PROPOSED

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

Recovery Strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Canada

Gattinger's Agalinis

2017

Government of Canada
Gouvernement du Canada
Canada

Recommended citation:

Environment and Climate Change Canada. 2017. Recovery Strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. 3 parts, 44 pp. + vi + 33 pp. + 7 pp.

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

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Également disponible en français sous le titre
« Programme de rétablissement de la gérardie de Gattinger (*Agalinis gattingeri*) au Canada [Proposition] »

ISBN
Catalogue no.

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

RECOVERY STRATEGY FOR THE GATTINGER'S AGALINIS (*Agalinis gattingeri*) IN CANADA

2017

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 Gattinger's Agalinis (*Agalinis gattingeri*) in Ontario* (Part 2) and the *Gattinger's Agalinis and Houghton's Goldenrod*[2] *– Ontario Government Response Statement*[3] (Part 3) under Section 44 of the *Species at Risk Act* (SARA). Environment and Climate Change Canada has included a federal addition (Part 1) which completes the SARA requirements for this recovery strategy.

The federal recovery strategy for the Gattinger's Agalinis in Canada consists of three parts:

Part 1 – Federal Addition to the *Recovery Strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Ontario*, prepared by Environment and Climate Change Canada.

Part 2 - *Recovery Strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Ontario*, prepared by J. Jones for the Ontario Ministry of Natural Resources and Forestry[4].

Part 3 – *Gattinger's Agalinis and Houghton's Goldenrod – Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources and Forestry.

[2] The recovery efforts for the Gattinger's Agalinis and Houghton's Goldenrod are addressed collectively in a single government response statement (Ontario Ministry of Natural Resources and Forestry).
[3] The Government Response Statement is the Ontario Government's policy response to the recovery strategy and summarizes the prioritized actions that the Ontario Government intends to take and support.
[4] On June 26, 2014, the Ontario Ministry of Natural Resources became the Ontario Ministry of Natural Resources and Forestry.

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Part 1 – Federal Addition to the *Recovery Strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Ontario*, prepared by Environment and Climate Change Canada

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[5] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change is the competent minister under SARA for the Gattinger's Agalinis and has prepared the federal component of this recovery strategy (Part 1), as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Ontario Ministry of Natural Resources and Forestry and the Manitoba Conservation Data Centre, as per section 39 (1) 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 Gattinger's Agalinis (Part 2) in cooperation with Environment and Climate Change Canada. The Province of Ontario also led the development of the attached Government Response Statement (Part 3), which is the Ontario Government's policy response to its provincial recovery strategy and summarizes the prioritized actions that the Ontario government intends to take and support.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment and Climate Change Canada or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Gattinger's Agalinis 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 and Climate Change 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 critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

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

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area[6] be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

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

[6] These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

Acknowledgements

The initial draft federal addition was prepared by Judith Jones, Winter Spider Eco-Consulting under contract to Environment and Climate Change Canada, Canadian Wildlife Service – Ontario Region (ECCC, CWS-ON). Christina Rohe, Angela Darwin (ECCC, CWS-ON) and Candace Neufeld (ECCC, CWS-Prairies) led the completion of this recovery strategy with assistance from Lee Voisin, Elisabeth Shapiro (ECCC, CWS-ON) and Lauren Schmuck (formerly ECCC, CWS-ON). Contributions from Elizabeth Rezek, Ken Corcoran, Jude Girard, Krista Holmes (ECCC, CWS-ON), Kim Borg (ECCC, CWS-National Capital Region), Michael J. Oldham (Ontario Ministry of Natural Resources and Forestry (OMNRF) Natural Heritage Information Centre), staff from the Species Conservation Policy Branch and the Protected Areas Section of the OMNRF, Chris Friesen and Colin Murray (Manitoba Conservation Data Centre (CDC)) are also gratefully acknowledged.

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 Indigenous organizations and individuals, individual citizens, and stakeholders who provided input and/or participated in consultation meetings.

Executive Summary

Gattinger's Agalinis (*Agalinis gattingeri*) is listed as Endangered on Schedule 1 of the federal *Species at Risk Act* (SARA). It is a slender plant that is typically less than 15 cm tall with an olive-green stem. It flowers for only one day before the pale pink flowers fall off of the plant, making it difficult to otherwise identify. It is an annual plant that must go through an entire life cycle from germination and seedling establishment to seed-set and dispersal all in one season. As a result, this species may be present and abundant in some years, but sparse or undetectable in other years.

Gattinger's Agalinis occurs at its northern limit in Canada, and is known from the provinces of Ontario and Manitoba. The bulk of populations and species abundance is found in Ontario, with 26 extant populations (25 populations on alvars of the Bruce Peninsula and the Manitoulin Island region, and 1 population in tallgrass prairie on the Walpole Island First Nation). There are 5 populations in the Interlake region of Manitoba, two of which were more recently discovered.

The primary threats to Gattinger's Agalinis include human intrusions and disturbance, natural system modifications caused by indiscriminate fire and fire suppression, invasive non-native species and inappropriately timed construction or activities along transportation and service corridors. Despite these threats and based on the criteria that Environment and Climate Change Canada uses to establish recovery feasibility, recovery is deemed biologically and technically feasible. The population and distribution objectives for Gattinger's Agalinis in Canada are to:

- Maintain self-sustaining populations for the 31 extant populations;
- Maintain the current distribution and where biologically and technically feasible; promote the natural expansion of Gattinger's Agalinis into unoccupied habitat at extant populations.

Critical habitat for Gattinger's Agalinis is partially identified in this recovery strategy. In Ontario, critical habitat is identified as the extent of suitable habitat where Gattinger's Agalinis is known to exist. In addition to the suitable habitat, a critical function zone of 50 m (radial distance) is applied when the biophysical attributes around a plant extend for less than 50 m. In Manitoba, critical habitat is identified as the area within a 300 m critical function zone of each occurrence that contains the biophysical attributes of Gattinger's Agalinis. A schedule of studies (section 7.2) has been developed and outlines the activities required for identification of additional critical habitat necessary to support the population and distribution objectives.

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

Additions and Modifications to the Adopted Document

The federal recovery strategy for Gattinger's Agalinis in Canada addresses the species range in Ontario and Manitoba. The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the *Recovery Strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Ontario* (Part 2 of this document, referred to henceforth as "the provincial recovery strategy"), and to provide the information required under SARA for the Manitoba portion of its range.

Environment and Climate Change Canada is adopting the provincial recovery strategy (Part 2) with the exception of section 2.0, Recovery. In place of section 2.0, Environment and Climate Change Canada has established its own performance indicators and population and distribution objectives, and is instead adopting the government-led and government-supported actions of the Gattinger's Agalinis and Houghton's Goldenrod – Ontario Government Response Statement[7] (GRS) (Part 3) as the broad strategies and general approaches to meet the population and distribution objectives. In Ontario, only those portions of the Ontario GRS pertaining to Gattinger's Agalinis are adopted in this federal strategy and additional information is included to provide strategic direction for recovery planning in Manitoba.

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. Recovery measures dealing with the protection of habitat are adopted; however, whether these measures will result in protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.

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

1. Recovery Feasibility Summary

Based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility, recovery of Gattinger's Agalinis has been deemed technically and biologically 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 31 known extant populations of Gattinger's Agalinis in Canada, and species abundance is estimated to be greater than 70,500 individuals, although this varies from year to year (Friesen and Murray 2010; Jones 2015; Murray and Church 2015; Manitoba Conservation Data Centre (CDC) unpublished data). Reproductively capable individuals are available; however, Gattinger's Agalinis is an annual plant that must go through an entire life cycle[8] within a single season, making the annual number of individuals particularly susceptible to seasonal conditions (Jones 2015). Loss of genetic diversity is an additional concern, as populations of this annual plant are found in fragmented and geographically disconnected areas within its Canadian range.

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

Yes. Although prairie habitat is limited, and alvar[9] habitat is rare and easily damaged, sufficient suitable habitat is available (or could be made available through habitat management or restoration) in both Ontario and Manitoba to support the species. In the Bruce Peninsula-Manitoulin Island region of Ontario, there are many alvars with Gattinger's Agalinis present that also have habitat patches that are currently unoccupied but which could support the species natural expansion (Jones 2015). There are also many suitable unoccupied alvars (Jones unpublished data 2004-2008) in this region which could potentially support species introductions if deemed necessary. Restoration of prairie habitat is underway on the Walpole Island First Nation (Jacobs pers. comm. 2014), and habitat adjacent to some occupied sites in Manitoba could be managed to improve habitat suitability for the species' natural expansion (Friesen pers. comm. 2016).

[8] From germination and seedling establishment to seed-set and dispersal.
[9] Open areas of shallow soil over flat limestone or dolostone bedrock with trees not forming a continuous canopy. They have a very characteristic association of species, many of which are restricted to these habitats (Brownell and Riley 2000).

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

Yes. The primary threats to the species include, human intrusions and disturbance, natural system modifications caused by indiscriminate fire and fire suppression, invasive non-native species and inappropriately timed construction or maintenance activities (e.g., soil disturbance or compression from heavy machinery) along transportation and service corridors. Primary threats can be avoided or mitigated through communicating and implementing beneficial management practices, land use planning, or stewardship activities.

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

Yes. Recovery techniques related to habitat conservation and adaptive habitat management can be implemented. These include but are not limited to, support for habitat conservation and habitat management through existing land securement and stewardship programs, restricting off-road vehicle use in suitable habitat and by implementing beneficial management practices to control invasive non-native species. With the possible exception of low genetic diversity as a biologically limiting factor, the reduction of threats is expected to allow Gattinger's Agalinis to maintain, or improve self-sustaining populations and may further promote the species natural expansion into unoccupied areas at extant populations in Canada.

2. COSEWIC* Species Assessment Information

Date of Assessment: May 2001

Common Name (population): Gattinger's Agalinis

Scientific Name: *Agalinis gattingeri*

COSEWIC Status: Endangered

Reason for Designation: Annual species of fragmented relict prairie and alvar habitats found at only a few small remaining sites in two geographically restricted areas with substantial losses of plants and populations due to habitat loss from agricultural expansion, residential property development and elevated water levels.

Canadian Occurrence: Manitoba, Ontario

COSEWIC Status History: Designated Endangered in April 1988. Status re-examined and confirmed in April 1999 and in May 2001.

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

2.1 Species Status Information

In its global range, Gattinger's Agalinis (*Agalinis gattingeri*) occurs from Ontario and Manitoba south to Nebraska, Texas, and Louisiana and has a global conservation rank of Apparently Secure[10] (G4) (Appendix C; NatureServe 2016a). The national conservation rank in the United States is Unranked[11] (NNR); it has been reported from 18 states in the United States, but since the Ontario recovery strategy was prepared, the species has been listed as Possibly Extirpated[12] (SH) in Alabama (Appendix C; NatureServe 2016a). The species has a conservation ranking of Vulnerable[13] (S3), Imperiled[14] (S2) or Critically Imperiled[15] (S1) in the 11 remaining states where it has

[10] Uncommon but not rare; some cause for long-term concern due to declines or other factors.
[11] Nation or state/province conservation status not yet assessed.
[12] Species or community occurred historically in the nation or state/province, and there is some possibility that it may be rediscovered.
[13] Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
[14] Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
[15] Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

been given a rank (Appendix C; NatureServe 2016a). According to the North American Plant Atlas, Gattinger's Agalinis is common in the six states where it has not been given a conservation rank (Kartesz 2014).

In Canada, the species is nationally ranked as Imperiled (N2) (NatureServe 2016a). It has been reported from two provinces in Canada, where it has a conservation ranking of Imperiled (S2) in Ontario and Critically Imperiled (S1) in Manitoba (NatureServe 2016a). Gattinger's Agalinis is listed as Endangered[16] on Schedule 1 of the federal *Species at Risk Act* (SARA), as Endangered[17] under the Ontario provincial *Endangered Species Act*, *2007* (ESA) and as Endangered[18] under the Manitoba provincial *Endangered Species and Ecosystems Act* (ESEA).

In Canada, Gattinger's Agalinis occurs at the northern edge of its North American range. The Canadian population of Gattinger's Agalinis is estimated to constitute less than ten percent of the species' global distribution (Jones 2015).

3. Species Information

3.1 Species Description

Gattinger's Agalinis is an annual plant with pale pink flowers that only last one day before falling off the plant (Jones 2015). The plant is slender, with olive-green stems that are usually less than 15 cm tall (Jones 2015). Without a flower, it can be very difficult to locate, and it is therefore essential to survey during the peak bloom period, as it is most easily located amongst dominant grasses at this time (i.e., individuals flowering at different times within the population). In Manitoba, this period usually occurs between August 8-16 and flowering is typically finished by August 26 (Jones 2015; Murray 2013).

A more comprehensive species description and Ontario bloom dates are provided in the provincial recovery strategy.

3.2 Species Population and Distribution

In Canada, Gattinger's Agalinis has been reported in Ontario and Manitoba (Jones 2015; Figure 1). The bulk of populations[19] and species abundance is found in Ontario,

[16] A wildlife species facing imminent extirpation or extinction.
[17] Lives in the wild in Ontario but is facing imminent extinction or extirpation.
[18] "Where the Lieutenant Governor in Council determines that a species indigenous to Manitoba is threatened with imminent extinction or with extirpation throughout all or a significant portion of its Manitoba range, the Lieutenant Governor in Council may, by regulation, declare the species an endangered species" (Sec. 8(1), Manitoba Endangered Species and Ecosystems Act.
[19] For the purposes of this recovery strategy, a population is defined as one or more occurrences (Gattinger's Agalinis plant(s)) and is equivalent to an element occurrence as defined by NatureServe (2016 b).

with a total of 26 extant[20] populations, 25 on alvars of the Bruce Peninsula and the Manitoulin Island region and one population in tallgrass prairie on the Walpole Island First Nation (Jones 2015). In addition to the two historical records noted in the provincial recovery strategy, there is one historic record (Glen Morris) from 1952 where the species was observed in a prairie area in Brant County, Ontario (NHIC 2016). Although the Glen Morris area and nearby prairie remnants have been surveyed on several occasions since, there have been no further observations reported from this region (NHIC 2016). Total species abundance in Ontario is estimated to be 70,000 individuals (Jones 2015).

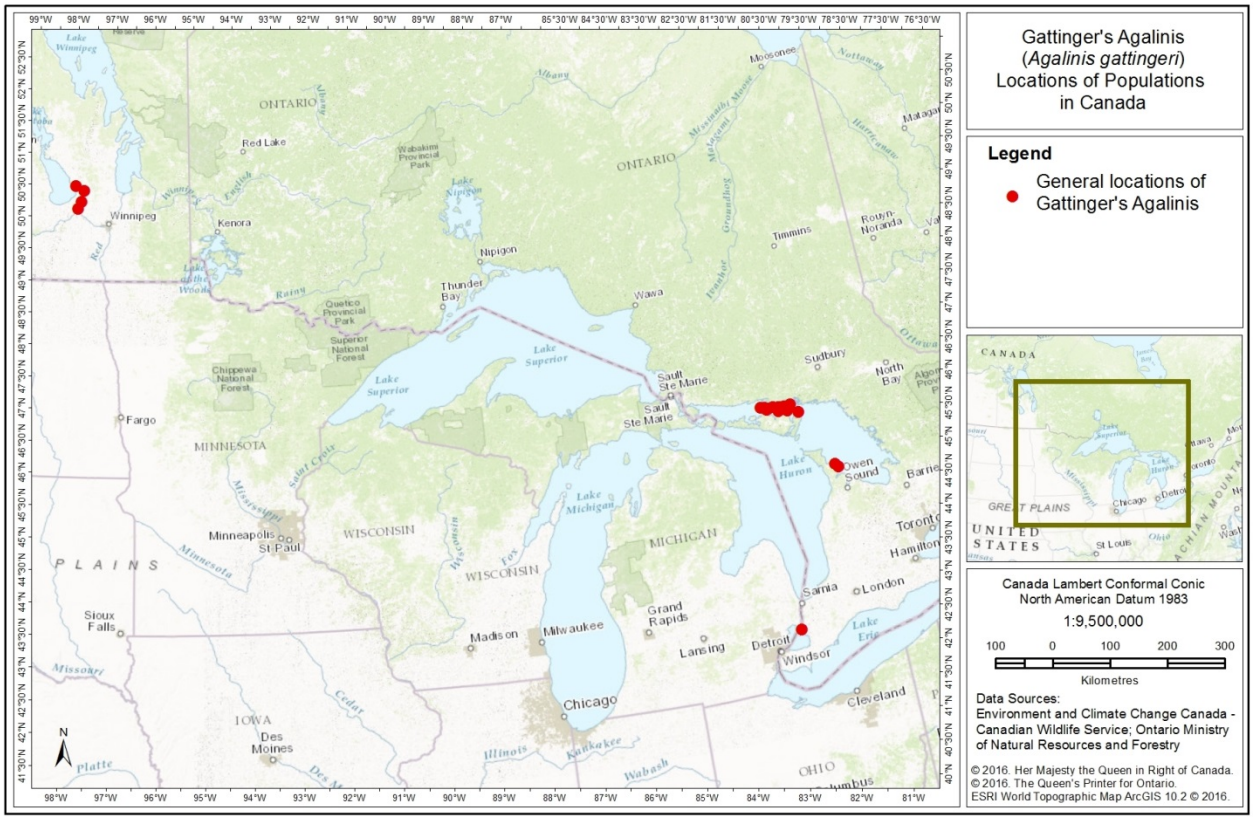

Figure 1. Range of Gattinger's Agalinis in Canada.

In Manitoba, there are five extant populations in tallgrass prairie of the Interlake region and total species abundance is estimated at greater than 500 individuals (Friesen and Murray 2010; Murray and Church 2015; Manitoba CDC unpublished data; Table 1). Although estimates of species abundance are available, it is difficult to assess for this species as Gattinger's Agalinis is an annual plant and large year-to-year fluctuations can be expected. The length of time seeds can remain viable in the seed bank[21] is

[20] A population which is considered to be still in existence, i.e., not destroyed or lost (extirpated).

[21] The natural storage of seeds, often dormant, within the soil. Annual plants may rely heavily on banked seeds for successful perpetuation from year to year, particularly in early successional and/or dynamic and naturally transient/patchy habitats; germination is favoured when and where ideal microhabitat conditions occur

unknown, but seeds in general storage (unrefrigerated with no special treatment for preservation) have germinated after more than 10 years (Jones 2015). Therefore, an absence of live plants for several years may be a result of poor growing conditions and does not necessarily indicate the population no longer exists. In addition, site visits to populations may unintentionally fall outside the short flowering period where the species is otherwise inconspicuous and not easily found.

In Manitoba, low population abundance and limited distribution may in part be attributed to survey effort; as most known populations were only recently located and have had few revisits (Table 1).

Additional information on the population and distribution of Gattinger's Agalinis in Ontario are further described in the provincial recovery strategy.

Table 1. Populations of Gattinger's Agalinis in Manitoba (sources: Friesen and Murray 2010; Murray and Church 2015; Manitoba CDC unpublished data).

EO ID[a]	Population Name	First observed	Last observed	Abundance and [most recent survey year]	Highest estimated population abundance [year]
5045	Site 18W/Poplar Point East	2004	2009	0 plants [2013]	100-200 plants [2007]
5193	Site 16W	2008	2014	Many [2014]	>100 plants [2008]
5196	St. Laurent	2008	2010	5 plants [2010]	45 plants [2009]
6095	Stony Ridge Road	2010	2014	4 plants [2014]	>60 plants [2010]
6096	Wagon Creek Road	2010	2014	2 plants [2014]	<100 plants [2010]

[a] Element Occurrence Identification (EO ID) is a code to identify individual element occurrences (populations). Values and populations in the table are those known to Environment Canada as of August 2015.

