PROPOSED

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

Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Canada

Virginia Goat's-rue

2015

Government of Canada
Gouvernement du Canada
Canada

Recommended citation:

Environment Canada. 2015. Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. 24 pp. + Annexes.

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].

Cover illustration: © Allen Woodliffe

Également disponible en français sous le titre
« Programme de rétablissement de la téphrosie de Virginie (*Tephrosia virginiana*) au Canada [Proposition] »

ISBN
Catalogue no.

[1] http://www.registrelep-sararegistry.gc.ca

RECOVERY STRATEGY FOR THE VIRGINIA GOAT'S-RUE (*Tephrosia virginiana*) IN CANADA

2015

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

In the spirit of cooperation of the Accord, the Government of Ontario has given permission to the Government of Canada to adopt the *Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario* (Part 2) and the *Bird's Foot Violet and Virginia Goat's-rue – Ontario Government Response Statement* (Part 3) under Section 44 of the *Species at Risk Act* (SARA). Environment Canada has included a federal addition (Part 1) which completes the SARA requirements for this recovery strategy.

The federal recovery strategy for the Virginia Goat's-rue in Canada consists of three parts:

Part 1 – Federal Addition to the *Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario*, prepared by Environment Canada.

Part 2 – *Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario*, prepared by Patricia Mohr for the Ontario Ministry of Natural Resources[2].

Part 3 – *Bird's Foot Violet and Virginia Goat's-rue – Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources and Forestry.

[2] On June 26, 2014, the Ontario Ministry of Natural Resources became the Ontario Ministry of Natural Resources and Forestry.

Table of Contents

PART 1 – Federal Addition to the *Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) 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)[3] 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 Virginia Goat's-rue 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 Virginia Goat's-rue (Part 2) in cooperation with Environment Canada.

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

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

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 federal addition was prepared by Patricia Mohr (MMM Group Limited). Additional preparation and review of the document was completed by Allison Foran and Krista Holmes (Environment Canada, Canadian Wildlife Service – Ontario). This federal addition benefited from input, review, and suggestions from the following individuals and organizations: Ken Tuininga and Lesley Dunn (Environment Canada, Canadian Wildlife Service – Ontario); Samuel Brinker, Melody Cairns, David Depuydt and John Sager (Ontario Ministry of Natural Resources and Forestry); and Jen Baker (Hamilton Naturalists' Club).

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

Additions and Modifications to the Adopted Document

The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the Province of Ontario's *Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario*, (Part 2) and to provide updated or additional information.

Environment Canada is adopting the Ontario recovery strategy (Part 2) with the exception of section 2.0, "Recovery". In place of section 2.0, Environment Canada has established its own population and distribution objectives that are consistent with the provincial recovery goal, and is adopting the government-led and government-supported actions of the *Bird's-foot Violet and Virginia Goat's-rue – Ontario Government Response Statement* (Part 3) as the broad strategies and general approaches to meet the population and distribution objective.

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

1. Species Status Information

The Virginia Goat's-rue is endemic to North America from Ontario south to Texas and Florida. In Canada, the species is at the northern edge of its North American range and occurs as two extant[4] populations in southwestern Ontario: the Turkey Point Natural Area (including both Turkey Point Provincial Park and St. Williams Conservation Reserve) and the Vittoria Dune Ridge population. The species is limited by its restriction to acidic soils in tallgrass savannah and tallgrass woodland, which are rare habitat types in Ontario and Canada (Mohr 2013).

The species has a global conservation rank of Secure[5] (G5; NatureServe 2013). In the United States the species has a national conservation rank of Secure (N5), and occurs in 35 states where its subnational conservation rank ranges from Critically Imperilled[6] (S1) to Secure (S5; Appendix A). In Canada, the Virginia Goat's-rue has a national and subnational (Ontario) conservation rank of Critically Imperilled (N1 and S1, respectively). It is listed as Endangered[7] on Schedule 1 of the federal *Species at Risk*

[4] In existence; still existing; not destroyed or lost.
[5] Secure: Common, widespread and abundant.
[6] Critically Imperilled: At a very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats or other factors.
[7] A wildlife species facing imminent extirpation or extinction in Canada.

Act (SARA). In Ontario, the species is listed as Endangered[8] under the provincial *Endangered Species Act, 2007* (ESA). The range of Virginia Goat's-rue in Canada represents less than 1% of the species' global range (COSEWIC 2009).

2. 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 Virginia Goat's-rue. 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.

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

   Yes. There are currently two extant populations in Canada (Turkey Point Natural Area and Vittoria Dune Ridge). Fieldwork in 2008 confirmed 566 plant patches and 6,958 stems in the Turkey Point Natural Area, growing as numerous scattered subpopulations (in and around Turkey Point Provincial Park and St. Williams Conservation Reserve) (COSEWIC 2009). Some occurred in open habitat where they were able to flower but a significant number were in overgrown areas existing as thin, weak, non-flowering clumps. These individuals may flower if open conditions return. It is not known how long individuals in shade can persist as reproductive specimens. There are plans to continue prescribed burns and expand their range at the Turkey Point Natural Area (Cairns pers. comm. 2014), such that additional individuals may reproduce in the foreseeable future. There may be individuals capable of reproduction in the Vittoria Dune Ridge population but access has not been possible since the 2001 census when 100 stems were found in a single plant patch, and the long-term viability of this population is uncertain due to ongoing erosion at this location (COSEWIC 2009).

   It should be noted that the Vittoria Dune Ridge population in Ontario is isolated and small, and therefore loss of genetic diversity may be a concern if the species does not continue to successfully reproduce for long periods of time.

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

   Unknown. The Virginia Goat's-rue demonstrates narrow habitat specificity owing to its requirement for oak savannah and oak woodland habitat (or remnant savannah habitat along forest or woodland edges) on dry, acidic, sandy soils. Oak savannah and oak woodland habitats are globally, nationally and provincially

[8] A species that lives in the wild in Ontario but is facing imminent extinction or extirpation.

rare (NHIC 2012). These habitats are rare in Ontario as a result of conversion of oak savannah, oak woodland and other tallgrass habitat to other land uses including urban areas and agricultural lands (Rodger 1998). Plants of savannah communities require periodic disturbance to maintain open conditions (i.e., limit woody encroachment, reduce duff[9]) and scarify[10] the soil surface to maintain conditions suitable for seed germination and establishment. Virginia Goat's-rue's shade intolerance and small shoots make it exceptionally susceptible to competition. Suitable habitat can be made available through prescribed burns (COSEWIC 2009). Prescribed burns have provided suitable habitat at Turkey Point Natural Area and, if resources allow, will continue to provide suitable habitat at this location (Cairns pers. comm. 2014). A prescribed burn occurred in 2011 and more are planned at Spooky Hollow (Baker pers. comm. 2014), a historical population of Virginia Goat's-rue. The species was last observed at Spooky Hollow in 1991. Two targeted surveys; one in the early 2000s and one in 2008, did not result in any observations of the species (COSEWIC 2009). It is not known exactly how long the species has been extirpated from the site (i.e., the population was lost sometime in the 1990s or early 2000s), or whether a viable seedbank remains (COSEWIC 2009). With continued habitat management, it is possible that this site may support the species in the future if viable seeds persist in the seedbank or methods for propagating the plant are developed.

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

Unknown. The primary threats include loss of habitat due to an altered disturbance regime (i.e., fire suppression), and the increasing presence of invasive plant species, especially Autumn Olive (*Elaeagnus umbellata)*, Multiflora Rose *(Rosa multiflora),* Norway Maple (*Acer platanoides)*, and Periwinkle (*Vinca minor)* (Mohr 2013). Prescribed burns have been undertaken in the Turkey Point Provincial Park and St. Williams Conservation Reserve to maintain habitat conditions required by the species. Although the impacts of invasive plant species may to some extent be controlled or mitigated through prescribed burning, some invasive species such as Oriental Bittersweet *(Celastrus orbiculata)* appear to thrive following prescribed burns, which increases competition for Virginia Goat's-rue. Mechanical removal may be required to control invasive species, such as Oriental Bittersweet, that are not discouraged by prescribed burns (Mohr 2013). The threat from invasive plant species is relatively recent and it likely can be mitigated using established techniques to eradicate or control invasive plant species.

In addition, the Vittoria Dune Ridge population occurs on a sand ridge that is experiencing habitat loss due to sand extraction activities which have increased the natural rate of erosion at this site (COSEWIC 2009). Although it is possible

[9] Organic matter in various stages of decomposition on the floor of the forest.
[10] To break the surface of the soil.

the impact of future erosion may be mitigated through habitat management activities, it is doubtful that this population will persist over the long-term due to the increased rate of erosion at this site, some of which may have led to irreversible habitat loss (COSEWIC 2009).

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

   Unknown. There are several techniques that exist or are in development, and could aid in the recovery of Virginia Goat's-rue where it persists today or in other suitable habitat. Prescribed burns have been effective at restoring tallgrass habitats in southern Ontario, by opening up the habitat and establishing earlier successional stages and may allow re-establishment of the species at historical sites (Mohr 2013). Threats posed by invasive species may be reduced by undertaking control measures (e.g., prescribed burning and mechanical removal of plants). Invasive plant control is considered more successful during early stages of invasion. The Vittoria Dune Ridge population occurs on private land. Although methods to stabilize the eroding ridge could be employed, these may not be sufficient to prevent the species from being extirpated from this site given that landowner support is unknown, mitigation techniques are not known or proven and it is possible that some erosion may be irreversible.

   However, techniques for propagation (including assisted dispersal, cultivation or transplantation) to encourage re-establishment are unknown. For example, in 2004, seeds were collected from the Turkey Point Natural Area and in 2005 an effort was made to plant the seeds at the James property (a site not previously occupied by the species, but with suitable habitat). These efforts were unsuccessful, and the best practices for propagating the plant remain unknown (Mohr 2013). The restoration of the species at sites it historically occupied may be dependent on the longevity of seeds in the seedbank which is also unknown (Mohr 2013).

In Canada, the Virginia Goat's-rue is only found at two locations in southern Ontario and is at the northern edge of the species' range. It was previously more widespread as four documented populations are now considered extirpated or historical in Canada. As such, it will likely always be vulnerable to human-caused stressors and natural, chance events. The species was never widespread in Canada (Mohr 2013), and will likely continue to be considered 'at risk' in Canada despite applying available recovery techniques and maintaining existing populations.

3. Threats

In addition to the known and potential threats outlined in Part 2 - *Recovery Strategy for the Virginia Goat's-rue* (Tephrosia Virginiana) *in Ontario*, another potential threat to the Virginia Goat's-rue is the decline in pollinator populations. The primary pollinator of Ontario populations has not been identified; however it is thought that the species is

adapted to bee pollination (COSEWIC 2009). It is speculated that *Megachile mucida* is a bee species that pollinates the Virginia Goat's-rue (Mohr 2013). 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 (Health Canada 2014). 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; Cutler et al. 2014).Currently, the extent to which the decline of pollinator populations may impact the Virginia Goat's-rue is not known.

4. Population and Distribution Objectives

The *Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario* (Part 2) contains the following recovery goal:

- The recovery goal is long-term survival of the species and its habitat in Ontario through protection and restoration efforts that increase the species' abundance and range.

The Government Response Statement for the province of Ontario (Part 3) addresses the Virginia Goat's-rue and the Bird's-foot Violet (*Viola pedata*) collectively due to their similar habitat type and threats. The Government Response Statement prepared by the province of Ontario states the following goal for the recovery of the Virginia Goat's-rue and the Bird's-foot Violet in Ontario:

- The government's goal for the recovery of the Bird's-foot Violet and Virginia Goat's-rue in Ontario is to maintain the provincial population of each species at, or enable natural increases to, sustainable levels, and re-establish the species at sites they have historically occupied if feasible and appropriate.

Under SARA, a population and distribution objective 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 Virginia Goat's-rue in Canada is to:

- Maintain, or where necessary and biologically and technically feasible, increase the species' current abundance and distribution at extant and historically occupied sites in Canada.

Though Virginia Goat's-rue was probably always rare, occurring at the northern edge of its range, it was previously more widespread as four documented populations are now considered extirpated or historical in Canada. Based on the 2008 census, the total count for Canadian populations is approximately 567 plants with 7,058 stems (566 plants and 6,958 stems in the Turkey Point Natural Area population and 1 plant with approximately 100 stems in the Vittoria Dune Ridge population). The area of habitat occupied by Virginia Goat's-rue is approximately 0.0016km^2 (COSEWIC 2009).

Currently two populations of the species are known to occur. Due to the rarity of this species within Canada, maintaining all sub-populations is considered important to ensure that the Canadian distribution is not further reduced. Government-supported protection activities in Part 3 - Ontario Government Response Statement include the implementation of management strategies to improve habitat conditions and support natural increases in the distribution and abundance of the species at extant locations (see Part 3). In addition, the species may be re-established at sites it has historically occupied if deemed feasible and appropriate (government-supported action #2 - Part 3). A population viability analysis for the Virginia Goat's-rue would be beneficial to determine if and where increases in population abundance are considered necessary to promote self-sustaining[11] populations and long-term persistence of the species.

