

# **Ontario Species at Risk Evaluation Report**

**for**

## **Yellow-banded Bumble bee (*Bombus terricola*)**

Committee on the Status of Species at Risk in Ontario  
(COSSARO)

Assessed by COSSARO as Special Concern

January 2016

Final

## Bourdon terricole (*Bombus terricola*)

Le bourdon terricole (*Bombus terricola*) est un bourdon de taille moyenne qui possède une langue relativement courte par rapport aux autres espèces de bourdons. Ses bandes jaunes et noires distinctives sont constantes à l'échelle de l'aire de répartition de l'espèce. Comme il s'agit d'une espèce qui émerge tôt, il est vraisemblablement un pollinisateur important des plantes sauvages à floraison précoce (par exemple le bleuet sauvage) et des récoltes agricoles (par exemple la pomme). Cette espèce est une généraliste en termes d'alimentation et d'habitat. Les sites de nidification sont, pour la plupart, des terriers abandonnés de rongeurs. Elle possède une aire de répartition mondiale étendue qui couvre la majeure partie du Canada, dont la presque totalité de l'Ontario ainsi que des régions des États-Unis. Bien que les régions nordiques de son aire de répartition n'aient pas été soumises à des relevés adéquats en Ontario, cette espèce montre des signes de diminution, et même, de disparition dans les endroits qui ont été échantillonnés dans la partie sud de son aire de répartition. Dans le sud de l'Ontario, elle est encore observée, mais elle est moins courante qu'elle ne l'a déjà été. Ce bourdon est étroitement apparenté au bourdon à tache rousse (*Bombus affinis*) en voie de disparition, car ils font partie du sous-genre *Bombus sensu stricto* et ils ont en commun certains traits liés au cycle biologique qui les rendent particulièrement vulnérables aux facteurs stressants.

En décembre 2015, le CDSEPO a évalué le bourdon terricole comme une espèce préoccupante en s'appuyant sur les diminutions marquées observées dans le sud de l'Ontario, les diminutions présumées ailleurs dans la province et les menaces persistantes dans l'ensemble de son aire de répartition. Il n'a pas été évalué auparavant à l'échelle provinciale.

*Cette publication hautement spécialisée « Ontario Species at Risk evaluation report prepared under the Endangered Species Act, 2007 by the Committee on the Status of Species at Risk in Ontario », n'est disponible qu'en anglais conformément au Règlement 671/92, selon lequel il n'est pas obligatoire de la traduire en vertu de la Loi sur les services en français. Pour obtenir des renseignements en français, veuillez communiquer avec le ministère des Richesses naturelles par courriel à [recovery.planning@ontario.ca](mailto:recovery.planning@ontario.ca)*

## Executive summary

The Yellow-banded Bumble Bee (*Bombus terricola*) is a medium-sized bee with a short tongue relative to other bumble bee species. It has distinctive yellow and black banding which is consistent throughout its range. It is an early emerging species, making it likely an important pollinator of early blooming wild flowering plants (e.g. wild blueberry) and agricultural crops (e.g. apple). This species is a forage and habitat generalist. Nest sites are mostly abandoned rodent burrows. It has a large global range throughout much of Canada, including most of Ontario as well as parts of the United States. While the northern parts of its range have not been adequately surveyed in Ontario, this species shows declines and even extirpation at sampled sites throughout the southern portion of its range. In southern Ontario, it is still observed but is less common than it was historically. This species is closely-related to the Endangered Rusty-patched Bumble Bee (*Bombus affinis*) as they are both members of the subgenus *Bombus sensu stricto* and share certain life history traits which may make it particularly vulnerable to stressors.

In December 2015, COSSARO assessed the Yellow-banded Bumble Bee as Special Concern based on observed steep declines in southern Ontario, inferred declines from elsewhere in Ontario and continuing threats throughout its range. It has not been previously assessed provincially.

# 1. Background information

## 1.1. Current designations

- GRANK: G2G4 rounded to G3 Vulnerable (NatureServe2015)
- NRANK Canada: NU
- COSEWIC: Special Concern (May 2015)
- SARA: No schedule, No status
- ESA 2007: Not assessed
- SRANK: S3S5 (ranked in 2014)
- IUCN Redlist: Vulnerable A2b (Aug 2014)

## 1.2. Distribution in Ontario

Historically, the Yellow-banded Bumble Bee occurred throughout much of the province (Figure 1). Search effort in documenting diversity of bumble bees has been reasonably intensive compared to most other insect groups. However, central and northern Ontario have not been adequately surveyed for bumble bees in recent years (Figure 2) and bumble bees are known to occur at high latitudes in Canada (COSEWIC 2015). Sporadic sightings submitted through BumbleBeeWatch.org indicate that the Yellow-banded Bumble Bee is still present at some sites throughout the province (Figure 3 and Figure 4). In 2013, it was collected at three sites in southern Ontario - Toronto, Oro Station and Ottawa (COSEWIC 2015).

In southern Ontario, declines in proportional abundance (PA) observed include 87% (Toronto) and 59% (Ottawa) (see Table 2 presented in COSEWIC 2015). In Guelph and Belwood, PAs decreased from 3% of specimens observed in the 1970s to 0% in the years 2004-2006. Considering all databased bumble bee specimens from Ontario, Yellow-banded Bumble Bees decreased in proportional abundance from 30% in 1992-2001 to <1% from 2002-2011 (Figure 6; see also Table 3 presented in COSEWIC 2015).

