



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.*

# 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](http://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

© Queen's Printer for Ontario, 2013.  
ISBN 978-1-4606-3064-8 (PDF)

*Content (excluding the cover illustration) may be used without permission, with appropriate credit to the source.*

*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

RECOMMENDED CITATION.....	i
AUTHORS.....	ii
ACKNOWLEDGMENTS.....	ii
DECLARATION.....	iii
RESPONSIBLE JURISDICTIONS .....	iii
EXECUTIVE SUMMARY.....	iv
1.0 BACKGROUND INFORMATION.....	1
1.1 Species Assessment and Classification.....	1
1.2 Species Description and Biology.....	1
1.3 Distribution, Abundance and Population Trends .....	4
1.4 Habitat Needs .....	7
1.5 Limiting Factors.....	9
1.6 Threats to Survival and Recovery .....	9
1.7 Knowledge Gaps.....	11
1.8 Recovery Actions Completed or Underway.....	11
2.0 RECOVERY .....	14
2.1 Recovery Goal .....	14
2.2 Protection and Recovery Objectives .....	14
2.3 Approaches to Recovery.....	15
2.4 Area for Consideration in Developing a Habitat Regulation .....	21
GLOSSARY .....	23
REFERENCES.....	25
LIST OF FIGURES	
Figure 1. Global distribution of Virginia Goat's-rue (COSEWIC 2009).....	6
Figure 2. Historical and current distribution of Virginia Goat's-rue in Ontario.....	7
LIST OF TABLES	
Table 1. Protection and recovery objectives.....	14
Table 2. Approaches to recovery of the Virginia Goat's-rue in Ontario.....	15



## 1.0 BACKGROUND INFORMATION

### 1.1 Species Assessment and Classification

COMMON NAME: Virginia Goat's-rue
SCIENTIFIC NAME: <i>Tephrosia virginiana</i>
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 segnipipes*. 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 segnipipes* 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 to 13 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<sup>2</sup> (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<sup>2</sup> that used to exist in Ontario (Rodger 1998).