Restoration of the species at historical sites through habitat management, as well as habitat improvement at extant populations may be required to meet the population and distribution objectives. Propagation and transplantation is not currently being recommended; rather, recovery will focus on natural expansion/re-establishment of populations through habitat management, which is dependent on seedbank viability (i.e., viable seeds will germinate if conditions are right). Information on the longevity of seeds in the seedbank, methods for propagating the plant, its lifespan, and pollination is lacking. Additional research into the species' ecology and reproduction may be required to determine the feasibility of restoring historical populations.

5. Broad Strategies and General Approaches to Meet Objectives

The government-led and government-supported actions tables from the *Bird's Foot Violet and Virginia Goat's-rue – Ontario Government Response Statement* (Part 3) are adopted as the broad strategies and general approaches to meet the population and distribution objective. Environment Canada is not adopting the approaches identified in section 2 of the *Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario* (Part 2).

6. Critical Habitat

6.1 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

[11] A population that on average demonstrates stable or positive population growth and is large enough to withstand random events and persist in the long term without the need for permanent active management intervention.

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. The Virginia Goat's-rue currently receives general habitat protection under the ESA; however, a description of the general habitat has not yet been developed. 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[12] as the habitat of the species by the Province of Ontario. A habitat regulation has not been developed for the Virginia Goat's-rue 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 Virginia Goat's-rue in Canada to the extent possible, based on the best available information as of February 2015.

Critical habitat is identified for the two extant populations of Virginia Goat's-rue in Ontario. It is recognized that the critical habitat identified below may be insufficient to achieve the population and distribution objectives for the species if increasing the abundance and distribution is determined to be necessary and feasible. Therefore, to confirm that the identified critical habitat is sufficient to meet the objective, a Schedule of Studies (section 6.2; Table 2) has been developed that outlines the activities required to obtain this information. Additional critical habitat may be added in the future if new or additional information supports the inclusion of areas beyond those currently identified (e.g., new sites become colonized or existing sites expand into adjacent areas).

The identification of critical habitat for Virginia Goat's-rue is based on two criteria: habitat occupancy and habitat suitability.

6.1.1. Habitat Occupancy

The habitat occupancy 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 Virginia Goat's-rue individuals have been observed in any year since 1995

Occupancy is based on recent occurrence reports available for all known populations from Ontario's Conservation Data Centre (Natural Heritage Information Centre) and the

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

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The timeframe is consistent with NatureServe's (2002) and conservation data centres' (e.g., Ontario's NHIC) threshold for considering populations to be extant versus historical (i.e., 20 years). The element occurrence[13] information for the Vittoria Dune Ridge population is ranked historical (last observed in 1986), however, a 2001 census contains abundance information and the last observed date is considered 2008, when field visits to inform the COSEWIC Status report confirmed presence at this location.

Despite considerable fieldwork, the species could no longer be found at four other locations now considered to be historical and therefore critical habitat will not be identified for these locations as they are not considered to be occupied. If new observations of Virginia Goat's-rue become available, they will be considered for the identification of additional critical habitat.

6.1.2. Habitat Suitability

Habitat suitability relates to areas possessing a specific set of biophysical attributes that can support individuals of the species carrying out essential aspects of their life cycle. In Canada, Virginia Goat's-rue is restricted to the Carolinian Zone within climatic influence of Lake Erie (COSEWIC 2009). It is typically found in black oak and white oak savannah and woodland communities on sandy, well-drained, acidic soils and with occasional disturbance to limit excessive shading (COSEWIC 2009, Mohr 2013). The species may also occur in remnant Black Oak savannah and Black Oak woodlands such as the edges of woods, forests and in human-made habitats created from human disturbance (e.g., hydro corridors). It may also be found in sand dune and sand barren habitat (i.e., Vittoria Dune Ridge population).

The biophysical attributes of suitable habitat for Virginia Goat's-rue typically include the characteristics below:

- Open areas (e.g.,less than 25-60% tree cover) with little woody growth (< 50% shrub component);
- Acidic to circumneutral[14], well-drained (dry) sandy loams or fine sands; and
- Oak savannah and oak woodland habitats (typically containing Black Oak or White Oak communities)

When the species occurs within a non-linear habitat, such as tallgrass savannah, woodland or forest edges, suitable habitat for Virginia Goat's-rue is currently defined as the extent of the biophysical attributes. In addition, a critical function zone of 50 m

[13] Element occurrence: an area of land and/or water in which a species or natural community is, or was present. Throughout this document, the term "population" is considered to be synonymous with the term "element occurrence" as used by the NHIC and NatureServe (i.e., populations that are more than 1 km apart) following standard guidelines developed by NatureServe for vascular plants.
[14] Nearly neutral; having a pH between 6.5 and 7.5.

(radial distance) is applied when the biophysical attributes around a plant extend for less than 50 m.

When the species occurs within a linear habitat, such as a utility corridor (i.e., where there is no limit to the immediate extent of suitable habitat), suitable habitat is currently defined as the extent of the biophysical attributes and up to 100 m from a Virginia Goat's-rue in both directions parallel to the linear feature. In addition, 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 Virginia Goat's-rue is best 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 hydrology and topography, and as such encompasses the biophysical attributes of the habitat for Virginia Goat's-rue. In Ontario, ELC terminology and methods are familiar to many land managers and conservation practitioners who have adopted this tool as the standard approach 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 Virginia Goat's-rue and the surrounding areas that provide suitable habitat conditions (e.g., open, well-drained, sand areas) to carry out essential life process for the species and should allow for natural processes related to population dynamics and reproduction (e.g., dispersal and pollination) to occur. The species does not typically disperse[15] over long distances and the occupied ELC ecosite should provide sufficient opportunity for dispersal and expansion of populations (i.e., increase abundance of extant populations). This larger area around the plant may also promote ecosystem resilience to invasive species while protecting what are typically rare communities in Ontario. Virginia's Goat's-rue may also be able to colonize areas following disturbance (many forest areas where it occurs could be considered ingrown savannah) (Bickerton 2013). In linear habitats, the suitable ELC ecosite will typically be a cultural (i.e., human modified) habitat type and the 100 m parallel distance should also allow for natural processes (increases to abundance, dispersal and pollination) to occur. Ecosites containing Virginia Goat's-rue have been described in Ontario as Dry Tallgrass Savannah and Dry Tallgrass Woodland or in canopy openings or along edges in Dry Oak Deciduous Forest, Dry Oak Mixed Forest, Cultural Woodland, Cultural Thicket or Cultural Savannah. ELC ecosite information is available for Turkey Point Provincial Park. Additional habitat assessments are required to describe and map the specific ELC ecosites currently occupied by the Virginia Goat's-rue.

[15] Seeds of the Virginia Goat's-rue are mostly dispersed by the plant through mechanical means; the plant will eject seeds forcibly and propelling them typically within 3m of the existing plant. Some seeds will be passively dispersed when consumed by birds and animals, their seed coating is relatively impervious allowing viability to remain unaffected as it passes through the animal's digestive system.

The 50 m radial distance used in both the linear and non-linear habitats is considered a minimum 'critical function zone', or the minimum size required for maintaining constituent microhabitat properties for a species (e.g. essential light, moisture, humidity levels necessary for survival). At present, it is not clear at what exact distances physical and/or biological processes begin to negatively affect Virginia Goat's-rue. Studies on micro-environmental gradients at habitat edges, i.e., 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 Virginia Goat's-rue plant was chosen as a precautionary distance to ensure that microhabitat properties were maintained as part of the identification of critical habitat. The area within the critical function zone may include both suitable and unsuitable habitat as Virginia Goat's-rue may be found near the transition area/zone between suitable and unsuitable habitat (e.g. within small forest openings, or along woodland edges). As new information on species' habitat requirements and site-specific characteristics 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.

6.1.3. Application of the Criteria to Identify Critical Habitat for Virginia Goat's-rue

Critical habitat for Virginia Goat's-rue is identified as the extent of suitable habitat (section 6.1.2) where the occupancy criterion (section 6.1.1) is met. In cases where the suitable habitat extends for less than 50 m around a Virginia Goat's-rue, a critical function zone capturing an area within a radial distance of 50 m is also included as critical habitat.

In Ontario, as noted above, suitable habitat for Virginia Goat's-rue is most appropriately identified as the ELC ecosite. At the present time, the 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, ELC community series level is identified as the area within which critical habitat is found. In Ontario, critical habitat is located within these boundaries where the biophysical attributes described in section 6.1.2 are found and where the occupancy criterion is met (section 6.1.1). When ecosite boundaries are determined, the identification of critical habitat will be updated.

Application of the critical habitat criteria to best available information identifies critical habitat for the two known extant populations of Virginia Goat's-rue in Canada (Figure 1, See also Table 1), totaling up to 251 ha[16]. The critical habitat identified is considered a partial identification of critical habitat at this time because it is unknown whether it is sufficient to meet the population and distribution objectives. Information to determine the feasibility of restoring historical populations is required. A schedule of studies (section 6.2) has been developed to provide the information necessary to complete the identification of critical habitat so that the population and distribution objectives are met.

Critical habitat for the Virginia Goat's-rue is presented using 1 x 1 km UTM grid squares. The UTM grid squares presented in Figure 1 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 6.1.1) and habitat suitability (section 6.1.2) are met. More detailed information on critical habitat to support protection of the species and its habitat may be requested on a need-to-know basis by contacting Environment Canada – Canadian Wildlife Service at ec.planificationduretablissement-recoveryplanning.ec@canada.ca.

[16] This is the maximum extent of critical habitat based on habitat boundaries that can be delineated from high resolution aerial photography (comparable to ELC, Community Series) for linear and non-linear habitats and/or a 50m radial distance around Virginia Goat's-rue. Actual critical habitat occurs only in those areas described in section 6.1 and therefore the actual area could be less than this and would require field verification to determine the precise amount.

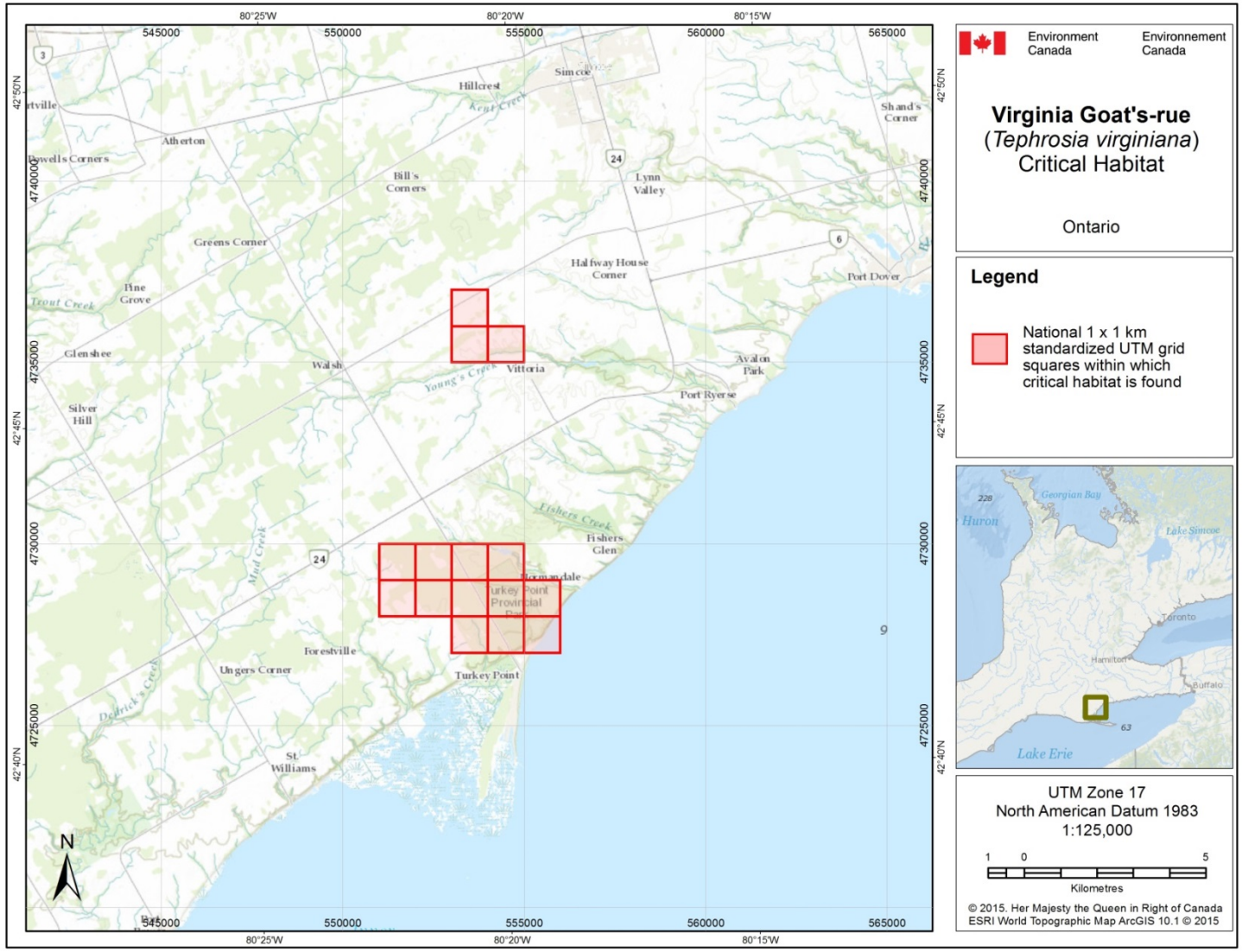

Figure 1. Grid squares that contain critical habitat for Virginia Goat's-rue in Canada. Critical habitat for the Virginia Goat's-rue occurs within these 1 x 1 km standardized UTM grid squares (red shaded squares), where the description of habitat occupancy (section 6.1.1) and habitat suitability (section 6.1.2) are met.