Wildlife Preservation Canada has surveyed for the species over the past two years in southern Ontario. In 2014, targeted searches yielded 85 Yellow-banded Bumble Bees relative to 3462 other bumble bees observed (i.e. 2% PA at 26 of 104 (25%) historical sites (V. MacPhail, pers. comm. 2015). In 2015, targeted searches yielded 61 Yellow-banded Bumble Bees relative to 1845 other bumble bees observed (i.e. 3% PA) at 21 of 108 (19%) historical sites (V. MacPhail, pers. comm. 2015).

For northern and central Ontario, where recent survey efforts are lacking, a comparison of historical data with that inferred from other sources has been used. In order to determine what historic proportional abundances might be in central and northern Ontario, all Ontario bumble bee data >49 degrees latitude were exported from 1970-1990 (n=1,847 records) from the "Bumble Bees of North America" database. Of these, 1,465 (79.3%) were Yellow-banded Bumble bees. If only one individual per site is counted per collecting event, Yellow-banded Bumble Bees represented 18 of 70 total

collections (25.7%). In both cases, it was the most commonly collected bumble bee. While it is difficult to determine the true historic PA in this area in the absence of repeatable transect surveys, based on this information it was likely somewhere in the range of 25-79%. For modern comparisons, the citizen science program Bumble Bee Watch ([bumblebeewatch.org](http://bumblebeewatch.org)) has received submissions from various individuals from Dokis, Thunder Bay, Dryden, Algonquin Provincial Park, French River Provincial Park, near Moosonee, Timmins, Sudbury and North Bay. The Yellow-banded Bumble Bee represents less than 5% of bumble bee photos submitted from these sites combined. While not an ideal method of comparison, it still suggests that there has been a notable decline in northern and central Ontario, paralleling the decline observed in southern Ontario.

Figure 1. All Ontario Yellow-banded Bumble Bee records from 'The Bumble Bees of North America' database (Williams et al. 2014) Created for this report using <http://geocat.kew.org/> [accessed November 21, 2015].

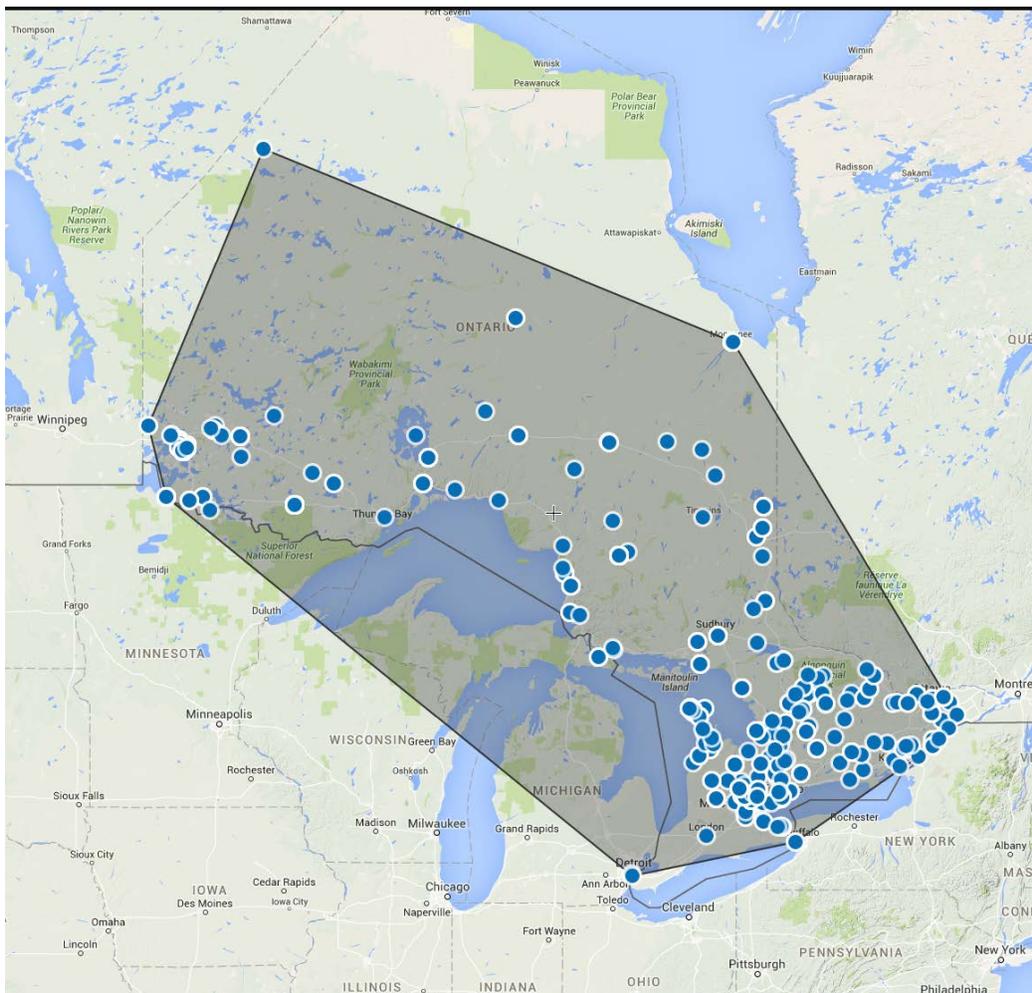


Figure 2. Collections of Yellow-banded Bumble Bees made in Canada in the last decade (red) and those made of other *Bombus* species during the same time period (grey) (from COSEWIC 2015). Note the almost complete lack of recent bumble bee surveys in central and Northern Ontario from 2004-2014. Bumble Bee Watch records

are not included.