3.3 Needs of the Gattinger's Agalinis

In Canada, Gattinger's Agalinis is native to both alvar and tallgrass prairie habitat and requires open unshaded conditions for growth. As an annual, the presence and abundance of live plants depends on the suitable conditions for seed germination and seedling establishment for seed-set and dispersal each year. Though it is not well known how the species is pollinated (Jones 2015); Sellers & McCarthy (2015) suggest that one bee species, *Anthophorula micheneri* may specialize to some degree on *Agalinis* flowers in the south-central United States.

Gattinger's Agalinis is a hemi-parasite[22] that receives some of its nutrients through specialized roots (haustoria) that attach to the roots of other plants (Musselman and Mann 1977; Canne-Hilliker 1988). The exact host plants used by Gattinger's Agalinis in Canada are not known. Once established, the species occurs across a range of

[22] Parasitic plant, that carries out photosynthesis but also obtains food from its host. An organism that can live independently or parasitically.

latitudes and is native to both prairie and alvar habitat type, which suggests the species, is tolerant to varying environmental conditions (Jones 2015). For example, it grows mainly in dry conditions in Manitoba (Murray and Church 2015), in moist conditions on the Walpole Island First Nation (Bowles pers. comm. 2008), and in conditions that can vary between extremes of drought and flooding on alvars in the Bruce Peninsula – Manitoulin Island Region (Jones 2015). Dieringer (pers. comm. 2014), commented that in Texas, the amount of rainfall received during seedling emergence can impact the abundance of Gattinger's Agalinis later in the summer. Changes to soil moisture levels at certain points in the lifecycle may also be a factor in the fluctuating abundance of Canadian populations (Jones 2015). *Agalinis* species in general may be tolerant of some disturbance and may require some soil disturbance for exposure of the seed bank and for germination (Canne-Hilliker 1988; COSEWIC 2006).

In Manitoba, Gattinger's Agalinis generally occurs on tallgrass prairie remnants as well as in the upper banks of roadside ditches. The occurrence of Gattinger's Agalinis in these remnant habitats may be because little native prairie remains intact. The general species habitat in Manitoba has been described as sparsely vegetated, dry prairie meadows on well-drained gravelly, calcareous soils (Murray and Church 2015). The ground at these sites is fairly flat with a relatively small proportion of exposed gravel and mineral soil. The majority of sites occur over dolomite bedrock (Foster 2008). In this region, it is generally found in areas of sparse cover, though tallgrass prairie species are present, with scattered clumps of Big Bluestem (*Andropogon gerardii*) dominant. Associated species from the habitat includes Switch Grass (*Panicum virgatum*), Wolf-willow (*Elaeagnus commutata*), White Sweet Clover (*Melilotus albus*) (introduced, non-native species), Gentian (*Gentiana sp.*), Bell Flower (*Campanula rotundifolia*), Silverweed (*Potentilla anserina*), Shrubby Cinquefoil (*Dasiphora floribunda*), Bluegrass (*Poa sp.*), Goldenrods (*Solidago spp.*), Blazing Star (*Liatris sp.*), Willows (*Salix spp.*), Wild Rose (*Rosa sp.*), Snowberry (*Symphoricarpos sp.*), Missouri Goldenrod (*Solidago missouriensis*) and Aspen seedlings (*Populus tremuloides*) (Manitoba CDC unpublished data). Within tallgrass prairie habitat, Gattinger's Agalinis is usually found in sparser spots, on bare ground between and around tussocks of grass (Krause-Danielsen pers. comm. 2008; Jones 2015).

Additional information on the species needs in Ontario is provided in the provincial recovery strategy.

3.4 Biologically Limiting Factors

Low abundance of Gattinger's Agalinis at some populations, annual fluctuations of live plants, large range between populations and low dispersal distance of seeds are all factors that may limit outcrossing[23], thereby reducing genetic diversity. The degree to which these factors contribute to low genetic diversity and how it can influence its ability to sustain the population or improve its abundance are not well understood.

[23] To cross (animals or plants) by breeding individuals of different strains but, usually, of the same breed. Thus reducing the probability of an individual being subject to disease or reducing genetic abnormalities.

4. Threats

4.1 Threat Assessment

Threats for Gattinger's Agalinis are assessed for both Manitoba and Ontario based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system. Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational). Limiting factors are not considered during this assessment process. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the Description of Threats section (Section 4.2).

Due to the geographic separation and difference in threats between the Manitoba and Ontario populations, the threats tables are included separately for each province.

Ontario

Historical threats, indirect or cumulative effects of the threats, and other relevant information regarding the nature of the threats are presented in the provincial recovery strategy. Limiting factors are not considered during this assessment process. See the table footnotes for details on how the values are assigned.

Table 2. Threat Classification Table for Gattinger's Agalinis in Ontario.

Threat #[a]	Threat Description	Impact[b]	Scope[c]	Severity[d]	Timing
1	**Residential & commercial development**				
1.1	Housing & urban areas	Low	Small	Extreme	Moderate
1.2	Commercial and industrial areas	Low	Small	Extreme	High
2	**Agriculture & aquaculture**				
2.1	Annual & perennial non-timber crops	Low	Small	Extreme	High
2.3	Livestock farming & ranching	Low	Small	Serious	High
3	**Energy production & mining**				
3.2	Mining & quarrying	Low	Small	Serious	High
5	**Biological resource use**				
5.3	Logging & wood harvesting	Negligible	Negligible	Unknown	Low
6	**Human intrusions & disturbance**				
6.1	Recreational activities	Medium	Restricted	Serious	High

7	**Natural System Modifications**				
7.1	Fire & fire suppression	Medium	Restricted	Serious	High
7.3	Other ecosystem modifications	Low	Small	Moderate	High
8	**Invasive & other problematic species & genes**				
8.1	Invasive non-native/alien species	Medium	Restricted	Serious	High

[a]**Threat #** - Threats are numbered using the IUCN Classification System. Only those threats relevant to Gattinger's Agalinis are presented in this table and in Section 4.2 Description of Threats and Part 2 (*Recovery Strategy for the Gattinger's Agalinis* (Agalinis gattingeri) *in Ontario*).

[b] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[c]**Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[d] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit $\geq$ 0%).[f] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Manitoba

In Manitoba, populations are relatively small leaving them vulnerable to damage or complete loss from seemingly small threats. See the table footnotes for details on how the values are assigned in the table. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the narrative section (Section 4.2). Limiting factors are not considered during this assessment process.

Table 3. Threat Classification Table for Gattinger's Agalinis in Manitoba.

Threat #[a]	Threat description	Impact[b]	Scope[c]	Severity[d]	Timing[e]
2	**Agriculture & aquaculture**				
2.1	Annual & perennial non-timber crops	Low	Small	Extreme	Moderate
4	**Transportation & service corridors**				
4.1	Roads & railroads	High	Large	Serious	High
4.2	Utility & service lines	High	Large	Serious	High
6	**Human intrusions & disturbance**				
6.1	Recreational activities	Medium	Restricted	Serious	High
6.1	Recreational activities	Low	Small	Moderate	High
7	**Natural system modifications**				
7.1	Fire & fire suppression	Unknown	Large	Unknown	High
7.3	Other ecosystem modifications	Low	Large	Slight	High
8	**Invasive & other problematic species & genes**				
8.1	Invasive non-native/alien species	Medium	Large	Moderate	High
8.2	Problematic native species	Low	Large	Slight-Moderate	High

[a] **Threat #** - Threats are numbered using the IUCN Classification System. Only those threats relevant to Gattinger's Agalinis are presented in this table and in Section 4.2 Description of Threats and Part 2 (*Recovery Strategy for the Gattinger's Agalinis* (Agalinis gattingeri) *in Ontario*).

[b] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines),

High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[c] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[d] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit $\geq$ 0%).[t] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

4.2 Description of Threats

Threats are listed in order as they appear in the Threats Classification Table (Table 2; Table 3).

Ontario

See Section 1.6 (Threats to Survival and Recovery) in the provincial recovery strategy for more information on threats to the Ontario populations. The list below identifies how the IUCN threat categories used in Table 2 correspond to the threat categories used in section 1.6 of the provincial recovery strategy.

IUCN Threat #1. Residential & commercial development:

Section 1.6 of the provincial recovery strategy: '*Development and Construction'*

IUCN Threat #2. Agriculture & aquaculture:

Section 1.6 of the provincial recovery strategy: '*Conversion of prairie to agriculture'* and '*Livestock grazing'*

IUCN Threat # 3. Energy production & mining:

Section 1.6 of the provincial recovery strategy: '*Quarrying and aggregate extraction'*

IUCN Threat #5. Biological resource use:

Section 1.6 of the provincial recovery strategy: '*Logging and Industrial Activities'.*

IUCN Threat #6. Human intrusions & disturbance:

Section 1.6 of the provincial recovery strategy: '*Off-road vehicle use*' and *'Trampling'*

IUCN Threat #7. Natural system modifications:

Section 1.6 of the provincial recovery strategy: '*Changes in ecological processes*'

IUCN Threat #8. Invasives & other problematic species & genes:

Section 1.6 of the provincial recovery strategy: '*Invasion by exotic species*'

Manitoba

In Manitoba, Gattinger's Agalinis frequently occurs with Rough Agalinis (*Agalinis aspera*), which grows in the same type of habitat but has a greater number of known populations than Gattinger's Agalinis (Foster 2008; Murray and Church 2015). Survey

work is on-going, and Gattinger's Agalinis may yet be discovered at other Rough Agalinis populations. Threats listed for Rough Agalinis, in addition to those listed for Gattinger's Agalinis; include gravel extraction, cultivation and alteration of hydrological regimes (COSEWIC 2006; Environment Canada 2015). At this time, these are not considered current threats at any habitat supporting Gattinger's Agalinis (Friesen pers. comm. 2016). However, these may be potential threats if Gattinger's Agalinis is discovered at other Rough Agalinis sites.

IUCN Threat # 2. Agriculture & Aquaculture (IUCN Threat 2.1 Annual & Perennial Non-Timber Crops

In Manitoba, it is estimated that tall-grass prairie habitat has declined 99.9% from its original 600,000 hectares, largely due to cultivation for forage and cereal crops (Samson and Knopf 1994). This has likely resulted in considerable historical habitat loss for species like Gattinger's Agalinis. Many of the remaining populations are in remnant strips of native prairie between cultivated fields and roadsides and may be further impacted by cultivation of the remaining strips, pesticide drift or encroachment of invasive tame forage species from adjacent cultivated fields (threat 8.1). Those populations still in larger tracts of native pasture may be at risk of future cultivation in years where crop prices are high (Honey and Oleson 2006, Farm Credit Canada 2013, Wright and Wimberly 2013).

IUCN Threat # 4. Transportation & service corridors (IUCN Threat 4.1 Roads & railroads; IUCN Threat 4.2 Utility & service lines)

Several Manitoba populations are along ditches and in roadside rights-of-way, which may leave them vulnerable to certain construction or maintenance actions, such as road improvements, cleaning out or deepening ditches with machinery (ditching), spraying with herbicide and mowing at inappropriate times (when active plants are present). Late summer roadside work particularly threatens Gattinger's Agalinis in Manitoba as this is when the plant is flowering and setting seed[24]; for an annual plant, seed dispersal is important for population persistence. For example, a population of Rough Agalinis was mowed in 2004 thereby damaging those plants and not letting them disperse seed (COSEWIC 2006; Foster 2008). Spraying of herbicides is common along roadsides and if done at the wrong time of year can destroy Gattinger's Agalinis and/or its host plants (Friesen pers. comm. 2016). Additionally, excavation associated with the installation of underground fibre-optic cable alongside ditches may also impact populations (Murray pers. comm. 2016).

[24] Gattinger's Agalinis typically flowers from August 8-16 in Manitoba and the flowering period typically finishes by August 26 (Murray 2013; Jones 2015).

IUCN Threat #6. Human intrusions & disturbance (IUCN Threat 6.1 Recreational activities)

At one population, Gattinger's Agalinis is found adjacent to a trail where ATV's are used. While it is presumed the vehicles mainly travel along the trail, the potential for damage to the occupied habitat or directly to the plants does exist.

IUCN Threat #7. Natural system modifications (IUCN Threat 7.1 Fire & fire suppression; IUCN Threat 7.3 Other ecosystem modifications)

IUCN Threat 7.1 Fire & fire suppression

A few populations of Gattinger's Agalinis occurring on upland tallgrass prairie are becoming overgrown from a lack of periodic natural disturbances (e.g., fire). Without disturbances like fire or grazing to maintain open, early successional habitat, vegetation becomes dense, filling in sparse or bare patches of ground that Gattinger's Agalinis is reliant upon for growth. This may also lead to the establishment of woody plants which may make the habitat unsuitably shady (see Threat 8.2).

IUCN Threat 7.3 Other ecosystem modifications

Some populations are in native prairies which are periodically mowed for hay. Haying or mowing can be a beneficial management practice for many prairie species as it can somewhat mimic natural disturbance and reduce litter or control invasive non-native plant species (IUCN threat 8.1) and problematic native woody species (IUCN threat 8.2); however the timing of mowing in the habitat of Gattinger's Agalinis is of critical importance. If the mowing is too infrequent, vegetation may become too dense for Gattinger's Agalinis survival, yet if mowing is done when live plants are present (between approximately July 1 – September 30), it may harm or destroy establishing plants and reduce their ability to mature, set and disperse seed, which in turn can lead to population level effects.

IUCN Threat #8. Invasives & other problematic species & genes (IUCN Threat 8.1 Invasive non-native/alien species; Threat 8.2 Problematic native species)

IUCN Threat 8.1 Invasive non-native/alien species

Competition from invasive plant species may be a threat at almost all Manitoba populations since White Sweet Clover (*Melilotus albus*) is a habitat associate (Manitoba CDC unpublished data). Smooth Brome (*Bromus inermis*) and Kentucky Bluegrass (*Poa pratensis*) are also present and highly invasive in these habitats (Friesen pers. comm. 2016).

IUCN Threat 8.2 Problematic native species

Native plant species can pose a direct threat to Gattinger’s Agalinis through competition, as they may alter the natural community assemblage. The species requires a relatively open and sunny habitat, and cannot compete in areas where overtopping plants persist (Canne-Hilliker 2001). The encroachment of native species such as Trembling Aspen (*Populus tremuloides)* and shrubs has been reported as a concern for a few of the Manitoba populations of Gattinger’s Agalinis

5. Population and Distribution Objectives

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 and Climate Change Canada’s population and distribution objectives for Gattinger's Agalinis in Canada are:

- Maintain self-sustaining populations for the 31 extant populations;
- Maintain the current distribution and where biologically and technically feasible, promote the natural expansion of Gattinger’s Agalinis into unoccupied habitat at extant populations.

The information currently available for this species is insufficient to demonstrate trends in population growth and stability. However, as the 31 extant populations continue to persist, it is assumed they are self-sustaining. Thus the objective is to maintain all known extant populations and to ensure that they remain self-sustaining. Recovery of Gattinger’s Agalinis is therefore based on population persistence and abundance of individuals within a population. The most recent species abundance surveys estimated the Gattinger’s Agalinis population to be approximately 70,500 individuals. More information on the species population dynamics and biology is required to determine the species normal range of variation in abundance in order to be used as a measure of recovery.

6. Broad Strategies and General Approaches to Meet Objectives

The government-led and government-supported actions tables from the *Gattinger's Agalinis and Houghton's Goldenrod - Ontario Government Response Statement* (Part 3) are adopted as the broad strategies and general approaches to meet the population and distribution objective for Ontario region.

The following broad strategies and general approaches to meet the population and distribution objectives apply only to the Manitoba region.

6.1 Actions Already Completed or Currently Underway

Ontario

See Section 1.8 of the provincial recovery strategy for a description of actions completed or underway in Ontario.

Manitoba

The Manitoba Conservation Data Centre has produced maps of road allowances where species at risk occur, to address threats related to road maintenance and construction. These maps include general rare plant population locations along stretches of road, identification information, and management recommendations to minimize disturbance to plants and avoid destruction of roadside habitat. These maps are intended to better guide road maintenance and construction activities undertaken by rural municipalities and the provincial government (Foster 2008; Friesen and Murray 2010). A more general management summary intended for the public and landowners/land managers has also been produced (Friesen pers. comm. 2016).

6.2 Strategic Direction for Recovery

Table 4. Recovery Planning Table for Manitoba Region.

Threat # or Limitation	Priority[g]	General Description of Research and Management Approaches
Broad Strategy: Habitat assessment, management, and conservation		
2.1, 4.1, 4.2, 8.1, 8.2 8.1	High Medium	• Mitigate the impact of threats to populations and habitat by engaging landowners and land managers in conservation agreements, fee-simple purchase or stewardship arrangements aimed at implementing beneficial management practices (BMPs) and protecting critical habitat; monitor effectiveness of conservation or stewardship arrangements in conserving habitat • Using adaptive habitat management, monitor the effectiveness of BMPs to improve habitat; amend BMPs as necessary. • Integrate habitat management with that for other species occurring in the same habitat and surrounding management area • Removal of invasive non-native species posing a direct threat to Gattinger's Agalinis
Broad Strategy: Communication, collaboration and engagement		
4.1, 4.2 All threats	High High	• Develop or expand communication/outreach strategies for road crews, city and municipal planners, and land users, to minimize or eliminate habitat deterioration or destruction during road maintenance or construction activities • Develop or expand communication/outreach strategies for the general public, land-users, stakeholders, and land managers to address threats such as off-road vehicle use, indiscriminate use of herbicides, introduction of invasive alien species, etc., and to change perceptions of management tools such as prescribed burns
Broad Strategy: Research as part of an adaptive management framework		
Knowledge gaps pertaining to population dynamics and biology of species (All threats)	Medium Medium	• Determine long-term impacts of threats and existing management practices on populations and habitat quality • Conduct research to develop an understanding of the species ecology and habitat needs (e.g., suitable host plants, seed bank dynamics and germination) • Apply findings to develop or refine BMPs for the species, particularly for mowing, burning and grazing • Determine effect of population size and isolation on genetic diversity and population viability, including developing a seed gene bank if deemed necessary

Broad Strategy: Inventory and monitoring		
Supports measuring of progress towards achieving the population and distribution objective	Medium	• Use models (e.g., habitat suitability and/or species distribution models) to predict priority search areas for new populations • Using consistent survey techniques (e.g. Henderson 2010a), continue surveys to locate new populations • Using consistent monitoring techniques, determine range of natural variation for population size and area of occupancy of extant populations

[g] *"Priority" reflects the degree to which the broad strategy contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.*

7. Critical Habitat

7.1 Identification of the Species' Critical Habitat

Section 41(1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. Under section 2(1) of SARA, critical habitat is "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species".

Identification of critical habitat is not a component of provincial recovery strategies under the Province of Ontario's ESA or Province of Manitoba's ESEA. Under both the Ontario ESA and Manitoba ESEA, when a species becomes listed as endangered or threatened in the respective regulations, it automatically receives general habitat protection. Gattinger's Agalinis currently receives general habitat protection under the Ontario ESA and Manitoba ESEA. In addition, tallgrass prairie and alvar habitat are listed as endangered ecosystems under the Manitoba ESEA although there is no regulatory protection affiliated with this. In some cases in Ontario, 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 as the habitat of the species by the Province of Ontario. A habitat regulation has not been developed for Gattinger's Agalinis under the ESA.

Critical habitat for Gattinger's Agalinis in Canada is identified to the extent possible, based on the best available information[25]. This is a partial identification, as critical habitat is identified for 15 of 26 known extant populations of Gattinger's Agalinis in Ontario and for all 5 extant populations in Manitoba, which is insufficient to achieve the population and distribution objectives. A Schedule of Studies (section 7.2; Table 5) has been developed and outlines the activities required for identification of additional critical habitat in Ontario necessary to support the population and distribution objectives.

[25] Gattinger's Agalinis occurrences known to Environment and Climate Change Canada as of August 2015 (for Manitoba) and April 2016 (for Ontario).

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).

Critical habitat identification is based on the best available information as reviewed and further developed by separate committees in each jurisdiction. Based on consensus expert opinion, different criteria for identifying critical habitat in each province have been developed. The identification of critical habitat in each province is described in detail below.