Table 1. Grid squares that contain critical habitat for the Virginia Goat's-rue in Canada. Critical habitat for the Virginia Goat's-rue occurs within these 1 x 1 km standardized UTM grid squares where the description of habitat occupancy (section 6.1.1) and habitat suitability (section 6.1.2) are met.

Population	1 x 1 km standardized UTM grid square ID[a]	Province/ Territory	UTM Grid Square Coordinates[b]		Estimated area (Ha) that contains critical habitat[c]	Land tenure
			Easting	Northing		
Turkey Point Natural Area	17TNH5218 17TNH5219 17TNH5228 17TNH5229 17TNH5237 17TNH5238 17TNH5239 17TNH5247 17TNH5248 17TNH5249 17TNH5257 17TNH5258	Ontario	551000 551000 552000 552000 553000 553000 553000 554000 554000 554000 555000 555000	4728000 4729000 4728000 4729000 4727000 4728000 4729000 4727000 4728000 4729000 4727000 4728000	245	Non-federal Land
Vittoria Dune Ridge	17TNH5335 17TNH5336 17TNH5345	Ontario	553000 553000 554000	4735000 4736000 4735000	6	Non-federal Land

[a] 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).

[b] 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.

[c] The area presented is that of the unit(s) containing critical habitat (rounded up to the nearest 1 ha); therefore, the actual area of critical habitat may be significantly less. Refer to Section 6 for a description of how critical habitat within these areas is defined.

6.2 Schedule of Studies to Identify Critical Habitat

Table 2. Schedule of Studies to Identify Critical Habitat

Description of Activity	Rationale	Timeline
As in the Ontario Government Response Statement (Part 3), investigate the feasibility of re-establishing the species at historically occupied sites by determining whether suitable habitat or opportunities for habitat restoration exist and are likely to be successful. A population viability analysis may be used to determine if and where increases in population abundance are necessary to establish self-sustaining populations capable of long-term persistence. Also, if feasible, support natural increases at extant locations. Assessing feasibility will likely require a further understanding of Virginia Goat's-rue ecology (e.g., longevity of seedbank) to determine if and which habitat restoration and management techniques would be successful.	If restoration is determined to be feasible and is proven successful and additional habitat becomes occupied and suitable, identify additional critical habitat.	2015-2022

6.3 Activities Likely to Result in 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 or multiple activities at one point in time or from the cumulative effects of one or more activities over time (Government of Canada 2009). It should be noted that not all activities that occur in or near critical habitat are likely to cause its destruction. Activities described in Table 3 are examples of those likely to cause destruction of critical habitat for the species; however, destructive activities are not necessarily limited to those listed.

Recognizing that Virginia Goat's-rue is a colonizing species that is able to establish following disturbance, activities that result in a temporary removal of critical habitat (e.g., removal of duff and woody encroachment) also have the potential to contribute to the future supply of critical habitat, given proper management. Some disturbance to Virginia Goat's-rue habitat may be beneficial to the species, opening up the canopy cover and suitable bare ground within a given site. In addition, some activities may have a threshold level at which they become harmful even to large populations rather than beneficial.

Table 3. Activities Likely to Result in the Destruction of Critical Habitat

Description of Activity	Description of Effect in Relation to Function Loss	Details of Effect
Any activity that results in changes to natural disturbance regimes (e.g., fire suppression)	Natural disturbances, which remove woody or competing vegetation, are essential to maintain open habitat which the species relies on for flowering, growth and germination.	Virginia Goat's-rue requires relatively open habitats for establishment, plants are unable to reproduce or survive unless habitat remains open through either fire or some other disturbance. When this activity occurs within or adjacent to critical habitat at any time of year, it can result in habitat degradation or loss of critical habitat due to increased cover, which in turn can ultimately lead to a complete decline and loss of the population.
Development and conversion of lands that results in the clearing of natural vegetation communities (e.g., residential, agricultural or commercial development, road construction)	The conversion of suitable habitat (e.g., black oak savannah, black oak woodland) results in the direct loss of critical habitat upon which the species relies for basic survival, successful seed germination and seedling establishment.	When this activity occurs within critical habitat at any time of year, the effects will be direct. This activity will result in habitat destruction because Virginia Goat's-rue requires the open conditions in a savannah environment. Land conversion practices adjacent to critical habitat at any time of year could cause destruction (e.g. shade effect, altered hydrology) of Virginia Goat's-rue critical habitat.
Activities that result in the temporary removal of critical habitat (e.g., forest harvesting, maintenance of hydro corridors)	Results in compaction of soils and removal of vegetation. Ultimately results in degraded habitat that is no longer suitable for the species.	When this activity occurs within or adjacent to (i.e., within 50 m) critical habitat at any time of year, the effects are likely to be direct. Some selective thinning of the forest canopy, and/or brush clearing, and mowing may be beneficial provided careful precautions are taken (e.g., no heavy equipment, direct harm to the species is avoided, removal of all brush and wood from habitat).
Activities that introduce exotic invasive species, especially plants (e.g., through introduction of non-native plant seeds, plants, foreign soil or gravel, composting or dumping of garden waste, recreational ATV use)	Invasive plant species can result in increased competition with Virginia Goat's-rue for limited resources (e.g., light is needed for flowering, growth, and germination). Invasive species can also cause physical and chemical changes to habitat (e.g. increased shade) that may also reduce habitat suitability.	Introduction of an invasive species in or adjacent to critical habitat can lead to gradual destruction of critical habitat over time. Thresholds are not applicable to this activity, as introduction of even a single individual could lead to further spread of the species.
Activities that cause physical disturbance to the soil substrate where the species occurs, resulting in increased soil compaction, loosening of the ground or alterations to natural sand dune processes (e.g., increased rate of erosion through sand extraction)	Any alteration to the natural dynamic processes of sand dune habitat could result in increased rates of erosion. Soil compaction, loosening of the ground and erosion eventually lead to the loss of critical habitat upon which the species relies for basic survival, successful seed germination and seedling establishment.	Erosion could occur as a result of a single activity (of significant magnitude), or through repeated smaller disturbances within or directly adjacent to critical habitat. This activity will result in habitat destruction regardless of what time of year it is conducted.

7. Measuring Progress

Every five years, success of recovery strategy implementation will be measured against the following performance indicators:

- Abundance and distribution of the extant populations of the Virginia Goat's-rue in Canada have been maintained, or increased where necessary and biologically and technically feasible;
- Where necessary and biologically and technically feasible, the species has also been restored at sites it has historically occupied.

8. Statement on Action Plans

One or more action plans will be completed for the Virginia Goat's-rue and posted on the Species at Risk Public Registry by December 31, 2022.

9. Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[17]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making 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[18] (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.

This recovery strategy will clearly benefit the environment by promoting the recovery of the Virginia Goat's-rue. The Bird's-foot Violet shares the same habitat and occurs together with Virginia Goat's-rue at sites in the Turkey Point Natural Area (Mohr 2013). Other species at risk in similar habitats within the Turkey Point Natural Area include the Spotted Wintergreen (*Chimaphila maculata*, END) and Eastern Flowering Dogwood (*Cornus florida*, END). Populations of fauna at risk (e.g., Acadian Flycatcher

[17] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[18] http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

(*Empidonax virescens,* END), Eastern whip-poor-will (*Antrostomus vociferus,*THR), Eastern Hog-nosed Snake (*Heterodon platyrhinos,* THR), and Eastern Foxsnake (*Pantherophis gloydi,* Carolinian population, END)) are also known from areas of St. Williams Conservation Reserve (White 2012), and are found occasionally in similar sandy, dry habitats within southwestern Ontario. In Michigan and Indiana, Virginia Goat's-rue was found to be a nectar source for the Karner Blue butterfly (*Lycaeides melissa samuelis*) (Grundel et al. 2000), this species is listed as Extirpated in Canada.

The potential for the strategy to inadvertently lead to adverse effects on other species was considered. Some management activities, including prescribed burns and the control of invasive species through mechanical removal, have the potential to harm some species in the short term. These activities are not anticipated to have adverse effect on these species and the ecological risks of such activities must be considered individually before undertaking them, in order to reduce possible negative effects. Prescribed burns are anticipated to also benefit several species including Bird's-foot Violet and Spotted Wintergreen which rely on disturbance regimes such as prescribed burns (Ursic et al. 2010; Bickerton 2013).

The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects.

References

Baker, J., pers. comm. 2014. Personal communication to Patricia Mohr. September 2014. Land Trust Coordinator, Hamilton Naturalists' Club, Hamilton, Ontario.

Bickerton, H.J. 2013. Recovery Strategy for the Bird's-foot Violet (*Viola pedata*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. v + 26 pp.

Cairns, M., pers. comm. 2014. Personal communication to Patricia Mohr. September 2014. Ecologist, Southwest Parks Zone, Ontario Ministry of Natural Resources and Forestry, London, Ontario.

COSEWIC. 2009. COSEWIC assessment and status report on the Virginia Goat's-rue Tephrosia virginiana in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 31 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.

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.

Fraver, S. 1994. Vegetation responses along edge-to-interior gradients in the mixed hardwood forests of the Roanoke River Basin, North Carolina. Conservation Biology 8(3):822-832.

Grundel, R., N. B. Pavlovic C. L. Sulzman. 2000. Nectar plant selection by the Karner Blue Butterfly (*Lycaeides melissa samuelis*) at the Indiana Dunes National Lakeshore. The American Midland Naturalist 144(1):1-10.

Harper K. A., S.E. Macdonald, P.J. Burton, J. Chen, K.D. Brosofske, S.C. Saunders, E.S. Euskirchen, D. Roberts, M.S. Jaiteh, and P.A. Esseen. 2005. Edge influence on forest structure and composition in fragmented landscapes. Conservation Biology 19:768–782.

Health Canada. 2014. Pollinator Health and Pesticides. Website: http://www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/pollinators-pollinisateurs/index-eng.php. [visited: 14 November 2014]

Government of Canada. 2009. *Species at Risk Act* Policies, Overarching Policy Framework [Draft]. *Species at Risk Act* Policy and Guidelines Series. Environment Canada. Ottawa. 38 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. Biological Conservation 66(3):185-194.

Mohr, P. 2013. Recovery Strategy for the Virginia Goat's-rue (Tephrosia virginiana) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 26 pp.

NatureServe. 2002. Element Occurrence Data Standards. NatureServe, Arlington, Virginia. 147 pp.

NatureServe. 2013. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Web-site: http://www.natureserve.org/explorer. [accessed: November 14, 2013].

NatureServe. 2014. Ranking Species Occurrences – A Generic Approach. Web-site: http://explorer.natureserve.org/eorankguide.htm. [accessed December 12 2014].

NHIC 2012. Natural Heritage Information Centre Biodiversity Explorer. 2012. Peterborough (ON): Ontario Ministry of Natural Resources. Web-site: www.biodiversityexplorer.mnr.gov.on.ca/nhicWEB/speciesDetailReport.do?elID=83220. [accessed 2012].

Rodger, L. 1998. Tallgrass communities of southern Ontario: A recovery plan. World Wildlife Fund Canada and Ontario Ministry of Natural Resources, February 1998. 66 pp.

Ursic, K., T. Farrell, M. Ursic and M. Stalker. 2010. Recovery Strategy for the Spotted Wintergreen (*Chimaphila maculata*) in Ontario. Ontario Recovery Strategy Series Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 28 pp.

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

White, D. J. 2012. Preliminary Forest Management Planning for Species at Risk Survey in the St. Williams Conservation Reserve. Unpublished report to the St. Williams Conservation Reserve Community Council and Aylmer District OMNR.

Appendix A: Subnational Conservation Ranks of Virginia Goat's-Rue (*Tephrosia Virginiana*) in Canada and the United States

Virginia Goat's-rue (*Tephrosia virginiana*)	
S-rank	**State/Province**
S1 (Critically Imperilled)	Nebraska, Ontario, Rhode Island
S3 (Vulnerable)	Iowa, Minnesota
S4 (Apparently Secure)	Delaware, New Jersey
S4S5 (Apparently Secure-Secure)	New York
S5 (Secure)	Kentucky, North Carolina, Virginia, West Virginia
SH (Possibly Extirpated)	New Hampshire
SNR (Unranked)	Alabama, Arkansas, Connecticut, District of Columbia, Florida, Georgia, Illinois, Indiana, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Wisconsin

Rank Definitions (NatureServe 2014)

S1: 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: 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.