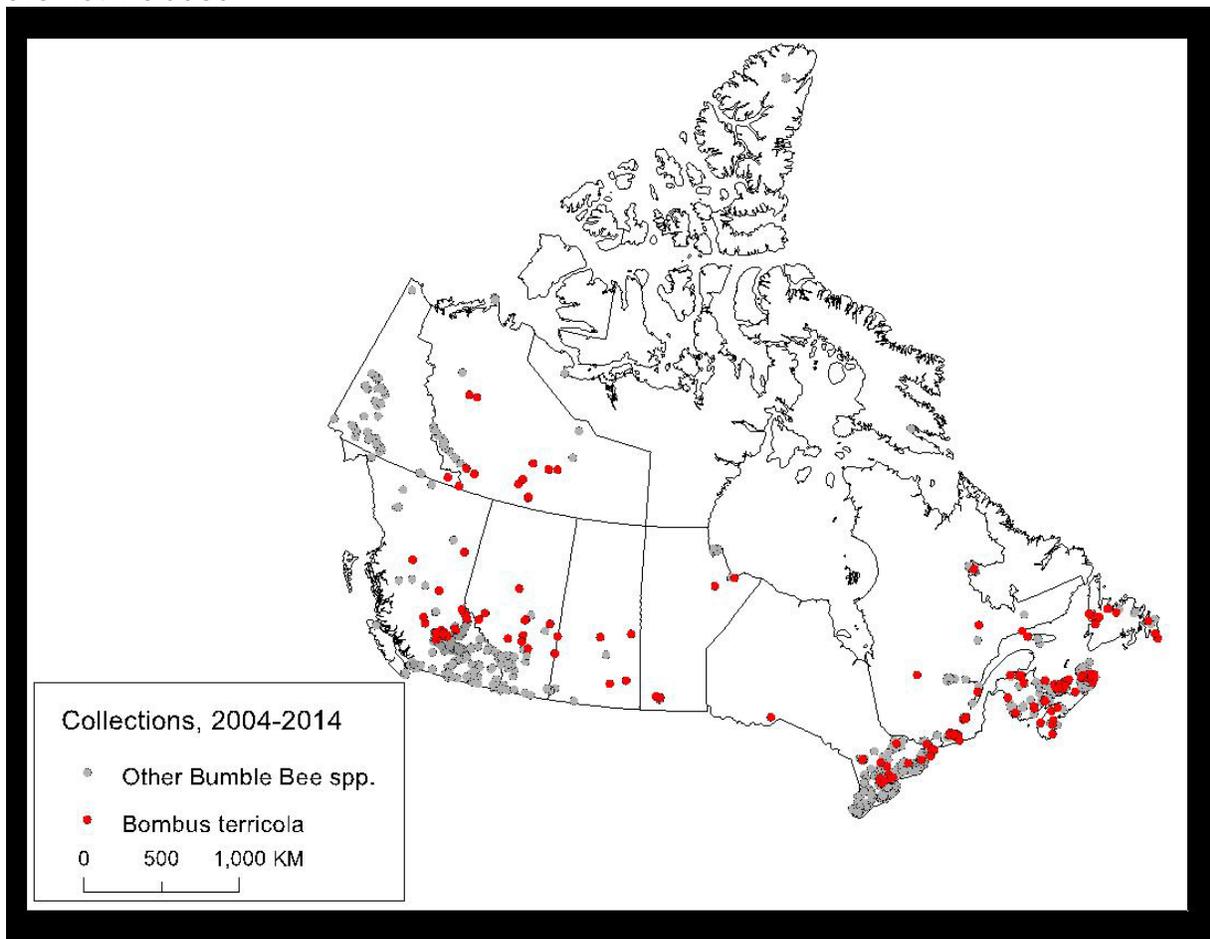


Figure 3. Bumble bee photo records submitted to Bumble Bee Watch in 2014 & 2015.. Overall, 27 records of Yellow-banded Bumble Bee were submitted relative to 1673 for all Ontario bumble bee records (1.6%) [accessed November 19, 2015].

