



Rusty-patched Bumble Bee

(Bombus affinis) in Ontario

Ontario Recovery Strategy Series

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

Natural. Valued. Protected.

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the Endangered Species Act (ESA) and the Accord for the Protection of Species at Risk in Canada.

What is recovery?

Recovery of species at risk is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

Under the ESA, a recovery strategy provides the best available scientific knowledge on what is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. There is a transition period of five years (until June 30, 2013) to develop recovery strategies for those species listed as endangered or threatened in the schedules of the ESA. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of Natural Resources Species at Risk webpage at: www.ontario.ca/speciesatrisk

RECOMMENDED CITATION

Colla, S.R. and A. Taylor-Pindar. 2011. Recovery Strategy for the Rusty-patched Bumble Bee (*Bombus affinis*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi + 21 pp.

Cover illustration: Johanna James-Heinz

© Queen's Printer for Ontario, 2011
ISBN 978-1-4435-6786-2 (PDF)

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

Cette publication hautement spécialisée Recovery strategies prepared under the Endangered Species Act, 2007, n'est disponible qu'en anglais en vertu du Règlement 411/97 qui en exempte l'application de la Loi sur les services en français. Pour obtenir de l'aide en français, veuillez communiquer avec Cathy Darevic au ministère des Richesses naturelles au 705-755-5580.

AUTHORS

Sheila Colla, York University

Alana Taylor-Pindar, York University

ACKNOWLEDGMENTS

We would like to thank Dr. Paul Catling and Dr. Laurence Packer for valuable comments. The University of Guelph Insect Collection, Canadian Museum of Nature and Royal Ontario Museum kindly provided specimens used in this report.

DECLARATION

The recovery strategy for the Rusty-patched Bumble Bee 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

EXECUTIVE SUMMARY

The Rusty-patched Bumble Bee has a distinctive rusty-coloured patch bordered by yellow on the first half of its abdomen and is medium to large in size. Like most bumble bee species the Rusty-patched Bumble Bee has an annual life cycle and a diversity of habitat is required to provide the necessary features/structures for each stage.

The Rusty-patched Bumble Bee was one of the most common species of bumble bee seen in southern Ontario up until the 1980s. Since then the species has exhibited a drastic decline and it is now virtually absent throughout its historical range. The species is currently listed as endangered on the Species at Risk in Ontario (SARO) List under the *Endangered Species Act, 2007* (ESA). The only locality within Ontario where the Rusty-patched Bumble Bee has been seen in the last five years is Pinery Provincial Park (Lambton County) despite widespread surveys in Ontario. Historically the Rusty-patched Bumble Bee was common from southern Ontario, east to Quebec, south to Georgia and west to the Dakotas.

There are several threats that may have led to the drastic decline in the species including pathogen spillover, the use of pesticides, habitat fragmentation and habitat loss. Knowledge gaps exist that should be addressed in order to assure the survival of the species. This includes a lack of information on the current population at Pinery Provincial Park and throughout its historic range.

The recovery goal for the Rusty-patched Bumble Bee is to ensure the species' long-term survival in Ontario by restoring and maintaining self-sustaining populations. This will be achieved through protection (and restoration to self-sustaining levels, if required) of the one extant population at Pinery Provincial Park and the establishment of additional populations within the species' historic range in Ontario, if feasible.

The protection and recovery objectives are to:

- protect, maintain and improve habitat in Pinery Provincial Park where the Rusty-patched Bumble Bee is known to be extant;
- attempt to establish a captive rearing program (contingent upon the availability and capture of reproductive individuals), if feasible;
- implement a monitoring program for Pinery Provincial Park and surrounding areas where the Rusty-patched Bumble Bee is known to be extant;
- survey historically occupied sites and suitable habitat to determine population status and species distribution; and
- initiate research to address knowledge gaps for the Rusty-patched Bumble Bee.

The area prescribed as habitat in a habitat regulation under the ESA should include the locations where the Rusty-patched Bumble Bee has been collected in the past 15 years: Pinery Provincial Park, the Humber River in Toronto, Manestar Tract in Norfolk County, University of Western Ontario campus, High Park in Toronto, Darlington Provincial Park and Guelph. Within these locations floral diversity is particularly important as it provides resources for foraging. Features used for overwintering, such as abandoned rodent

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

burrows and rotting wood, are also critical to ensure habitat remains suitable within these locations.

It is recommended that if the Rusty-patched Bumble Bee is found at any new locations, the habitat regulation should be updated to include those locations.

If individuals are found at any location it is recommended that habitat be prescribed as a 2 kilometre radius around the area where the individual was seen. A radius of 2 kilometres was chosen as it is known that bumble bee species can forage approximately 1000 to 1750 metres.

TABLE OF CONTENTS

RECOMMENDED CITATION.....	i
AUTHORS.....	ii
ACKNOWLEDGMENTS.....	ii
DECLARATION.....	iii
RESPONSIBLE JURISDICTIONS	iii
EXECUTIVE SUMMARY.....	iv
1.0 BACKGROUND INFORMATION.....	1
1.1 Species Assessment and Classification.....	1
1.2 Species Description and Biology.....	1
1.3 Distribution, Abundance and Population Trends.....	3
1.4 Habitat Needs	4
1.5 Threats to Survival and Recovery	4
1.6 Knowledge Gaps.....	6
2.0 RECOVERY	7
2.1 Recovery Goal	7
2.2 Protection and Recovery Objectives	7
2.3 Approaches to Recovery.....	8
2.4 Area for Consideration in Developing a Habitat Regulation	11
GLOSSARY	13
REFERENCES.....	15

LIST OF FIGURES

Figure 1. Bumble bee colony cycle outlining major stages in annual life cycle.....	2
Figure 2. Historic and recent distribution of the Rusty-patched Bumble Bee in Ontario.	3