SH: Possibly Extirpated (Historical) - Species or community occurred historically in the state/province, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. A species or community could become SH without such a 20-40 year delay if the only known occurrences in a nation or state/province were destroyed or if it had been extensively and unsuccessfully looked for. The SH rank is reserved for species or communities for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.

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

PART 2 – *Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario*, prepared by Patricia Mohr for the Ontario Ministry of Natural Resources

Photo: Allen Woodliffe

Virginia Goat's-rue
(Tephrosia virginiana) in Ontario

Ontario Recovery Strategy Series

Recovery strategy prepared under the Endangered Species Act, 2007

2013

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

Mohr, P. 2013. Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 26 pp.

Cover illustration: Photo by Allen Woodliffe

ISBN 978-1-4606-3064-8 (PDF)

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.

AUTHORS

The strategy was prepared by Patricia Mohr.

ACKNOWLEDGMENTS

The author would like to thank staff at the Ontario Ministry of Natural Resources including Donald Sutherland, Mike Oldham, Graham Buck, Sandy Dobbyn and Melody Cairns for providing updates on the status of the species and its habitat, as well as Bree Walpole for advice and resources. Kyle Breault provided valuable information on the activities and progress of the organization where he serves as provincial program coordinator, Tallgrass Ontario. Also critical to the completion of this strategy was the editorial expertise contributed by Nigel Heseltine.

DECLARATION

The recovery strategy for the Virginia Goat's-rue 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

Virginia Goat's-rue (*Tephrosia virginiana*) is a showy erect herb with bicoloured pink and yellow flowers and a varying degree of hairiness that can lend the plant a distinct silvery appearance. The plant is native to North America and its range includes Canada and the United States. Although considered globally secure, in Canada the species occurs as only two populations a few kilometres apart both in Norfolk County, Ontario. The plant is listed as endangered under Ontario's *Endangered Species Act, 2007* and under Schedule 1 of the federal *Species at Risk Act*.

Virginia Goat's-rue was never widespread in Canada. Historically it has been found at only four other sites, also in Norfolk County, Ontario. Its scarcity can be attributed to its restriction to acidic soils in tallgrass savannah and tallgrass woodland, which are rare habitat types in Ontario and Canada. In Ontario, Virginia Goat's-rue occurs mostly as scattered patches within Turkey Point Natural Area, a portion of Crown land that includes Turkey Point Provincial Park and St. Williams Conservation Reserve. The remainder, encompassing less than five percent of the total population size and area of habitat occupied, occurs on private land.

The main threat to Virginia Goat's-rue is habitat loss. Fire suppression and land conversion to agricultural and urban use have reduced tallgrass habitats to less than three percent of their former Ontario range. Tallgrass communities depend on disturbance such as fire to discourage woody succession and maintain open conditions.

The recovery goal for Virginia Goat's-rue in Ontario is long-term survival of the species and its habitat in Ontario through protection and restoration efforts that increase the species' abundance and range.

The objectives are to:

1. protect the species and its habitat within the current area of occupancy;
2. monitor the condition of the species and its habitat within the area of occupancy;
3. increase the area of occupancy using existing suitable habitat;
4. create habitat where feasible; and
5. communicate with partners and the public to speed recovery and build awareness.

Studies on the biology and ecology of Virginia Goat's-rue reveal the narrowly defined conditions under which the species persists in Ontario and the high level of dependency of the species on its habitat. Accordingly, this recovery strategy focuses on protection and restoration of the species' habitat. Prescribed burns have been effective at maintaining open habitat conditions, but they may be encouraging the growth of exotic invasive plants. Burn programs that include management of invasive plants will help ensure recovery efforts are not undermined.

Efforts at protecting and restoring tallgrass habitats in Ontario have been under way for over a decade. These efforts can benefit not just Virginia Goat's-rue, but the numerous

other species at risk associated with tallgrass habitats. Actions taken to protect and recover Virginia Goat's-rue that are implemented in cooperation with ongoing habitat and species' initiatives will minimize redundancy, conserve resources and speed the plant's recovery.

It is recommended that the minimum area for consideration in a habitat regulation include the area occupied by all extant populations, the extent of the tallgrass habitat in which the Virginia Goat's-rue plants grow, and a 30-metre vegetation protection zone to protect this habitat. The boundaries should be flexible enough to incorporate new species' occurrences as well as refinements to the 30-metre vegetation protection zone.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Virginia Goat's-rue
SCIENTIFIC NAME: *Tephrosia virginiana*
SARO List Classification: Endangered
SARO List History: Endangered (2009), Endangered (2004)
COSEWIC Assessment History: Endangered (2009), Endangered (2000), Threatened (1996)
SARA Schedule 1: Endangered (June 5, 2003)
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

Virginia Goat's-rue (*Tephrosia virginiana*) is an erect perennial herb in the Legume Family (Fabaceae). It is a showy plant, bearing a compact 4 to 8 cm raceme (Gleason 1952) of bicoloured pink and yellow flowers that terminates a 30 to 70 cm stem. Racemes may also be axillary. Plants typically have a distinct silvery appearance due to dense, fine hairs covering the stems, branches, flowers and fruit, but the hairiness varies greatly between colonies. Leaves are compound (consisting of multiple leaflets), 5 to 14 cm long and alternately arranged. Most have 15 to 25 leaflets that range in length from one to three cm. Fruit are dry, flattened linear pods (COSEWIC 2009). The plant has a diversified, efficient root system consisting of a profuse fibrous rhizome and an extensive woody taproot that can penetrate to one metre in depth (Clark 1971). Ontario populations of Virginia Goat's-rue occur as large patches or scattered individual plants (COSEWIC 2012).

Species Biology

Virginia Goat's-rue is genetically diverse; however, the variations are not distinct enough to warrant varieties of the species and it is considered a single species (Wood 1949). Clark (1971) gathered considerable information on the species through field and greenhouse studies conducted in Arkansas between 1966 and 1970. His objective was to determine why Virginia Goat's-rue occupies its particular ecological niche and he

selected 10 stands showing structural variability between populations as representative sites.

Virginia Goat's-rue spreads primarily by seed. Though some seeds may be transported by birds, the majority are disseminated solely by the plant through mechanical means. As the ripe fruit dries, it shrinks and snaps open, ejecting seeds forcibly and propelling them to within three metres of the plant. Virginia Goat's-rue plants are distributed randomly in a pattern that reflects this mode of dissemination. Seed are dispersed over the first 15 days of August in Arkansas (Clark 1971).

Insect larvae have been observed feeding on seeds of Virginia Goat's-rue in Ontario, and weevils were found in most mature seed pods collected during field surveys in 1991 and 1994 (COSEWIC 2012). The weevil is likely *Apion segnipes*. Species of the genus *Tephrosia* are the only documented host for this weevil and there is no other weevil in Canada that has *Tephrosia* as a host. Furthermore, the only known location in Canada for this weevil is Turkey Point. *Apion segnipes* adults have been seen on Virginia Goat's-rue flowers in the United States and larvae have been collected from the seed pods (D. A. Sutherland pers. comm. 2012). This weevil destroyed a large proportion of the Virginia Goat's-rue seed crop harvested by Clark between 1966 and 1969 (Clark 1971).

Clark (1971) identified the conditions under which Virginia Goat's-rue seeds germinate. Optimal conditions are non-calcareous soils of low moisture content and coarse texture at 30°C to 35°C. Under these conditions and with a high rainfall period, seeds will germinate and produce seedlings in five days. Seeds (and seedlings) are incapable of penetrating dense soils of high clay content and firmly packed sand. Soil moisture increases germination success up to 21 ml of water per 100 gm of sand, after which germination rates diminish. Clark found that given appropriate rainfall and temperature, larger seeds germinate shortly after dissemination in late summer or early fall, while smaller seeds germinate only after exposure to fluctuating winter temperatures. Virginia Goat's-rue seeds can survive for years in soil and then germinate once conditions are suitable (Clark 1971).

The variability in the germination period can be attributed to the seeds' impermeable coat, a feature common to legumes which discourages germination until the seed is scarified (i.e., scratched or cracked). Clark (1971) demonstrated this function under greenhouse conditions of suitable moisture and temperature using freshly collected seeds. He observed about 5 to13 percent germination from unscarified seed and 83 percent germination from seed exposed to mechanical or chemical scarification. In a natural setting, mechanical scarification would occur through soil abrasion and temperature extremes, while chemical scarification would likely result from organic acids in the soil (Clark 1971).

Virginia Goat's-rue's ability to germinate under a variety of conditions makes the plant more adaptable by increasing the opportunities under which it can produce a seedling. This could give it a competitive advantage over adjacent plants, were it not for inherent

limitations at the seedling stage. Virginia Goat's-rue seedlings are intolerant of shade and their shoots grow less than 10 cm in the first year. This is particularly limiting for seedlings from spring-germinating seeds, which, because of relatively high germination temperatures, emerge in late spring when competition with surrounding plants is typically greater. Most Virginia Goat's-rue seedlings fall into this category (Clark 1971).

Seedling growth occurs primarily in the root, which may penetrate the soil as much as six to eight cm during the first week following germination. After its first growing season, a rhizome begins to form. Each year the rhizome sends up erect stems and each year it expands radially to eventually become a sprawling horizontal base. This growth pattern accounts for the large patch structure observed within Virginia Goat's-rue populations. Mature Virginia Goat's-rue can linger for many years under closed canopy woodland because of its well-developed root system, as well as its perennial growth habitat and certain degree of tolerance for shade. Though persisting merely as thin, weak clumps devoid of flowers, the plants are capable of resuming normal growth when favourable conditions return (Clark 1971).

Virginia Goat's-rue has wilt-resistant leaves and is adapted to drought. Mature plants cannot survive sustained flooding and three-year-old plants die after three weeks in saturated soil. Seedlings show only slight decline after two months in saturated soil during the growing season, but are unable to survive high-moisture soils once freezing temperatures set in. Wet soils prevent the plant from halting vegetative growth and bringing on the dormant state that sustains it through the winter. Virginia Goat's-rue seedlings and mature plants require a late summer and early fall drought period for dormancy to occur; diminishing temperature and light are of lesser importance. Dormancy is not initiated internally and dormant plants transplanted to warmer temperatures in a greenhouse resume growth immediately. In the species' natural habitat, vegetative growth resumes with daytime temperatures of 21°C (Clark 1971).

Virginia Goat's-rue is adapted to disturbance and thrives under conditions of recurring fire. As long as there is no shading and low competition, Virginia Goat's-rue will begin flowering in the fourth year of its life and continue to flower annually (Clark 1971). It flowers from late June through July in the northern parts of its range (COSEWIC 2009). The flower structure – irregular shape, sturdy landing platform and narrow floral tube – implies bee pollination. In a study of bee pollination in the Black Oak savannahs of Indiana, 70 percent of the species visiting plants of the genus *Tephrosia* were from the genus *Megachile* (Jean, et al. 2002). It is likely that *Megachile mucida* is a species that pollinates Virginia Goat's-rue in Ontario. This bee is known to use members of the genus *Tephrosia* as a floral host/nectar source and its only known location in Canada is an area that supports a population of Virginia Goat's-rue (St. Williams Conservation Reserve) (COSEWIC 2009). Confirming the bee's presence at other Virginia Goat's-rue locations in Canada will provide additional evidence for its role as a pollinator.

The traits described in this section explain why Virginia Goat's-rue occupies its particular niche. The species' low tolerance for competition and shading and for wet, firm and calcareous soils limit it to open, dry, infertile habitats. It can invade these

habitats because of its long seed germination period and seed dispersal mechanism, and is able to persist because of its perennial growth habit, diversified and efficient root system, and its ability at maturity to linger in woodlands after the canopy has filled in (Clark 1971).

The tallgrass habitats in which Ontario populations of Virginia Goat's-rue grow support about 30 percent of the plant species at risk listed under Ontario's *Endangered Species Act, 2007* (ESA). One species in particular, the Bird's-foot Violet (*Viola pedata*), is frequently found growing with Virginia Goat's-rue. This plant is listed as endangered in Canada under both the federal *Species at Risk Act* (SARA) and Ontario's ESA. Based on studies carried out in Michigan and Indiana, Virginia Goat's-rue is a nectar source for the Karner Blue (*Plebejus melissa samuelis*) (COSEWIC 2009), a butterfly designated Extirpated in 2010 under SARA and the ESA.

Virginia Goat's-rue has a symbiotic relationship with nitrogen-fixing bacteria (Clark 1971) that may give it a key role in replacing nitrogen lost through frequent fires (COSEWIC 2009). Like other plants of the genus *Tephrosia*, Virginia Goat's-rue produces rotenone, a chemical that imparts varying degrees of toxicity to the root, seed and herbage. *Tephrosia* is toxic to fish and certain insects but not to mammals (Duncan, et al. 1955). When investigated for use as an insecticide, the rotenone levels of Virginia Goat's-rue proved insufficient for commercial viability (COSEWIC 2009).