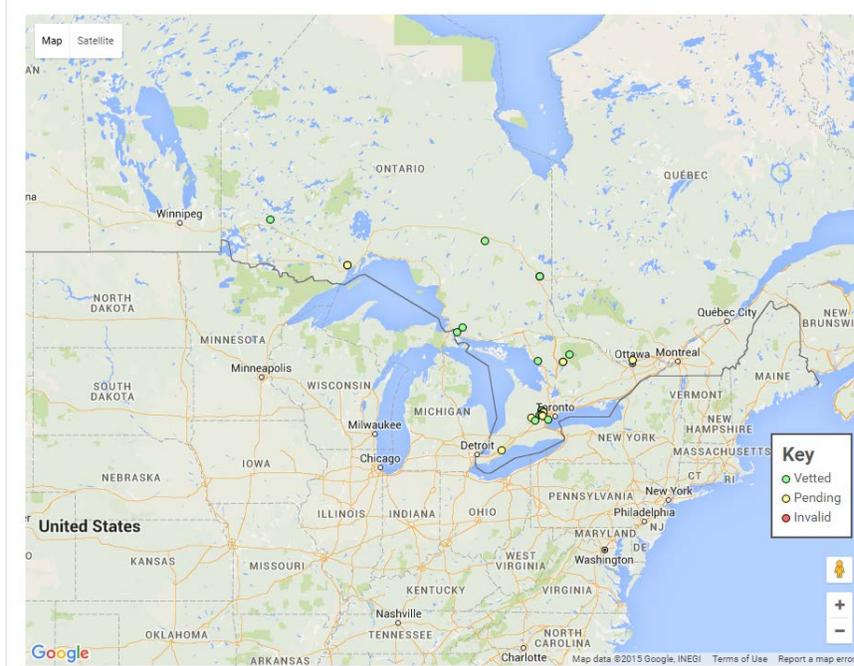
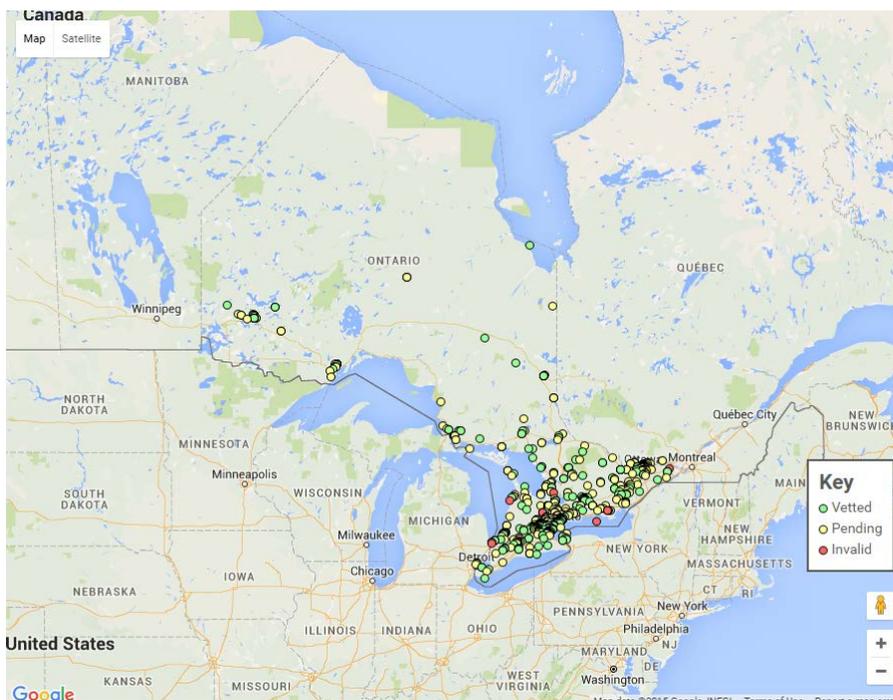


Figure 4. Occurrences during the same time period [accessed November 19, 2015].



### 1.3. Distribution and status outside Ontario

The Yellow-banded Bumble Bee has declined dramatically across much of its global range since about 2003, although the decline has not been as precipitous as that for the Rusty-patched Bumble Bee (NatureServe 2015). It originally occurred across much of southern Canada, from Newfoundland west to interior British Columbia and the

Northwest Territories, as well as the northeastern United States (Figure 5). As of 2014, the distribution also includes Yukon Territory (COSEWIC 2015). The Yellow-banded Bumble Bee has been found to be in decline in the southern portions of BC and QC as well as throughout the entire provinces of Prince Edward Island, Nova Scotia, Newfoundland and New Brunswick (Table 2 from COSEWIC 2015). Its current distribution is scattered with a lower abundance compared with historic data throughout much of its historical Canadian range.

In the mid-late 1970s James Thomson performed research on bumble bee populations in Northern Wisconsin, New Brunswick and Maine in transitional Great Lakes or Acadian forest habitats. During these years, the Yellow-banded Bumble Bee was one of the two most common species [the Tri-coloured Bumble Bee (*Bombus ternarius*) being the other] in disturbed openings and lowbush blueberry fields at about 30% relative abundance each (J. Thomson, pers. comm. 2015). This is consistent with PAs in surrounding provinces as well as Ontario during the same time period (Figure 5).

In northern Quebec (Chibougamau), a biologist with Faune Nord states the Yellow-banded Bumble Bee occurs currently at approximately 10% proportional abundance and that its distribution is very patchy, with occasional sightings in open areas and complete absence in similar suitable habitats (Y. Gobeil, pers. comm. 2015). This indicates the species is exhibiting declines in northern Quebec compared to inferred historic PAs.

A study throughout much of the continental United States found the Yellow-banded Bumble Bee to have suffered a range reduction of 31% (Cameron et al. 2011). Few states within the Yellow-banded Bumble Bee's historic range have undertaken extensive bumble bee surveys but those which have shown various levels of decline. Gixti et al. (2009) found it to be extirpated throughout the state of Illinois. In the state of Vermont, the species historically represented 13% of state bumble bee records from 1915-2011 (total *Bombus* n= 2500) (Richardson et al. in prep.). An extensive study was carried out throughout the state of Vermont in 2012 & 2013 with the Yellow-banded Bumble Bees representing 0.5% and ~1% respectively of the relative abundance of all bumble bees sampled (total *Bombus* n = 5053 in 2012 and 5000 in 2013) (Richardson et al. in prep.). Over the two years, the species was found in 73 of 1500 (4.9%) survey sites (Richardson et al. in prep.). The species is currently listed as threatened in Vermont (Vermont ANR 2015). It is ranked as S1 (Critically imperiled) in the neighbouring states of New York and Wisconsin.

Figure 5. Global range of Yellow-banded Bumble Bees. Red dots indicate recent (2004-2013) collections & grey dots pre-2004 records. (COSEWIC 2015). Note: recent Bumble Bee Watch records from Northern Ontario (Figure 3) are not included here.