LIST OF TABLES

Table 1. Protection and recovery objectives.....	7
Table 2. Approaches to recovery of the Rusty-patched Bumble Bee in Ontario.....	8

APPENDICES

Appendix 1. Known plant food sources for the Rusty-patched Bumble Bee.....	18
Appendix 2. Monitoring the Rusty-patched Bumble Bee Population at Pinery Provincial Park.....	19
Appendix 3. Monitoring protocol to locate new populations of the Rusty-patched Bumble Bee.	20
Appendix 4. Sample data sheet.	21

1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Rusty-patched Bumble Bee

SCIENTIFIC NAME: *Bombus affinis*

SARO List Classification: Endangered

SARO List History: Endangered (2010)

COSEWIC Assessment History: Endangered (2010)

SARA Schedule 1: No Schedule, No Status

CONSERVATION STATUS RANKINGS:

GRANK: GU

NRANK: N1

SRANK: S1

The glossary provides definitions for the abbreviations above.

1.2 Species Description and Biology

The Rusty-patched Bumble Bee is a medium to large sized bumble bee in the subgenus *Bombus sensu stricto*. Males and workers are about 11 to 16 mm in length and 5 to 9 mm in breadth (Mitchell 1962). They have a distinctive rusty brown spot in the middle of the second abdominal segment, on the dorsal surface. Queens are larger at 21 to 22 mm and 9.5 to 11 mm in length and breadth respectively (Mitchell 1962) and generally lack this rusty-coloured patch. Instead their second abdominal segment is completely yellow (a colour pattern common to eastern North American bumble bees). This species can be differentiated from other species in that it has a very short space between the eye and the mandible and an entirely black head and face. The thorax of the body is mostly yellow, usually with a black band between the wing bases (Lavery and Harder 1988).

Species Biology

The Rusty-patched Bumble Bee is an early emerging (i.e., April) species with an annual life or colony cycle (Colla and Dumesh 2010). As for most bumble bees, the colony cycle consists of four stages: emergence of queens, production of workers, development of new queens, and hibernation (Figure 1). Generally, queens emerge from overwintering sites to forage and build up resources and to locate suitable nest sites. Once a nest site is selected, queens lay eggs and continue to forage to provision their first brood. Feeding is progressive in that the adult(s) feed the growing larvae at intervals throughout the larval growth cycle (in contrast to mass feeding where enough food to suffice all larval growth is provided upon egg-laying). Once workers hatch, they

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

take over nest care and foraging well into October and the queen focuses on egg-laying. Towards the end of the cycle, the colony begins producing new queens and males, instead of workers. These individuals mate with conspecifics. Newly-mated queens locate suitable overwintering sites and the rest of the colony perishes with the onset of cold weather (Benton 2006).

Since reproductive individuals are produced at the end of the colony cycle, the accumulation of resources (i.e., pollen and nectar) by workers throughout the summer and into the fall, as well as by queens in spring, combine to have an overall impact on the number of successful colonies in the subsequent year. This species is a generalist in terms of food plant choice. Food plant records can be found in Appendix 1. The Rusty-patched Bumble Bee is one of only two bumble bee species in Ontario exhibiting nectar-robbing behaviour; this behaviour leaves tell-tale signs that can help detect the species' presence in a given area. Bees that nectar-rob usually have short tongues and cannot access nectar found at the bottom of long flowers. Thus, they pierce the petals of a flower to access nectar instead of visiting the flower normally.

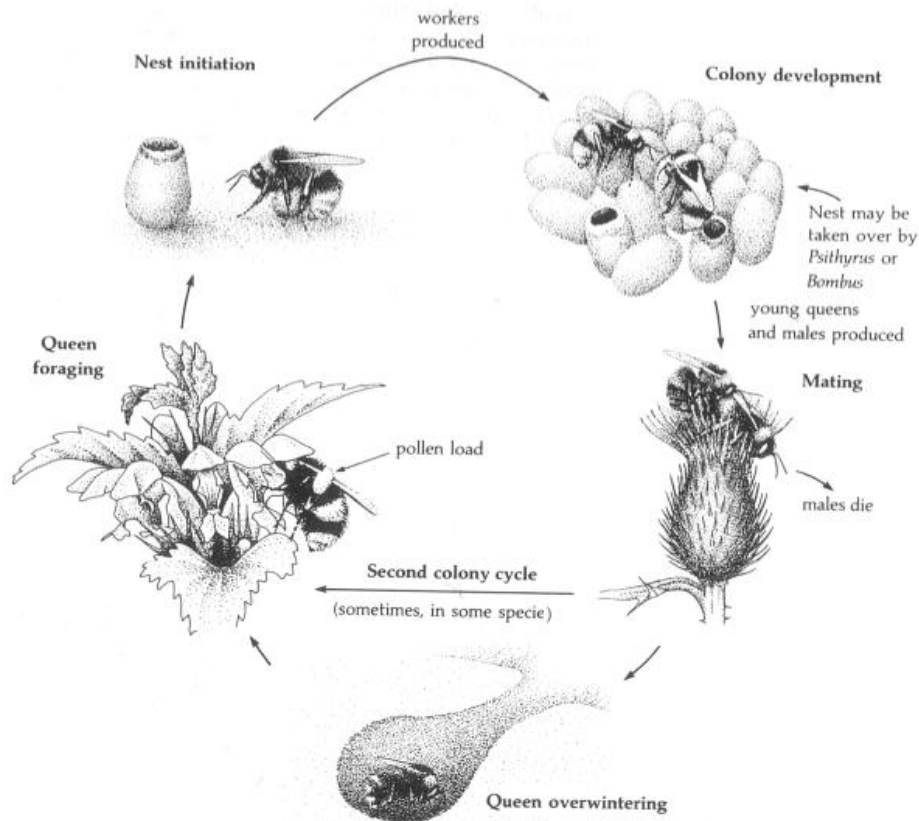


Figure 1. Bumble bee colony cycle outlining major stages in annual life cycle (www.bumblebees.org)