Recovery Strategy for the Virginia Goat's-rue in Ontario

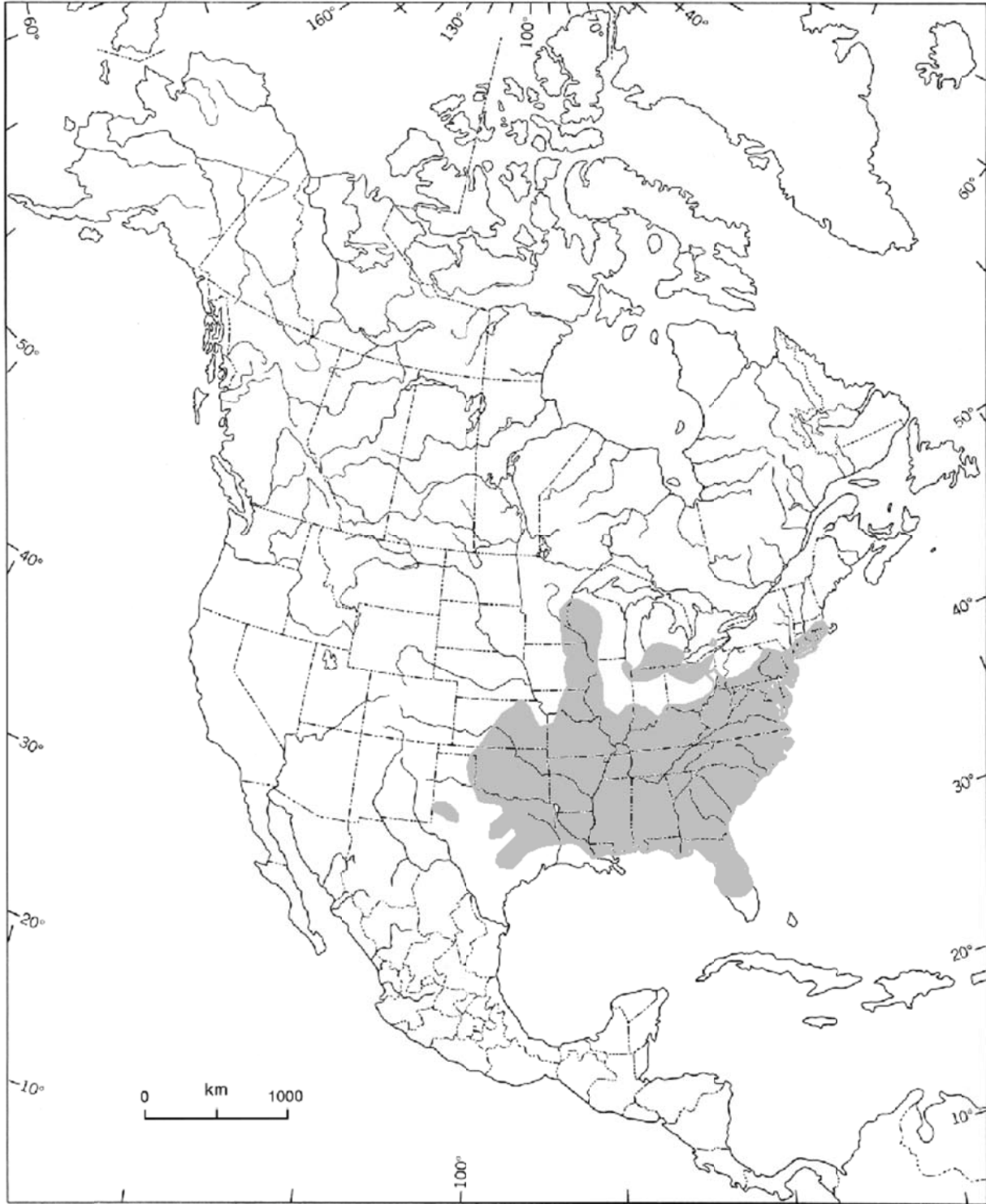


Figure 1. Global distribution of Virginia Goat's-rue (COSEWIC 2009)