7.1.1 Critical Habitat Identification in Ontario

In Ontario, Gattinger's Agalinis is found in alvar and tallgrass prairie habitats. These suitable habitats are typically characterized by biophysical attributes described below:

In tallgrass prairie habitats:

- Open, unshaded conditions for growth with few woody plants;
- Prairie meadows containing patches of short, sparse vegetative cover;
- Some patches of exposed gravel and mineral soil present in the habitat;
- Grasses or sedges with tufted (cespitose) growth form are dominant;
- Tallgrass prairie species such as Little Bluestem (*Schizachyrium scoparium*), Big Bluestem, Indian Grass (*Sorghastrum nutans*), and Switch Grass are present;
- Sandy loam soil type;
- Moisture regimes may be seasonally moist.

In alvar habitats:

- Open, unshaded conditions for growth usually with few woody plants;
- If conifers are present, they do not form a continuous canopy;
- Alvar meadow or bedrock vegetation with patches of short, sparse vegetative cover;
- Some patches of exposed bedrock or gravelly substrate;
- Grasses or sedges with tufted (cespitose) growth form are the dominant cover;
- Soils are shallow over limestone or dolostone bedrock;
- Alvar species such a Little Bluestem, Northern Dropseed (*Sporobolus heterolepis*), and Scirpus-like Sedge (*Carex scirpoidea*);
- Moisture regimes may range between flooded and drought and may change quickly.

In Ontario, suitable habitat for Gattinger's Agalinis can be described using the Ecological Land Classification (ELC) framework for Southern Ontario (Lee et al. 1998) and based on the best available information, they are described by the following ELC vegetation types (Jones 2015).

- Dry Annual Open Alvar Pavement (ALO1-2)
- Dry-Fresh Little Bluestem Open Alvar Meadow (ALO1-3)
- Dry-Fresh Poverty Grass Open Alvar Meadow (ALO1-4)
- Creeping Juniper-Shrubby Cinquefoil Dwarf Shrub Alvar (ALS1-2)
- Jack Pine – White Cedar – White Spruce Treed Alvar (Savanna) (ALT1-4)
- Fresh-Moist Tallgrass Prairie (TPO2-1)

The ELC framework provides a standardized approach to the interpretation and delineation of dynamic ecosystem boundaries. The ELC approach classifies habitats not only by vegetation community but also considers soil moisture conditions and topography, and as such provides a basis for describing the ecosystem requirements and encompasses the biophysical attributes of suitable habitat for Gattinger's Agalinis. In addition, ELC terminology and methods are familiar to many land managers and conservation practitioners who have adopted this tool as the standard approach for Ontario.

Within the ELC system in Ontario, the vegetation type boundary best captures the extent of biophysical attributes required by the species. The vegetation type includes the areas occupied by Gattinger's Agalinis and the surrounding areas that provide suitable habitat conditions 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. There is no specific information about seed dispersal, other than the seeds appear to lack any special adaptation that would enable dispersal to be long-distance (Jones 2015). As such, the occupied ELC vegetation type should provide sufficient opportunity for dispersal and natural expansion of populations. This larger area around the plant may also promote ecosystem resilience to invasive non-native species while protecting what are typically rare communities in Ontario. It will also generally preserve the local surface water movement that determines the alvar's seasonal water cycle.

In Ontario, critical habitat is identified as the extent of suitable habitat where Gattinger's Agalinis is known to exist. In addition to the extent of suitable habitat, a critical function zone of 50 m (radial distance) is applied when the biophysical attributes around a plant extend for less than 50 m (e.g., plants that occur at or near the edge of the extent of suitable habitat). The 50 m is considered a minimum 'critical function zone', or the threshold habitat fragment size required for maintaining constituent microhabitat properties for a species (e.g., critical light, temperature, litter 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 Gattinger's Agalinis in Ontario. Studies on micro-environmental gradients at habitat edges, including light, temperature, litter moisture (Matlack 1993), and of edge effects on plants in mixed hardwood forests, as evidenced by changes in plant community structure and composition (Fraver 1994), have shown that edge effects could be detected up to 50 m into habitat fragments although other studies show that the magnitude and distance of edge effects will vary depending on the structure and composition of adjacent habitat types (Harper et al. 2005). Forman and Alexander (1998) and Forman et al. (2003) found that most

roadside edge effects on plants resulting from construction and repeated traffic have their greatest impact within the first 30 to 50 m. Therefore, a 50 m radial distance from any Gattinger's Agalinis plant was chosen to ensure that microhabitat properties were maintained as part of the identification of critical habitat. As new information on species' habitat requirements and site-specific characteristics, such as hydrology, become available, these distances may be refined.

Existing human developments and infrastructure do not possess the biophysical attributes of suitable habitat or assist in the maintenance of natural processes and are therefore not identified as critical habitat.

7.1.2 Critical Habitat Identification in Manitoba

The approach used for identifying critical habitat for Gattinger's Agalinis in Manitoba is based on a decision tree developed by the Recovery Team for Plants at Risk in the Prairie Provinces as guidance for identifying critical habitat for terrestrial and aquatic prairie plant species at risk (see Appendix A in Environment Canada 2012 for the full decision tree). Gattinger's Agalinis inhabits dry, sparsely vegetated, tallgrass prairie with open conditions lending full exposure to sun (little to no shrub or forest overstory), and dolomitic or limestone (calcareous) soils (see Section 3.3). The habitat may be characterized as early successional, and is influenced by some level and type of soil disturbance, resulting in habitat patches being hard to define in space and time. Thus, identification of critical habitat for Gattinger's Agalinis is occurrence-based rather than habitat-based. Critical habitat is identified as the area within a 300 metre critical function zone of each occurrence (area of occupancy) of Gattinger's Agalinis. Rivers, lakes, wetlands as well as existing human developments and infrastructure, within the critical function zone, are not considered to be critical habitat.

Although the exact extent of habitat needed to surround Gattinger's Agalinis plants to fulfill the reproductive, dispersal and long-term survival needs of the population is not fully known, the 300 m critical function zone is based upon a detailed literature review that examined edge-effects of various land use activities that could affect resource availability, and contribute to negative population growth for native prairie plants generally (Henderson 2010b and Appendix B in Environment Canada 2012). It is also based upon a literature review of factors affecting the quality of native prairie patches and persistence of rare plants and pollinators in the tall-grass prairie of Manitoba (Environment and Climate Change Canada 2016 unpublished review). This approach is consistent with the critical habitat identification for other prairie plant species that occupy similar type habitats in Manitoba (e.g. Rough Agalinis (*Agalinis aspera*), Western Silvery Aster (*Symphyotrichum sericeum*)). Thus, to ensure the viability, and where feasible, the natural expansion, of Gattinger's Agalinis in Manitoba, the 300 metre critical function zone is thought to be the minimum distance needed to maintain the habitat required to meet the population and distribution objectives. As new information on species' habitat requirements and site-specific characteristics become available, this distance may be refined.

7.1.3 Application of Criteria to Identify Critical Habitat for Gattinger's Agalinis

In Ontario, critical habitat is identified for 15 of the 26 extant populations (Appendix A, Table A1, Figure A1). This is a partial identification of critical habitat. A schedule of studies (section 7.2; Table 4) has been established to provide the information necessary to complete the identification of critical habitat needed to meet the population and distribution objectives. In Ontario, critical habitat is the extent of suitable habitat occupied by the species, plus a 50 metre critical function zone around the plants where they occur near the edge of suitable habitat. Due to provincial data sharing agreements in Ontario, critical habitat in Ontario is only presented using the 1 x 1 km UTM grid squares to indicate the general geographic areas containing critical habitat (Appendix A, Figure A1).

In Manitoba, critical habitat is identified for all 5 extant populations (Appendix A, Figs. A2, A3). The area containing critical habitat is approximately 304 hectares (3 km^2) and occupies or overlaps into approximately 22 quarter sections of land in the Dominion Land Survey in Manitoba. Generalized geographic locations at the scale of standardized 1x1 km grids and detailed critical habitat unit polygons are provided in critical habitat maps (Appendix A, Figs. A2 and A3).

The detailed information on critical habitat may be requested on a need to know basis by contacting Environment and Climate Change Canada – Canadian Wildlife Service at ec.planificationduretablissement-recoveryplanning.ec@canada.ca

7.2 Schedule of Studies to Identify Critical Habitat

Table 5. Schedule of Studies to identify critical habitat.

Description of Activity	Rationale	Timeline
Work with applicable organizations in Ontario to secure the necessary information and identify critical habitat.	Further work is required to complete the identification of critical habitat to meet the population and distribution objectives.	2017-2022
Confirm/obtain population and habitat information for extant populations in Ontario where critical habitat is not currently identified.	Location of population becomes known and habitat associations, biophysical habitat attributes and extent of suitable habitat are confirmed.	2017-2022

7.3 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 activity or multiple activities at one point in time or from the cumulative effects of one or more activities over time. It should be noted that not all activities that occur in or near critical habitat are likely to cause its destruction. Activities described in Table 6 are examples of those likely to cause destruction of critical habitat for the species; however, destructive activities are not necessarily limited to those listed**.**

Additionally, a few types of light disturbance, such as light hiking off-trail, or light raking, may be beneficial at certain times of year, as they can expose the soil and allow establishment of seedlings and Gattinger's Agalinis to re-emerge from the seed bank.

Table 6. Activities Likely to Result in the Destruction of Critical Habitat.

Description of Activity	Description of effect in relation to function loss	Details of effect
Covering of soils which can be caused by activities such as: creation or expansion of permanent / temporary structures such as land conversion to residential / cottage developments, road widening or realigning.	Covering the soil prevents solar radiation and water infiltration needed for germination and survival of plants, such that critical habitat is destroyed.	This activity must occur within the bounds of critical habitat to cause its destruction, is a direct effect, and is applicable at all times of the year. Links to Threat #1.1; 1.2 and 4.1
Inversion/excavation/extraction of soils, which can be caused by activities such as: new or expanded cultivation (conversion of prairie to agriculture); quarrying and aggregate extraction; utility line installation.	Inverting, excavating or extracting soil results in the direct loss of critical habitat by removing or disturbing the substrate within which the plant grows, and altering the biophysical attributes required for germination, establishment and growth of Gattinger's Agalinis.	This activity must occur within the bounds of critical habitat to cause its destruction, may result in destruction either directly or cumulatively, and is applicable at all times of the year. Links to Threat #2.1; 2.3; 3.2; 4.2; 5.3; 6.1
Compression or erosion of soils, which can be caused by activities such as: using alvars as staging areas for logging operations in adjacent forests; moving logs, materials and heavy machinery across alvars; creation of trails and roads; off-road vehicle use; destructive or excessive human trampling; high intensity livestock grazing on alvars and camping in habitat (placing tents, fire pits, and latrines in the vegetation) also causes similar effects.	Compression and erosion can damage soil structure and porosity, reduce water availability by increasing runoff and decreasing infiltration, prevent establishment of seedlings, or increase the likelihood of invasive non-native species disturbing native ground cover. Foot traffic may have similar effects but at higher thresholds of use.	This activity must occur within the bounds of critical habitat to cause its destruction, may result in destruction either directly or cumulatively, and is applicable at all times of the year, with the exception of winter months when the ground is snow covered and frozen solid (soil temperature below -10C). Links to Threat #2.3; 5.3; 6.1

Introduction or promotion of Invasive non-native species and woody vegetation (shrubs and trees), which can be caused by activities such as: intentional dumping or spreading of feed bales containing viable seed of invasive non-native species; seeding invasive non-native species or woody species within critical habitat; transporting invasive non-native species (e.g., on wheel tires); or planting of woody vegetation.	Once established, invasive non-native species and woody vegetation can alter hydrology, soil nutrient and moisture availability, and create shade, thereby altering the biophysical attributes, altering the structure of plant communities and resulting in direct competition with Gattinger's Agalinis and other native prairie and alvar species, such that population declines can occur, effectively destroying critical habitat.	This activity can occur within or adjacent to the bounds of critical habitat to cause its destruction, can be a direct or a cumulative effect, and is applicable at all times of the year. Links to Threat #7.1; 7.3; 8.1; 8.2
Application of herbicides, fertilizers or pesticides, which can be caused by activities such as; spraying of herbicide and insecticide; or additions of fertilizers to soil.	Herbicide and fertilizer can alter soil or water nutrient status, creating conditions suitable for some plant species and unfavourable for others, such that species composition in the surrounding plant community can change. Changes to soil or water nutrient status will also influence the outcome of interspecific competition for nutrients. Pesticide runoff and drift can alter plant and pollinator communities, thereby possibly reducing the capability of the habitat to support Gattinger's Agalinis, or result in complete habitat loss if herbicide is directly used on a regular basis.	Loss of suitable vegetative conditions for the life cycle of the species. This activity may result in destruction of critical habitat whether it occurs within or outside the bounds of critical habitat (e.g. chemical drift, groundwater or overland flow of contaminated water), may result in destruction either directly or cumulatively, and is applicable at all times of the year. Links to Threat #7.3; 8.1; 8.2
Alteration to hydrological regimes, which can be caused by activities such as: temporary or permanent inundation from construction of impoundments downslope or downstream; release of water upslope and upstream, including but not limited to damming, ditching, drainage, culvert installation, road widening or straightening; or residential/cottage developments that affect the hydrology of critical habitat.	As the seed bank and plants of Gattinger's Agalinis are adapted to well-drained soils, flooding or inundation by water, even for a short period of time, can be sufficient to alter habitat enough to be unsuitable for survival and re-establishment. Altering hydrology can also result in conditions being too dry, mimicking prolonged drought. For example, road construction can interrupt or alter overland water flow, altering habitat conditions and threatening the long-term survival of the species at a said location. An increase in moisture may also lead to increased encroachment by woody vegetation and some invasive plant species.	This activity may result in destruction of critical habitat whether it occurs within or outside the bounds of critical habitat, may result in destruction either directly or cumulatively, and is applicable at all times of the year. Links to Threat #1.1; 4.1; 7.3

8. Measuring Progress

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

- Self-sustaining populations have been maintained at the 31 extant populations;
- The current distribution of Gattinger’s Agalinis is maintained;
- Where biologically feasible, populations have naturally expanded into unoccupied sites at extant populations.

9. Statement on Action Plans

One or more action plans for Gattinger’s Agalinis in Canada will be posted on the Species at Risk Public Registry by December 2022.

10. References

Bowles, J.M. 2005. pers. comm. 2008. Email correspondence to J. Jones. August 27, 2008. Consulting Biologist and curator, herbarium University of Western Ontario, London. (Deceased 2013).

Brownell, V.R. and J.L. Riley, 2000. The Alvars of Ontario: Significant alvar natural areas in the Ontario Great Lakes Region. Federation of Ontario Naturalists, Don Mills, Ontario. 269 pp.

Canne-Hilliker, J.M. 1988. COSEWIC status report for Gattinger's Agalinis (*Agalinis gattingeri*). Committee on the Status of Endangered Wildlife in Canada, Ottawa.19 pp.

Canne-Hilliker, J.M. 2001. Update COSEWIC status report on the Gattinger's Agalinis (*Agalinis gattingeri*) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa.1-11 pp.

Catling, P.M. 1995. The extent of confinement of vascular plants to alvars in southern Ontario. Canadian Field-Naturalist 109(2): 172-181.

COSEWIC. 2006. COSEWIC assessment and status report on the Rough Agalinis (*Agalinis aspera*) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. vi + 22 pp. http://www.sararegistry.gc.ca/status/status_e.cfm

Dieringer, Gregg 2014. Personal communication to J. Jones on September 16, 2014. Professor/Chair, Department of Biology, Northwest Missouri State University, Maryville, Missouri.

Environment Canada. 2012. Amended Recovery Strategy for the Tiny Cryptantha (*Cryptantha minima*) in Canada [Final]. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. Vii + 38 pp.

Environment Canada. 2014. Recovery Strategy for the Small White Lady’s-slipper (*Cypripedium candidum*) in Canada [Final]. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. v + 30 pp.

Environment Canada 2015. Recovery Strategy for the Rough Agalinis (*Agalinis aspera*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. iv + 31 pp.

Environment and Climate Change Canada. 2016. Rationale for critical habitat identification based on a 300 metre critical function zone buffer. Unpublished literature review.

Farm Credit Canada. 2013. 2013 Farmland Values Report. Website: https://www.fcc-fac.ca/fcc/about-fcc/corporate-profile/reports/farmland-values/farmland-values-report-2013.pdf [Accessed October 26, 2016].

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. 481 pp.

Foster, C. 2008. Rare Plant Surveys and Stewardship Activities by the Manitoba Conservation Data Centre, 2007. MS Report 08-01. Manitoba Conservation Data Centre, Winnipeg, Manitoba. 35 pp.

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

Friesen, C. 2016. Personal communication to J. Jones on February 9, 2016. Biodiversity information manager, Manitoba Conservation Data Centre, Winnipeg, MB.

Friesen, C. and Murray, C. 2010. Rare Species Surveys and Stewardship Activities by the Manitoba Conservation Data Centre, 2009. Report No. 2009-04. Manitoba Conservation Data Centre, Winnipeg, Manitoba. 20 pp.

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, P.A Esseen 2005. Edge influence on forest structure and composition in fragmented landscapes. Conservation Biology 19:768–782.

Henderson, D.C. 2010a. Occupancy Survey Guidelines for Prairie Plant Species at Risk. Environment Canada, Prairie and Northern Region, Canadian Wildlife Service. Edmonton, AB. Website: http://www.npss.sk.ca/docs/2_pdf/Rare_Plant_Occupancy_Survey_Guidelines.pdf [Accessed July 12, 2016].

Henderson, D.C. 2010b. Set-back distance and timing restriction guidelines for prairie plant species at risk. Environment Canada, Prairie and Northern Region, Canadian Wildlife Service. Edmonton AB. Website: http://ec.gc.ca/Publications/BA6052B1-136B45C69BCD38F160A80475/ActivitySetBackDistanceGuidelinesForPrairiePlantSpeciesAtRRisk.pdf [Accessed May 2, 2015].

Honey, J. and B. Oleson. 2006. A century of agriculture in Manitoba, a proud legacy. Credit Union Central of Manitoba. 33 pp. Website: https://umanitoba.ca/faculties/afs/dept/agribusiness/media/pdf/ACenturyofAgriculture(1).PDF [Accessed October 26, 2016].

Jacobs, C.R. 2014. Personal communication to J. Jones on January 21, 2014. Walpole Island Heritage Centre and Walpole Island Land Trust.

Jones, J. 2004-2008. Unpublished field data from surveys of alvars on the North Channel Islands and Manitoulin Island.

Jones, J. 2015. Recovery strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vi + 33 pp.

Kartesz, J.T. 2014. *Agalinis gattingeri* in The Biota of North America Program (BONAP). North American Plant Atlas. http://bonap.net/napa. Chapel Hill, N.C. [accessed January 28, 2016]

Krause-Danielsen, Allison. 2008. Email and telephone correspondence to J. Jones, November 21, 2008. Formerly with Manitoba Conservation Data Centre, Winnipeg, MB.

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. OMNR, Southcentral Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02. 225 pp.

Manitoba Conservation Data Centre. Unpublished data from field surveys of Gattinger's Agalinis 2004 – 2015.

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

Murray, C. 2013. Manitoba Conservation Data Centre Surveys and Stewardship Activities, 2012. Report No. 2013-01. Manitoba Conservation Data Centre, Winnipeg, Manitoba. 30 pp.

Murray, C. and C. Church 2015. Manitoba Conservation Data Centre Surveys and Stewardship Activities, 2014. Report No. 2015-01. Manitoba Conservation Data Centre, Winnipeg, Manitoba. v+47 pp.

Musselman, L.J. and W.F. Mann. 1977. Host plants of some Rhinanthoideae (Scrophulariaceae) of Eastern North America. Plant Systematics and Evolution 127: 45-53.