1.3 Distribution, Abundance and Population Trends

Historically, the Rusty-patched Bumble Bee was widespread and common in eastern North America (Mitchell 1962). Its historic range extends south to Georgia and west to the Dakotas. It reaches the northern limit of its range in Canada (southern Ontario) and, historically, extreme southwestern Quebec. In the 1970s, it was the fourth most common bumble bee species in southern Ontario (Colla and Packer 2008). The species has since suffered rapid, severe decline throughout its entire range with only a handful of specimens collected in recent years in Ontario (Colla and Packer 2008) and the US (Cameron et al. 2011). The only occurrence of Rusty-patched Bumble Bee in Canada from 2002 to 2010 was at Pinery Provincial Park (one individual in 2005 and two in 2009); this is despite thorough survey work performed throughout Ontario (Colla and Packer 2008, Colla unpub. data). Other sites where this species has been found recently (last 15 years) are: Manestar Tract (Norfolk County); Middlesex County London- University of Western Ontario Campus; High Park, Toronto; Darlington Provincial Park; Guelph (Wellington County) and the Humber River in Toronto. Despite surveys at these sites in the past six years, the species has not been relocated (Colla and Packer 2008, Colla unpub. data).

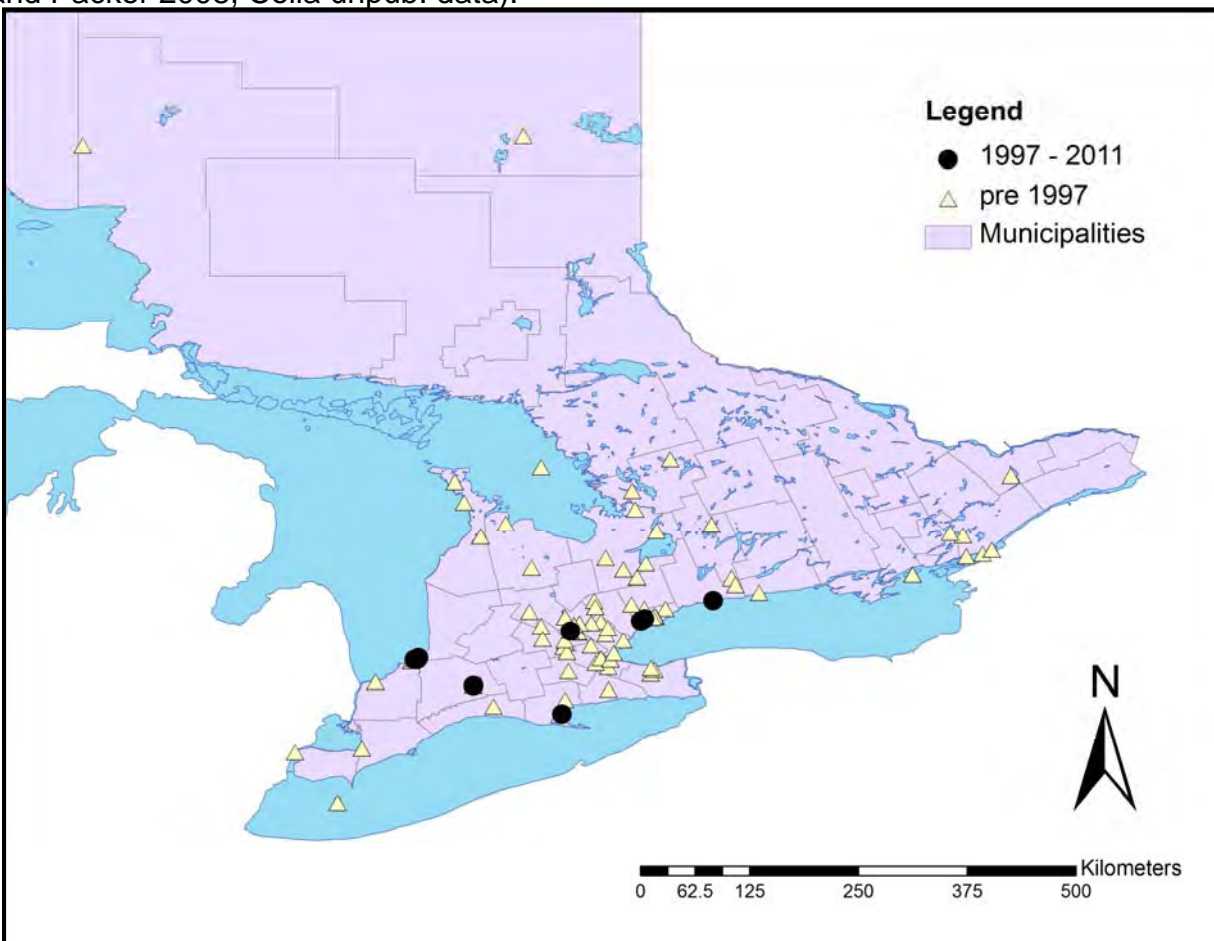


Figure 2. Historic and recent distribution of the Rusty-patched Bumble Bee in Ontario (Colla and Dumesh 2010). The species has only been found at Pinery Provincial Park in the past 10 years, despite recent resampling of its historic sites.

1.4 Habitat Needs

The Rusty-patched Bumble Bee is a generalist species that occurs in Ontario from the southern Great Lakes-St. Lawrence forest south through the Carolinian. This species, relative to other sympatric bumble bees, is cold-tolerant, allowing it to occur at high elevations and emerge earlier in the year (Colla and Dumesh 2010). This species, much like other bumble bees, can be found in open habitat such as mixed farmland, savannah, sand dune, urban and lightly wooded areas. Habitat requirements at different stages in the colony cycle of the Rusty-patched Bumble Bee are listed below.