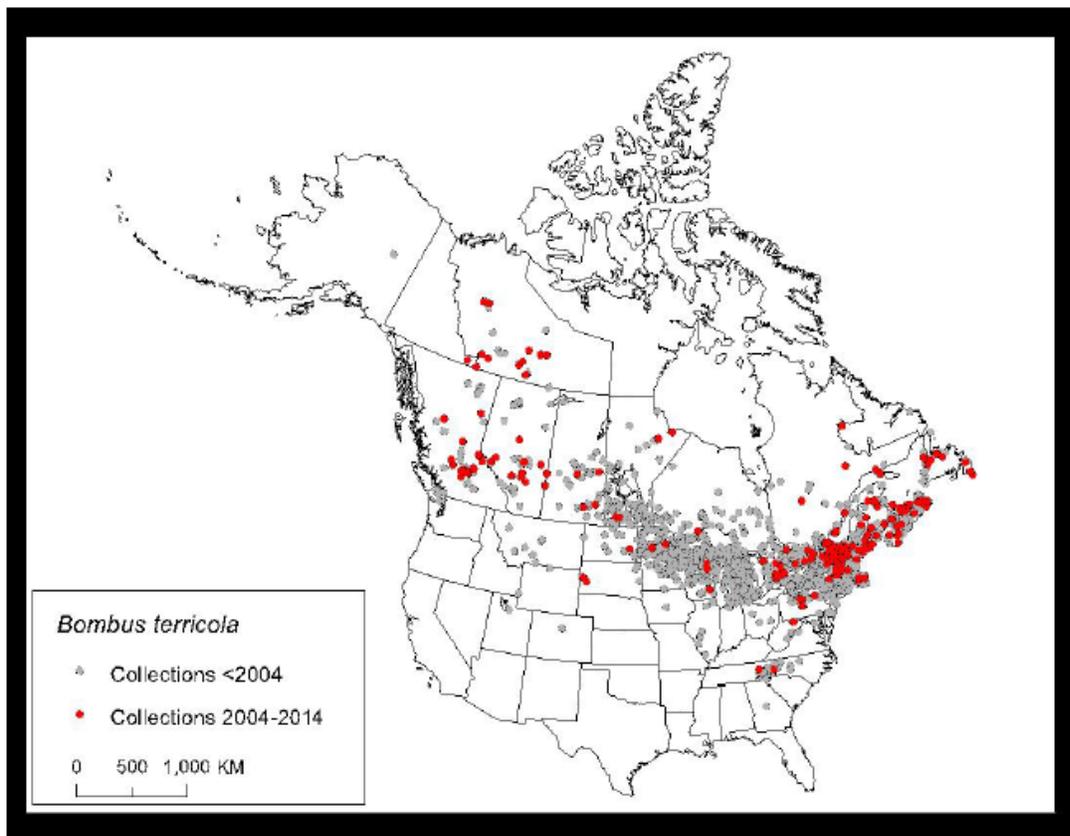


Figure 6. Proportional abundance of Ontario Yellow-banded Bumble Bees relative to all Ontario bumble bees by decade from the 'Bumble Bees of North America database' (Williams et al. 2014, from COSEWIC 2015).