1.3 Distribution, Abundance and Population Trends

Virginia Goat's-rue occurs only in North America, where it is the most widespread of *Tephrosia* species and is considered Globally Secure (G5) (NatureServe 2012). Less than one percent of the total distribution is in Canada, confined to Norfolk County in the Carolinian life zone of southwestern Ontario. Only two populations are known to be extant, one in the Turkey Point Natural Area, which includes Turkey Point Provincial Park and St. Williams Conservation Reserve, and the other several kilometres away on private land at Vittoria Dune Ridge. The Vittoria Dune Ridge site is part of a provincial Earth Science Area of Natural and Scientific Interest (ANSI) and was designated a Significant Site in the Natural Areas Inventory of the Regional Municipality of Haldimand-Norfolk (COSEWIC 2009). Virginia Goat's-rue was known from four historical locations, all located in Norfolk County: Simcoe, Walsh, Normandale and Spooky Hollow. Despite considerable fieldwork, the species could no longer be found at these locations and was last seen in 1941, 1950, 1971 and 1991, respectively (COSEWIC 2009).

The largest population of Virginia Goat's-rue in Canada occurs within Turkey Point Natural Area, growing as numerous scattered subpopulations. In July and October 2008, a census was conducted of the individual plant patches comprising these subpopulations. An individual plant patch was defined as all stems appearing to originate from the same root crown. The census revealed 566 individual plant patches containing a total of 6,958 mature stems. This total includes many non-flowering plants

assumed to be mature plants that were suppressed by over-shading. Access was not granted at Vittoria Dune Ridge in 2007 and 2008; however, observation from the roadside confirmed presence of the species during both years. The latest census date for the Vittoria Dune Ridge population is 2001, when about 100 stems were counted in a single patch. No Virginia Goat's-rue was found at Spooky Hollow, the only historical site surveyed during the 2008 census. Based on these data, the total count for Canadian populations is about 570 plants with 7,060 stems. The area of habitat occupied by Virginia Goat's-rue is approximately 0.0016 km^2 (COSEWIC 2009).

The lack of sufficient long-term standardized data precludes the identification of population trends. Few sites have stem count data and methods of distinguishing individuals, plants and stems likely vary (COSEWIC 2009). A declining population trend may be inferred from the species' habitat. Tallgrass communities once covered about 90 million hectares of the central United States, Manitoba and southern Ontario. Now only about one percent remains, and less than three percent of the approximate 1,000 km^2 that used to exist in Ontario (Rodger 1998).

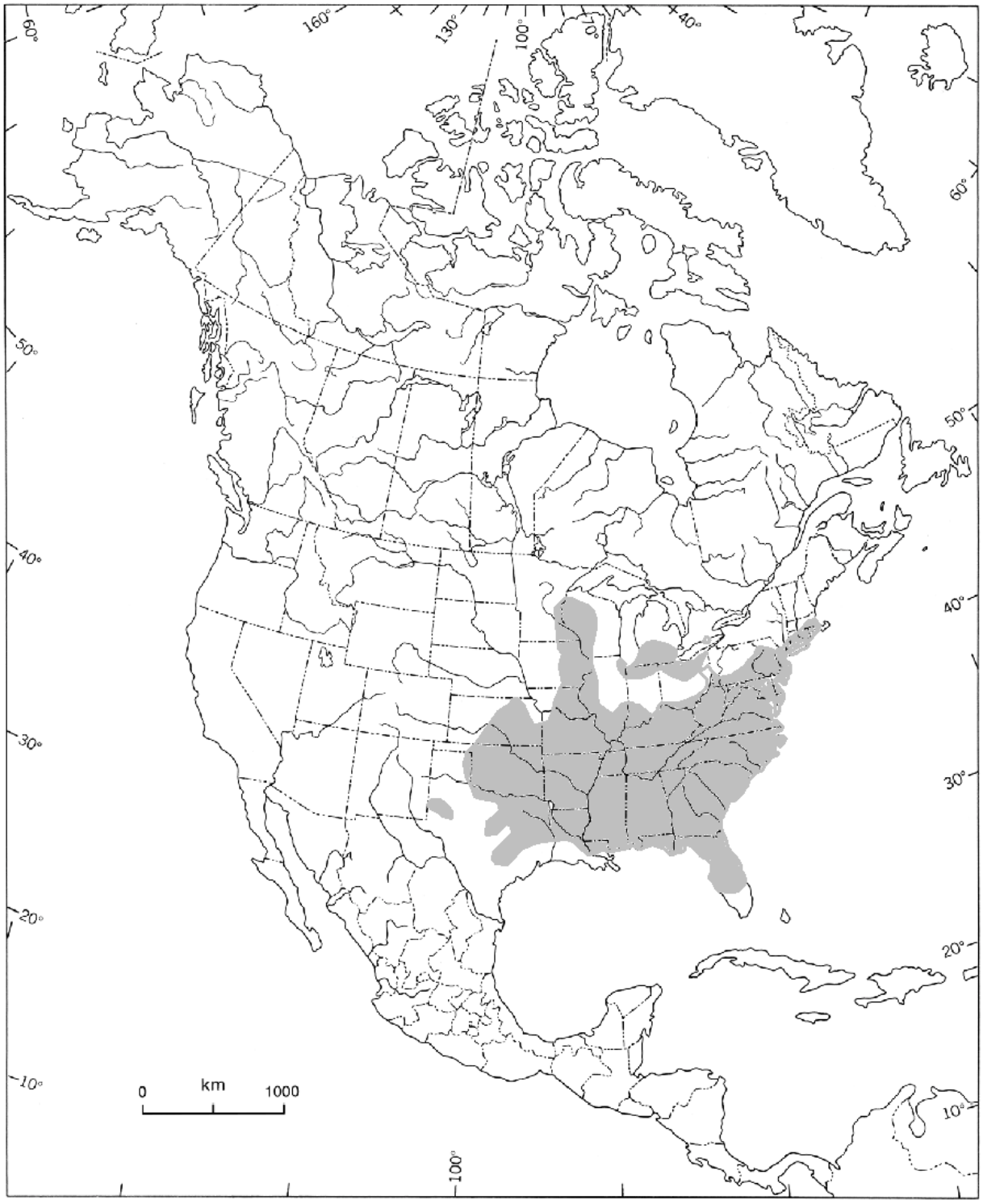

Figure 1. Global distribution of Virginia Goat's-rue (COSEWIC 2009)

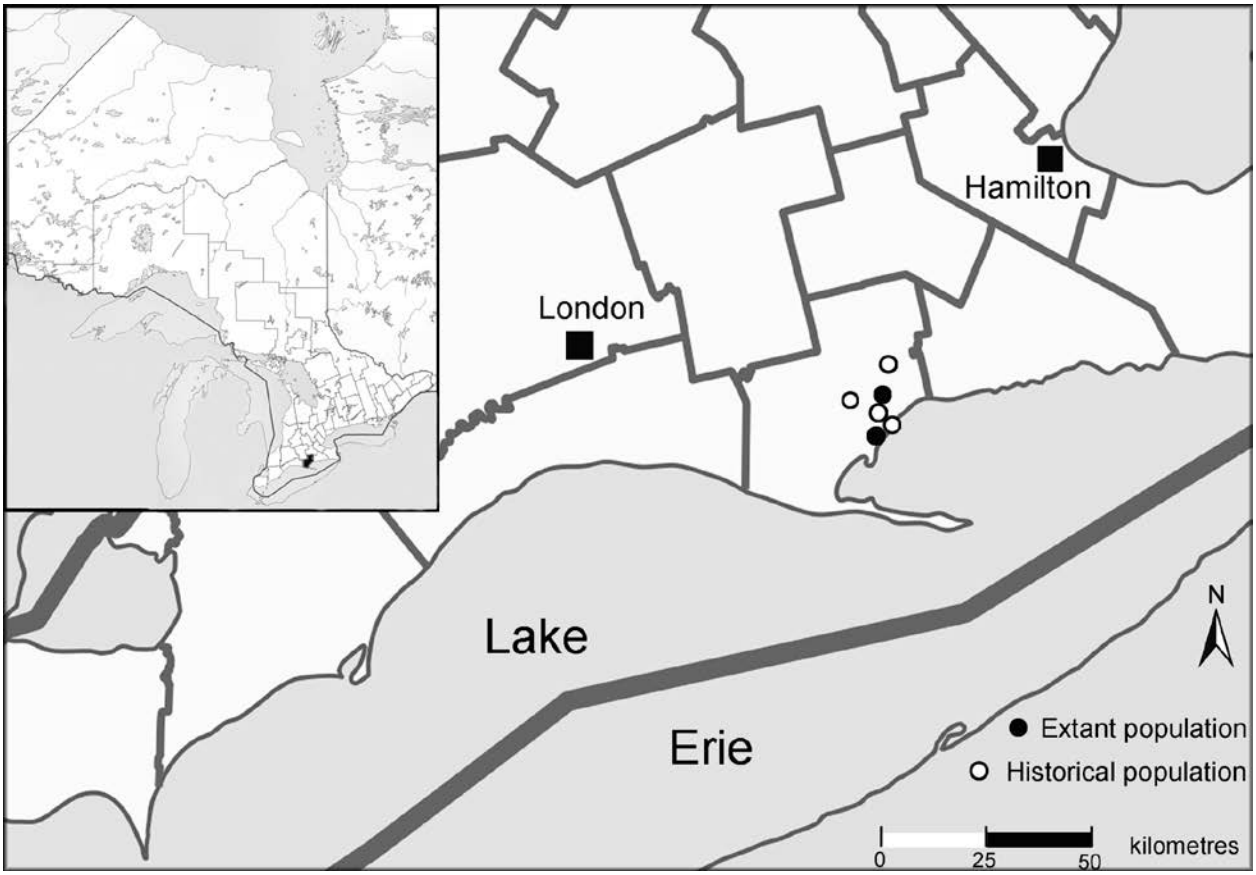

Figure 2. Historical and current distribution of Virginia Goat's-rue in Ontario

1.4 **Habitat Needs**

Virginia Goat's-rue can be found throughout its range growing in soil that is dry, sterile, sandy, well-drained and typically circumneutral to acidic. The species occurs in open oak or pine woods, dry-mesic oak woodland and oak savannah, sand prairies, open sand dunes and sand barrens, particularly those that evolved through frequent, low-intensity ground fires. The plant may be found in degraded habitats where woody vegetation is removed, such as along roadsides and in abandoned fields, but it appears to have difficulty surviving these conditions, especially at the northern edge of its range (COSEWIC 2009).

In Ontario, Virginia Goat's-rue typically occurs in open mixed Black Oak (*Quercus velutina*) and White Oak (*Quercus alba*) savannah and woodland. The Ontario Natural Heritage Information Centre (NHIC) recognizes three vegetation types in association with Virginia Goat's-rue, including Dry Black Oak Tallgrass Savannah, Dry Black Oak–Pine Tallgrass Savannah and Dry Black Oak–White Oak Tallgrass Woodland. Subpopulations within Turkey Point Provincial Park occur primarily within three Ecological Land Classification types including Dry-Fresh Black Oak Deciduous Savannah (SVDM3-23), Dry Red Oak Deciduous Savannah (SVDM3-1) and Dry-Fresh Oak-Pine Mixed Woodland (WOMM3-21). They also occur in small clumps in Dry-

Fresh Oak-Red Maple Deciduous Forest (FODM2-1), Dry-Fresh Black Oak Woodland (WODM3-2), Dry Mixed Oak Deciduous Woodland (WODM3-20), Dry-Fresh Mixed Oak Deciduous Forest (FODM1-4) and Hydro Corridors (CVI_22) (Chambers 2010). Soils at the Turkey Point Natural Area are well-drained loamy fine sands and fine sandy loams with a surface ranging from between medium acidic and neutral (COSEWIC 2009). The Vittoria Dune Ridge population grows in dune habitat (NHIC 2012) where the soils are relatively acidic, rapid to well-drained fine sand with a low mean organic content (COSEWIC 2009).

Like other plants endemic to savannah communities, Virginia Goat's-rue relies on periodic disturbance to limit woody succession and maintain open habitat conditions. In Turkey Point Provincial Park, a significant proportion of the Virginia Goat's-rue population consisted of non-flowering plants until vegetation management including prescribed burns began and the habitat became more open (D. A. Sutherland pers. comm. 2012). In areas of the park left unburned, the habitat became extremely overgrown and several patches of Virginia Goat's-rue were eliminated. Similarly, Virginia Goat's-rue appeared to grow more vigorously after a prescribed burn in St. Williams Conservation Reserve. The disappearance of plants in other parts of the conservation reserve is probably due to woody succession (COSEWIC 2009).

Virginia Goat's-rue may also rely on disturbance for seed germination. Most of the seed collected by Clark (1971) required scarification to germinate, and mechanical and chemical scarification can occur through disturbance. Fire is one type of disturbance that can scarify the seed. Another way in which fire can assist germination is by reducing duff, thereby exposing the soil surface, and by providing ash. Ash left by fire absorbs solar radiation and warms the soil, offering plants an earlier start in the spring. Fire also volatizes nitrogen and may leave soils with a low nitrogen content (Rodger 1998), giving nitrogen-fixers like Virginia Goat's-rue a competitive advantage in their habitat.