Nesting Habitat

The Rusty-patched Bumble Bee usually nests in old rodent burrows, hollow tree stumps and fallen dead wood (Macfarlane 1974). All members of the subgenus *Bombus sensu stricto* usually nest underground (Macfarlane 1974, Lavery and Harder 1988).

Overwintering Habitat

There are no data on the overwintering requirements of the Rusty-patched Bumble Bee. Overwintering requirements are assumed to be similar to those of other species in the *Bombus* genus, including sites suitable for underground burrows in loose soil or the presence of fallen dead wood (MacFarlane 1974).

Foraging Habitat

Foraging habitat for the Rusty-patched Bumble Bee typically contains an abundance of wild flowers in the forest understory or in open fields. A list of the food plant species utilized by the Rusty-patched Bumble Bee in southern Ontario is provided in Appendix 1.

The most recent sightings of the Rusty-patched Bumble Bee have been in oak savannah habitat. Oak savannah is a habitat that contains both woodland and grassland flora and fauna. Oak savannah is characterized by a moderately open tree canopy, well-drained sandy soils and a floristically diverse understory (Lee et al. 1998). These habitat characteristics provide optimal nesting and foraging conditions for bee communities.

1.5 Threats to Survival and Recovery

The exact cause of the rapid and widespread decline of the Rusty-patched Bumble Bee is currently unknown. Suspected causes for decline are summarized below in order of suspected immediate to long-term threats.

Pesticide use has long been known to cause the decline of insects, including bees (Kevan et al. 1997). Recently, Canada approved numerous pesticides in the neonicotinoid class for a variety of uses (e.g., crop, forest and turf pest control). Neonicotinoids are systemic pesticides which are absorbed through the roots of the plant and are then present in plant tissues. These pesticides are persistent in soil and

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

water and are present in the pollen and nectar of exposed plants (Choudhary and Sharma 2008). Neonicotinoids are a suspected cause for Colony Collapse Disorder in the United States of America and also pose a substantial threat to wild bees even at extremely low levels (approximately 12 ppb) (Marletto et al. 2003). Colony Collapse Disorder is a rapid and abrupt loss of adult bee individuals from a population (Johnson et al. 2009). At high levels, the pesticides are acutely toxic and at low levels they have sub-lethal effects which can affect a bee's ability to forage or reproduce.

Pathogen spillover is considered to be one of the main threats to North American bumble bees, particularly in the subgenus *Bombus sensu stricto*. A study performed in southern Ontario documented the transfer of disease (*Nosema bombi* and *Crithidia bombi*) from bumble bees used to pollinate greenhouse vegetable crops to nearby wild foraging bumble bees (Colla et al. 2006). The exact impacts of these diseases on the Rusty-patched Bumble Bee are unknown but pathogen spillover (i.e., spread of disease from domestic to wild animals) has caused rapid decline in other taxa (e.g., Morton et al 2004). Additionally, diseased bumble bee colonies of a different species kept outdoors under natural conditions produced no males or new queens (Moret and Schmid-Hempel 2000).

Habitat loss is a likely threat to the survival of remaining populations. Suitable nesting and overwintering sites are required in close proximity to adequate forage (for the entire colony cycle length). In particular, the loss of early blooming plant species may affect the survival of spring queens with few alternative foraging options. Despite thorough surveys throughout the species' historical range in southern Ontario, populations were only found at Pinery Provincial Park (Colla and Packer 2008). This may indicate a paucity of suitable habitat for this species outside of protected areas. Habitat fragmentation can lead to limited dispersal of the population and create barriers to important foraging areas and nesting substrate. It can also lead to isolation of small populations. Bumblebees are primitively eusocial organisms (meaning the queen is not very different from the workers) with a haplodiploid genetic system [i.e. males have half the number of chromosomes (haploid) of the females (diploid)]. Once populations become fragmented, small population size can result in the production of diploid males as a result of inbreeding, which can hinder a population and further decrease the effective population size as diploid males are either inviable or sterile (Elias et al. 2009). This phenomenon, known as the Diploid Male Extinction Vortex, makes bees more vulnerable to extinction than other organisms under similar conditions (Zayed and Packer 2005). Thus, the Rusty-patched Bumble Bee is likely very susceptible to habitat fragmentation and small population size. Habitat fragmentation can lead to limited dispersal of the population and isolation from important areas to forage and nesting substrate (Bhattacharya et al. 2003).

Climate change is a potential threat to the Rusty-patched Bumble Bee. During a meta-analysis considering fauna from three continents, Williams et al (2009) found that bumble bee species with narrow climatic tolerances tend to be more vulnerable to extinction than more generalist species. There is evidence that the Rusty-patched Bumble Bee may have a restricted climatic niche given its narrow distribution only at

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

high elevations in the southern parts of its range and only in southern Ontario and Quebec in Canada. Climate change could affect ecological elements which are required in climatically sensitive species such as precipitation variability, soil humidity, forage availability and temperature. More information is needed to determine whether climate change is a long-term threat to the Rusty-patched Bumble Bee.

Additional possible threats include the introduction of non-native competing bees [e.g., the Wool Carder bee (*Anthidium manicatum*), honey bees (*Apis mellifera*)], the introduction of pathogens from honey bees and the introduction of predators such as non-native wasps). Also, cow grazing has been found to negatively impact bumble bee diversity and abundance (e.g., Hatfield and LeBuhn 2007).