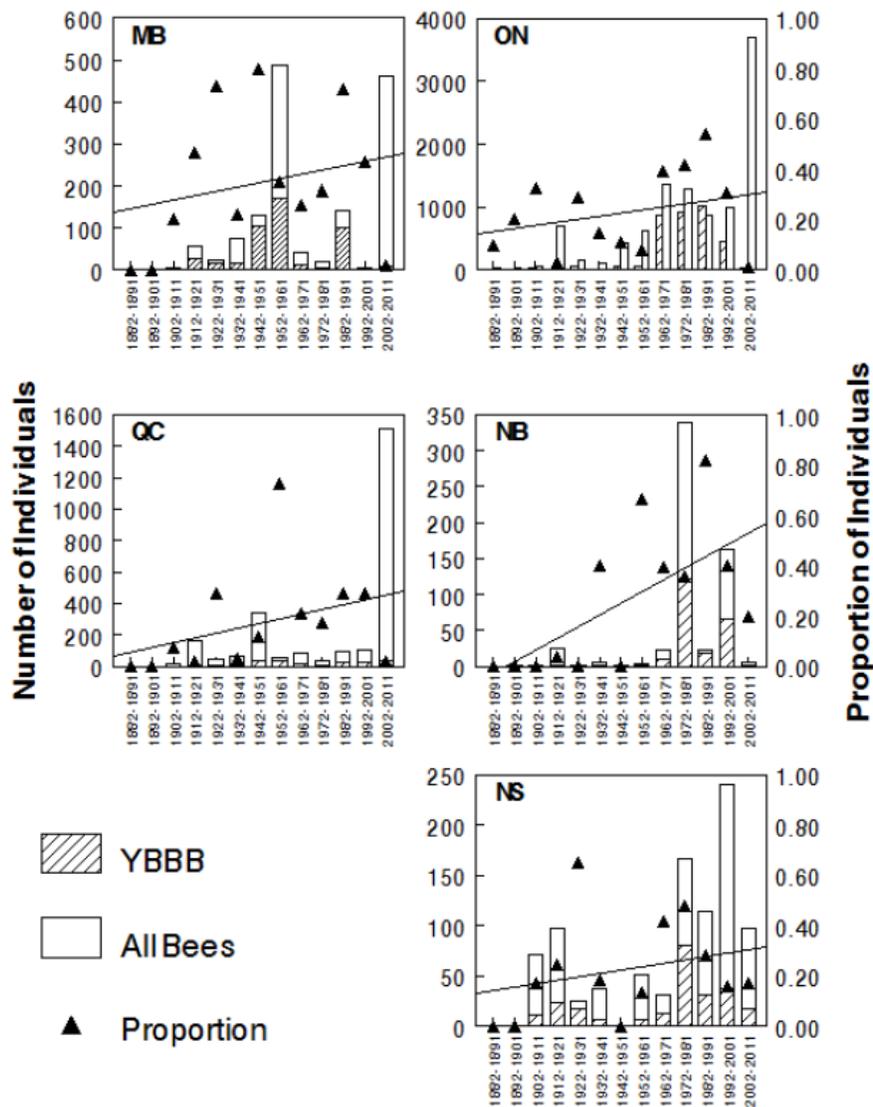


Figure 11. Proportional abundance of the Yellow-banded Bumble Bee (YBBB) based on a dataset of *Bombus* records in MB, ON, QC, NB and NS (1882 – 2011). The left Y-axis (shaded portions of bars) indicates YBBB specimens and the right Y-axis (solid triangles) represents the proportion of YBBB specimens by ten-year intervals. Linear regression was used to examine trends in proportional abundance over time; the line represents a best fit of the data. Graphs generated using Minitab® software.

#### 1.4. Ontario conservation responsibility

Ontario occurs in the center of this species' global range, comprising approximately

1/8<sup>th</sup> of the global range (Figure 6).

## 1.5. Direct threats

While the specific reasons for the population decline of Yellow-banded Bumble Bees are unknown, it is likely due to a combination of factors (COSEWIC 2015). Known high and continuing threats (COSEWIC 2015) include:

- Pathogen spillover from managed bumble bees:
  - This threat is considered the primary threat to this and other species in the same subgenus (Cameron et al. 2011; Hatfield et al. 2015). Managed bumble bees are used to pollinate primarily greenhouse but also field crops and tend to have high levels of disease (Graystock et al. 2013). Ontario is a leader in the greenhouse vegetable sector, representing 68% of total Canadian harvested area (AAFC 2015a). The sector is experiencing substantial growth in Ontario. From 2009-2013, the amount of harvested area increased by 1.5 million m<sup>2</sup> and the metric tonnes produced grew from 212,600 to over 410,000 with the majority being bee-pollinated crops (AAFC 2015a). A study completed in southern Ontario found wild bumble bees foraging near greenhouses had higher levels of disease than congenics foraging far from greenhouses (Colla et al. 2006). Szabo et al. (2012) found that declines in the Yellow-banded Bumble Bee were weakly correlated with the density of vegetable greenhouses indicating pathogen spillover from managed greenhouse bees may be a factor threatening this species.
- Pathogen spillover by managed honey bees:
  - Recent research suggests honey bee diseases can also spillover and affect bumble bees (e.g. Furst et al. 2014). This is an emerging and generally understudied threat in Ontario. Ontario has the highest number of registered beekeepers in Canada (AAFC 2015b). Recent “bee conservation” initiatives in Ontario promote beekeeping, particularly among amateurs who may not have the skills required to quickly identify and mitigate disease occurrence in their hives before transmission to the wild. Beekeeping practices occur not only on agricultural lands but also increasingly in cities and surrounding natural areas. Beekeepers can also be found keeping bees in logged and other open areas in the boreal ecozone or northern Ontario.
- Habitat loss:
  - The loss of natural habitat poses a threat to native bumble bees, including the Yellow-banded Bumble Bee. Threats throughout this species range which may cause local declines include urban development, agricultural intensification, grazing and forestry activities (COSEWIC 2015).
- Competition with non-native or invading native bee species:
  - While still understudied, managed honey bees and the natural and anthropogenically-caused spread of the Common Eastern Bumble Bee (*Bombus impatiens*) may pose a threat to the Yellow-banded Bumble Bee in parts of its range (COSEWIC 2015).

- Pesticide exposure:
  - Exposure to insecticides in agricultural, urban or suburban landscapes can cause lethal or sublethal effects on bumble bees (COSEWIC 2015). These include a variety of insecticides meant to kill agricultural pests that have an effect on non-target organisms as well (Desnoux et al. 2007). Exposure can be direct on the bee or colony or through ingestion of contaminated nectar and pollen as is the case with systemic pesticides such as neonicotinoids (Desnoux et al. 2007). This is a particular threat locally to the Yellow-banded Bumble Bee in the southern portion of its range in Ontario. The use of pesticides does not completely explain the patterns of decline noted in this species throughout its eastern North American range (Szabo et al. 2011; Colla et al. 2012).
- Climate change:
  - This species is clearly experiencing recession at the southern parts of its range. While the northern portions of its range have not been adequately surveyed, a recent study shows that bumble bees in North America and Europe are not tracking climate change northwards (Kerr et al. 2015) despite speculation that there is “probably potential for this bee to expand further north in Canada as the climate there warms” (NatureServe 2015).

## 1.6. Specialized life history or habitat use characteristics

The Yellow-banded Bumble Bee is a habitat and forage generalist. It has been noted to visit many species of plants for pollen and/or nectar (Colla and Dumesh 2010). However, nesting sites (abandoned rodent burrows) may be limiting and are directly related to the status of rodent populations throughout its range. Also this species is an early spring-emerging species with relatively late production of new queens and males at the end of summer (Colla and Dumesh 2010), and thus might be particularly susceptible to phenological shifts in key forage plants, spring storms and other climate-related factors which may alter its ability to access food resources. Very little is known with respect to mating and overwintering habitat needs. Other member in the subgenus *Bombus sensu stricto* share various life history traits and are known to be in rapid decline [i.e. Rusty-patched Bumble Bee, the Western Bumble Bee (*B. occidentalis*), and Franklin Bumble Bee (*B. franklini*)]. It is also a host species for the Endangered Gypsy Cuckoo Bumble Bee (*B. bohemicus*).