Plants growing in tallgrass prairies and savannahs may depend on a diverse environment. Tallgrass habitats reflect the patchiness of the fast-moving fires that formed them, exhibiting localized wet and disturbed dry spots that in turn support species with varied requirements and tolerances (Rodger 1998). Studies of legume reproduction in longleaf pine savannahs of the United States suggest that a variable fire season is important for conserving biodiversity in fire-dependent communities (Hiers et al. 2000). Pinery and Rondeau provincial parks in Ontario provide examples of where prescribed burns in the spring are favouring grasses to the detriment of forbs (S. Dobbyn pers. comm. 2012). There might be elements of the high diversity maintained by a variable fire season that are critical to survival of Virginia Goat's-rue over the long term.

1.5 Limiting Factors

Virginia Goat's-rue's late-spring germination and low tolerance for competition, shading, and wet, firm and calcareous soils predisposes them to a limited range in Ontario. Acidic sand deposits in Ontario are uncommon and local (COSEWIC 2009), and the Black Oak savannah and Black Oak woodland in which the species occurs in Ontario are considered globally, nationally and provincially rare (NHIC 2012). Virginia Goat's-rue populations in Ontario are living at the northern extent of their range and the stress associated with this may limit their adaptability. With dry pods and seeds that disperse a short distance from the plant, migration to additional habitat fragments is limited and natural recruitment from the nearest American populations, over 100 km away, is extremely unlikely. The number of pollinators may also be limiting Ontario populations of Virginia Goat's-rue (COSEWIC 2009); however, this requires confirmation through further study.

1.6 Threats to Survival and Recovery

Loss of Habitat

The primary threat to Virginia Goat's-rue is loss of habitat due to land conversion or degradation. Habitat was lost through agricultural land use and fire suppression associated with European settlement beginning early in the 18th century. Habitat continues to be lost mainly through conversion to urban land use, fire suppression and invasion by exotic species (COSEWIC 2009).

Woody encroachment probably eliminated Virginia Goat's-rue from the historical location, Spooky Hollow. Subpopulations of Virginia Goat's-rue in Turkey Point Natural Area appear to be suppressed by competition with Poison Ivy (*Rhus radicans ssp. negundo*), Riverbank Grape (*Vitis riparia*), Northern Dewberry (*Rubus flagellaris*) and regenerating Black Cherry (*Prunus serotina*) (COSEWIC 2009).

The Vittoria Dune Ridge population is located by a roadside at the edge of a sand ridge that is experiencing rapid erosion resulting from sand extraction activities. It is likely that some plants have already been lost, and persistence of Virginia Goat's-rue over the long-term at this site is doubtful (COSEWIC 2009).

Exotic Invasive Plants

Exotic invasive species are considered the second largest threat to biodiversity next to habitat loss and degradation. This is due to their capacity to eliminate native species, either directly, through predation, hybridization or competition for food or space, or indirectly, by altering the food web or habitat. Exotic invasive plants are most successful in disturbed habitats, which makes them especially threatening for species like Virginia Goat's-rue that are endemic to this type of habitat.

Since the mid-1980s, exotic invasive plants have been spreading widely through Norfolk County, including into areas occupied by Virginia Goat's-rue. Predominantly, they

include Multiflora Rose (*Rosa multiflora)* and Autumn Olive (*Elaeagnus umbellata)*, which are bird dispersed, and Norway Maple (*Acer platanoides*), which has spread from plantings near the Turkey Point Provincial Park entrance (D. A. Sutherland pers. comm. 2012). According to the strategic plan prepared by the Ontario Invasive Plants Working Group, the first two are category 1 species, top priority for control because they take over sites and dominate them indefinitely. The third is a category 2 species, highly invasive, but either slower spreading or niche-restricted (Havinga 2000).

Two other category 2 invasive plants, Periwinkle (*Vinca minor*) and Oriental Bittersweet (*Celastrus orbiculata*) (Havinga 2000), are also posing a threat to Virginia Goat's-rue. Periwinkle eliminated all herbs including several Virginia Goat's-rue plants in a 20 by 30 m area of oak savannah in Turkey Point Provincial Park. Oriental Bittersweet is in direct proximity to a patch of Virginia Goat's-rue in the northeast portion of the park (COSEWIC 2009). Oriental Bittersweet also occurs on a portion of the park known as the James Property where Virginia Goat's-rue seed was spread in 2005. Evident at the time only along the roadside, this invasive has now spread through the seeded property, likely encouraged by prescribed burns. Fire appears to give Oriental Bittersweet a competitive advantage (G. Buck pers. comm. 2012).

As species-at-risk habitat, Virginia Goat's-rue sites qualify as high priority for control of invasive species (Havinga 2000). The sites meet three more of the high priority criteria, including: in a unique area (i.e., provincial park, conservation reserve, ANSI, Significant Site); with the potential for long-term management (i.e., park and reserve maintenance programs); and exposed to early stages of invasion. Invasive species are much more difficult to control once they dominate a habitat (Havinga 2000).

Public Recreation

Public use and maintenance practices in Turkey Point Provincial Park and St. Williams Conservation Reserve threaten Virginia Goat's-rue but the threats are relatively minor. Several patches within the Turkey Point Natural Area have experienced occasional trampling (next to frequently used campsites) and mowing (of roadside verges and a road allowance). Over the short term, Virginia Goat's-rue plants may appear more vigorous due to increased sunlight (COSEWIC 2009), but over time these disturbances can lead to poor soil quality (e.g., compacted soil). In addition, disturbance can create prime conditions for germination of invasive plant seeds.

All-terrain vehicle (ATV) use can cause similar disturbances, but typically on a larger scale. Studies have shown that ATVs can interfere with a plant's development of root systems and above-ground stability and its absorption capabilities (Minnesota DNR 2002). All-terrain Vehicles are also conduits for invasive plants. They can carry thousands of invasive plant seeds over many kilometres (MSU 2001). All-terrain Vehicle use threatened most patches of Virginia Goat's-rue in St. Williams Conservation Reserve until 2002, when the area was designated a reserve and protective measures were taken. Although Crown ownership and park and reserve status have led to increased protection for the species and its habitat, the combined mandate with recreation ensures that public use and fire suppression will be ongoing issues for this

population of Virginia Goat's-rue. The threat of public use is enhanced by lack of awareness.

Other Threats

Virginia Goat's-rue plants have been eliminated from Turkey Point Provincial Park through hydro corridor clearing (COSEWIC 2009). The plants and habitat along roadsides are exposed to greater levels of contaminants like salt, herbicides, dust and vehicle emissions that may suppress plant growth. Off-site development could alter drainage patterns and raise water in habitats to levels intolerable for Virginia Goat's-rue.

1.7 Knowledge Gaps

Certain biological and ecological attributes of Virginia Goat's-rue in Ontario are yet unknown, including:

- the viability of seed in the seed bank;
- the most effective means of propagating the plant;
- its lifespan;
- its pollinators and whether self-pollination is possible;
- the identity of herbivores; and
- the effect of herbivory (COSEWIC 2009).

It is not known whether habitat alteration by humans is increasing herbivory and rendering it a threat. The effects of habitat diversity and of a variable fire season on the species are other unknowns.

1.8 Recovery Actions Completed or Underway

Virginia Goat's-rue in the Turkey Point Natural Area receives protection under the *Provincial Parks and Conservation Reserves Act*. As an endangered species, all Virginia Goat's-rue populations in Ontario receive protection under the ESA.

Several prescribed burns have been carried out in portions of Turkey Point Provincial Park and St. Williams Conservation Reserve to enhance the oak savannah and encourage the spread of rare species. Prescribed burns were completed before May 24th to target a period when public use is minimal and conditions are favourable. In the fall, minimal public use coincides with a period when prescribed burns are complicated by rain and leaf litter (S. Dobbyn pers. comm. 2012). In nine of the last 18 years, about six to seven blocks were burned in the park on a rotational basis, leaving one block unburned to act as a control (S. Dobbyn pers. comm. 2012). In 2006, a prescribed burn was carried out at the site of a Virginia Goat's-rue subpopulation in St. Williams Conservation Reserve (COSEWIC 2009). Another burn was carried out in this conservation reserve in 2010, but as part of recovery efforts for Bird's-foot Violet (G. Buck pers. comm. 2012). Prescribed burns are also carried out in the area of the historical Normandale population of Virginia Goat's-rue on the Fish Culture Station

property (D. A. Sutherland pers. comm. 2012). The site of the prescribed burn for Bird's-foot Violet in St. Williams Conservation Reserve and the prescribed burn site at Normandale represent suitable habitat in which Virginia Goat's-rue may be successfully established.

In 2004, 10 grams of Virginia Goat's-rue seed were collected from Turkey Point Natural Area and in 2005 were broadcast along a firebreak in the James property, a site not previously known to support the species. This property, which is contiguous with Turkey Point Provincial Park, was transferred from Nature Conservancy of Canada (NCC) to Ontario Parks in 2005. The Nature Conservancy of Canada carried out prescribed burns on the property in 2001 and 2005 with the help of the Ministry of Natural Resources to restore oak savannah on the property, which is now part of the provincial park. No subsequent burns have taken place and it has become overgrown. Efforts in 2008 and as recently as 2011 to locate Virginia Goat's-rue plants resulting from the seeding were unsuccessful. The dry spring of the latter year may have discouraged germination, though it did not prevent the growth of seeds from another legume, Wild Lupine (*Lupinus perennis*), that were spread along with the Virginia Goat's-rue seeds (G. Buck pers. comm. 2012). Wild Lupine is another plant of oak savannahs but its seedlings appear to prefer partial shade (Pavlovic 2009). This suggests that it may be the light conditions limiting Virginia Goat's-rue at the James Property.

Park personnel avoid Virginia Goat's-rue when mowing, and enforcement officers minimize threats from ATV use through signage, fencing and patrols. Hydro personnel clear by hand so they can bypass rare plants (S. Dobbyn pers. comm. 2012). Threats were assessed in the Turkey Point Natural Area during the 2008 census (COSEWIC 2009).

Progress at a broader scale is being achieved by Tallgrass Ontario, a non-profit organization working to preserve tallgrass prairie and savannah habitat. Habitat protected and created through this work may prove valuable for expanding the range of Virginia Goat's-rue. In 1998, Tallgrass Ontario produced a tallgrass communities recovery plan for World Wildlife Fund Canada and the Ontario Ministry of Natural Resources and, in 2001, established Save Ontario Savannahs to implement key objectives of the plan. The Save Ontario Savannas initiative resulted in a database of Ontario tallgrass prairie and savannah remnant locations and conditions, their landowners and adjacent site information. Remnants were ranked according to level of threat and landowners of priority sites were contacted to identify stewardship opportunities. Save Ontario Savannas communicated its message through open houses and printed materials (report, fact sheets, newsletters and media releases). Implementation occurred primarily in Brant County, the jurisdiction adjoining the northeast corner of Norfolk County. High cost and a shortage of strong stewardship commitment prevented the restoration of additional remnants (K. Breault pers. comm. 2012). The database developed by Tallgrass Ontario and their experiences with restoration, communication and stewardship will help with developing recovery actions for Virginia Goat's-rue.

In October 2011, Tallgrass Ontario broadened its approach with the launch of the Ontario Grassland Initiative (OGI). Along with Tallgrass Ontario's primary objective of restoring specific remnants to past conditions, the new initiative seeks to expand native grassland in general by working with willing landowners across all of southern Ontario. The type of grassland planted, including savannah, will depend on the opportunities that arise. The OGI also seeks to reduce the cost of genotype seed and increase its supply by collecting forb seed from existing grassland restoration projects and by raising funds to purchase grass seed from approved suppliers. The OGI will also provide staff support to landowners and other organizations that wish to develop a grassland reconstruction project. The OGI has a target of 400 hectares of native grassland established per year (K. Breault pers. comm. 2012). This initiative generates habitat, seed, and habitat creation techniques that will be valuable when implementing recovery actions for Virginia Goat's-rue.

The Ontario Ministry of Municipal Affairs and Housing released the Oak Ridges Moraine Conservation Plan in 2002, which identifies sand barrens, savannahs and tallgrass prairie on the Oak Ridges Moraine in south-central Ontario as key natural heritage features deserving protection. Although there are no records of Virginia Goat's-rue occurring on this moraine, the plan includes measures that can be applied in protecting Virginia Goat's-rue habitat. Specifically, the plan defines a minimum vegetation protection zone of 30 m from sand barrens, savannahs and tallgrass prairie, and a minimum area of influence of 120 m. Development and site alteration are prohibited within the minimum vegetation protection zone, and are permitted in the minimum area of influence only with a natural heritage evaluation that demonstrates no adverse effects. A list of exceptions accompanies these restrictions. This plan has legislative authority under the *Oak Ridges Moraine Conservation Act* (MMAH 2002).

2.0 RECOVERY

2.1 Recovery Goal

The recovery goal for Virginia Goat's-rue in Ontario is long-term survival of the species and its habitat in Ontario through protection and restoration efforts that increase the species' abundance and range.

The predominant threat to Virginia Goat's-rue in Ontario is the very limited abundance and range of the species and its habitat. Increasing the species' abundance and range will involve protecting extant populations and their habitat as well as securing suitable habitat for introducing populations.