1.6 Knowledge Gaps

Continued research on the potential impact of threats, such as pathogen spillover, habitat loss and fragmentation, climate change and pesticide use on Rusty-patched Bumble Bee populations is required to guide the development, prioritization and implementation of recovery actions.

Even though individuals have been found at Pinery Provincial Park, it is possible the population is not large enough to be sustainable. More research should be completed in order to gain a better understanding of the current population at Pinery Provincial Park.

Monitoring programs should be established in order to determine effective population size and to better understand its current distribution in Ontario. Other aspects of the species biology, including overwintering and nesting habitat preferences should be examined. Additionally population viability should be determined.

2.0 RECOVERY

2.1 Recovery Goal

The recovery goal for the Rusty-patched Bumble Bee is to ensure the species' long-term survival in Ontario by restoring and maintaining self-sustaining populations. This will be achieved through protection (and restoration to self-sustaining levels, if required) of the one extant population at Pinery Provincial Park and the establishment of additional populations within the species' historic range in Ontario, if feasible.

2.2 Protection and Recovery Objectives

Table 1. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Protect, maintain and improve habitat in Pinery Provincial Park where the Rusty-patched Bumble Bee is known to be extant.
2	Attempt to establish a captive rearing program (contingent upon the availability and capture of reproductive individuals), if feasible.
3	Implement a monitoring program for Pinery Provincial Park and surrounding areas where the Rusty-patched Bumble Bee is known to be extant.
4	Survey historically occupied sites and suitable habitat to determine population status and species distribution.
5	Initiate research to address knowledge gaps for the Rusty-patched Bumble Bee.

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

2.3 Approaches to Recovery

Table 2. Approaches to recovery of the Rusty-patched Bumble Bee in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
1. Protect, maintain and improve habitat in Pinery Provincial Park where the Rusty-patched Bumble Bee is known to be extant.				
Critical	Ongoing	Management	1.1 Continue park restoration efforts in habitat where the Rusty-patched Bumble Bee has been found.	<ul style="list-style-type: none"> ● Habitat loss and degradation
Critical	Ongoing	Assessment, Education and Outreach, Communications, Stewardship	1.2 For the area surrounding Pinery Provincial park: <ul style="list-style-type: none"> – Determine whether there are greenhouses using managed bumble bees for commercial crop pollination within 15 km of the park boundaries. Work with greenhouse owners/managers to prevent escape of managed bees (e.g., sealing of gaps, freezing of colonies before disposal). – Determine the extent of possible avenues for pesticide contamination (especially neonicotinoids) in the park. Work with surrounding land-owners to decrease the use of pesticides which may travel in soil and water into the park. 	<ul style="list-style-type: none"> ● Pathogen spillover ● Pesticide use

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

2. Attempt to establish a captive rearing program (contingent upon the availability and capture of reproductive individuals), if feasible.				
Necessary	Long-term	Management, Monitoring and Assessment, Research	2.1 If queens are captured: <ul style="list-style-type: none"> – Rear colonies in rearing chambers by collecting spring queens. – Once many colonies are established, mated queens can be released into former habitat if threats are mitigated. – Determine release sites based on habitat suitability, possibly only in protected areas, and reintroduce reproductive individuals. Current bumble bee reintroduction programs in the United Kingdom provide possible guidelines (http://www.bumblebeeconservation.org.uk/subt_project.html). 	<ul style="list-style-type: none"> • All threats
3. Implement a monitoring program for Pinery Provincial Park and surrounding areas where the Rusty-patched Bumble Bee is known to be extant.				
Critical	Ongoing	Monitoring and Assessment	3.1 Develop and implement a Rusty-patched Bumble Bee park-wide monitoring program to be conducted by qualified personnel at Pinery Provincial Park (see Appendix 2 for an outline of such program).	<ul style="list-style-type: none"> • All threats
4. Survey historically occupied sites and suitable habitat to determine population status and species distribution.				
Necessary	Ongoing	Inventory	4.1 Conduct an inventory program for the Rusty-patched Bumble Bee prioritized by most recent historical localities (past 15 years) (see Appendix 3 for an outline of such program).	<ul style="list-style-type: none"> • Unknown current distribution
Necessary	Ongoing	Inventory, Education and Outreach	4.2 Include information on the Rusty-patched Bumble Bee in ongoing inventory programs.	<ul style="list-style-type: none"> • Unknown current distribution
Necessary	Ongoing	Inventory, Education and Outreach	4.3 Engage volunteers (e.g., field naturalist groups) to undertake surveys, using digital photographs to determine the presence or absence of the species.	<ul style="list-style-type: none"> • Unknown current distribution

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

5. Initiate research to address knowledge gaps for the Rusty-patched Bumble Bee.				
Necessary	Long-term	Research	5.1 Determine why the Rusty-patched Bumble Bee appears to occur only at Pinery Provincial Park.	<ul style="list-style-type: none"> • Lack of understanding of habitat requirements or threats
Necessary	Long-term	Research	5.2 Carry out research on basic biology such as phenology, forage requirements, response to restoration practices, overwintering, population dynamics and nesting requirements.	<ul style="list-style-type: none"> • Lack of information on basic biology
Critical	Short-term	Inventory, Monitoring and Assessment	5.3 Develop a protocol for inventorying and monitoring Rusty-patched Bumble Bee populations (see Appendix 3 for suggested program).	<ul style="list-style-type: none"> • Lack of inventory and monitoring protocol
Necessary	Long-term	Research	5.4 Determine lethal and sub-lethal effects of pesticides, such as the neonicotinoids, on native bumble bee species. Mitigate impacts where feasible.	<ul style="list-style-type: none"> • Lack of knowledge on impacts of pesticides on native bumble bees

2.4 Area for Consideration in Developing a Habitat Regulation

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

Due to the extremely limited distribution of the Rusty-patched Bumble Bee and lack of knowledge concerning its current distribution, it is recommended that the area prescribed as habitat in the habitat regulation include the locations where the Rusty-patched Bumble Bee has been collected in the past 15 years: Pinery Provincial Park (Norfolk County), Manestar Tract (Norfolk County), University of Western Ontario Campus, London (Middlesex County), High Park, Toronto (York County), Darlington Provincial Park, Guelph (Wellington County) and the Humber River in Toronto (York County).