Bees are haplodiploid organisms which are more prone to extinction for genetic reasons than other animal taxa (Zayed and Packer 2005). This mechanism can result in the production of inviable or sterile diploid males (Zayed and Packer 2005). Diploid male production can elevate the extinction risk in bees by over an order of magnitude higher than that caused by inbreeding depression in threatened diploid animals (Zayed and Packer 2005).

## 2. Eligibility for Ontario status assessment

### 2.1. Eligibility conditions

### 2.1.1. Taxonomic distinctness

Yes. The Yellow-banded Bumble Bee was first described by Kirby in 1837 (COSEWIC 2015). While it has been considered conspecific with another species (Western Bumble Bee) in western North America in the past, morphological and barcoding data have confirmed its status as a distinct species (COSEWIC 2015).

### 2.1.2. Designatable units

No. This species occurs across multiple ecozones in Canada with no evidence of genetic substructure or population isolation (COSEWIC 2015). Thus, DUs have not been identified.

### 2.1.3. Native status

Yes. Specimens housed in the Royal Ontario museum date back to 1899 from the Ottawa area (S. Colla, pers. obs.).

### 2.1.4. Occurrence

This species occurs in Ontario with recent sightings this past summer.

## 2.2. Eligibility results

Yellow-banded Bumble Bee (*Bombus terricola*) is eligible for status assessment in Ontario.

## 3. Ontario status assessment

### 3.1. Application of endangered/threatened status in Ontario

#### 3.1.1. Criterion A – Decline in total number of mature individuals

Insufficient information. Proportional abundance is considered an index of abundance appropriate to this taxon in the peer-reviewed literature and by the IUCN (Hatfield et al 2015; COSEWIC 2015; Cameron et al. 2011). This species has observed declines in proportional abundance in Ontario both in multi-year surveys at certain sites in southern Ontario and overall specimens captured in Ontario over time. However, recent collections have only covered a small portion of the species' historic range in Ontario. The status of this species in central and northern Ontario is not fully understood.

#### 3.1.2. Criterion B – Small distribution range and decline or fluctuation

Does not apply. EOO and IAO values are greater than thresholds for Endangered and Threatened.

### 3.1.3. Criterion C – Small and declining number of mature individuals

Insufficient information based on lack of recent surveys, particularly of queens and thus estimated population size, in Ontario. Less than 10,000 mature individuals is a possibility but there is too much uncertainty to meet the threshold.

### 3.1.4. Criterion D – Very small or restricted total population

Does not apply. The species occurs at numerous sites across its range.

### 3.1.5. Criterion E – Quantitative analysis

Insufficient information. The species probability of extinction has not been quantified.

## 3.2. Application of Special Concern in Ontario

While the species does not meet specific thresholds for Endangered or Threatened status, there is considerable cause for concern over the status of this species in Ontario. While much of the Yellow-banded Bumble Bee's range has not been surveyed in Ontario and specific trend data are lacking, extensive declines can be inferred from southern Ontario, other provinces and the continental United States. Photos submitted to BumbleBeeWatch.org indicate its presence in central and northern Ontario has lower than expected proportional abundances compared with historical museum collections in the region, suggesting that the Ontario decline is not limited to southern Ontario where more comprehensive trend data are available.

## 3.3. Status category modifiers

### 3.3.1. Ontario's conservation responsibility

Not applicable, although Ontario represents a significant portion of the species' remaining global range.

### 3.3.2. Rescue effect

Species is noted to be in decline in surrounding jurisdictions, and is designated as S1 in the two adjacent jurisdictions where S ranks have been assigned (New York, Wisconsin).

## 3.4. Other status categories

### 3.4.1. Data deficient

Not applicable. Although data are largely lacking for the species' range in central and northern Ontario, existing data appear sufficient to support a status designation.

### 3.4.2. Extinct or extirpated

Not applicable. This species has been observed in recent years.

### 3.4.3. Not at risk

Not applicable. There are numerous lines of evidence indicating decline.

## 4. Summary of Ontario status

Yellow-banded Bumble Bee (*Bombus terricola*) is classified as Special Concern in Ontario.

## 5. Information sources

Agriculture and Agri-foods Canada (AAFC). 2015a. [2013 Statistical Overview of the Canadian Greenhouse Vegetable Industry](#). [website accessed December 8, 2015].

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Hatfield, R., S. Jepsen, R. Thorp, L. Richardson and S.R. Colla. 2015. [Bombus terricola. The IUCN Red List of Threatened Species 2015: e.T44937505A46440206](#). [website accessed 22 November 2015].

Kerr, J.T., A. Pindar, P. Galpern, L. Packer, S.G. Potts, S.M. Roberts, P. Rasmont, O. Schweiger, S.R. Colla, L.L. Richardson, D.L. Wagner, L.F. Gall, D.S. Sikes and A. Pantoja. 2015. Climate change impacts on bumblebees converge across continents. *Science* 349:177-180.

NatureServe. 2015. [Yellow-banded Bumble Bee \(\*Bombus terricola\*\) NatureServe Explorer](#). [website accessed November 24, 2015].

Richardson, L.L., K.P. McFarland and S. Zahendra. In preparation. Declines in bumble bee diversity in Vermont, USA, 1915-2014.

Szabo, N., S.R. Colla, D. Wagner, L. Gall and J. Kerr. 2012. Is pathogen spillover, habitat loss or pesticide use responsible for North American wild bumblebee declines? *Conservation Letters* 5: 232-239.