Natural Heritage Information Centre (NHIC). 2016. Element Occurrence Data from the Natural Heritage Information Centre. Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario.

NatureServe 2016a. *Agalinis gattingeri* in NatureServe Explorer: An online encyclopedia of life, NatureServe, Arlington, Virginia. http://explorer.natureserve.org [Accessed January 2016].

NatureServe. 2016b. Habitat-based Plant Element Occurrence Delimitation Guidance, 1 October 2004. Version 7.1. NatureServe, Arlington, Virginia. Website: www.natureserve.org/explorer/decision_tree.htm [Accessed March 18, 2016].

Reschke, C., R. Reid, J. Jones, T. Feeney and H. Potter 1999. Conserving Great Lakes Alvars: Final Technical Report of the International Alvar Conservation Initiative. The Nature Conservancy, Chicago, Illinois. 230 pp.

Samson, F.B. and F.L. Knopf. 1994. Prairie conservation in North America. Bioscience 44: 418-421.

Sellers, E., and D. McCarthy. 2015. Distribution and floral hosts of Anthophorula micheneri (Timberlake, 1947) and Hylaeus sparsus (Cresson, 1869), (Insecta: Hymenoptera: Apoidea: Anthophila), with new state records in Giles and Loudoun counties, Virginia, eastern USA. Check List 11(3):1665.

Wright, C.K. and M.C. Wimberly. 2013. Recent land use change in the Western Corn Belt threatens grasslands and wetlands. Proceedings of the National Academy of Sciences of the United States of America 110: 4134-4139.

Appendix A: Critical Habitat for Gattinger's Agalinis in Canada

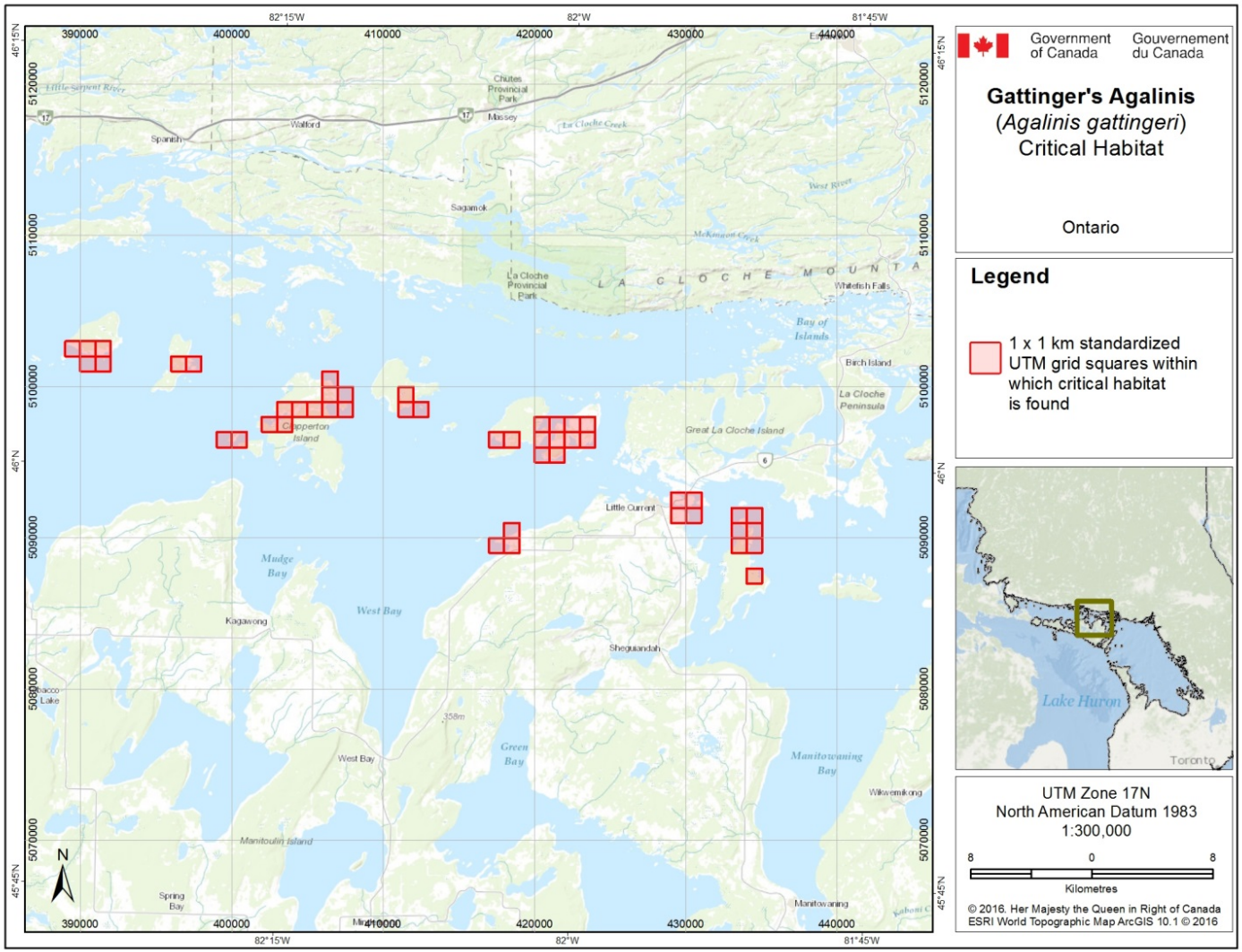

Figure A1. Critical habitat for Gattinger's Agalinis in Ontario is represented by the red shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on the figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

Table A1. Grid squares that contain critical habitat for Gattinger's Agalinis in Ontario. Critical habitat for Gattinger's Agalinis occurs within these 1 x 1 km standardized UTM grid squares where the description of critical habitat in Section 7.1 is met. Site # refer to the sites listed in Part 2; Table 1.

Population [Site #]	1 x 1 km Standardized UTM grid square ID[1]	Province/ Territory	UTM Grid Square Coordinates[2]		Land Tenure
			Easting	Northing	
Amedroz Island [4]	17TML1918	Ontario	411000	5098000	Non-federal Land
	17TML1919	Ontario	411000	5099000	
	17TML1928	Ontario	412000	5098000	
Bedford Island East [6]	17TML2906	Ontario	420000	5096000	Non-federal Land
	17TML2907	Ontario	420000	5097000	
Bedford Island West [7]	17TML1976	Ontario	417000	5096000	Non-federal Land
	17TML1986	Ontario	418000	5096000	
Clapperton Island - Beatty Bay & NW of Baker's Bay [8]	17TML0927	Ontario	402000	5097000	Non-federal Land
	17TML0937	Ontario	403000	5097000	
	17TML0938	Ontario	403000	5098000	
	17TML0948	Ontario	404000	5098000	
Clapperton Island - northern alvars and Logan Bay [9]	17TML0958	Ontario	405000	5098000	Other Federal Land and Non-federal Land
	17TML0968	Ontario	406000	5098000	
	17TML0969	Ontario	406000	5099000	
	17TML0978	Ontario	407000	5098000	
	17TML0979	Ontario	407000	5099000	
	17TMM0060	Ontario	406000	5100000	
Courtney Island [10]	17TLL9996	Ontario	399000	5096000	Non-federal Land
	17TML0906	Ontario	400000	5096000	
Darch Island [11]	17TLM8092	Ontario	389000	5102000	Non-federal Land
	17TLM9001	Ontario	390000	5101000	
	17TLM9002	Ontario	390000	5102000	
	17TLM9011	Ontario	391000	5101000	
	17TLM9012	Ontario	391000	5102000	
Freer Point [12]	17TML1879	Ontario	417000	5089000	Non-federal Land
	17TML1889	Ontario	418000	5089000	
	17TML1980	Ontario	418000	5090000	

Goat Island (Little Current Swing Bridge) [13]	17TML2992	Ontario	429000	5092000	Non-federal Land
	17TML3902	Ontario	430000	5092000	
Innes Island [18]	17TLM9061	Ontario	396000	5101000	Non-federal Land
	17TLM9071	Ontario	397000	5101000	
Little Current, Harbour View Road [19]	17TML2991	Ontario	429000	5091000	Non-federal Land
	17TML3901	Ontario	430000	5091000	
East Rous Island [20]	17TML2926	Ontario	422000	5096000	Non-federal Land
	17TML2927	Ontario	422000	5097000	
	17TML2936	Ontario	423000	5096000	
	17TML2937	Ontario	423000	5097000	
West Rous Island [21]	17TML2905	Ontario	420000	5095000	Non-federal Land
	17TML2915	Ontario	421000	5095000	
	17TML2916	Ontario	421000	5096000	
	17TML2917	Ontario	421000	5097000	
Strawberry Island (north end) [22]	17TML3839	Ontario	433000	5089000	Other Federal Land and Non-federal Land
	17TML3849	Ontario	434000	5089000	
	17TML3930	Ontario	433000	5090000	
	17TML3931	Ontario	433000	5091000	
	17TML3940	Ontario	434000	5090000	
	17TML3941	Ontario	434000	5091000	
Strawberry Island (W of Bowell Cove) [23]	17TML3847	Ontario	434000	5087000	Non-federal Land

[1] Based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography/topographic-information/maps/9775), where the first 2 digits and letter represent the UTM Zone, the following 2 letters indicate the 100 x 100 km standardized UTM grid followed by 2 digits to represent the 10 x 10 km standardized UTM grid. The last 2 digits represent the 1 x 1 km standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology produced from the Breeding Bird Atlases of Canada (See http://www.bsc-eoc.org/ for more information on breeding bird atlases).

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

[3] Land tenure is provided as an approximation of the types of land ownership that exist at the critical habitat units and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information.

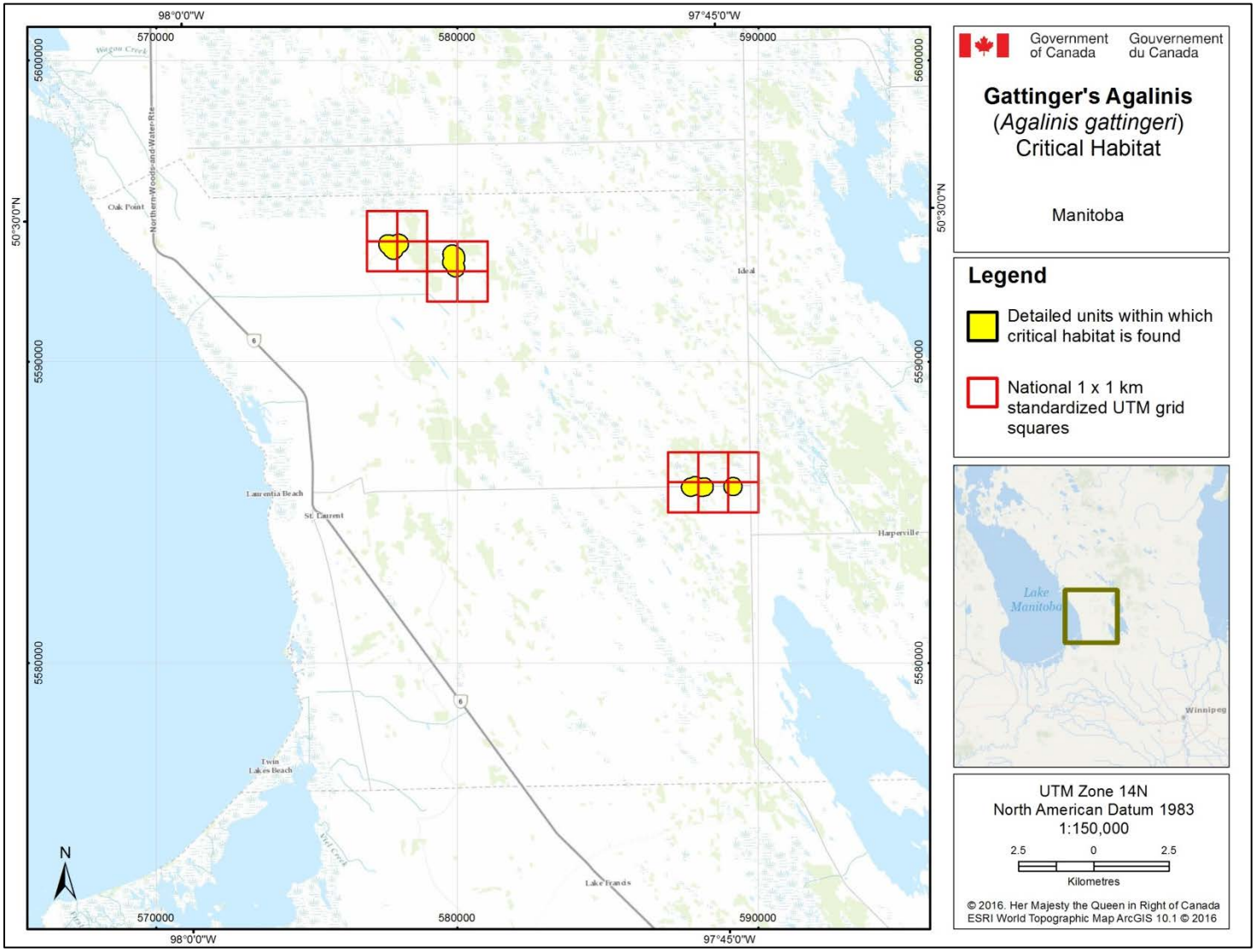

Figure A2. Critical habitat for Gattinger's Agalinis in Manitoba (Stony Ridge Road [EO 6095], Wagon Creek Road [EO 6096], St. Laurent [EO 5196]) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on the figure is a standardized national grid system that indicates the general geographic area containing critical habitat. Areas outside of the yellow shaded units do not contain critical habitat.

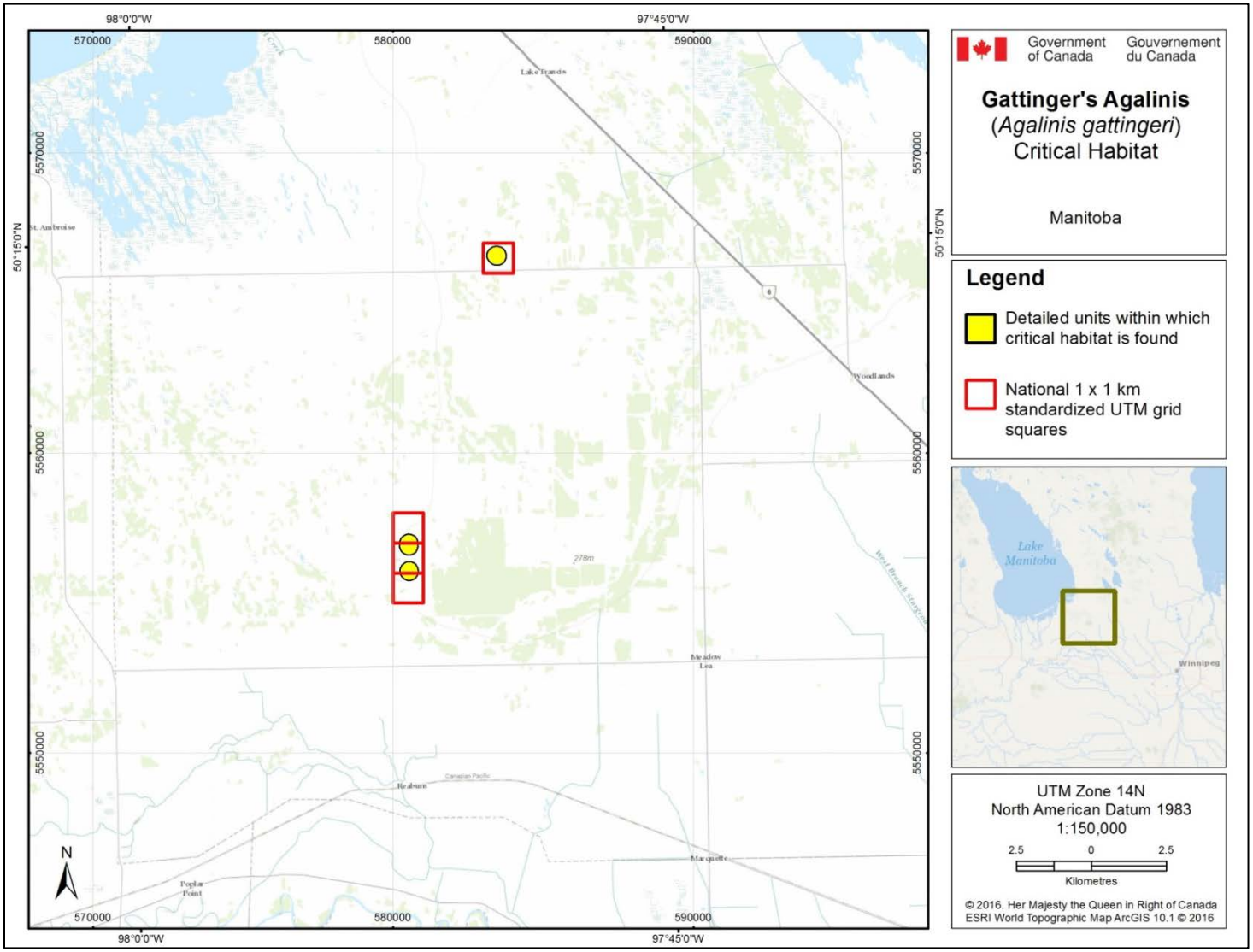

Figure A3. Critical habitat for Gattinger's Agalinis in Manitoba (Site 18W [EO 5045], Site 16W [EO 5193]) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on the figure is a standardized national grid system that indicates the general geographic area containing critical habitat. Areas outside of the yellow shaded units do not contain critical habitat.

Appendix B: 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*[26]. 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[27] (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.

The primary threats to Gattinger's Agalinis include transportation and service corridors, human intrusions and disturbance, natural system modifications caused by fire and fire suppression and invasive non-native/alien species. The recommended broad strategies, general approaches and actions are intended to support the recovery of Gattinger's Agalinis in Canada. For the most part, the conservation and management activities associated with Gattinger's Agalinis will benefit non-target species, natural communities and ecological processes. As a general rule, actions that incorporate or mimic natural regimes are natural components of any ecosystem and are not likely to negatively impact the persistence of other native species, particularly if the timing, intensity and frequency mimic those natural processes (e.g., fire) (Samson and Knopf 1994). However, some management practices, including prescribed burns, mowing or grazing, and some forms of integrated weed management, have the potential to affect other species negatively in the short or long-term. For example, while Dakota Skipper (*Hesperia dacotae*), Western Silvery Aster, Gattinger's Agalinis and Rough Agalinis, can be negatively affected by mowing if done in late summer/fall, another species at risk, the Small White Lady's-slipper (*Cypripedium candidum*) can be harmed if the area is mowed in spring/early summer (Environment Canada 2014, MB Conservation unpublished management summaries). Prescribed burning can improve habitat for many rare and at-risk tallgrass prairie species, but may also harm some species sensitive to fire. Historically, fire was a natural process that maintained prairie

[26] www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[27] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

ecosystems, and it has been used by Indigenous communities as a management tool for millennia. It is intended that any reduction of fire-sensitive species should still result in population levels within the range of fluctuations that would occur from a natural burning regime. As well, fire may reduce the presence of woody species to the benefit of tallgrass prairie native species. This is not expected to have a significant impact since the encroaching woody species are common in non-burned habitats.

A list of some of the species that may benefit and their conservation status is presented in Table B1. There are also numerous additional unranked and provincially rare species (Catling 1995; Reschke et al. 1999; Brownell and Riley 2000) that will benefit.

Table B1. Federal species at risk which co-occur, or may co-occur, in areas occupied by Gattinger's Agalinis.