Locations where the Rusty-patched Bumble Bee was collected between 2001 and 2011 are described below:

- 1a) Pinery Provincial Park - Between the driveway between parking lot 3 and 4 on the south side.
- 1b) Pinery Provincial Park on the north side of parking lot 4 - Between group camping 1 and the driveway for parking lot 4.
- 1c) Pinery Provincial Park traffic circle - South of the traffic circle separating one way road to beaches and main road

Specimens have been collected at the following locations from 1997 to 2000 but recent surveys have not found any new records.

- 2) Norfolk County Manestar Tract - between Norfolk County Rd 24 and Norfolk Concession Rd VI, Lot 20, Concession V, Norfolk Township, Norfolk County.
- 3) Toronto, Humber River - West of Old Mill Rd and south of Dundas Street West
- 4) Middlesex County, London- University of Western Ontario Campus.
- 5) High Park, Toronto
- 6) Darlington Provincial Park
- 7) Guelph, Wellington County

Pinery Provincial Park and Manestar Tract locations are considered to be remnants of oak savannah. Currently, oak savannah constitutes only a small proportion of the

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

available habitat within the Rusty-patched Bumble Bee's historical distribution in North America; loss and degradation of oak savannah habitat has occurred due to anthropogenic activities (Nuzzo 1986). Pinery Provincial Park is arguably the largest remaining intact Black/White Oak savannah remnant in Canada (McKenzie pers. comm. 2008). Since recognition in the early 1980s as prime oak savannah habitat, restoration efforts such as prescribed burns, deer exclosures and removal of invasive species have taken place (Bakowsky and Riley 1994, Bazely et al. 1997). Within the locations described above, floral resources are particularly important as they provide the necessary sources of pollen and nectar. Features used for overwintering, such as abandoned rodent burrows and rotting wood, are also critical to ensure habitat remains suitable within these locations.

The other locations listed above were likely not oak savannah habitat at the time of the Rusty-patched Bumble Bee sighting, supporting evidence that this species is a habitat generalist (Colla and Dumesh 2010).

In studies considering the conservation of other bumble bee species, landscape factors which encourage populations include the proportion of hedgerow and/or meadow area with diverse flowering plants near agricultural and urban areas (Walther-Hedwig and Frankl 2000, Hatfield and LeBuhn 2007).

It is recommended that if the Rusty-patched Bumble Bee is found at any new locations, the habitat regulation should be updated to include those locations.

If individuals are found at any location it is recommended that habitat be prescribed as a two kilometre radius around the area where the individual was seen. A radius of two kilometres was chosen as it is known that bumble bee species can forage approximately 1000 to 1750 m (Walther-Helwig and Frankl, 2000).

GLOSSARY

Bombus sensu stricto (*Bombus* s.s.): The subgenus of 11 bumble bee species including the endangered Rusty-patched Bumble Bee (*Bombus affinis*), the Western Bumble Bee (*B. occidentalis*), the globally widespread and managed Buff-tailed Bumble Bee (*B. terrestris*) and the critically endangered Franklin's Bumble Bee (*B. franklini*).

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee responsible for assessing and classifying species at risk in Canada.

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

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

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

Diploid Males: Inviabile or sterile male bee that cannot reproduce.

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

Haplodiploid Genetic System: The genetic method of sex determination in bees, ants, and wasps where males are haploid and females are diploid.

Pathogen Spillover: Infection of a host population where transmission is not driven by infection within the population but by the presence of another population.

Species at Risk Act (SARA): The federal legislation that provides protection to species at risk in Canada. This act establishes Schedule 1 as the legal list of wildlife species at risk to which the SARA provisions apply. Schedules 2 and 3 contain lists of species that at the time the act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

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.

Worker Bees: A female eusocial bee that lacks full reproductive capabilities.

REFERENCES

- Bakowsky, W., and J. L. Riley. 1994. A survey of the prairies and savannas of southern Ontario. Pages 7-16 in R. G. Wickett, P. D. Lewis, A. Woodliffe and P. Pratt, editors. Proceedings of the thirteenth North American prairie conference. Department of Parks and Recreation, Windsor, Ontario, Canada.
- Bazely, D. R. L. W. Carr, S. Koh, J. Carnie, A. S. Greenberg, L. A. Issac, N. Falkenberg, A. M. Hunt, C. A. Sykes, T. J. Carleton, D. R. Voigt and S. M. Carleton. 1997. Situ Report: 1995-1996; Interactions between deer and vegetation in southern Ontario, Canada: Monitoring and restoration of overgrazed plant communities in Pinery and Rondeau Provincial Parks. Report 2: covering the 1995 and 1996 field seasons. Report to Southern Region Science and Technology Transfer Unit, OMNR, London, Ontario, Canada.
- Benton, T. 2006. Bumblebees Collins New Naturalist London, U.K., 592 pp.
- Bhattacharya, M., R. B. Primack, and J. Gerwein. 2003. Are roads and railroads barriers to bumblebee movement in a temperate suburban conservation area? *Biological Conservation* 109:37-45.
- Cameron, S.A., J.D. Lozier, J.P. Strange, J.B. Koch, N. Cordes, L.F. Solter and T. Griswold. (2011) Patterns of widespread decline in North American bumble bees. *Proceedings of the National Academy of Science*.
- Choudhary, A. and D.C. Sharma. 2008. Dynamics of pesticide residues in nectar and pollen of mustard (*Brassica juncea*) grown in Himachal Pradesh (India). *Environmental Monitoring and Assessment* 144:143-150.
- Colla, S.R. and S. Dumesh. 2010. Natural history notes for the bumble bees of southern Ontario. *JESO* 141: 38-67.
- Colla, S. R., M. C. Otterstatter, R. J. Gegear and J. D. Thomson. 2006. Plight of the bumble bee: Pathogen spillover from commercial to wild populations. *Biological Conservation* 129:461-467.
- Colla, S.R. and L. Packer. 2008: Evidence for decline in eastern North American bumble bees (Hymenoptera: Apidae), with special focus on *Bombus affinis* Cresson. *Biodiversity and Conservation* 17: 1379-1391.
- Elias, J. D. Mazzi, and S Dorn. 2009. No need to discriminate? Reproductive diploid males in a parasitoid with complementary sex determination. *PLoS ONE* 4(6): e6024. doi:10.1371/journal.pone.0006024.
- Hatfield, LeBuhn, G. 2007. Patch and landscape factors shape community assemblage