2.2 Protection and Recovery Objectives

Table 1. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Protect the species and its habitat within the current area of occupancy.
2	Monitor the condition of the species and its habitat within the area of occupancy.
3	Increase the area of occupancy using existing suitable habitat.
4	Create habitat where feasible.
5	Communicate with partners and the public to speed recovery and build awareness.

2.3 Approaches to Recovery

Table 2. Approaches to recovery of the Virginia Goat's-rue in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
1. Protect the species and its habitat within the current area of occupancy.				
Critical	Ongoing	Protection, Management	**1.1** Continue prescribed burns where species is present. – Survey burn sites for exotic invasive plants within and adjacent to sites. – Continue burns as needed to prevent woody succession at Turkey Point Provincial Park and St. Williams Conservation Reserve if invasive plants are discouraged by burns. – Control invasive plants before continuing burns and control annually as needed if invasive plants are not discouraged by burns.	• Habitat loss • Succession • Exotic invasive plants
Critical	Ongoing	Protection, Management	**1.2** Initiate prescribed burns where species is present. – Confirm recovery potential at Vittoria Dune Ridge. – Assess burn feasibility at sites of extant populations where prescribed burns are not currently occurring. – Initiate burns where appropriate, addressing invasive plants, as in 1.1. – If burns are not feasible, mechanically clear woody vegetation and exotic invasive plants.	• Habitat loss • Succession • Exotic invasive plants

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Critical	Ongoing	Protection, Management	**1.3** Continue enforcement at St. Williams Conservation Reserve, modified mowing and clearing at Turkey Point Provincial Park, and address potential contamination and flood risks. – Ensure signs, fencing and patrols provide adequate protection for species and habitat. – Avoid the species when mowing and clearing. – Minimize roadside contamination and prevent flooding.	• ATV use • Mowing • Hydro corridor clearing • Contamination • Flooding
2. Monitor the condition of the species and its habitat within the area of occupancy.				
Critical	Short-term	Inventory	**2.1** Census Vittoria Dune Ridge population to confirm status. – Apply 2008 method (i.e., plants and stems).	• Population status
Critical	Ongoing	Monitoring and Assessment	**2.2** Monitor plant health and threats, including: – encroachment by woody native species; – encroachment by exotic invasive plants; – other threats including drainage issues, salt and pesticides; – effects of prescribed burns; and – new plants populations and seeded areas.	• Population trends • All threats
Necessary	Short-term	Research	**2.3** Conduct research to fill knowledge gaps on: – germination rates; – seedling success; – lifespan; – effects of variable fire seasons; – effects of herbivory; – identify herbivores; – identify pollinators; – confirm ability to self-pollinate; and – propagation by seed and transplant.	• Biological and ecological knowledge gaps

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Necessary	Ongoing	Research	**2.4** Update protection and management. – Refine recovery approaches based on knowledge gained through monitoring and research.	• All threats
3. Increase the area of occupancy using existing suitable habitat.				
Necessary	Ongoing	Management	**3.1** Plant Virginia Goat's-rue on suitable habitat. – Seed Normandale Fish Culture Station and James properties, and Bird's-foot Violet site at St. Williams C.R. if appropriate for both species. – Plant new suitable habitat identified in 3.2 using propagation method recommended by research in 2.3 when available and prioritize sites based on threats, proximity to existing plants, opportunity, and potential impacts to species at risk that share habitat.	• Habitat loss
Necessary	Ongoing	Research	**3.2** Search for additional suitable habitat, such as: – Simcoe, Walsh and Spooky Hollow historical sites; – sites protected for other species at risk; – sites restored by Tallgrass Ontario; and – other suitable habitat.	• Habitat loss
Necessary	Ongoing	Protection, Management	**3.3** Conduct prescribed burns on suitable habitat. – Continue prescribed burns at Normandale Fish Culture Station and James properties, Bird's-foot Violet site at St. Williams C.R., and on new suitable habitat identified in 3.2 where burns have been carried out, addressing exotic invasive plants as in 1.1. – Initiate prescribed burns on new suitable habitat identified in 3.2 as in 1.2. – Incorporate variable fire seasons if recommended by research in 2.3.	• Habitat loss • Succession • Exotic invasive plants

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
4. Create habitat where feasible.				
Beneficial	Ongoing	Research	**4.1** Prioritize sites for habitat creation. – Consider planned restoration for other species at risk. – Consider planned restoration by Tallgrass Ontario. – Consider opportunities to enlarge existing areas. – Check the soil map for other candidate sites within southwestern Ontario. – Contact landowners to identify opportunities, making use of the Tallgrass Ontario database and experiences. – Document existing threats on the sites. – Prioritize sites based on threat results.	• Habitat loss • All threats
Beneficial	Ongoing	Management	**4.2** Create habitat in order of priority. – Review experiences of Tallgrass Ontario in habitat creation. – Initiate habitat management as in 1.2, incorporating lessons learned by Tallgrass Ontario. – Build in natural habitat diversity that accommodates other species including species at risk.	• Habitat loss • Succession • Exotic invasive plants
5. Communicate with partners and the public to speed recovery and build awareness				
Necessary	Ongoing	Research and Outreach	**5.1** Coordinate with plans for species at risk that share habitat to avoid redundancy and conflicts. – Exchange knowledge about species' needs. – Develop cooperative plan.	• Habitat loss

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Necessary	Ongoing	Research and Outreach	**5.2** Coordinate with existing habitat initiatives including the Ontario Grassland Initiative to avoid redundancy. – Exchange knowledge. – Procure seed. – Share stewardship actions. – Develop a cooperative plan.	• Habitat loss
Beneficial	Short-term	Education	**5.3** Inform park and conservation reserve visitors of the significance of the species and its habitat. – Review Tallgrass Ontario communication. materials for possible sharing of resources – Develop interpretive signs, posters, articles and presentations.	• Lack of awareness • Trampling • ATV use

Narrative to Support Approaches to Recovery

With Virginia Goat's-rue endemic to rare tallgrass savannah and woodland, a precautionary approach is to focus efforts on protecting the habitat. The habitat of extant populations is particularly important since habitat creation is a complicated and unpredictable undertaking.

At Turkey Point Natural Area, there is clear evidence that without prescribed burns the habitat will quickly become overgrown and too shady to support the species; hence the emphasis on prescribed burning as a habitat protection approach. Some exotic invasive plants are destroyed by fire but others show little effect or are even encouraged by it. Before conducting prescribed burns, species of exotic invasive plants that are in the vicinity and are not eliminated by fire will need to be removed to protect this management investment. It is unlikely that species' recovery will be successful in habitats infested with exotic invasive plants.

Research into variable fire seasons and habitat diversity of extant populations could result in the scheduling of additional prescribed burns later in the season to protect or increase biodiversity. High biodiversity provides resilience, which helps protect the habitat. A variable fire season may accommodate more species at risk, allowing recovery objectives to be achieved more readily through combined actions. Prescribed burns could be conducted later in the season in Turkey Point Provincial Park if kept to lighter public-use periods, such as during the week in September, or conducted at other times of the year if the scale of the burn is small (S. Dobbyn pers. comm. 2012).

Enforcement efforts have proven to be effective in minimizing threats from ATV use and maintaining this momentum is a critical priority. Reduction of all threats is important for protecting habitat. Information on access and site condition at Vittoria Dune Ridge will help determine recovery potential and appropriate actions for this population of Virginia Goat's-rue.

Monitoring provides the opportunity to assess the effectiveness of recovery actions and adjust methods in a timely manner. This will speed achievement of the recovery goal. Critical to this process, and to the assessment of recovery success in general, is an accurate baseline of population status. Some of the research approaches to recovery will be addressed through these monitoring activities. The research topics identified in the approaches table reflect the gaps in knowledge, such as the best method of propagating the plant and expanding the species' range.

Establishing Virginia Goat's-rue in new areas will increase the species' long-term viability. Use of existing suitable habitat will help advance this objective, as these areas can be planted earlier and hold greater promise for success. Historical sites may be the most successful, if seeds are still present and can be coaxed out of dormancy. The presence and severity of threats are prominent considerations in prioritizing candidate sites. Care will have to be taken to ensure that activities to establish Virginia Goat's-rue in new areas do not introduce invasive plants.

With limited suitable habitat available, habitat will likely need to be created to ensure long-term recovery of the species. Locating these sites adjacent to existing habitat will provide increased protection for this habitat, effectively enlarging it and buffering it from threats. The presence and severity of threats are important factors in prioritizing habitat creation, as they were with existing suitable habitat. Turkey Point Provincial Park contains pine plantations and a deciduous woodland that could be restored to tallgrass savannah through prescribed burning (S. Dobbyn pers. comm. 2012).

Habitat is currently being protected and created through other initiatives and the recovery of Virginia Goat's-rue may be expedited through cooperative efforts. Efficiency can also be gained by combining recovery actions associated with other species. Each species at risk that depends on tallgrass habitat will require implemented actions to protect this habitat. A multi-species plan that targets a variety of species' requirements and tolerances will promote the recovery of more natural tallgrass habitat and biodiversity. Natural habitat diversity may be important to the recovery of Virginia Goat's-rue and would be consistent with a precautionary approach. Combining actions will help eliminate redundancy, conserve limited resources and ensure that recovery actions do not exclude species at risk other than Virginia Goat's-rue.

As popular destinations, Turkey Point Provincial Park and St. Williams Conservation Reserve offer excellent educational opportunities. Signs, posters, articles and presentations on the species and its habitat will help reduce threats and the need for enforcement, and will gradually build public support for Virginia Goat's-rue in the Turkey Point Natural Area and elsewhere in the province. Materials produced through other initiatives may simplify this approach.

2.4 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.

Virginia Goat's-rue in Ontario exists as only two populations restricted to acidic sand deposits in open Black Oak woodland and Black Oak savannah, habitats that are rare in the province. Historically, frequent fires maintained the open conditions of these habitats and since then fire suppression has allowed woody plants to encroach and either eliminate Virginia Goat's-rue plants or prevent them from flowering. Woody succession will continue at the site of extant populations unless there is active habitat management.

It is recommended that the minimum area for consideration in a habitat regulation includes the area occupied by each extant population (Turkey Point Natural Area and Vittoria Dune Ridge), the extent of the tallgrass habitat surrounding the populations, and

a vegetation protection zone of 30 m beyond this habitat. This would allow for habitat management to protect and restore the species and for protection of the tallgrass habitat and its biodiversity. The tallgrass habitat boundary for Turkey Point Provincial Park subpopulations should conform to the descriptions for the ecological land classification types in which Virginia Goat's-rue occurs. These include: Dry-Fresh Black Oak Deciduous Savannah (SVDM3-23), Dry Red Oak Deciduous Savannah (SVDM3-1), Dry-Fresh Oak-Pine Mixed Woodland (WOMM3-21), Dry-Fresh Oak-Red Maple Deciduous Forest (FODM2-1), Dry-Fresh Black Oak Woodland (WODM3-2), Dry Mixed Oak Deciduous Woodland (WODM3-20), Dry-Fresh Mixed Oak Deciduous Forest (FODM1-4) and Hydro Corridors (CVI_22). The tallgrass habitat boundaries for St. Williams Conservation Reserve and Vittoria Dune Ridge where an ecological land classification has not been completed should conform to the NHIC descriptions for Dry Black Oak Tallgrass Savannah, Dry Black Oak–Pine Tallgrass Savannah and Dry Black Oak–White Oak Tallgrass Woodland.

The 30-metre vegetation protection zone is the same as the minimum width adopted by the Oak Ridges Moraine Conservation Plan to protect sand barrens, savannahs and tallgrass prairie. The zone would provide opportunities to control exotic invasive plants before they enter the tallgrass habitat and will buffer tallgrass species from other threats like recreational activities and roadside contaminants. Where land adjacent to the tallgrass habitat is paved over or is similarly converted, leaving no room for a zone that fulfills the stated purposes, the boundary should be the extent of the tallgrass habitat. It is likely that Virginia Goat's-rue in these locations will require a corresponding increase in protection efforts.

Both the species and its habitat have very limited distribution in Ontario and in Canada and the extent of the habitat needs of the species is not entirely known. The area recommended for consideration in a habitat regulation will benefit other species endemic to the habitat whose implications to the survival of Virginia Goat's-rue are yet unknown.

Considering the emphasis of this recovery strategy on increasing the range of Virginia Goat's-rue, it is recommended that the habitat regulation be written in a manner that will readily protect new occurrences of the species. It is anticipated that the boundary will need adjustment as knowledge regarding the needs of the species and the effectiveness of the vegetation protection is gained.

GLOSSARY

Axillary: Located where the leaf joins the stem of a plant.

Circumneutral: On a pH scale expressing degree of acidity or alkalinity where neutral is 7.0, this is a pH of between 6.5 and 7.5 (nearly neutral).

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 sub-national (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

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

Forb: An herbaceous plant that is not a grass.

Raceme: A cluster of single short-stalked flowers arranged along the main stem in which the lowest flower opens first.

Radially: With parts radiating from or converging to a common centre.