Common Name	Scientific name	SARA status
Rough Agalinis	*Agalinis aspera*	ENDANGERED
Western Silvery Aster	*Symphyotrichum sericeum*	ENDANGERED
Houghton's Goldenrod	*Solidago houghtonii*	SPECIAL CONCERN
Skinner's Agalinis	*Agalinis skinneriana*	ENDANGERED
Small White Lady's Slipper	*Cypripedium candidum*	ENDANGERED
Western Prairie Fringed Orchid	*Platanthera praeclara*	ENDANGERED
Riddell's Goldenrod	*Solidago riddellii*	SPECIAL CONCERN
Dakota Skipper	*Hesperia dacotae*	ENDANGERED
Hill's Thistle	*Cirsium hillii*	THREATENED
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	ENDANGERED
Dense Blazing Star	*Liatris spicata*	THREATENED
Pink Milkwort	*Polygala incarnata*	ENDANGERED
Showy Goldenrod	*Solidago speciosa*	ENDANGERED
Colicroot	*Aletris farinosa*	THREATENED
Poweshiek Skipperling	*Oarisma poweshiek*	THREATENED
Monarch	*Danaus plexippus*	SPECIAL CONCERN

Appendix C: Subnational Conservation Ranks of Gattinger's Agalinis (*Agalinis gattingeri*) in Canada and the United States

Table C1. Rank Definitions (NatureServe 2016a)

Gattinger's Agalinis (*Agalinis gattingeri*)				
Global (G) Rank	**National (N) Rank (Canada)**	**Sub-national (S) Rank (Canada)**	**National (N) Rank (United States)**	**Sub-National (S) Rank (United States)**
G4	N2	Ontario (S2); Manitoba (S1)	NNR	Alabama (SH), Arkansas (SNR), Illinois (S3), Indiana (S3), Iowa (S1), Kansas (SNR), Kentucky (S3S4), Louisiana (SNR), Michigan (S1), Minnesota (S1), Mississippi (SNR), Missouri (SNR), Nebraska (S1S3) Ohio (S2), Oklahoma (SNR), Tennessee (S2S3), Texas (S2), Wisconsin (S2)

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

S2/N2: 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/G4: Apparently Secure – At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences but with possible cause for some concern as a result of local recent declines, threats or other factors.

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

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

SH: Possibly Extirpated

Part 2 – *Recovery Strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Ontario*, prepared by Judith Jones for the Ontario Ministry of Natural Resources and Forestry

Photo: Theodore Flamand

Gattinger's Agalinis
(*Agalinis gattingeri*) in Ontario

Ontario Recovery Strategy Series

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

2015

Natural. Valued. Protected.

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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 was 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 and Forestry Species at Risk webpage at: **www.ontario.ca/speciesatrisk**

RECOMMENDED CITATION

Jones, J. 2015. Recovery strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vi + 33 pp.

Cover illustration: Gattinger's Agalinis by Theodore Flamand. *This photo may not be reproduced separately from this document without permission of the photographer.*

ISBN 978-1-4606-5717-1

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ACKNOWLEDGMENTS

Previous versions of some material in this document were prepared by Judith Jones, Jarmo Jalava, and Holly Bickerton under the direction of the Bruce-Manitoulin Alvar Recovery Team and Parks Canada Agency.

The author gratefully acknowledges the following people and agencies for sharing information: Anthony Chegahno (Neyaashiinigmiing First Nation), Theodore Flamand (Wikwemikong Department of Lands and Natural Resources), Clint Jacobs (Walpole Island Heritage Centre), G'mewin Migwans (United Chiefs and Councils of M'nidoo M'nising), Will Kershaw (Ontario Parks), and Nikki Boucher (Ontario Ministry of Natural Resources and Forestry, Sudbury District) for sharing information. Thanks to Theodore Flamand for the use of his photos.

DECLARATION

The recovery strategy for Gattinger's Agalinis 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 and Forestry
Environment Canada – Canadian Wildlife Service, Ontario

EXECUTIVE SUMMARY

Gattinger's Agalinis (*Agalinis gattingeri*) is listed as endangered in Ontario under Ontario's *Endangered Species Act, 2007* (ESA) and as endangered in Canada on Schedule 1 of the *Species at Risk Act* (SARA).

Gattinger's Agalinis is a small, wiry, annual plant, less than 15 cm tall, with very slender opposite leaves and pale pink, funnel-shaped flowers that occur singly at the end of long slender stalks. It flowers from late July through September. The species has a long-lived seed bank and seeds have been known to germinate after more than 10 years of storage. Population sizes may fluctuate, and if live plants of Gattinger's Agalinis are not observed in any given year, a site cannot be presumed to be unoccupied.

There are 26 extant occurrences of Gattinger's Agalinis in Ontario and 5 in Manitoba. In Ontario, Gattinger's Agalinis occurs in both tallgrass prairie and alvar habitats. The species is found on and around Manitoulin Island, on the Bruce Peninsula, and on Walpole Island. At least 18 occurrences are on First Nation reserves, or on other lands that are traditional territory or claimed by First Nations. Three occurrences are in protected areas and two are in a proposed addition to a provincial park. Total abundance in Ontario is around 70,000 individuals, but this fluctuates. On Walpole Island, the species is in serious decline. In the Manitoulin Region, damage has occurred at four corporately-owned sites, but the extent is unknown. Most other sites likely have stable populations.

Threats to Gattinger's Agalinis include development, changes to ecological processes, conversion of prairie to agriculture, aggregate extraction, invasion by exotic species, logging and industrial activities, off-road vehicle use, livestock grazing, trampling, with a lack of awareness about alvar sensitivity underlying many threats.

The recovery goal is to maintain self-sustaining populations of Gattinger's Agalinis in their current distribution in Ontario by maintaining and protecting habitat and reducing other threats. The recovery objectives are to:

- assess threats and undertake actions for mitigation and reduction;
- use policy tools, where appropriate, to protect Gattinger's Agalinis;
- raise awareness about Gattinger's Agalinis and its sensitive habitats; and
- fill knowledge gaps.

A number of steps and actions are suggested to fulfill these goals and objectives and to address threats.

It is recommended that the habitat to be considered for regulation be prescribed as follows.

- All areas where Gattinger's Agalinis grows or has grown unless surveys show that the species has been absent for more than 10 years.
- Any new areas where the species becomes discovered in the future.

- The area where live Gattinger's Agalinis plants grow or have previously grown and the entire ELC vegetation polygon in which the occurrence is found.
- An additional distance of 50 m around the outside of the polygon, so that in cases where individuals occur at the edge of a polygon, there will be sufficient distance from activities in adjacent areas to prevent negative effects, such as changes in drainage that affect soil moisture.

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1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Gattinger's Agalinis

SCIENTIFIC NAME: *Agalinis gattingeri*

SARO List Classification: Endangered

SARO List History: Endangered (2008), Endangered – not regulated (2004)

COSEWIC Assessment History: Endangered (2001, 1999, and 1988).

SARA Schedule 1: Endangered (June 5, 2003)

CONSERVATION STATUS RANKINGS:
GRANK: G4 NRANK: N2 SRANK: S2

The glossary provides definitions for the abbreviations above and for other technical terms in this document.

1.2 Species Description and Biology

Species Description

Gattinger's Agalinis (*Agalinis gattingeri*), also called Round-stem False Foxglove (NatureServe 2014) or Gattinger's False Foxglove (Brouillet et al. 2014), is a small, wiry, annual plant (Figure 1). In Ontario and in its northern range, plants are generally less than 15 cm tall with very slender opposite leaves 10 to 34 mm long and 0.4 to 1.0 mm wide. Stems of well-developed plants may branch. The pale pink, funnel-shaped flowers are about 1 to 1.5 cm long and occur individually at the end of slender stalks more than 7 mm long. Flowering occurs from late July through September, and flowers last for only one day before falling off the plant. The round, brown-yellow capsules contain numerous small (0.5 – 1.2 mm) seeds. This species is hemiparasitic, attaching to other plants by specialized roots (Canne-Hilliker 1988, 1998).

Gattinger's Agalinis is easily distinguished from Large Purple Agalinis (*A. purpurea* var. *purpurea*) and Small-flowered Agalinis (*A. purpurea* var. *paupercula*) by having flowers that stick out from the main stem on slender stalks, whereas Large Purple and Small-flowered Agalinis have flowers very close to the main stem on short stalks less than 7 mm long. However, it can be extremely difficult to distinguish Gattinger's Agalinis from Skinner's Agalinis (*A. skinneriana)* and Slender-leaved Agalinis (*A. tenuifolia*), which are sometimes found in the same locations as Gattinger's Agalinis. Many common keys (c.f. Newcomb 1977; Gleason and Cronquist 1991; Voss 1996) give insufficient or

incorrect information to separate these species. A useful key can be found in Michigan Flora Online (Reznicek et al. 2011) and Voss and Reznicek (2012).

Figure 1. Gattinger's Agalinis in bloom. (photo credit: Judith Jones)

Gattinger's Agalinis can be distinguished from other members of the genus by: pale pink flowers with reddish spots and yellow lines in the funnel; flowers borne on long spreading (not stiffly upright) stalks; the lobes on the top rim of the flower upright or reflexed, but not pointing forward; leaves which spread out from the stem and are generally only one mm wide or less; a softly hairy outside surface on the lower petals; and the yellowy-green colour of the plant even when dried (Canne-Hillike 1998; J. Canne-Hilliker pers. comm. 2008; Reznicek et al. 2011). Many of these characteristics can be difficult to assess on dried specimens.

Gattinger's Agalinis has traditionally been classified in the Figwort Family (Scrophulariaceae) (Gleason and Cronquist 1991; Newmaster and Ragupathy 2012). However, genetic work on parasitic members of the Figwort and Broomrape (Orobanchaceae) families (Olmstead et al. 2001; Bennett and Mathews 2006) suggests that the parasitic species are most closely related to other Broomrape genera and evolved from a single lineage. Thus, as a hemiparasitic species, it is more appropriate to place Gattinger's Agalinis in the Broomrape Family.

Species Biology

The biology of Gattinger's Agalinis is not well known. The species occurs across a wide range of latitudes and in both alvar and tallgrass prairie communities in North America (Gleason and Cronquist 1991; NatureServe 2014) which suggests a broad tolerance to varying environmental conditions such as mean temperature, day length, length of growing season, and possibly moisture regime.

Plants in the genus *Agalinis* are hemiparasites which gain nutrients from other plants through specialized roots (haustoria) that form attachments to the roots of a host plant (Canne-Hilliker 1988). The preferred hosts of Gattinger's Agalinis are not known but probably vary over the range of latitude. Other species of *Agalinis* use a broad range of hosts, and may attach to almost any neighbouring root (Musselman and Mann 1977). Some genera in the Broomrape Family have the ability to utilize as many as 79 different kinds of host species, and some are able to attach to more than one host species at the same time (Piehl 1963; Phoenix and Press 2005). Thus, Gattinger's Agalinis may or may not be restricted to only one or a few host species. On the other hand, Gattinger's Agalinis occurs only in alvars and prairies and is not found in weedy areas, which suggests that it may actually have a somewhat narrow range of hosts. According to Voss and Reznicek (2012) the genus (at least in Michigan) is thought to have diverse hosts, especially graminoids. In prairies in the Midwestern United States, most Agalinis species are likely using Indian Grass (*Sorghastrum nutans*) (G. Dieringer pers. comm. 2014).

As an annual plant, Gattinger's Agalinis must go through its entire life cycle from germination to fruiting and seed dispersal all in one season (within roughly an 8–10 week period). Flowering occurs from late July through September, and fruits mature during September to October. Thus, live plants of this species are present only in the second half of the summer and early fall. At other times, Gattinger's Agalinis persists in the seed bank.

Gattinger's Agalinis may have a long-lived seed bank. It is not known how long the seeds remain viable in the soil, but seeds have been known to germinate in the laboratory after more than 10 years of general storage (J. Canne-Hilliker pers. comm. 2008). At one site in the Manitoulin Region, live plants of Gattinger's Agalinis recurred after four years of documented absence (J. Jones unpublished data), and absences of three to five years have been observed for other *Agalinis* species (G. Dieringer pers. comm. 2014). The seeds likely need a certain level of moisture for germination (J. Jones pers. obs. 2004-2014; G. Dieringer pers. comm. 2014). However, water availability is quite variable on alvars, which often undergo extreme drought in mid-summer. This may be one reason why annual population sizes are observed to fluctuate greatly and why the species may appear to be present in some years but not in others (Canne-Hilliker 1988; Jones unpub. data). Thus, if live plants of Gattinger's Agalinis are not observed in any given year, a site cannot be presumed to be unoccupied until there have been several years of regular searches.

It is not known how Gattinger's Agalinis is pollinated, but the open, funnel shape of the flower suggests that it may attract a number of insect species (Canne-Hilliker 1988). In

addition, self-fertilization has been shown to occur in the related species Skinner's Agalinis (Dieringer 1999) and Nova Scotia Agalinis (*A. neoscotica*) (Stewart et al. 1996), especially in small populations and in the absence of bees. It is possible this also occurs in Gattinger's Agalinis.

No information is known about dispersal distances in Gattinger's Agalinis, but the seeds do not appear to have any special adaptations for long-distance dispersal. Dispersal probably occurs when wind or other disturbance causes movement of open capsules on the long, slender stalks (Canne-Hilliker 1988).

The ecological role of Gattinger's Agalinis in either prairie or alvar is not known, but as a hemiparasite, it may have some influence on its host plants (Phoenix and Press 2005).

1.3 **Distribution, Abundance and Population Trends**

The global range of Gattinger's Agalinis stretches from Ontario and Manitoba to Nebraska, Texas, Louisiana and Alabama. The species is most common in the Ozark-Ouchita uplands of Missouri and Arkansas. In the United States, Gattinger's Agalinis is found in 18 states. It has a conservation rank of rare (S1-S3 or critically imperilled to vulnerable) in the ten states where it has been given a conservation ranking (NatureServe 2014) but is common in the other eight states where it is not ranked (BONAP 2013). The species has only one extant occurrence in Michigan in a remnant oak barren last observed in 1999 (Michigan Natural Features Inventory 2007). Gattinger's Agalinis is officially listed as threatened in Wisconsin (Wisconsin Department of Natural Resources 2014), endangered in Michigan and Minnesota (Minnesota Department of Natural Resources 2013; Michigan Natural Features Inventory 2014), and on the state watch list in Indiana (Indiana Department of Natural Resources 2007).

In Canada, there are 31 extant occurrences of Gattinger's Agalinis, of which 5 are in the interlake region of south-central Manitoba, and 26 are in Ontario (Figures 2 and 3; Table 1) (COSEWIC 2009a). In Ontario, Gattinger's Agalinis occurs in both tallgrass prairie and alvar. The species is found on Manitoulin Island and on smaller islands in the North Channel of Lake Huron, on the Bruce Peninsula, and on Walpole Island. Three occurrences are in protected areas, and two others are in a proposed addition to a provincial park.

At least 18 occurrences, including the most abundant, are on First Nation reserves or other lands within traditional territory, or on lands under claim by First Nations. Almost half of the populations of Gattinger's Agalinis in Ontario are on lands within the traditional territory of the First Nations of the United Chiefs and Councils of M'nidoo M'nising (UCCMM) on Manitoulin Island. Several other populations are on lands belonging to or claimed by Wikwemikong Unceded Indian Reserve (WUIR). There are also two extant populations on lands belonging to or within the traditional territory of the Neyaashiinigmiing First Nation (formerly Chippewas of Nawash), and one extant and two historical populations on the Walpole Island First Nation (WIFN).

Total abundance of Gattinger's Agalinis in Ontario is around 70,000 individuals, based on estimates between 2000 and 2010. However, population sizes can fluctuate from year to year, and the size of the population in the seed bank is not known. Populations of other Agalinis species have been observed to vary from 2 or 3 plants to as many as 500 plants (G. Dieringer pers. comm. 2014). COSEWIC (2009a) estimated the population at approximately 11,000 individuals, but at least one new large population has been discovered since then, and new abundance information has been gathered for a few others. Other than on Walpole Island, there is little information on population trends because most sites have had only one observation. No historical populations other than on Walpole Island are known.

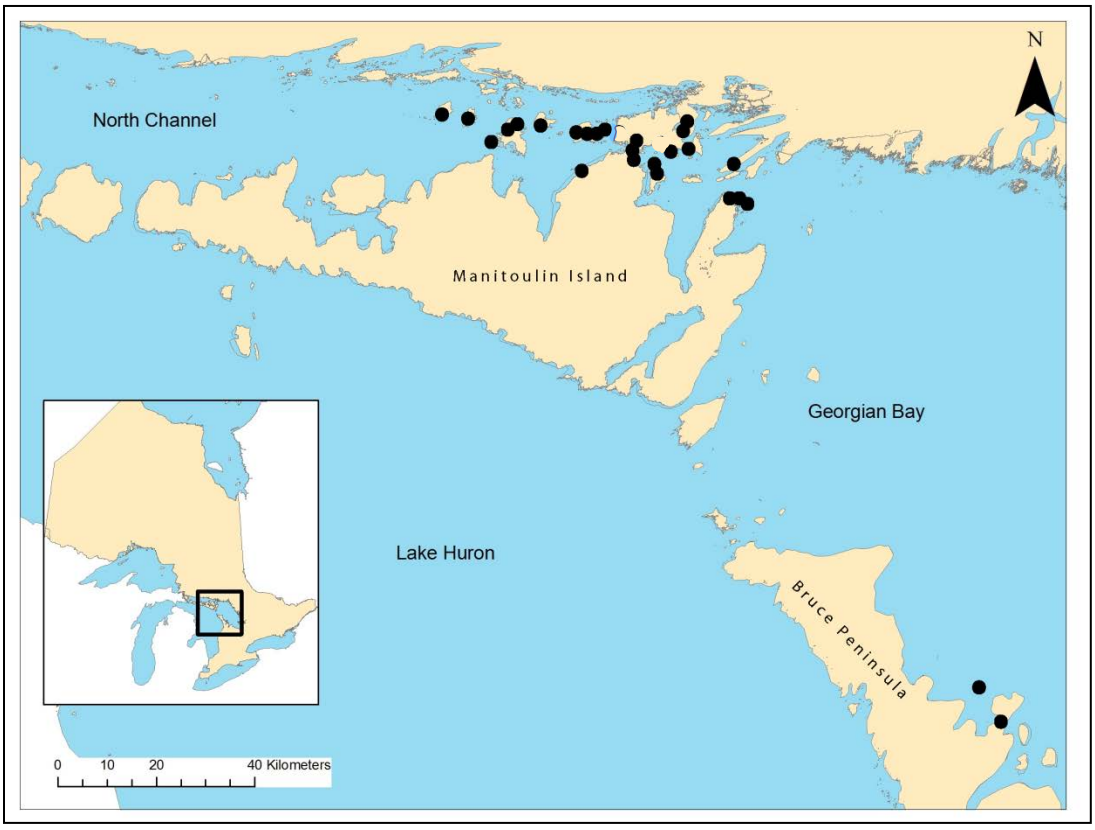

Figure 2. Distribution of Gattinger's Agalinis in the Manitoulin Island and Bruce Peninsula regions. Black dots indicate generalized locations of extant occurrences (Brownell and Riley 2000; Jones 2004, 2005; COSEWIC 2009a; A. Chegahno pers. comm. 2014). No historical or extirpated occurrences are known in these regions.

Figure 3. Distribution of Gattinger's Agalinis on Walpole Island (source: J. Bowles pers. comm. 2008). Black dot indicates generalized location of the extant occurrence. Historical or possibly extirpated occurrences not shown.

Table 1. List of occurrences of Gattinger's Agalinis in Ontario (sources: Brownell and Riley 2000; Jones 2004, 2005, and unpublished data; COSEWIC 2009a; A. Chegahno pers. comm. 2014). Italics indicate an extirpated population or a population where Gattinger's Agalinis has not been seen for 10 years or more. Legend: Corp. = Corporate; FN = First Nation; NGO = non-governmental organization; UCCMM = United Chiefs and Councils of M'nidoo M'nising (Manitoulin Island); WUIR = Wikwemikong Unceded Indian Reserve.