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

- of bumble bees, *Bombus* spp. (Hymenoptera: Apidae), in montane meadows. *Biological Conservation* 139:150-158.
- Johnson, R. M., J. D. Evans, G. E. Robinson, M. R. Berenbaum. 2009. Changes in transcript abundance relating to colony collapse disorder in honey bees (*Apis mellifera*). *Proceedings of the National Academy Science* .106 (35):14790-14795.
- Kevan, P.G., C.F. Greco and S. Belaousoff. 1997. Log-normality of biodiversity and abundance in diagnosis and measuring of ecosystemic health: pesticide stress on pollinators on blueberry heaths. *Journal of Applied Ecology* 34: 1122-1136.
- Laverty, T. and L.D. Harder. 1988. The Bumblebees of Eastern Canada. *Canadian Entomologist*. 120:965-987.
- Lee, H., W. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. *Ecological Land Classification for Southern Ontario*. Ministry of Natural Resources. Reproductive
- MacFarlane, R. P. 1974. *Ecology of Bombinae (Hymenoptera: Apidae) of Southern Ontario, with emphasis on their natural enemies and relationships with flowers*. PhD, thesis, University of Guelph, Guelph, ON, Canada.
- Marletto, F., A. Patetta, and A. Manino. 2003. Laboratory assessment of pesticide toxicity to bumble bees. *Bulletin of Insectology* 56:155-158.
- McKenzie, A. Personal Communication. September 2008.
- Mitchell, T.B. 1962. *Bees of the Eastern United States*. North Carolina Agricultural Experiment Station Technical Bulletin No. 152
- Morton, A., Routledge, R. C. Peet and A. Ladwig. 2004. Sea lice infection rates on juvenile pink and chum salmon in the nearshore environment of British Columbia, Canada. *Canadian Journal of Fish and Aquatic Sciences* 61:147-158.
- Moret, Y. and P. Schmid-Hempel. 2000. Survival for immunity: the price of immune system activation for bumblebee workers. *Science*. 290(5494): 1166-1168.
- Nuzzo, V.A. 1986. Extent and status of Midwest oak savanna: presettlement and 1985. *Natural Areas Journal* 6:6-36.
- Walther-Hellwig, K. and R. Franki. 2000. Foraging habitats and foraging distances of bumblebees, *Bombus* spp. (Hym., Apidea), in an agriculture landscape. *Journal of Applied Entomology*. 124: 299-306.
- Williams, P.H., S.R. Colla and Z. Xie. 2009. Bumble bee vulnerability: common correlates of winners and losers across three continents. *Conservation Biology* 23: 931-940

Recovery Strategy for the Rusty-patched Bumble Bee in Ontario

Zayed, A. and L. Packer. 2005. Complementary sex determination substantially increases extinction proneness of haplodiploid populations. *Proceedings of the National Academy of Sciences* 102:10742-10746.

APPENDIX 1

Known plant food sources for the Rusty-patched Bumble Bee from Colla and Dumesh (2010) (* indicates non-native species in Southern Ontario).

<i>Arctium minus*</i>	<i>Rubus</i>
<i>Asclepias syriaca</i>	<i>Salix</i>
<i>Berberis thunbergii*</i>	<i>Silene dichotoma*</i>
<i>Carduus nutans*</i>	<i>Solanum dulcamara*</i>
<i>Centaurea cyanus*</i>	<i>Solidago canadensis</i>
<i>Cotoneaster adpressa*</i>	<i>Solidago flexicaulis</i>
<i>Crataegus</i>	<i>Sonchus oleraceus*</i>
<i>Cucumis melo*</i>	<i>Stachys palustris*</i>
<i>Deutzia gracilis*</i>	<i>Symphotrichum (Aster) ericoides</i>
<i>Echium vulgare*</i>	<i>Symphotrichum (Aster) lateriflorum</i>
<i>Hydrophyllum virginianum</i>	<i>Symphotrichum novae-angliae</i>
<i>Hypericum perforatum*</i>	<i>Symphytum officinale*</i>
<i>Impatiens capensis</i>	<i>Syringa vulgaris*</i>
<i>Kalmia latifolia</i>	<i>Taraxacum officinale*</i>
<i>Linaria vulgaris*</i>	<i>Trifolium pratense*</i>
<i>Lonicera caerulea</i>	<i>Trifolium repens*</i>
<i>Lonicera periclymenum*</i>	<i>Vicia cracca*</i>
<i>Lonicera tatarica*</i>	<i>Vinca minor*</i>
<i>Lotus corniculatus*</i>	<i>Weigelia florida*</i>
<i>Melilotus alba*</i>	<i>Eupatorium maculatum</i>
<i>Medicago sativa*</i>	<i>Eupatorium perfoliatum</i>
<i>Nepeta cataria*</i>	<i>Eupatorium rugosum</i>
<i>Prunus americana</i>	<i>Euthamia graminifolia</i>
<i>Prunus cerasus*</i>	<i>Helianthus decapetalus</i>
<i>Prunus tomentosa*</i>	<i>Helianthus divaricatus</i>
<i>Pyrus malus*</i>	<i>Kalmia</i>
<i>Rhododendron</i>	<i>Onopordum acanthium*</i>
<i>Ribes grossularia*</i>	<i>Rhexia virginica</i>
<i>Ribes nigrum*</i>	<i>Rhus</i>
<i>Ribes rubrum*</i>	<i>Spiraea</i>
<i>Robinia fertilis*</i>	<i>Vaccinium angustifolium</i>
	<i>Vaccinium vacillans.</i>

