County. Bird's-foot Violet would then remain only within a very restricted range that represents a small fraction of its former extent and would be increasingly vulnerable to localized threats. In this situation, habitat restoration and population (re-) establishment in Ontario is warranted and should be actively pursued.

Given the likelihood of the above scenario, accomplishing the stated recovery goal will require additional populations. The preferred approach is to re-establish populations at historically documented locations, at least where these are known and ideally under long-term conservation ownership and/or management. Unfortunately, locality data for most extirpated sites is vague, and many sites have been converted to other uses. Areas of oak savanna habitat found at Backus Woods in the 1980s may no longer be suitable (W. Draper, pers. comm. 2012). If Bird's-foot Violet does not re-establish naturally at the Brantford Golf Course savanna, this site is considered suitable for re-introduction (G. Buck, pers. comm. 2012).

An alternative approach could be to consider establishment of populations in suitable habitat within the former Ontario range, even if the species has not previously been documented from that location. Criteria for the selection of such sites would need to be developed and include factors such as landowner commitment, ownership, site suitability, restoration potential, and existing management framework(s). For example, suitable habitat exists or could be restored within the nearby Nursery Tract of the St. Williams Conservation Reserve (R. Gould, pers. comm. 2012). Thompson (2006) also identified sites with suitable but unoccupied habitat; these may provide additional areas for consideration.

Due to its specific habitat requirements, cultivating this species may require expertise and practice. Some information on its cultivation and use in prairie restoration in the United States exists (e.g., Cullina 2000). Local seed sources are not currently available (Gartshore, pers. comm. 2012). Introducing species at risk to the wild in Ontario, either through seed or transplants of local origin, is subject to provisions under the ESA and would require authorization from the Ministry of Natural Resources. The use of seed

collected outside Ontario should not be used for management of Bird's-foot Violet in Ontario.

2.4 Performance Measures

Objective	Performance Measures
1. Protect extant populations by working collaboratively with landowners.	<ul style="list-style-type: none"> • No populations lost • Current landowners identified and made aware of stewardship opportunities and financial resources • Increase observed in the number of sites protected through stewardship, easement or acquisition • Site access granted for monitoring purposes
2. Manage extant populations to maintain suitable habitat conditions.	<ul style="list-style-type: none"> • Habitat quality improved (i.e., through cutting or prescribed burning) and threats reduced at most sites • Increase observed in the number of land owners actively managing sites
3. Monitor populations and habitats regularly, particularly in response to management actions.	<ul style="list-style-type: none"> • Standard monitoring protocol developed and sites regularly monitored • Current population information available to stakeholders (e.g., municipalities)
4. If necessary to fulfill recovery goal, re-establish and/or introduce populations in suitable habitat within the species' former range.	<ul style="list-style-type: none"> • The current range extent and area of occupancy of Bird's-foot Violet in Ontario are maintained.

2.5 Area for Consideration in Developing a Habitat Regulation

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

It is recommended that the area prescribed as habitat in a regulation for Bird's-foot Violet include the extent of the Ecological Land Classification (ELC) Ecosite polygon(s) (Lee et al. 1998) within which extant populations of the species occur. It is recommended that accurate inventory and ELC mapping of these habitats be conducted to support the habitat regulation. If plants are close to the edge of an Ecosite polygon, a minimum distance of 50 metres is recommended for regulation. Protecting a minimum radius of 50 metres around the extent of each population represents a precautionary approach to ensure the necessary habitat conditions are maintained and that plants are protected from harm.

Regulating habitat based on the vegetation community, rather than an arbitrary distance from the outer limits of the population, will help to preserve ecological functions required for the recovery of Bird's-foot Violet. Such functions include pollination, seed dispersal and recruitment in suitable habitat.

The level of Ecosite is recommended over the narrower Vegetation Type for two reasons. First, where they occur, Dry Tallgrass Savanna Ecosites (Lee et al. 1998) would be considered as suitable habitat for this species. Second, this broader delineation will encourage preservation of Bird's-foot Violet's very rare, oak savanna habitat in Ontario. All Ontario savanna Vegetation Types, and therefore Ecosites, are considered to be of conservation concern by the NHIC (NHIC 2012). A wider level of protection will help to conserve this species, which is particularly at risk on private lands.

Populations that have not been recently observed should be presumed extant until determined otherwise by the Ontario Natural Heritage Information Centre, following standard guidelines. Habitat at such sites may or may not be suitable for Bird's-foot Violet, but a potential for habitat restoration should exist. Such areas should remain protected in order to preserve the seed bank, in the event that habitat restoration may one day occur. The longevity of seeds in soil is not currently known, but is identified as a knowledge gap.

There is a very small amount of suitable but unoccupied habitat within the species' Ontario range. Should new populations be discovered or established through restoration, it is recommended that a habitat regulation be applied to those sites. Because Bird's-foot Violet may establish in disturbed areas, it is recommended that vegetation communities that are anthropogenic in origin (e.g., Cultural Meadows) also be included in a habitat regulation. However, clearly unsuitable areas, such as manicured lawns, gardens, driveways and structures, should not be included.

Bird's-foot Violet can be cultivated as an ornamental plant and is available for purchase in Canada (L. Campbell, pers. comm. 2012). Most nursery stock in Canada is likely of American origin (M. Gartshore, pers. comm. 2012). It is recommended that horticultural populations and those known to have originated from sources outside Canada be excluded from a habitat regulation.

GLOSSARY

Cleistogamous: A flower that is fertilized and sets seed without opening, common in many violet species.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee, established under section 14 of the *Species at Risk Act*, that is responsible for assessing and classifying species at risk in Canada.

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

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

- 1 = critically imperilled
- 2 = imperilled
- 3 = vulnerable
- 4 = apparently secure
- 5 = secure

Ecological Land Classification (ELC): This refers to a standard method of vegetation community classification for southern Ontario. For more information, please see Lee et al. (1998).

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

Mycorrhiza: An association between a fungus and the roots of a vascular plant.

Rhizome: A horizontally creeping underground stem with roots and leaves, which usually persists from season to season.

***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. 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.

Stolon: A stem that grows horizontally; a runner (e.g., as in the strawberry).

Symbiotic: A close association between two or more (usually dissimilar) species, in which each species benefits. Such interactions may be obligate (i.e., both species entirely depend on the other) or facultative (i.e., each can, but does not have to live with the other).

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