Site #	Site Name	Region	Owner-ship	Abund-ance	Most recent observer and date.	Comments
WALPOLE ISLAND FN						
1	Walpole I. FN #1	Walpole	FN	At least 35	J. Bowles & C. Jacobs 2008	"several dozen" in 1998; "several thousand" in 1987"
	Walpole I. FN #2	*Walpole*	*FN*	*Not seen since 1990*	*J. Bowles & C. Jacobs 2008*	*Probably extirpated*
	Walpole I. FN #3	*Walpole*	*FN*	*Not seen since 1987; "common " in 1982*	*J. Bowles & C. Jacobs 2008*	*Habitat very disturbed but restoration starting to be successful for other prairie species (J.M. Bowles pers. comm. 2008; C. Jacobs pers. comm. 2014).*
BRUCE PENINSULA						
2	Neyaashiinigming[1] FN #1	Bruce P.	FN	50,000	J. Jalava & A. Chegahno 2009	
3	Neyaashiinigming FN island	Bruce P.	FN	3	A. Chegahno 2012	
MANITOULIN ISLAND / NORTH CHANNEL						
4	Amedroz Island	Algoma	FN/ Crown	>200	J. Jones 2008	Within the traditional territory of UCCMM First Nations
5	Badgely Peninsula South	Manitoulin	Crown/ Ontario Parks	10,000	J. Jones & WUIR staff 2009	Killarney Coast Proposed Provincial Park/WUIR traditional territory
6	Bedford Island E	Manitoulin	FN/ Crown	>200	J. Jones 2005	Within the traditional territory of UCCMM First Nations
7	Bedford Island W	Manitoulin	FN/ Crown	~75	J. Jones 2005	Within the traditional territory of UCCMM First Nations
8	Clapperton Island (Beatty Bay & NW of Baker's Bay)	Manitoulin	FN/ Crown	~400	J. Jones 2005	Within the traditional territory of UCCMM First Nations
9	Clapperton Island (northern alvars and Logan Bay)	Manitoulin	FN/ Crown	>1,300	J. Jones 2006	Within the traditional territory of UCCMM First Nations

[1] Neyaashiinigmiing First Nation has also been known as Chippewas of Nawash or Cape Croker.

Site #	Site Name	Region	Owner-ship	Abund-ance	Most recent observer and date.	Comments
10	Courtney Island	Manitoulin	FN/ Crown	> 30	J. Jones 2004	Within the traditional territory of UCCMM First Nations
11	Darch Island	Algoma	FN/ Crown	100's	J. Jones, 2008	Within the traditional territory of UCCMM First Nations
12	Freer Point	Manitoulin	NGO	1,000's	J. Jones 2008	Private nature reserve
13	Goat Island (="Little Current Swing Bridge")	Manitoulin	Corp.	59	J. Jones 2005	
14	Great Cloche Island SE (Little River; W of Hwy 6)	Manitoulin	Corp.	100's	P. Catling & V. Brownell 1990's	See Brownell and Riley 2000
15	Great Cloche Island (Stony Pt., English Pt.)	Manitoulin	Corp.	1000's	P. Catling & V. Brownell 1990's	See Brownell and Riley 2000
16	La Cloche Peninsula #1 (Whitefish River First Nation)	Manitoulin	FN	1,000's	J. Jones and UCCMM staff 2010	
17	La Cloche Peninsula #2 (Whitefish River First Nation)	Manitoulin	FN	<100	J. Jones and UCCMM staff 2010	
18	Innes Island	Algoma	FN/ Crown	100's	J. Jones 2004	Within the traditional territory of UCCMM First Nations
19	Little Current, Harbour View Road	Manitoulin	Private/ Corp.	Unknown	From OMNR 2013	
20	East Rous Island	Manitoulin	FN/ Crown	~50	J. Jones and UCCMM staff 2010	Within the traditional territory of UCCMM First Nations
21	West Rous Island	Manitoulin	FN/ Crown	>1,000	J. Jones 2005	Within the traditional territory of UCCMM First Nations
22	Strawberry Is. (northern end)	Manitoulin	Ontario Parks	>500	J. Jones 2005	
23	Strawberry Island (W of Bowell Cove)	Manitoulin	Ontario Parks	>250	J. Jones 2005	
24	Wikwemikong #1	Manitoulin	FN	36	J. Jones & WUIR staff 2008	
25	Wikwemikong island #3	Manitoulin	FN	>1,000	J. Jones & WUIR staff 2008	
26	Wikwemikong island #4	Manitoulin	FN	~500	J. Jones & WUIR staff 2008	
Unsurveyed sites with suitable habitat where presence is not confirmed						
	Wikwemikong island #2	Manitoulin	FN	Presence likely	J. Jones & WUIR staff 2008	

Site #	Site Name	Region	Owner-ship	Abund-ance	Most recent observer and date.	Comments
	Badgely Peninsula North	Manitoulin	Crown/ Ontario Parks	Presence likely	W. Bakowsky & W. Kershaw 2000	Killarney Coast Proposed Provincial Park
	Beauty Island	Manitoulin	Private	Presence likely		
	Little Cloche Island (Mary Pt.)	Manitoulin	Corp.	Presence likely	J. Jones 1996	
	Islands off Gr. Cloche I. (Matlas, Patten, Flat, etc.)	Manitoulin	Unknown	Presence likely	J. Jones 1996	
Totals: 26 occurrences; 5 potential, unconfirmed sites ~70,000 individuals between 2000-2012, but total in seed bank is unknown.						

On Walpole Island, Gattinger's Agalinis is in serious decline. Two populations have likely become extirpated since 1988, with only one confirmed as extant in 2014. Numbers of individuals have declined from thousands in the 1980s to several dozen in 1998 to only around 35 in 2008 (COSEWIC 2009a). However, there are some challenges to surveying for Gattinger's Agalinis on Walpole Island because both Skinner's Agalinis and Slender-leaved Agalinis are also present in the same area, making it difficult to determine how many individuals of each species there are (J.M. Bowles pers. comm. 2008; C. Jacobs pers. comm. 2014). At one site where Gattinger's Agalinis may be extirpated, restoration work is underway, and native prairie plants are starting to reappear (C. Jacobs pers. comm. 2014). It remains to be seen whether restoration will improve the situation for Gattinger's Agalinis at this site.

In the Manitoulin Island region, quarrying, development, and bulldozing at three of the four corporately-owned sites (Table 1) appear to have impacted or wiped out Gattinger's Agalinis in some areas, but the extent of the impacts and potential declines is not known. Most other populations are on islands that have no human residents and that are visited infrequently. These likely have stable populations.

1.4 **Habitat Needs**

In the Manitoulin Region and on the Bruce Peninsula, Gattinger's Agalinis occurs in alvar grasslands and jack pine savannas on Ordovician limestone. Within the Ecological Land Classification (ELC) (Lee et al. 1998), suitable microhabitat occurs in these vegetation types (Reschke et al. 1999; Brownell and Riley 2000, Jones 2004, 2005, unpub. data):

- Dry Annual Open Alvar Pavement (ALO1-2)
- Dry-Fresh Little Bluestem Open Alvar Meadow (ALO1-3)
- Dry-Fresh Poverty Grass Open Alvar Meadow (ALO1-4)
- Creeping Juniper-Shrubby Cinquefoil Dwarf Shrub Alvar (ALS1-2)
- Jack Pine – White Cedar – White Spruce Treed Alvar (Savanna) (ALT1-4).

Polygon sizes may range from 0.5 ha to more than 100 ha, with most being under 20 ha (Reschke et al. 1999; Brownell and Riley 2000; J. Jones unpublished data).

Within these vegetation types, the microhabitat is usually in areas dominated by Northern Dropseed (*Sporobolus heterolepis*) or Little Bluestem (*Schizachyrium scoparium*). Gattinger's Agalinis is usually found in small patches of bare ground (bedrock or a few centimetres of organic soil) between tussocks of grass (Figure 4), often with other small annual plants such as Grooved Yellow Flax (*Linum sulcatum*) and Neglected Dropseed (*Sporobolus neglectus*). Drainage is very poor due to the underlying bedrock, so these alvars are known to spend extended periods of time in extreme conditions of drought or inundation (Reschke et al. 1999).

On Walpole Island First Nation (and in Manitoba) Gattinger's Agalinis grows in sandy loam soils in open, tallgrass prairie remnants (Walpole Island Heritage Centre 2006; J.M. Bowles pers. comm. 2008; COSEWIC 2009a). Based on the moisture regime and associate species (J.M. Bowles pers. comm. 2008), suitable microhabitat is found within the ELC community type Fresh-Moist Tallgrass Prairie (TPO2-1). Common associates include Little Bluestem as well as other prairie grasses such as Big Bluestem (*Andropogon gerardii*), Switch Grass (*Panicum virgatum*), and Indian Grass (*Sorghastrum nutans*). Gattinger's Agalinis is also sometimes found in shallow swales (low, damp areas). In prairie habitats as well as on alvars, the species is usually found in shorter, sparser vegetation, on bare ground between and around tussocks of grass (Jones 2004, 2005; A. Kraus-Danielsen pers. comm. 2008; COSEWIC 2009a).

Figure 4. Microhabitat of Gattinger's Agalinis on alvar. The small pink flowers are visible between clumps of Northern Dropseed Grass and slabs of pitted limestone. (Photo credit: Theodore Flamand).

Native grasses in the habitat of Gattinger's Agalinis generally have a cespitose, tufted, or tussocked shape. In sparse vegetation, there are bare spots between tussocks, and these bare spots are the preferred microhabitat for Gattinger's Agalinis (J. Jones pers. obs. 1996-2014). By contrast, non-native and adventive grass species generally grow from longer rhizomes and create dense patches of grass cover that do not have the small gaps required by Gattinger's Agalinis (J. Jones pers. obs. 1996-2014).

Fire is used to maintain the open state of tallgrass prairies on Walpole Island (C. Jacobs pers. comm. 2014), and burning has long been a traditional part of prairie management (COSEWIC 2009a; Riley 2013). Fire has also probably occurred at the Neyaashiinigmiing site (Jalava pers. com. 2008) and may be beneficial or required by some types of alvars (Catling and Brownell 1998; Catling et al. 2001; Catling 2009). However, most Manitoulin Region alvars where Gattinger's Agalinis is found show little or no evidence of burning (Reschke et al. 1999; Jones and Reschke 2005). It is possible that these alvars did not originate from fire but are relics of post-glacial times and are becoming vegetated at an extremely slow rate (over centuries) (Jones and Reschke 2005). Alternatively, it may be that the drought-flood cycle and shallow soils

perpetually inhibit growth of woody vegetation, keeping these alvars in a sparse, open state without fire (Rosén 1995; Reschke et al. 1999).

1.5 **Limiting Factors**

The hemiparasitic nature of Gattinger's Agalinis may be a limitation if the species is restricted to a specific host plant, rather than being able to use a number of different hosts. An absence of host plants could prevent individuals of Gattinger's Agalinis from establishing or growing. Natural ecological and climatic factors may also be a limitation, especially in years with little precipitation, because some level of moisture is required for germination and alvars and prairies are frequently droughty in mid-summer (Reschke et al. 1999; COSEWIC 2009a).

Gattinger's Agalinis is an annual species that is only present as a live plant in the second half of the summer and early fall and may not be present above ground every year. Thus, time of year may affect the severity of a threat or the effectiveness of a recovery technique.

1.6 **Threats to Survival and Recovery**

Gattinger's Agalinis is a delicate plant in a sensitive habitat. As such, there are many factors that may negatively affect the plants, the habitat, or both. The main threats, whether to prairie or alvar, cause habitat degradation and loss. Threats include development, changes to ecological processes, conversion of prairie to agriculture, aggregate extraction, invasion by exotic species, fire suppression, logging and industrial activities, off-road vehicle use, livestock grazing, and trampling by pedestrians. Habitat degradation arising from a lack of awareness of the sensitivity of alvar is also a general threat.

Development and Construction

Many alvar habitats containing Gattinger's Agalinis are in close proximity to the Lake Huron shoreline and thus are in demand for residential or cottage development. On Walpole Island, land for housing and other development is extremely limited but is an urgent need. Industrial and commercial development are also current threats to habitat in one area of Manitoulin Island. Constructing buildings, yards, driveways, and roads on alvar or prairie may completely eliminate suitable habitat. Negative effects of development may result from clearing vegetation, blasting bedrock to level foundations or anchor other structures, trucking in fill which introduces invasive plants and covers suitable ground, displacing shallow soil, and trampling vegetation with heavy machinery.

Changes in Ecological Processes

In the absence of fire or other ecological processes, open alvar and prairie habitats gradually become too densely vegetated to be suitable for Gattinger's Agalinis, which requires sparse spots in short, grassy vegetation. Short plants that produce small

seeds, such as Gattinger's Agalinis, are known to be particularly susceptible to loss in fire-suppressed prairies (Leach and Givnish 1996). Crow et al. (2003) calculated a 36 percent loss of prairie vegetation on Walpole Island between 1972 and 1998, which was mostly due to natural succession from the absence of fire (Bowles 2005). Controlled burning is done at Walpole Island in some prairie habitats but may not be done often enough at all sites (C. Jacobs pers. comm. 2014). In addition, there is some evidence that burning at the wrong time of year may be reducing the population of the related species Skinner's Agalinis (Bowles unpub. data; Environment Canada 2012), and thus may affect Gattinger's Agalinis as well. Thus, changes in timing of natural processes may also be a threat.

On many of the alvars where Gattinger's Agalinis occurs, there is little or no evidence that the habitat originated from fire or is maintained by it (Jones and Reschke 2005; Jones unpub. data), but a few alvar populations do have evidence of historical burning (J. Jones unpub. data; J. Jalava pers. comm. 2008). Some researchers maintain that fire is harmful to alvars (Gilman 1995, 1997). However, it is unknown whether controlled burning on alvar would be beneficial or harmful to Gattinger's Agalinis, and correct timing of fire may be important.

Changes to the natural moisture regime may also threaten Gattinger's Agalinis. On Walpole Island, installation of drainage tiles and ditching for agriculture in the 1980s altered the hydrologic regime in some prairie sites. This probably caused the extirpation of two populations (Canne-Hiliker 1998; COSEWIC 2009a). In addition, changes in lake levels have also increased wetness in some prairie habitat on Walpole Island (COSEWIC 2009a). Some parts of the currently extant population may continue to be threatened by habitat degradation from increased wetness.

Conversion of Prairie to Agriculture

At Walpole Island, conversion of prairie to agriculture continues to be an on-going, current threat because the prairie land has never been sprayed and can thus be used for certified organic farming. Rental fees that are double the usual rate are being offered for prairie land (C. Jacobs pers. comm. 2014). Historically, most of North America's prairies were converted to agricultural fields, and today only about 0.5 percent of the prairie and savannah present in Ontario in the 19th century still remains (Bakowsky and Riley 1994).

Quarrying and Aggregates Extraction

Alvars are often in demand for quarry development because the limestone bedrock is close to the surface, and little clearing of forest and soil is necessary. Quarrying may completely destroy alvar habitat. Several alvars containing populations of Gattinger's Agalinis are within an area licensed for aggregate extraction. As per the conditions of an agreement issued under the *Endangered Species Act, 2007* (ESA), the licence holders must do surveys for Gattinger’s Agalinis before any new expansion, and should the species be found on site, appropriate mitigation measures must be undertaken (R. Steedman, pers. comm. 2014).

Invasion by Exotic Species

The presence of non-native species in alvar or prairie is usually the result of past disturbance which has brought in seeds or other propagules. On alvar, exotic species compete with native species for space and nutrients, and may become dominant and reduce the presence of native species (Reschke et al. 1999). Exotic species degrade habitat for Gattinger's Agalinis by taking up the small spaces between grass tussocks, as well as by shading, increasing litter accumulation, and changing other dynamics such as moisture retention (J. Jones unpublished data). Some examples of problem species in Gattinger's Agalinis alvar habitat include White Sweet Clover (*Melilotus albus*), Smooth Brome (*Bromus inermis*), and Common St. John's Wort (*Hypericum perforatum*) (J. Jones unpublished data). On Walpole Island, European Common Reed (*Phragmites australis* spp. *australis*) is present surrounding the habitat of Gattinger's Agalinis (C. Jacobs pers. comm. 2014), and this aggressive species is known to be a threat in other prairie habitats (WEMG 2012).

Fungal pathogens in the soil may also negatively affect the growth and abundance of Gattinger's Agalinis. Klironomos (2002) found that Gattinger's Agalinis grew more poorly in soil where fungal pathogens were present, while invasive species tended to be able to resist fungal pathogens. The presence of pathogens may be one mechanism by which invasive or weedy species affect Gattinger's Agalinis.

Logging and Industrial Activities

The alvar habitats of Gattinger's Agalinis are frequently used as staging areas for logging operations in adjacent forests and for storage of materials and machinery for industrial uses. Moving logs, materials, and heavy machinery across alvars tramples plants, dislodges shallow soils, and brings in exotic species that degrade habitat.

Off-road Vehicle Use

Off-road use of all-terrain vehicles (ATVs) and other vehicles is a threat to both the habitat and the plants of Gattinger's Agalinis. Use of ATVs especially is a serious concern because ATVs are nearly unrestricted in where they can go and do not need roads or trails. Vehicle use disturbs or destroys vegetation, displaces shallow layers of soil, and brings in weed species. Off-road vehicle use is a current threat both at Walpole Island and on Manitoulin Island.

Livestock Grazing

Livestock grazing degrades habitat, reduces populations of plants, and spreads non-native weeds (Reschke et al. 1999). Historically, many alvars in the Manitoulin region had livestock on them, and the resulting weeds and degraded habitat quality are still evident. In 2014, only one Ontario Gattinger's Agalinis site (in the Manitoulin region) was being grazed (J. Jones pers. obs.), but grazing remains a potential threat in a few places.

Trampling

Foot traffic can damage vegetation and delicate plants such as Gattinger's Agalinis. In addition, on islands in the North Channel of Lake Huron (Figure 2) unmonitored camping (putting tents, fire pits, and latrines on alvars) is a threat.

Lack of Public Awareness

Habitat may become degraded simply as the result of a lack of awareness. Perhaps due to the sparse vegetation and lack of trees, alvars are frequently perceived as waste land where indiscriminate use doesn't matter because "there is nothing there". As a result, alvars frequently become locations for unsanctioned activities such as illegal dumping and unmonitored camping. As well, the perception of alvars as waste land often leads people to select alvars preferentially as the locations for many of the activities that cause the threats listed above. Despite an increase in awareness about alvars in Ontario in the last ten years, many people still do not know the word "alvar", even in the Manitoulin Island region where alvars are quite common.

1.7 **Knowledge Gaps**

Gattinger's Agalinis population sizes fluctuate greatly from year to year. In some years, live plants of this species may be completely absent although seeds may remain viable in the soil. It is not clear whether population fluctuations are natural and due to inherent limitations in the life history of the species, whether they may be linked to climatic events (drought, heavy rainfall, etc.), or whether in some cases they may be due to threats. The population fluctuations create a challenge for recovery, monitoring, and protection because it can sometimes be difficult to know if the species is still present or where it may occur. Therefore, filling knowledge gaps pertaining to the magnitude, periodicity, and cause of population fluctuations will be important. Research is needed on the life history and ecological needs of Gattinger's Agalinis, particularly factors that affect reproduction and germination success, such as mechanisms that induce or break seed dormancy, seed bank viability, host plants, pollinators, and seed dispersal mechanisms. Understanding population viability in terms of both mature plants and seed banks is important to guide recovery actions and to measure recovery success.

The taxon has an extensive geographic distribution in the Midwestern United States, yet it occurs in very small populations at widely dispersed locations in Ontario. The reasons for this distribution pattern are unclear, but knowing them could potentially assist recovery. Genetic factors, including genetic isolation and the existence of evolutionarily significant units are also knowledge gaps. The results of this research may shed light on whether Ontario populations are small due to genetic inbreeding.

The effects of various management techniques on this species are unknown. For example, it is not known if hand removal of weeds and the use of controlled burning to maintain open ground would be beneficial.