APPENDIX 2

Monitoring the Rusty-patched Bumble Bee Population at **Pinery Provincial Park**.

Implementation of the following protocol is recommended to broadly survey for the presence of *Bombus affinis* and determine approximate population size each year.

1. Selecting a Survey Site

Suitable habitat for bumble bee surveys includes areas with suitable flowering plants in bloom and/or sites where the species has previously been observed. This includes meadows, fields, gardens, parks, roadsides, etc. Because various flowering plant species are associated with different habitat types, aim to survey more than one type of habitat. In wooded areas in the spring, search near the ground where queens can usually be found looking for suitable nesting sites. See Appendix 1 for plant species to target.

2. When to Survey and/or Collect Bees

Surveys for queens should begin when the first suitable plants are in bloom (e.g. willow). Surveys in late July, August and early September are ideal for locating workers and males as the colony size should be at its peak. Collect on days which are precipitation-free and wind speeds are less than 16 kph (10mph). The ideal temperature range for collecting bumble bees is 15°C to 30°C. On hot days, this may mean the best time to collect is early morning and in the evening.

3. How to Collect Bumble Bees

Using hand nets (e.g. Bioquip's Professional Series Insect Nets with an 18 inch diameter aerial net bag and a 36 inch handle), slowly walk along flower patches and collect any bumble bees on either side of you. Each time you catch a bee, transfer it to a vial with a snap-on lid, determine if it is the target species, release and continue collecting. If you are unsure whether the species is *B. affinis*, take a digital photo which includes its dorsal abdominal colouration and another of its face. Be sure to record location and plant forage information for any individuals of this species collected (Appendix 4). For a visual aid on how to collect bees, please see Sam Droege's instructional video (<http://www.youtube.com/watch?v=n6ZF1z3uA7E>). Avoid killing or injuring bumble bees of this species, especially queens.

In order to estimate population size, queens should be individually marked and the date, location and marking recorded. Marking can be done using a bee marker pen or numbered tags which are available from honeybee suppliers.

4. Fieldwork Equipment required

Ventilated vials with snap-on lids, GPS, Pencils, Data Sheet for Field Work, Marking pen or tags, Bioquip's Professional Series Insect Nets with an 18 inch diameter aerial net bag and a 36 inch handle.

APPENDIX 3

Monitoring protocol to locate **new populations** of the Rusty-patched Bumble Bee.

Implementation of the following protocol is recommended to determine the presence of *B. affinis* at sites throughout its historical range.

1. Selecting a Survey Site

Suitable habitat for bumble bee surveys includes areas with suitable flowering plants in bloom. This includes meadows, fields, gardens, parks, roadsides, etc. Because various flowering plant species are associated with different habitat types, aim to survey more than one type of habitat. See Appendix 1 for plant species to target. Use historical records to select sites the species has occupied previously.

2. When to Survey and/or Collect Bees

Surveys in late July, August and early September are ideal for locating the species as the colony size should be at its peak. Additionally, surveying during this time is ideal for locating workers and males, which are more distinctive in colour pattern. Collecting queens earlier in the season should be avoided to diminish possible effects on nest-founding. Collect on days which are precipitation-free and wind speeds are less than 16kph (10mph). The ideal temperature range for collecting bumble bees is 15°C - 30°C. On hot days, this may mean the best time to collect is early morning and in the evening.

3. How to Collect Bumble Bees

Using hand nets (e.g. Bioquip's Professional Series Insect Nets with an 18 inch diameter aerial net bag and a 36 inch handle), slowly walk along flower patches and collect any bumble bees on either side of you. Each time you catch a bee, transfer it to a vial with a snap-on lid, determine if it is the target species, release and continue collecting. If you are unsure whether the species is *B. affinis*, take a digital photo which includes its dorsal abdominal colouration and another of its face. Be sure to record location and plant forage information for any individuals of this species collected (Appendix 4). For a visual aid on how to collect bees, please see Sam Droege's instructional video (<http://www.youtube.com/watch?v=n6ZF1z3uA7E>). Avoid killing or injuring bumble bees of this species, especially queens.

4. Fieldwork Equipment required

Ventilated vials with snap-on lids, GPS, Pencils, Data Sheet for Field Work, Bioquip's Professional Series Insect Nets with an 18 inch diameter aerial net bag and a 36 inch handle

APPENDIX 4

Sample data sheet.

Sample Data Sheet For Fieldwork At Each Site

Name of Collector:

Total Time Spent

Collecting:

Name of Transect Site:
direction, end, etc.):

Description of Transect (starting point,

Date/ Time	Site Code (to be written on label with correspo nding bees)	Weather condition s	GPS (Long/Lat of start and end points)	Locality	Habitat Type/ Plant Species	Additional Notes
01 vii 09 9:00- 10:00	A1	75° F and overcast		Hwy 8, 7 m south of Springfield	Roadside/ White clover	