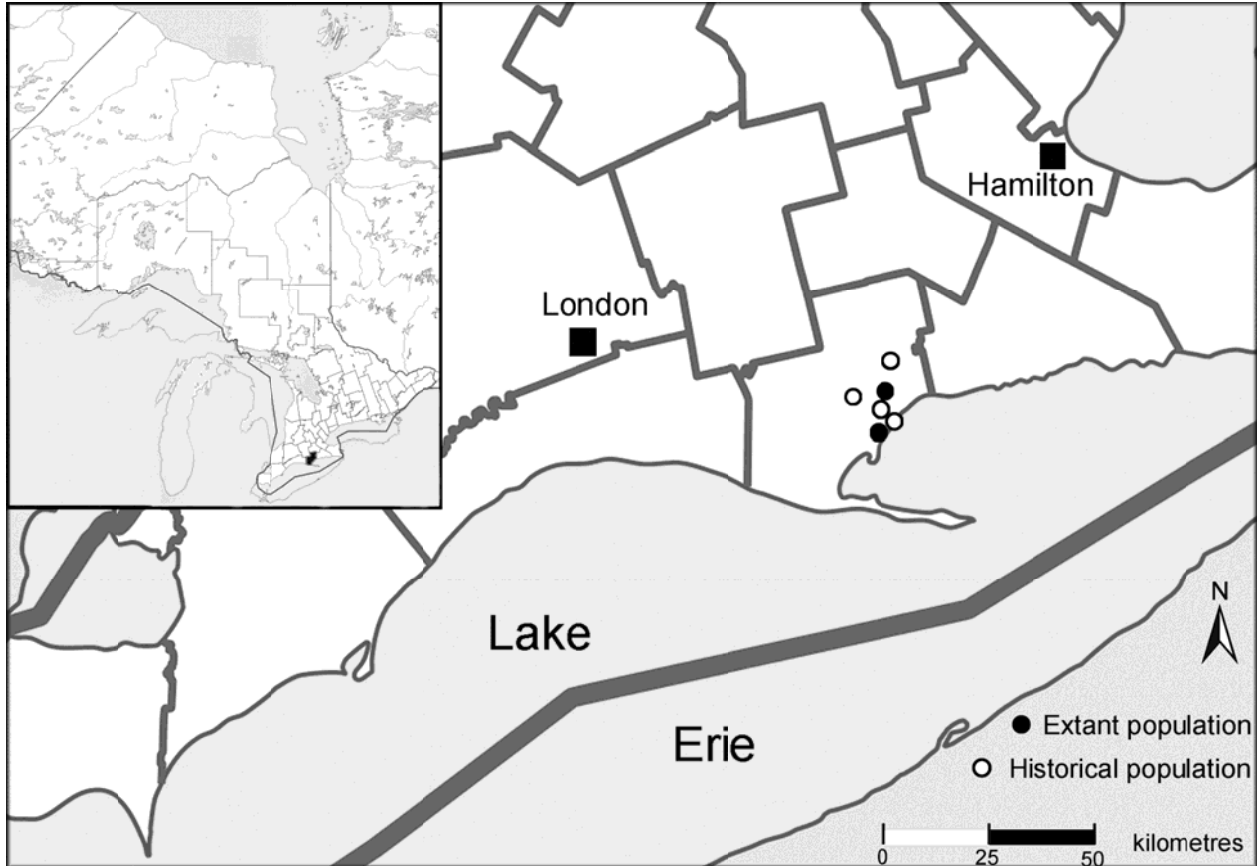


Figure 2. Historical and current distribution of Virginia Goat's-rue in Ontario

#### 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 volatilizes 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 18<sup>th</sup> 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 24<sup>th</sup> 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 Savannahs 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 Savannahs 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
<b>1. Protect the species and its habitat within the current area of occupancy.</b>				
Critical	Ongoing	Protection, Management	<p><b>1.1</b> Continue prescribed burns where species is present.</p> <ul style="list-style-type: none"> <li>– Survey burn sites for exotic invasive plants within and adjacent to sites.</li> <li>– 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.</li> <li>– Control invasive plants before continuing burns and control annually as needed if invasive plants are not discouraged by burns.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Succession</li> <li>• Exotic invasive plants</li> </ul>
Critical	Ongoing	Protection, Management	<p><b>1.2</b> Initiate prescribed burns where species is present.</p> <ul style="list-style-type: none"> <li>– Confirm recovery potential at Vittoria Dune Ridge.</li> <li>– Assess burn feasibility at sites of extant populations where prescribed burns are not currently occurring.</li> <li>– Initiate burns where appropriate, addressing invasive plants, as in 1.1.</li> <li>– If burns are not feasible, mechanically clear woody vegetation and exotic invasive plants.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Succession</li> <li>• Exotic invasive plants</li> </ul>

Recovery Strategy for the Virginia Goat's-rue in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Critical	Ongoing	Protection, Management	<p><b>1.3</b> Continue enforcement at St. Williams Conservation Reserve, modified mowing and clearing at Turkey Point Provincial Park, and address potential contamination and flood risks.</p> <ul style="list-style-type: none"> <li>– Ensure signs, fencing and patrols provide adequate protection for species and habitat.</li> <li>– Avoid the species when mowing and clearing.</li> <li>– Minimize roadside contamination and prevent flooding.</li> </ul>	<ul style="list-style-type: none"> <li>• ATV use</li> <li>• Mowing</li> <li>• Hydro corridor clearing</li> <li>• Contamination</li> <li>• Flooding</li> </ul>
<b>2. Monitor the condition of the species and its habitat within the area of occupancy.</b>				
Critical	Short-term	Inventory	<p><b>2.1</b> Census Vittoria Dune Ridge population to confirm status.</p> <ul style="list-style-type: none"> <li>– Apply 2008 method (i.e., plants and stems).</li> </ul>	<ul style="list-style-type: none"> <li>• Population status</li> </ul>
Critical	Ongoing	Monitoring and Assessment	<p><b>2.2</b> Monitor plant health and threats, including:</p> <ul style="list-style-type: none"> <li>– encroachment by woody native species;</li> <li>– encroachment by exotic invasive plants;</li> <li>– other threats including drainage issues, salt and pesticides;</li> <li>– effects of prescribed burns; and</li> <li>– new plants populations and seeded areas.</li> </ul>	<ul style="list-style-type: none"> <li>• Population trends</li> <li>• All threats</li> </ul>
Necessary	Short-term	Research	<p><b>2.3</b> Conduct research to fill knowledge gaps on:</p> <ul style="list-style-type: none"> <li>– germination rates;</li> <li>– seedling success;</li> <li>– lifespan;</li> <li>– effects of variable fire seasons;</li> <li>– effects of herbivory;</li> <li>– identify herbivores;</li> <li>– identify pollinators;</li> <li>– confirm ability to self-pollinate; and</li> <li>– propagation by seed and transplant.</li> </ul>	<ul style="list-style-type: none"> <li>• Biological and ecological knowledge gaps</li> </ul>