[Vermont Agency of Natural Resources \(ANR\)](#). 2015. [website accessed November 23, 2015].

Williams, P., R. Thorp, S.R. Colla and L. Richardson. 2014. [A Field Guide to the Bumblebees of North America](#). Princeton University Press. 208 pp. [Database details online]

[Ontario specimens housed at Algonquin Provincial Park, American Museum of Natural History, Canadian Museum of Nature, Canadian National Collection, Essig Museum of Entomological Collections, Illinois Natural History Survey, Natural History Museum (London, UK), Ohio State University, P. Hallett Personal Collection, Royal Ontario Museum, Royal Saskatchewan Museum, University of Colorado (Boulder), University of Connecticut, University of Guelph, York University].

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## Appendix 1: Technical summary for Ontario

Species: Yellow-banded Bumble bee (*Bombus terricola*)

### Demographic information

Demographic attribute	Value
Generation time. Based on average age of breeding adult: age at first breeding = X year; average life span = Y years.	1 year
Is there an observed, inferred, or projected continuing decline in number of mature individuals?	Yes. Observed based on lower abundance during surveys at revisited sites. Inferred decline based on overall decreases in proportional abundance throughout surveyed parts of ON using museum collections.
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years or 3 generations.	In southern Ontario, declines in relative abundance of >50% over the most recent decade for which data are available (1992-2001 vs 2002-2011)
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 years, or 3 generations, over a time period including both the past and the future.	Unknown
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	No. Causes of decline are not fully understood
Are there extreme fluctuations in number of mature individuals?	No.

### Extent and occupancy information in Ontario

Extent and occupancy attributes	Value
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Estimated extent of occurrence. ( <a href="http://geocat.kew.org/">http://geocat.kew.org/</a> )	1,094,754 km <sup>2</sup> based on all records
Index of area of occupancy (IAO). ( <a href="http://geocat.kew.org/">http://geocat.kew.org/</a> )	Unknown
Is the total population severely fragmented? (i.e. is >50% of its total area of occupancy is in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?)	Unknown
Number of locations ( <i>as defined by COSEWIC</i> ).	>10
Number of NHIC Element Occurrences ( <i>Request data from MNRF</i> )	Not available
Is there an observed, inferred, or projected continuing decline in extent of occurrence?	No
Is there an observed, inferred, or projected continuing decline in index of area of occupancy?	Unknown for Ontario but inferred from recent observation data
Is there an observed, inferred, or projected continuing decline in number of populations?	Yes, loss has been observed where data exists
Is there an observed, inferred, or projected continuing decline in number of locations?	Unknown
Is there an observed, inferred, or projected continuing decline in [area, extent and/or quality] of habitat?	Yes, inferred continuing decline in area, extent and quality of habitat in the southern parts of its range due to agriculture (i.e. habitat loss, pesticide use, competition with and pathogen spillover from managed bees) and urbanization (COSEWIC 2015).
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of mature individuals in each sub-population or total population (if known)

The population is unknown but likely to be greater than 1000.

## Quantitative analysis (population viability analysis conducted)

Probability of extinction in the wild is unknown, not calculated.

### Rescue effect

<b>Rescue effect attribute</b>	<b>Likelihood</b>
Is immigration of individuals and/or propagules between Ontario and outside populations known or possible?	Theoretically possible from the northeastern states and QC, but declines noted in all surrounding jurisdictions
Would immigrants be adapted to survive in Ontario?	Yes
Is there sufficient suitable habitat for immigrants in Ontario?	Likely
Is the species of conservation concern in bordering jurisdictions?	Yes, ranked as S1 in the two jurisdictions where assessed.
Is rescue from outside populations reliant upon continued intensive recovery efforts?	No.

## Appendix 2: Adjoining jurisdiction status rank and decline

### Information regarding rank and decline for Yellow-banded Bumble Bee

Jurisdiction	Subnational rank	Population trend	Sources
Ontario	S3S5 (ranked in 2014)	Decreasing (according to COSEWIC 2015 and published studies)	Explorer.NatureServe.org
Quebec	Likely to be designated Vulnerable or threatened	decreasing	Liste des espèces susceptibles d'être désignées menacées ou vulnérables, QC
Manitoba	SNR	n/a	Explorer.NatureServe.org
Michigan	SNR	n/a	Explorer.NatureServe.org
Minnesota	Not assessed	n/a	<a href="http://www.dnr.state.mn.us/ets/index.html">http://www.dnr.state.mn.us/ets/index.html</a>
Nunavut	Not Present	n/a	COSEWIC (2015)
New York	S1, critically imperiled	decreasing	Explorer.NatureServe.org
Ohio	Not assessed	n/a	<a href="http://www.fws.gov/midwest/endangered/lists/ohio-spp.html">http://www.fws.gov/midwest/endangered/lists/ohio-spp.html</a>
Pennsylvania	SNR	n/a	Explorer.NatureServe.org
Wisconsin	S1, critically imperiled	decreasing	Explorer.NatureServe.org

### Acronyms

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

COSSARO: Committee on the Status of Species at Risk in Ontario

ESA: Endangered Species Act

GRANK: global conservation status assessments

IAO: index of area of occupancy

MNRF: Ministry of Natural Resources and Forestry

NHIC: Natural Heritage Information Centre

NNR: Unranked

NRANK: National conservation status assessment

SARA: Species at Risk Act

SNR: unranked

SRANK: subnational conservation status assessment

S1: Critically imperiled

S3: Vulnerable

S5: Secure

IUCN: International Union for Conservation of Nature and Natural Resources

CDSEPO: Le Comité de détermination du statut des espèces en péril en Ontario