A number of Bruce and Manitoulin sites with potential habitat still need to be surveyed for Gattinger's Agalinis. On the Bruce Peninsula in particular, Gattinger's Agalinis has had little attention in the past, and as a result there are a number of sites that still have not been surveyed (J. Jalava pers. comm. 2008). However, even if the species were found at some of these sites, it is still estimated that less than 10 percent of the global distribution of Gattinger's Agalinis would be within Canada.

1.8 **Recovery Actions Completed or Underway**

Major Alvar Studies

The International Alvar Conservation Initiative (IACI) (Reschke et al. 1999) was a large collaborative project that included surveys and research on alvars across the entire Great Lakes basin. The results contributed a great deal to knowing where alvars occur, what types of vegetation communities exist in them, and what ecological dynamics operate there. A number of alvars with Gattinger's Agalinis were surveyed as part of the IACI. As well, outreach to alvar landowners and the aggregates industry was conducted, and the ecological significance of alvars also became more widely known through magazine articles and exposure in other media.

The Ontario Alvar Theme Study (Brownell and Riley 2000) collected information on all Ontario alvars and ranked the alvars according to significance. As a result of this study, many alvars were recommended for designation as Areas of Natural and Scientific Interest (ANSI) including several that support Gattinger's Agalinis. However, no alvar ANSIs in the Manitoulin District have been confirmed (Manitoulin Planning Board 2013).

Field Work

Field surveys of Gattinger's Agalinis and its habitat in both prairie and alvar were done at many locations as part of several different projects (Jones 2004, 2005; Bowles 2005; Jalava 2008; COSEWIC 2009a). All First Nations jurisdictions that have Gattinger's Agalinis on their lands have completed surveys for this species and have baseline data on where it occurs. The First Nations are working on protection and management of habitat for Gattinger's Agalinis (T. Flamand pers. comm. 2014; A. Chegahno pers. comm. 2014; C. Jacobs pers. comm. 2014; G. Migwans pers. comm. 2014).

Outreach

Educational booklets about species at risk including Gattinger's Agalinis have been prepared by WIFN (Walpole Island Heritage Centre 2006) and WUIR (Wikwemikong Department of Lands and Natural Resources 2012). The booklets are very popular and have quickly become out of print. Neyaashiinigmiing First Nation hosts a website about species at risk (Neyaashiinigmiing Nature 2014) and takes school field trips twice a year to teach youth about the alvar and its rare species (A. Chegahno pers. comm. 2014). Fact sheets have also been prepared and distributed in that community.

Stewardship and Acquisitions

Two sites for Gattinger's Agalinis have been protected by acquisition. Freer Point has become a private nature reserve owned by the Escarpment Biosphere Conservancy, and Strawberry Island has become an Ontario provincial nature reserve park. WIFN has established a registered, non-profit land trust which is leasing or acquiring land for conservation purposes. Efforts by the land trust have resulted in a reduced rate of conversion of prairie and savanna habitat (COSEWIC 2009b). Some parts of the habitat where Gattinger's Agalinis is found at WIFN have been acquired (C. Jacobs pers. comm. 2014). WIFN also conducts controlled burning to maintain prairie habitats and has done hand-pulling and other management techniques to reduce exotic species (C. Jacobs pers. comm. 2014). Neyaashiinigmiing First Nation is planning construction of a boardwalk to prevent trampling of the alvar. The community is also actively working to keep vehicles on an existing road and off the vegetation (A. Chegahno pers. comm. 2014).

Policy and Planning

WUIR and Neyaashiinigmiing First Nation are in the process of preparing land use plans that will guide future development of their lands. In the WUIR plan, alvars and lands with species at risk (SAR), including Gattinger's Agalinis, are already designated areas of concern and will have some protection during planning (J. Manitowabi pers. comm. 2014). In addition, the community is working on a process where an assessment of SAR will be done before new projects get approved (T. Flamand pers. comm. 2014).

In the Manitoulin Region, a new official plan that will guide land use and development is in the process of being approved (Manitoulin Planning Board 2013). The new official plan restricts site alteration in alvar habitats unless an environmental study shows there will be no impacts from the proposed project. Local municipalities still have to develop by-laws to implement the new plan, but this is expected in the next two years.

2.0 RECOVERY

2.1 Recovery Goal

Maintain self-sustaining populations of Gattinger's Agalinis in their current distribution in Ontario by maintaining and protecting habitat and reducing other threats.

2.2 Protection and Recovery Objectives

The protection and recovery objectives (Table 2) and the approaches to recovery (Table 3) are intended to assist all jurisdictions, whether they be governments, First Nations, private or corporate landowners, or non-governmental organizations, with guidance on recovery.

Table 2. Protection and recovery objectives.

No.	Protection or Recovery Objective
1	Assess threats and undertake actions for mitigation and reduction.
2	Use policy tools, where appropriate, to protect Gattinger's Agalinis.
3	Raise awareness about Gattinger's Agalinis and its sensitive habitats.
4	Fill knowledge gaps.

2.3 **Approaches to Recovery**

Table 3. Approaches to recovery of Gattinger's Agalinis in Ontario.

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
1. Assess threats and undertake actions for mitigation and reduction.				
Critical	Short-term	Protection, Management, Monitoring and Assessment, Outreach, Stewardship	**1.1** Liaise with and support UCCMM and Neyaashiinigmiing in recovery actions developed by the community. Some actions may include the following. – Planning protection for North Channel Islands and Neyaashiinigmiing locations. – Erecting signage as needed. – Scheduling periodic site checks to monitor and prevent unsanctioned activities. – Talking with local users of the islands to enlist their help with monitoring and protection.	Development/Construction Invasion by Exotic Species Logging and Industrial Activities Indiscriminate ATV use Trampling Lack of Public Awareness
Critical	On-going	Protection, Management, Stewardship	**1.2** Liaise with and support WIFN and WUIR in recovery actions developed by the community. – Support the community in efforts to secure funding for ongoing work. – Assist with threats reduction, mitigation, and habitat restoration as requested by the community.	Development/Construction Conversion of Prairie to Agriculture Changes in Ecological Processes Invasion by Exotic Species Logging and Industrial Activities Indiscriminate ATV use Trampling Lack of Public Awareness
Necessary	On-going	Outreach	**1.3** Assist with leasing and/or acquisitions of land for conservation on WIFN if requested.	Conversion to Agriculture Changes in Moisture Regime

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Necessary	On-going	Protection, Management, Education and Outreach, Stewardship	**1.4** Ensure appropriate zoning and protection within parks and protected areas, which would include the following. – Identifying specific management needs. – Designating trails to prevent trampling and introduction of exotic species. – Preparing educational materials and/or signage. – Considering feasibility of controlled burning at some sites.	Changes in Ecological Processes Invasion by Exotic Species Indiscriminate ATV use Trampling Lack of Public Awareness
Necessary	Long-term	Protection	**1.5** Provide enhanced enforcement of *ESA 2007* and *SARA* if stewardship and other actions are not effective.	Development/Construction Logging and Industrial Activities Indiscriminate ATV use Trampling Lack of Public Awareness
2. Use policy tools, where appropriate, to protect Gattinger's Agalinis.				
Critical	Short-term	Protection	**2.1** Ensure alvar ANSIs become recognized in the Manitoulin Official Plan. – Responsible government jurisdictions to liaise with planning authorities.	Development/Construction Quarrying and Aggregates Extraction Lack of Public Awareness
Critical	Short-term	Protection	**2.2** Design community-based policies to protect alvars, prairies, and Gattinger's Agalinis on First Nations lands. – Design development approvals processes that include protection of SAR. – Divert projects to other locations.	Development/Construction Quarrying and Aggregates Extraction Invasion by Exotic Species Logging and Industrial Activities Lack of Public Awareness
Critical	Short-term	Protection	**2.3** Ensure that alvars and SAR are considered in municipal by-laws by: – including recognition of alvars and SAR in development of new by-laws; and – diverting projects to other locations.	Development/Construction Quarrying and Aggregates Extraction Invasion by Exotic Species Logging and Industrial Activities Lack of Public Awareness

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
3. Raise awareness about Gattinger's Agalinis and its sensitive habitats.				
Critical	Short-term	Education and Outreach, Communications	**3.1** Discuss Gattinger's Agalinis and alvar with corporate landowners and aggregate operators. – Coordinate meetings individually or with other landowners as a group. – Provide informative materials.	Quarrying & Aggregates Extraction Logging and Industrial Activities Livestock Grazing Invasion by Exotic Species Development/Construction Lack of Public Awareness
Critical	On-going	Protection, Communications, Stewardship	**3.2** Discuss Gattinger's Agalinis with municipal planners. – Provide informative materials and general information on habitat locations.	Development/Construction Quarrying and Aggregates Extraction Logging and Industrial Activities Indiscriminate ATV use Livestock Grazing Trampling Lack of Public Awareness
Necessary	On-going	Protection, Monitoring, Communications, Stewardship	**3.3** Discuss Gattinger's Agalinis with enforcement officials. – Provide informative materials and information on population and habitat locations.	Invasion by Exotic Species Logging and Industrial Activities Indiscriminate ATV use Trampling Lack of Public Awareness
Beneficial	On-going	Education and Outreach, Communications	**3.4** Assist with reprinting WUIR and WIFN educational materials and assist with preparations of materials for UCCMM and Neyaashiinigmiing communities if requested. – Share booklets with community members and other interested groups.	Any or all threats

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
4. Fill knowledge gaps.				
Necessary	Long-term	Inventory, Monitoring and Assessment, Research	**4.1** Develop and undertake annual monitoring to assess population levels and fluctuations, and to monitor threats. – Develop a range-wide protocol if possible. – Use data to track trends in abundance and habitat quality. – Use data to discern important biological needs or habitat requirements.	Knowledge gaps on size, frequency, and cause of fluctuations in abundance; current status of the populations and active threats; status of conditions of habitats; response of plants/populations to recovery actions.
Necessary	Long-term	Inventory, Monitoring and Assessment, Research	**4.2** Study life history and biological needs of Gattinger's Agalinis as research becomes feasible. – Study seed viability, germination, genetics, host plants, etc. – Use data to discern important biological needs or habitat requirements.	Knowledge gaps on how natural limitations and threats affect the populations; whether fire to maintain habitat may harm the plants; whether and when to use fire as a management tool.
Necessary	Long-term	Inventory, Monitoring and Assessment, Research	**4.3** Study Gattinger's Agalinis seed banks. – Research whether seed banks can be detected and measured; – Use data to evaluate population viability levels in terms of both live plants and seed banks.	Knowledge gaps on population viability; better measures of abundance; better tracking of effects of threats and of recovery success.

Narrative to Support Approaches to Recovery

Abundance of Gattinger's Agalinis is subject to natural fluctuations, and the magnitude and periodicity of the fluctuations are unknown. In addition, if fluctuations turn out to be linked to climatic events, such as drought or exceptional rainfall, changes in abundance levels may be unrelated to threats. Therefore, abundance is currently not a useful measure for recovery success. Until knowledge gaps on abundance and biological factors are filled, the recovery goal is to maintain self-sustaining populations of Gattinger's Agalinis, where self-sustaining will mean that Gattinger's Agalinis is present in most of the years it is surveyed.

It is recognized that First Nations will have a key role to play in recovery for Gattinger's Agalinis. First Nations community members are in contact with many of the sites where this species is found, so it is likely that community members will need to be involved on many levels in order for recovery to be successful.

Many Gattinger's Agalinis populations are on lands where there is little presence of ownership or jurisdictional authority, be it First Nations, Crown, or a corporation or municipality. Some of these lands are under land claim by First Nations, or are included in lands proposed for provincial park status. During the time that may elapse until legal ownership is clarified and resolved, recovery actions may still be undertaken through many different means. It is recommended that the various jurisdictions contact each other and work together for the protection and recovery of this species.

Gattinger's Agalinis has narrow habitat requirements that occur in a very restricted geographic range in Ontario. The distribution of the species is unlikely to expand much, even with recovery efforts, because suitable alvar and prairie habitat is limited. Furthermore, the main threats to Gattinger's Agalinis are threats to its habitat. The two historical locations that are known (from Walpole Island) were both lost due to loss of habitat. Therefore, the recovery goal for this species focuses on maintaining the existing distribution of the species by maintaining existing habitat and populations. Reintroduction and augmentation of populations with extra individuals or seeds is not contemplated for the foreseeable future.

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 and Forestry 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.

Considerations

Determining occupancy may be a challenge. Gattinger's Agalinis is an annual that arises from a seedbank. Population sizes in this species may fluctuate from year to

year, and there may be some years when live plants do not appear above the ground at all. Locating this small wiry plant among grass can be extremely difficult if the plants are not in flower. Gattinger's Agalinis is a late-blooming species, so presence/absence of live plants for any given year is best determined from late August to approximately the end of September when some plants will be in flower.

Furthermore, the maximum time that seeds of Gattinger's Agalinis remain viable in the soil is not known, but seeds have germinated in the laboratory after 10 years of storage. In anecdotal reports, live plants of several *Agalinis* species have been known to recur after absences of three to five years (J. Jones pers. obs. 2004-2014; G. Dieringer pers. comm. 2014), but in the field, no species of *Agalinis* has been documented to recur after an absence of more than 10 years. It is recognized that this has not been studied specifically for Gattinger's Agalinis and that seed viability is a knowledge gap. However, until further studies are done, it is reasonable to presume a ten year viability period for Gattinger's Agalinis seeds in the field.

Thus, even if live plants of Gattinger's Agalinis are not seen for several years, it cannot be presumed that the habitat is unoccupied. It is recommended that for any site where Gattinger's Agalinis has previously been reported, occupancy be presumed to a maximum of ten years' absence of live plants. If suitable habitat for Gattinger's Agalinis is no longer present, it is recommended that occupancy still be presumed for the 10 year period in case management actions or natural disturbance may permit habitat to be restored, potentially allowing live plants to recur.

The following methodology is recommended to determine that Gattinger's Agalinis has been absent for more than 10 years. Surveys should be done by a qualified person every year for 10 consecutive years, and in each year, brief surveys to determine presence/absence are conducted once a week from August 20 to September 30. If Gattinger's Agalinis is not found in any of these surveys, it may be concluded that Gattinger's Agalinis is no longer present.

It is recommended that the habitat to be considered for regulation be prescribed as follows.

1. All areas where Gattinger's Agalinis grows or has grown unless surveys show that the species has been absent for more than 10 years.

2. Any new areas where the species becomes discovered in the future.

3. The area where live Gattinger's Agalinis plants grow or have previously grown, and the entire alvar or prairie ELC vegetation type polygon (listed above) in which Gattinger's Agalinis is or has been found. Although only a small portion of the polygon may be occupied, the entire polygon is required for a number of reasons. First, alvars and prairies are not static communities. Rather, there are dynamics (e.g., fire, flooding) that act to create, fill up, destroy, and recreate the sparse patches that are suitable for Gattinger's Agalinis. These ecological

processes act over the entire alvar or prairie community, not just in the open spots where the species is found, so space is required to allow such processes to take place. Second, the extent of occupancy in the seed bank is not known, and it is possible that if burning or other processes occur, Gattinger's Agalinis may recur in spots that previously did not appear occupied or that did not appear suitably sparse. As well, suitable natural habitat is extremely limited, so where the species occurs it is important to protect all of the existing habitat. In addition, space is needed to allow dispersal and establishment of the species. Finally, the pollinators for this species are likely generalists that require other species and more area for survival.

4. An additional distance of 50 m around the outside of the polygon, so that in cases where individuals occur at the edge of a polygon, there will be sufficient distance from activities in adjacent areas to prevent impacts, such as changes in drainage that could affect soil moisture. Although the area around the outside of a polygon may contain unsuitable non-alvar or non-prairie habitat, it is recommended that this area be included as a protective measure.

   A distance of 50 m has been shown to provide a minimum critical function zone to ensure microhabitat properties for rare plants. A study on micro-environmental gradients at habitat edges (Matlack 1993) and a study of forest edge effects (Fraver 1994) found that effects could be detected as far as 50 m into habitat fragments. 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 m to 50 m.

   Reschke et al. (1999) studied the hydrology of alvars and found that most water on alvars derived from surface rainwater rather than from ground water. They also found that surface waters outside the alvars were not the source of flooded grasslands at their study sites. Therefore, for alvars, 50 m may be a sufficient distance to protect the hydrological regime. On prairies, where there are deeper soils with potential influence from ground water, it is recognized that additional distances may be warranted to protect the soil moisture regime. However, no research was available to inform the recommendation of a particular protective distance. Therefore, for prairies, it is recommended that the 50 m distance be used as a guideline until additional information becomes available,

It is recommended that existing infrastructure, such as roads, buildings, and planted vegetation be excluded from the habitat regulation.

GLOSSARY

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 conveys the degree of rarity of the species or community at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. The conservation status of a species or ecosystem is ranked on a scale 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: At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
- 2 = imperilled: At high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors.
- 3 = vulnerable: At moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors.
- 4 = apparently secure: Uncommon but not rare; some cause for long-term concern due to declines or other factors.
- 5 = secure: Common; widespread and abundant.

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

Germinate: The process in which a seed begins to grow by breaking dormancy and sprouting roots and shoots.

Hemiparasite: A plant that gets nutrition from both photosynthesis and by taking it from other species.

Occurrence: All the patches of a species that are within one kilometre of each other. Patches separated by more than one kilometre are considered different occurrences or separate populations.

Propagule: Parts of a plant that disperse and allow growth to occur in a new place. Propagules may be fruits, seeds, or any other part of the plant that is capable of rooting and becoming established.

Rhizome: A horizontal underground stem from which additional stems and roots may grow, resulting in a colonial or rhizomatous growth form.

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.

Sessile: Leaves, flowers, or other plant structures that are attached directly at their base with no stalk.

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

Bakowsky, W.D. and J.L. Riley. 1994. A survey of the prairies and savannas of southern Ontario. Proceedings of the Thirteenth North America Prairie Conference: 7-16. Edited by R.G. Wickett, P.D. Lewis, A. Woodliffe, and P. Pratt.

Bennett, J.R. and S. Mathews. 2006. Phylogeny of the parasitic plant family Orobanchaceae inferred from phytochrome A. American Journal of Botany 93(7):1039-1051.

BONAP. 2013. *Agalinis gattingeri*, in North American Plant Atlas, Biota of North America Program. http://bonap.org/index.html [accessed September 6, 2014].

Bowles, J.M. 2005. Draft Walpole Island ecosystem recovery strategy. Walpole Island Heritage Centre, Environment Canada and The Walpole Island Recovery Team.

Bowles, Jane M. pers. comm. 2008. *Email correspondence to J. Jones.* August 27, 2008. Consulting biologist and curator, herbarium University of Western Ontario, London. (Deceased 2013).

Brouillet, L., F. Coursol, S.J. Meades, M. Favreau, M. Anions, P. Bélisle and P. Desmet. 2014. *Agalinis gattingeri* (Small) Small in VASCAN, the Database of Vascular Plants of Canada. http://data.canadensys.net/vascan/taxon/6956 [accessed January 19 and August 31, 2014].

Brownell, V.R. and J.L. Riley. 2000. The Alvars of Ontario: Significant Natural Areas in the Ontario Great Lakes Region. Federation of Ontario Naturalists, Don Mills, Ontario. 269 pp.

Canne-Hiliker, J.M. 1988. COSEWIC status report for Gattinger's Agalinis (*Agalinis gattingeri*). Committee on the Status of Endangered Wildlife in Canada, Ottawa. 19 pp.

Canne-Hiliker, J.M. 1998. Update COSEWIC status report for Gattinger's Agalinis (*Agalinis gattingeri*). Draft copy for review [update], Committee on the Status of Endangered Wildlife in Canada, Ottawa. 4 pp.

Canne-Hiliker, Judith M. pers. comm. 2008. *Email correspondence to J. Jones.* September 9, 2008. Professor emeritus, University of Guelph, Ontario. (Deceased 2013).