Recovery Strategy for the Virginia Goat's-rue in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Necessary	Ongoing	Research	<p><b>2.4</b> Update protection and management.</p> <ul style="list-style-type: none"> <li>– Refine recovery approaches based on knowledge gained through monitoring and research.</li> </ul>	<ul style="list-style-type: none"> <li>• All threats</li> </ul>
<b>3. Increase the area of occupancy using existing suitable habitat.</b>				
Necessary	Ongoing	Management	<p><b>3.1</b> Plant Virginia Goat's-rue on suitable habitat.</p> <ul style="list-style-type: none"> <li>– Seed Normandale Fish Culture Station and James properties, and Bird's-foot Violet site at St. Williams C.R. if appropriate for both species.</li> <li>– 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss</li> </ul>
Necessary	Ongoing	Research	<p><b>3.2</b> Search for additional suitable habitat, such as:</p> <ul style="list-style-type: none"> <li>– Simcoe, Walsh and Spooky Hollow historical sites;</li> <li>– sites protected for other species at risk;</li> <li>– sites restored by Tallgrass Ontario; and</li> <li>– other suitable habitat.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss</li> </ul>
Necessary	Ongoing	Protection, Management	<p><b>3.3</b> Conduct prescribed burns on suitable habitat.</p> <ul style="list-style-type: none"> <li>– 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.</li> <li>– Initiate prescribed burns on new suitable habitat identified in 3.2 as in 1.2.</li> <li>– Incorporate variable fire seasons if recommended by research in 2.3.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Succession</li> <li>• Exotic invasive plants</li> </ul>

Recovery Strategy for the Virginia Goat's-rue in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
<b>4. Create habitat where feasible.</b>				
Beneficial	Ongoing	Research	<b>4.1</b> Prioritize sites for habitat creation. <ul style="list-style-type: none"> <li>– Consider planned restoration for other species at risk.</li> <li>– Consider planned restoration by Tallgrass Ontario.</li> <li>– Consider opportunities to enlarge existing areas.</li> <li>– Check the soil map for other candidate sites within southwestern Ontario.</li> <li>– Contact landowners to identify opportunities, making use of the Tallgrass Ontario database and experiences.</li> <li>– Document existing threats on the sites.</li> <li>– Prioritize sites based on threat results.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• All threats</li> </ul>
Beneficial	Ongoing	Management	<b>4.2</b> Create habitat in order of priority. <ul style="list-style-type: none"> <li>– Review experiences of Tallgrass Ontario in habitat creation.</li> <li>– Initiate habitat management as in 1.2, incorporating lessons learned by Tallgrass Ontario.</li> <li>– Build in natural habitat diversity that accommodates other species including species at risk.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss</li> <li>• Succession</li> <li>• Exotic invasive plants</li> </ul>
<b>5. Communicate with partners and the public to speed recovery and build awareness</b>				
Necessary	Ongoing	Research and Outreach	<b>5.1</b> Coordinate with plans for species at risk that share habitat to avoid redundancy and conflicts. <ul style="list-style-type: none"> <li>– Exchange knowledge about species' needs.</li> <li>– Develop cooperative plan.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss</li> </ul>

Recovery Strategy for the Virginia Goat's-rue in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Necessary	Ongoing	Research and Outreach	<p><b>5.2</b> Coordinate with existing habitat initiatives including the Ontario Grassland Initiative to avoid redundancy.</p> <ul style="list-style-type: none"> <li>- Exchange knowledge.</li> <li>- Procure seed.</li> <li>- Share stewardship actions.</li> <li>- Develop a cooperative plan.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss</li> </ul>
Beneficial	Short-term	Education	<p><b>5.3</b> Inform park and conservation reserve visitors of the significance of the species and its habitat.</p> <ul style="list-style-type: none"> <li>- Review Tallgrass Ontario communication materials for possible sharing of resources</li> <li>- Develop interpretive signs, posters, articles and presentations.</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of awareness</li> <li>• Trampling</li> <li>• ATV use</li> </ul>

### 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](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](http://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?eIID=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](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.