Taproot: A large single root that grows straight downward from the stem and bears smaller lateral roots.

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.

REFERENCES

Buck, G., pers. comm. Species at Risk Biologist. Ontario Ministry of Natural Resources. March 2012.

Breault, K. pers. comm. Provincial Program Coordinator. Tallgrass Ontario. February 2012.

Chambers, J. 2010. Ecological Land Classification of Turkey Point Provincial Park. Ontario Parks, Ontario Ministry of Natural Resources.

Clark, G. T. 1971. The ecological life history of Tephrosia virginiana (L.) Pers. Ph.D. dissertation for the University of Arkansas.

COSEWIC 2012. Species at Risk Public Registry. http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=218

COSEWIC. 2009. COSEWIC assessment and status report on the Virginia Goat's-rue Tephrosia virginiana in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 31 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Duncan, W. H., P. L. Piercy, R. J. Starling. 1955. Toxicological Studies of Southeastern Plants. I. Leguminosae. Economic Botany 9(3): 243–255.

Gleason, H. A. 1952. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. Hafner Press. New York. vol. 2. p. 412.

Havinga, D. 2000. Sustaining Biodiversity: a strategic plan for managing invasive plants in southern Ontario. City of Toronto. 28 pp.

Henderson, D.C. 2011. Activity Set-back Distance Guidelines for Prairie Plant Species at Risk. Canadian Wildlife Service – Prairie and Northern Region. Environment Canada. 18 pp.

Hiers, J. K., R. Wyatt and R. J. Mitchell. 2000. The effects of fire regime on legume reproduction in longleaf pine savannas: is a season selective? Oecologia 125(4): 521—530.

Jean, R., T. Dailey, and S. Peter. 2002. Native bee communities, honeybees, and flower use in black oak savannas. Abstract from ESA 2002 Annual Meeting.

Lemieux, C., D. Scott and R. Davis. Climate Change and Ontario's Provincial Parks: A Preliminary Analysis of Potential Impacts and Implications for Policy, Planning and Management. 2004 Proceedings of the Parks Research Forum of Ontario. p. 92–95. http://casiopa.mediamouse.ca/wp-content/uploads/2010/05/PRFO-2004-Proceedings-p83-104-Lemieux-Scott-and-Davis.pdf

Minnesota DNR (Department of Natural Resources) 2002. Assessing the ecological impacts of ATV trail construction and use on public lands: factors to consider and a review of the literature. Prepared by and for the Environmental Review Program, Ecological Services Division. Internal Peer Review Draft #5. October 3, 2002. p.12. http://friendscvsf.org/AssessingATVimpacts-pdf.pdf

MMAH (Ontario Ministry of Municipal Affairs and Housing). 2002. Oak Ridges Moraine Conservation Plan. 82 pp.

MSU (Montana State University, Extension Service). 2001. Montana Knapweeds: Identification, Biology and Management. Circular 311, Revised March 2001. p.6. http://www.co.yellowstone.mt.gov/extension/ag/pubs/knapweed311.pdf

NatureServe. 2012. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer (Accessed: March 1, 2012).

NHIC 2012. Natural Heritage Information Centre Biodiversity Explorer. Accessed March 2, 2012. https://www.biodiversityexplorer.mnr.gov.on.ca/nhicWEB/speciesDetailReport.do?elID=83220

Pavlovic, N. B., R. Grundel. 2009. Reintroduction of Wild Lupine (Lupinus perennis L.) Depends on Variation in Canopy, Vegetation, and Litter Cover. Abstract Restoration Ecology 17(6): 807–817.

Rodger, L. 1998. Tallgrass communities of southern Ontario: A recovery plan. World Wildlife Fund Canada and Ontario Ministry of Natural Resources, February 1998. 66 pp.

Species at Risk. 2011. Species at Risk Public Registry. http://www.sararegistry.gc.ca/sar/listing/schedules_e.cfm?id=1

Sutherland, D. A., pers. comm. Zoologist. Natural Heritage Information Centre, Ontario Ministry of Natural Resources. February 2012.

Wood, C. E. 1949. The American Barbistyled Species of Tephrosia (Leguminosae). Rhodora 51: 202, 207–208, 275.

PART 3 – *Bird's Foot Violet and Virginia Goat's-rue – Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources and Forestry

Ministry of Natural Resources and Forestry

Natural. Valued. Protected.

Bird's Foot Violet and Virginia Goat's-Rue

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 and Forestry (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 the Bird's-foot Violet (*Viola pedata*) and the recovery strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) in Ontario were completed on November 22, 2013 (http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_rs_brds_ft_en.pdf), and (http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_rs_vrgn_gtsr_en.pdf).

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.

Bird's-foot Violet is a stemless violet with five lilac to purple coloured petals. The leaflets of its thin, finely divided leaves resemble the splayed toes of a bird.

Virginia Goat's-rue is a perennial herb in the Pea Family that grows up to 70 cm tall. It produces yellow and pink bi-coloured flowers, and there are typically dense, fine hairs on its stem, branches, leaves, flowers, and fruit that give the plant a silvery appearance.

Ontario

Given their similar habitat types and threats, the recovery efforts for Bird's-foot Violet and Virginia Goat's-rue are addressed collectively in a single government response statement.

MOVING FORWARD TO PROTECT AND RECOVER BIRD'S-FOOT VIOLET AND VIRGINIA GOAT'S-RUE

Bird's-foot Violet and Virginia Goat's-rue are both listed as endangered species under the ESA, which protects both the plants and their habitats. The ESA prohibits harm or harassment of the species and damage or destruction of their habitat without authorization. Such authorization would require that conditions established by the Ministry be met.

Bird's-foot Violet occurs in eastern North America, and its distribution ranges from Ontario and New York, south to Georgia and west to Minnesota and Texas. Fourteen populations have been observed in southwestern Ontario, only five of which are believed to still exist today. The largest population, which consists of at least 6,500 plants, is located within Turkey Point Natural Area, which includes Turkey Point Provincial Park and St. Williams Conservation Reserve. This population is considered stable or increasing due to ongoing habitat protection and management, including prescribed burns. Most plants within Turkey Point Provincial Park occur along a hydro corridor. The four remaining populations are located on private lands, and three of those populations have fewer than 10 plants.

Like Bird's-foot Violet, Virginia Goat's-rue occurs in eastern North America. Its distribution ranges from Ontario and Minnesota, south to Florida and west to Texas. Less than one percent of the total distribution of the species is in Canada, where six populations of the species have been observed, all within Norfolk County, Ontario. Only two of these populations continue to exist today; the largest of these, with an estimated 566 individual plants, occurs within the Turkey Point Natural Area. The other population is located on private land; recent population estimates at this site are lacking, as the site has not been accessed since 2001. Historically, the species was documented from four additional locations in Norfolk County; however the species has not been observed at any of these locations in more than 20 years, despite considerable targeted effort.

Bird's-foot Violet and Virginia Goat's-rue can both be found in dry, open, sandy habitats and are commonly associated with oaks or pines. In Ontario, both species occur in oak savanna habitats, dominated by Black Oak (*Quercus velutina*), White Oak (*Quercus alba*) or Red Oak (*Quercus rubra*). Virginia Goat's-rue also occurs in woodland habitats dominated by oaks and pines.

The predominant threats to Bird's-foot Violet and Virginia Goat's-rue in Ontario are habitat loss due to alteration of the natural disturbance regime (i.e., fire suppression), as well as conversion to agricultural lands and housing developments. Other threats include management and recreational pressures, invasive species, and erosion at specific sites.

Bird's-foot Violet and Virginia Goat's-rue are both endemic to rare and fragmented ecosystems in Ontario. Ever since plant inventories were first conducted in the province, neither species has been found to be common. The distribution and abundance of Bird's-foot Violet and Virginia Goat's-rue prior to this period are unknown. For both these species, recovery is focused on protecting and enhancing remaining habitat, and enabling increases to existing populations. Because only a few, small, isolated populations remain, and approaches to protect and improve the habitat of these species are generally well understood, recovery is also focused on investigating the feasibility of re-establishing the species at historically occupied sites.

The government's goal for the recovery of Bird's-foot Violet and Virginia Goat's-rue in Ontario is to maintain the provincial population of each species at, or enable natural increases to, sustainable levels, and re-establish the species at sites they have historically occupied if feasible and appropriate.

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 Bird's-foot Violet and Virginia Goat's-rue, the government will directly undertake the following actions:

- Continue to undertake periodic monitoring of Bird's-foot Violet and Virginia Goat's-rue populations, habitat conditions, and threats to the species and their habitat within Turkey Point Provincial Park.
- Continue to undertake ecosystem enhancement activities such as prescribed burning and invasive species control within Turkey Point Provincial Park, as resources permit.
- Continue to work with partners to undertake monitoring, habitat management, research to address significant knowledge gaps, and to increase awareness and promote stewardship of species at risk including Bird's-foot Violet and Virginia Goat's-rue in St. Williams Conservation reserve.
- Continue to implement the Ontario Invasive Species Strategic Plan to address the invasive species (e.g., Multiflora Rose (*Rosa multiflora*), Autumn Olive (*Elaeagnus umbellate*), Garlic Mustard (*Alliaria petiolata*)) that threaten Bird's-foot Violet and Virginia Goat's-rue.
- Educate other agencies and authorities involved in planning and environmental assessment processes on the protection requirements under the ESA.
- Encourage the submission of Bird's-foot Violet and Virginia Goat's-rue 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 Bird's-foot Violet and Virginia Goat's-rue and their habitat through the ESA.
- Support conservation, agency, municipal and industry partners, and Aboriginal communities and organizations to undertake activities to protect and recover the Bird's-foot Violet and Virginia Goat's-rue. Support will be provided where appropriate through funding, agreements, permits with appropriate conditions, and/or advisory services.
- Encourage collaboration, and establish and communicate annual priority actions for government support in order to reduce duplication of efforts.

GOVERNMENT-SUPPORTED ACTIONS

The government endorses the following actions as being necessary for the protection and recovery of Bird's-foot Violet and Virginia Goat's-rue. Actions identified as "high" will be given priority consideration for funding under the ESA. Where reasonable, the government will also consider the priority assigned to these actions when reviewing and issuing authorizations under the Endangered Species Act. Other organizations are encouraged to consider these priorities when developing projects or mitigation plans related to species at risk. The government will focus its support on these high-priority actions over the next five years.

Focus Area: Protection and Management
Objective: Improve habitat conditions and promote increases in the distribution and abundance of Bird's-foot Violet and Virginia Goat's-rue.

Actions:

1. (HIGH) Develop and implement site-specific management strategies to manage and improve habitat where these species occur, with consideration for other rare species and invasive species present on site. Monitor the effectiveness of actions taken and revise strategies, as appropriate, based on the best available information. Strategies may include, but are not limited to:
   - prescribed burns to prevent woody succession;
   - woody vegetation removal (e.g., where burns are not feasible); and,
   - invasive species control.
2. Investigate whether it is feasible and appropriate to re-establish Bird's-foot Violet or Virginia Goat's-rue at sites historically occupied by the species, and where it is deemed feasible and appropriate, undertake actions to do so.

Focus Area: Research
Objective: Increase knowledge about habitat management for Bird's-foot Violet and Virginia Goat's-rue, as well as factors influencing reproductive success and propagation.

Actions:

3. (HIGH) Undertake research to determine optimal conditions at which habitat management techniques should be conducted (e.g., optimal temperature and frequency for prescribed burns).
4. Undertake research to:
   - determine factors influencing reproductive success of Bird's-foot Violet and Virginia Goat's-rue (e.g., conditions under which pollination, germination, and recruitment are optimal; seed bank characteristics and longevity); and
   - identify the best practices for propagation (including assisted dispersal, cultivation, or transplantation) of these species.

Focus Area: Inventory and Monitoring
Objective: Confirm where the species remain and improve understanding of the species and their habitat at these sites.

Actions:

5. Survey the sites where Bird's-foot Violet and Virginia Goat's-rue occur on private land to confirm whether the species remain at these sites and, where they are found to remain, determine population sizes. Surveys should be conducted using a consistent, standardized methodology.
6. Undertake regular monitoring of the species demographics, health, habitat conditions, and threats at all sites where they occur.

Focus Area:	**Awareness**
Objective:	Increase awareness and stewardship of the species and their habitat.

Actions:

7. Increase awareness among land owners and the public about Bird's-foot Violet and Virginia Goat's-rue, including:
   - identification of the species;
   - the species' habitat requirements;
   - protection afforded to the species and their habitat under the ESA; and,
   - actions they can take to minimize threats, including habitat loss, invasive species, trampling, and erosion.

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, or the Species at Risk Farm Incentive 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 Bird's-foot Violet and Virginia Goat's-rue.

ACKNOWLEDGEMENT

We would like to thank all those who participated in the development of the Recovery Strategy for the Bird's-foot Violet (*Viola pedata*) in Ontario and the Recovery Strategy for the Virginia Goat's-rue (*Tephrosia virginiana*) 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 MNRF district office
Contact the Natural Resources Information Centre
1-800-667-1940
TTY 1-866-686-6072
mnr.nric.mnr@ontario.ca
ontario.ca/mnr