Catling, P. 2009. Vascular plant diversity in burned and unburned alvar woodland: more evidence of the importance of disturbance to biodiversity and conservation. Canadian Field-Naturalist 123(3):240-245.

Catling, P.M. and V.R. Brownell. 1998. Importance of fire in alvar ecosystems-evidence from the Burnt Lands, eastern Ontario. Canadian Field-Naturalist 112(4):661-667.

Catling, P.M., A. Sinclair, and D. Cuddy. 2001. Vascular plants of a successional alvar burn 100 days after a severe fire and their mechanisms of re-establishment. Canadian Field-Naturalist 115(2):214-222.

Chegahno, Anthony. pers. comm. 2014. *Telephone correspondence to J. Jones.* January 31, 2014. Elder, band councillor, and species at risk specialist, Neyaashiinigmiing First Nation.

COSEWIC. 2009a. Update COSEWIC status report on Gattinger's Agalinis (*Agalinis gattingeri*). Provisional draft. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 28 pp.

COSEWIC. 2009b. COSEWIC assessment and status report on the Pink Milkwort (*Polygala incarnata*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 24 pp.

Crow, C., J. Demelo, J. Hayes, J. Wells and T. Hundey. 2003. Walpole Island land use change 1972-1998. Unpublished class report, Department of Geography, University of Western Ontario.

Dieringer, G. 1999. Reproductive biology of *Agalinis skinneriana* (Scrophulariaceae), a threatened species. Journal of the Torrey Botanical Society 126:289-295.

Dieringer, Gregg. pers. comm. 2014. *Email correspondence to J. Jones.* September 16, 2014. Professor of Biology, Northwest Missouri State University, Maryville, MO.

Environment Canada. 2012. Recovery Strategy for the Skinner's Agalinis (*Agalinis skinneriana*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. iv + 16 pp.

Flamand, Theodore. pers. comm. 2014. *In person communication to J. Jones*. January 15, 2014. Species at Risk program coordinator, Wikwemikong Department of Lands and Natural Resources.

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. Covelo, CA.

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.

Gilman, B. 1995. Vegetation of Limerick cedars: pattern and process in alvar communities. Doctoral dissertation, State University of New York. College of Environmental Science and Forestry, Syracuse.

Gilman, B. 1997. Recent Fire History Data for the Perch River Barrens Alvar Site. Unpublished report for The Nature Conservancy's Alvar Conservation Initiative.

Gleason, H.A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, 2nd ed. New York Botanical Garden, 910 pp.

Indiana Department of Natural Resources. 2007. Endangered, Threatened, Rare and Extirpated Plants of Indiana http://www.in.gov/dnr/naturepreserve/files/etrplants.pdf [accessed January 21, 2014].

Jacobs, Clint. pers. comm. 2014. *Telephone correspondence to J. Jones*. January 21, 2014. Walpole Island Heritage Centre and Walpole Island Land Trust.

Jalava, J.V. 2008. Alvars of the Bruce Peninsula: A Consolidated Summary of Ecological Surveys. Prepared for Parks Canada, Tobermory, Ontario. iv + 350 pp + appendices.

Jalava, Jarmo V. pers. comm. 2008. *In person correspondence to J. Jones.* November 28, 2008. Consulting Ecologist, Stratford, Ontario.

Jones, J.A. 2004. Alvars of the North Channel Islands. Report to NatureServe Canada, Ottawa, Ontario.

Jones, J.A. 2005. More alvars of the North Channel Islands and the Manitoulin Region: Report prepared for Ontario Ministry of Natural Resources, Espanola Office.

Jones, J.A. and C. Reschke. 2005. The role of fire in Great Lakes alvar landscapes. The Michigan Botanist 44(1):13-27.

Klironomos, J.N. 2002. Feedback with soil biota contributes to plant rarity and invasiveness in communities. Nature 417:67-70.

Krause-Danielsen, Allison. pers. comm. 2008. *In person correspondence to J. Jones.* November 21, 2008. Formerly with Manitoba Conservation Data Centre, Winnipeg MB.

Leach, M.K. and T.J. Givnish. 1996. Ecological determinants of species loss in remnant prairies. Science 273:1555-1558.

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. SCSS Field Guide FG-02. Ontario Ministry of Natural Resources, Southcentral Science Section, North Bay, Ontario.

Manitoulin Planning Board. 2013. District of Manitoulin Official Plan, final draft December 2013. http://www.manitoulinplanning.ca/attachments/article/43/Manitoulin%20OP%20Revised%20Draft_Jan%202014.pdf [accessed January 21, 2014].

Manitowabi, John., pers. comm. 2014. *In person correspondence to J. Jones*. January 17, 2014. Planner, Wikwemikong Department of Lands and Natural Resources.

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

Michigan Natural Features Inventory. 2007. *Agalinis gattingeri,* in Rare Species Explorer http://mnfi.anr.msu.edu/explorer/species.cfm?id=14903 [accessed Sep 6, 2014]

Michigan Natural Features Inventory. 2014. Michigan's Special Plants. http://mnfi.anr.msu.edu/data/specialplants.cfm [accessed January 21, 2014].

Migwans, G'mewin. pers. comm. 2014. *In person correspondence to J. Jones*. January 17, 2104. Community Engagement Coordinator, United Chiefs and Councils of M'nidoo M'nising, M'chigeeng, Ontario.

Minnesota Department of Natural Resources. 2013. Minnesota's list of endangered, threatened, and special concern species http://files.dnr.state.mn.us/natural_resources/ets/endlist.pdf [accessed January 21, 2014].

Musselman, L.J. and W.F. Mann. 1977. Host plants of some Rhinanthoideae (Scrophulariaceae) of Eastern North America. Plant Systematics and Evolution 127:45-53.

NatureServe. 2014. *Agalinis gattingeri* in NatureServe Explorer: an online encyclopedia of life. Version 7.1. NatureServe, Arlington, Virginia. http://www.natureserve.org/explorer [accessed January 20, 2014]

Newcomb, L. 1977. Newcomb's Wildflower Guide. Little, Brown, and Company, Toronto. 490 pp.

Newmaster, S.G. and S. Ragupathy. 2012. Flora Ontario – Integrated Botanical Information System (FOIBIS), Phase I. University of Guelph, Canada. http://www.uoguelph.ca/foibis/ [accessed January 19, 2014]

Neyaashiinigmiing Nature. 2014. Caring for the land, water, and rare species. http://neyaashiinigmiing-nature-com.webs.com [accessed January 31, 2014]

Olmstead, R.C., C.W. Depamphilis, A.D. Wolfe, N.D. Young, W.J. Elisens, and P.J. Reeves. 2001. Disintegration of the Scrophulariaceae. American Journal of Botany 88:348-361.

Phoenix, G.K. and M.C. Press. 2005. Linking physiological traits to impacts on community structure and function: the role of root hemiparasitic Orobanchaceae (ex-Scrophulariaceae). Journal of Ecology 93:67-78.

Piehl, M.A. 1963. Mode of attachment, haustorium structure, and hosts of *Pedicularis canadensis*. American Journal of Botany 50(10):978-985.

Reschke, C., R. Reid, J. Jones, T. Feeney and H. Potter 1999. Conserving Great Lakes Alvars: Final Technical Report of the International Alvar Conservation Initiative. The Nature Conservancy, Chicago, Illinois. 230 pp.

Reznicek, A.A., E.G. Voss, and B.S. Walters. 2011. *Agalinis gattingeri* in Michigan Flora Online. University of Michigan. http://michiganflora.net/species.aspx?id=1850 [accessed January 18, 2014]

Riley, J.L. 2013. The Once and Future Great Lakes Country. McGill Queens University Press, Montreal. 488 pp.

Rosén, E. 1995. Periodic droughts and long-term dynamics of alvar grassland vegetation on Öland, Sweden. Folia Geobotanica et Phytotoxonomica 30(2):131-140.

Steedman, Ruth. pers. comm. 2014. *Email correspondence to J. Jones*. January 24, 2014. Aggregate Officer, Ontario Ministry of Natural Resources, Espanola Area Office.

Stewart, H.M., S.C. Stewart, and J.M. Canne-Hilliker. 1996. Mixed mating system in *Agalinis neoscotica* (Scrophulariaceae) with bud pollination and delayed pollen germination. International Journal of Plant Science 157(4):501-508.

Voss, E.G. 1996. Michigan Flora: Vol. 3. Cranbrook Institute of Science and Regents of the University of Michigan, Ann Arbor, Michigan. 622 pp.

Voss, E.G. and A.A. Reznicek. 2012. Field Manual of Michigan Flora. University of Michigan Press, Ann Arbor, MI. 990 pp.

Walpole Island Heritage Centre. 2006. E-niizaanag Wii-Ngoshkaag Maampii Bkejwanong: Species at Risk on the Walpole Island First Nation. Bkejwanong Natural Heritage Program. 130 pp.

WEMG. 2012. Willowleaf Aster (*Symphyotrichum praealtum*) 2011 annual monitoring report. The Windsor-Essex Parkway. Windsor-Essex Mobility Group and Parkway Infrastructure Constructors document no. PIC-83-225-0224.

Wikwemikong Department of Lands and Natural Resources. 2012. Interesting plants and shrubs of Wikwemikong. Wikwemikong Unceded Indian Reserve, Wikwemikong, Ontario. 48 pp.

Wisconsin Department of Natural Resources. 2014. Endangered and Threatened Species of Wisconsin. http://dnr.wi.gov/files/PDF/pubs/er/ER001.pdf [accessed January 21, 2014]

Part 3 – *Gattinger's Agalinis and Houghton's Goldenrod – Ontario Government Response Statement*, prepared by the Ontario Ministry of Natural Resources and Forestry

Ministry of Natural Resources and Forestry

Natural. Valued. Protected.

Gattinger's Agalinis and Houghton's Goldenrod

Ontario Government Response Statement

Photo: Theodore Flinterud

Photo: Michael Patriquin

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 strategies for Gattinger's Agalinis (*Agalinis gattingeri*) and Houghton's Goldenrod (*Solidago houghtonii*) in Ontario were completed on June 25, 2015 (http://www.ontario.ca/document/gattingers-agalinis-recovery-strategy) (http://www.ontario.ca/document/houghtons-goldenrod-recovery-strategy).

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,

Gattinger's Agalinis is a small annual plant, less than 15 cm tall, with pale pink, funnel-shaped flowers at the end of slender stalks.

Houghton's Goldenrod is a perennial plant in the Aster family measuring 30 to 60 cm high that produces bright yellow flowers after a few years.

Ontario

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.

Given their similar distribution, habitat, and threats, the recovery efforts for Gattinger's Agalinis and Houghton's Goldenrod are addressed collectively in a single government response statement. The combined government response statement also recognizes the importance of collaborative implementation of recovery actions with partners across the species' range.

MOVING FORWARD TO PROTECT AND RECOVER GATTINGER'S AGALINIS AND HOUGHTON'S GOLDENROD

Gattinger's Agalinis is listed as an endangered species and Houghton's Goldenrod is listed as a threatened species under the ESA, which protects both the plants and their habitat. 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.

Gattinger's Agalinis

The global range of this annual plant extends from Ontario and Manitoba to Nebraska, Texas, Louisiana and Alabama. In the United States, Gattinger's Agalinis is found in 18 states; it is considered rare in 10 states and common in the other eight states. The majority of the Canadian population of Gattinger's Agalinis is found in Ontario with 26 of the 31 occurrence locations.

In Ontario, Gattinger's Agalinis is found on Manitoulin Island, the Bruce Peninsula, and Walpole Island, as well as on smaller islands in the North Channel of Lake Huron. The majority of the occurrences, including the most abundant, are in areas managed by Aboriginal communities.

The current Ontario population size is estimated at 70,000 individuals (2010) but it is difficult to estimate given that population sizes fluctuate from year to year, and the size of the seed bank is not known. Other than on Walpole Island, there is little information on population trends because most sites have had only one observation. Further research on habitat requirements, general species' biology, responses to habitat management techniques, and monitoring work, would support effective protection and recovery actions in Ontario.

Houghton's Goldenrod

The global range of this perennial plant is limited to areas on or near the northern shores of Lake Michigan, Lake Huron and Georgian Bay. There is one group of populations that occurs in the state of Michigan and around the Straits of Mackinac that includes the Ontario population on Cockburn Island. Another group of populations occurs at the eastern end of the Manitoulin Island region, and a single population occurs on the Bruce Peninsula.

There are 33 populations of Houghton's Goldenrod in Ontario. Populations are found on lands owned or managed by private citizens, corporations, the Government of Ontario, and Aboriginal communities. It is currently not possible to determine population and

abundance trends because most sites have had only one observation or lack abundance data. Several populations and a large number of individual plants are on lands managed by Aboriginal communities in the Manitoulin region.

Recent research on Houghton's Goldenrod suggests that there may be complexities associated with the genetic origins of the species. Specifically, it is not known at this time whether the Cockburn Island population may be a genetically distinct entity from the other Ontario populations occurring in the Manitoulin Region and on the Bruce Peninsula. Further research on the species' genetics, as well as integral population monitoring work, and research on habitat requirements and the species' biology would support future protection and recovery activities.

Gattinger's Agalinis and Houghton's Goldenrod

Both Gattinger's Agalinis and Houghton's Goldenrod experience similar threats based on overlap in the areas they inhabit. Both species occur in sensitive ecosystems in Ontario, specifically alvars, dunes and prairies, and are threatened by loss of suitable habitat, primarily due to human impacts. These threats include development, trampling by pedestrians, all-terrain vehicles, pesticide usage, introduction of invasive species (e.g., Common Reed), and heavy machinery movements associated with industry activities. Non-native and invasive species are often able to out compete native species for resources; invasive species present in the habitat of both Gattinger's Agalinis and Houghton's Goldenrod include Common Reed (*Phragmites australis ssp. australis*), Smooth Brome (*Bromus inermis*), and White Sweet Clover (*Melilotus alba*). In addition to the introduction of invasive species, the general lack of public knowledge of alvar ecosystems and their sensitivity to disturbance poses a threat. Natural succession of woody plants, potentially due to fire suppression, as well as browsing and grazing of animals may also pose challenges to both species. Approaches to recovery will include protecting and managing habitat in collaboration with local landowners, partners, and Aboriginal communities, filling knowledge gaps, especially with regards to population trends, and research on the biology (e.g., mechanisms of pollination, seed dispersal and conditions for germination), habitat requirements and response to management techniques of both Gattinger's Agalinis and Houghton's Goldenrod.

The government's goal for the recovery of Gattinger's Agalinis and Houghton's Goldenrod is to maintain self-sustaining populations across their Ontario distribution by reducing threats to the species and their habitats to allow for natural increases.

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 Gattinger's Agalinis and Houghton's Goldenrod, the government will directly undertake the following actions:

- Continue to manage the habitat of Gattinger's Agalinis and Houghton's Goldenrod in provincially protected areas to maintain the ecological integrity of their habitats and to minimize the threat of recreational pressures and impacts.
- Continue to implement the Ontario Invasive Species Strategic Plan to address the invasive species (e.g., Common Reed) that threaten Gattinger's Agalinis and Houghton's Goldenrod.
- Educate other agencies and authorities involved in planning and environmental assessment processes on the protection requirements under the ESA.
- Encourage the submission of Gattinger's Agalinis and Houghton's Goldenrod 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 Gattinger's Agalinis and Houghton's Goldenrod and their habitat through the ESA.
- Develop direction to provide greater clarity to proponents and partners on the areas of general habitat protected under the ESA for plant species at risk.
- Support conservation, agency, municipal and industry partners, and Aboriginal communities and organizations to undertake activities to protect and recover Gattinger's Agalinis and Houghton's Goldenrod. Support will be provided where appropriate through funding, agreements, permits (including 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 Gattinger's Agalinis and Houghton's Goldenrod. 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: **Habitat Management and Protection**
Objective: Work collaboratively to support landowners, land managers and Aboriginal communities in protecting and managing Gattinger's Agalinis and Houghton's Goldenrod habitat and reducing the threats to the species.

Habitat loss and degradation is the primary threat to both Gattinger's Agalinis and Houghton's Goldenrod. Working in collaboration with landowners, land managers, and Aboriginal communities many of whom are already undertaking actions to support the species, will ensure that the best available resources and information are being used to support the recovery of Gattinger's Agalinis and Houghton's Goldenrod.

Actions:

1. **(HIGH)** Implement best management practices in collaboration with landowners, land managers, municipalities, and Aboriginal communities to prevent and minimize impacts to Gattinger's Agalinis and Houghton's Goldenrod and their habitats. Actions may include:
   - erecting barriers, designating walkways, and constructing boardwalks to reduce trampling by pedestrians and all-terrain vehicles;
   - posting information signage in and around alvar, tallgrass prairie, and dune habitat areas used by the species on the sensitive nature of the ecosystems, the importance of limiting disturbance, and basic information on Gattinger's Agalinis and Houghton's Goldenrod;
   - removal of invasive species posing a direct threat to Gattinger's Agalinis or Houghton's Goldenrod;
   - thinning of the canopy and use of grazing treatments to maintain habitat conditions for the two species; and,
   - monitoring the species' and habitat responses to canopy thinning, invasive species control and grazing treatments to inform adaptive management of the habitat.
2. As opportunities arise, support the securement of Gattinger's Agalinis and Houghton's Goldenrod habitat that exists on privately owned lands through existing land securement and stewardship programs.

Focus Area: **Research and Monitoring**
Objective: Increase knowledge about the population dynamics and biology of Gattinger's Agalinis and Houghton's Goldenrod.

A greater understanding of the current population abundance of both Gattinger's Agalinis and Houghton's Goldenrod would support our ability to determine the progress and effectiveness of recovery actions and monitor population trends over time. Knowledge gaps, such as specific habitat requirements, site-specific threats, and the role of specific habitat management techniques, should also be addressed to help better inform the implementation of recovery actions for these species.

Actions:

3. **(HIGH)** Develop and implement a standardized long-term monitoring program at priority sites for Gattinger's Agalinis and for Houghton's Goldenrod in order to:
   - monitor population trends and demographics;
   - identify vegetation community types present; and,
   - assess and monitor all known and potential threats to populations.
4. **(HIGH)** Determine if the Cockburn Island population of Houghton's Goldenrod may be genetically distinct from populations occurring in alvar habitat outside of Cockburn Island.
5. Conduct research on the species' habitat needs, specifically the moisture regime and microhabitat conditions that support Gattinger's Agalinis and Houghton's Goldenrod.
6. Research the species' life history characteristics and response to habitat management activities that will inform the implementation of recovery actions for each species. This may include:
   - conducting a population viability analysis;
   - studying mechanisms of pollination, seed dispersal and conditions for germination; and,
   - studying the potential role of prescribed burns in managing alvar habitats used by Gattinger's Agalinis and Houghton's Goldenrod.

Focus Area : **Awareness**
Objective: Increase public awareness of the presence, habitat requirements and threats to Gattinger's Agalinis and Houghton's Goldenrod.

Community members, visitors, and managers/owners of the land all have a vital role to play in reducing threats to both species. By increasing the awareness of the species and its habitat amongst a broader public audience, individuals will be more inclined to take steps to prevent and reduce threats to the species across the landscape.

Actions:

7. Increase awareness among land owners, municipalities, park and conservation reserve visitors, and Aboriginal communities by distributing information on Gattinger's Agalinis and Houghton's Goldenrod, such as:
   - how to identify the species;
   - the species' habitat requirements and the sensitivity of alvar ecosystems; and,
   - actions individuals can take to minimize threats to the species including habitat loss, invasive species, and trampling, and to report occurrence information.

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 Gattinger's Agalinis and Houghton's Goldenrod.

ACKNOWLEDGEMENT

We would like to thank all those who participated in the development of the Recovery Strategy for the Gattinger's Agalinis (*Agalinis gattingeri*) in Ontario and the Recovery Strategy for the Houghton's Goldenrod (*Solidago houghtonii*) 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/mnrf