SPECIES STATUS REPORT

Western Bumble Bee, Yellow-banded Bumble Bee, and Gypsy Cuckoo Bumble Bee

(Bombus occidentalis, Bombus terricola, Bombus bohemicus)

Bourdon de l'ouest, Bourdon terricole, Psithyre bohémien (French)
Ineedzit (Teetl'it and Gwichyah Gwich'in)
Kw'ıahnǫ dekwoo (Dogrib)
Tł'ıstthó Tł'ıstthóghe (Chipewyan)
Tth'ıhnǫ detthoı (South Slavey)

April 2019

NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE

DATA DEFICIENT – Western bumble bee
NOT AT RISK – Yellow-banded bumble bee
DATA DEFICIENT – Gypsy cuckoo bumble bee

Status of Western Bumble Bee, Yellow-banded Bumble Bee, and Gypsy Cuckoo Bumble Bee in the NWT

Species at Risk Committee status reports are working documents used in assigning the status of species suspected of being at risk in the Northwest Territories (NWT).

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ABOUT THE SPECIES AT RISK COMMITTEE

The Species at Risk Committee was established under the *Species at Risk (NWT) Act*. It is an independent committee of experts responsible for assessing the biological status of species at risk in the NWT. The Committee uses the assessments to make recommendations on the listing of species at risk. The Committee uses objective biological criteria in its assessments and does not consider socio-economic factors. Assessments are based on species status reports that include the best available Aboriginal traditional knowledge, community knowledge, and scientific knowledge of the species. The status report is approved by the Committee before a species is assessed.

ABOUT THIS REPORT

This species status report is a comprehensive report that compiles and analyzes the best available information on the biological status of the western bumble bee, yellow-banded bumble bee, and gypsy cuckoo bumble bee in the NWT, as well as existing and potential threats and positive influences. Full guidelines for the preparation of species status reports, including a description of the review process, may be found at www.nwtspeciesatrisk.ca.

Northwest Territories Environment and Natural Resources

Environment and Natural Resources, Government of the Northwest Territories, provides full administrative and financial support to the Species at Risk Committee.

Cover illustration photo credit: Yellow-banded bumble bee (credit: Leif Richardson)

NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE

Preface

The subjects of this status report - western bumble bee, yellow-banded bumble bee, and gypsy cuckoo bumble bee - have been experiencing declines nationally. Southern populations of western bumble bee are experiencing a serious, apparently northward-moving decline (COSEWIC 2014b). The yellow-banded bumble bee has experienced declines of at least 34% in southern Canada (COSEWIC 2015). The gypsy cuckoo bumble bee has declined in relative abundance over the last 20-30 years even where it was once common, and where hosts are still relatively abundant (COSEWIC 2014a).

The cause(s) of these declines are uncertain, but are suspected to include pathogen spillover from managed bee populations, pesticide use (neonicotinoid compounds in particular), and habitat change, as well as host declines for gypsy cuckoo bumble bee (COSEWIC 2014a, b; 2015).

At present, there is little evidence of decline in NWT populations of these species and they enjoy a relatively undisturbed habitat and few threats in this jurisdiction. It is important to consider, however, the lessons from southern jurisdictions and to manage threats to these species in a precautionary manner.

Assessment of Western Bumble Bee

The Northwest Territories Species at Risk Committee met in Fort Simpson, Northwest Territories on April 2, 2019 and assessed the biological status of western bumble bee in the Northwest Territories. The assessment was based on this approved status report. The assessment process and objective biological criteria used by the Species at Risk Committee are available at: www.nwtspeciesatrisk.ca.

Assessment: Data Deficient in the Northwest Territories

The Species at Risk Committee does not have sufficient information to categorize as Extinct, Extirpated, Endangered, Threatened, Special Concern, or Not at Risk.

Main Factors:

- The status report has fully investigated all the best available information, but there is not enough information to assess the species or assign status.

Additional Factors:

- Only the *mckayi* subspecies has been found in the Northwest Territories. There are not enough specimens to be able to comment on population size, population trends, or changes in range use over time.
- The western bumble bee has only been collected from five sites in the Northwest Territories; however, it could conceivably be present throughout much of the southwestern Northwest Territories.

Positive influences to western bumble bees and their habitat:

- Bumble bees have been the focus of recent studies. Increased sampling has demonstrated that this bumble bee is not limited to only one ecozone in the Northwest Territories.
- There is an emerging awareness of the importance of bumble bees and other pollinators through national and territorial information campaigns.
- Western bumble bee has a number of characteristics that reduce its susceptibility to land use changes and other threats, including early emergence in the spring, below-ground nesting, flexible habitat selection, and flexible foraging.
- Conservation planning initiatives and the development of new protected areas may provide safe havens for the species.
- The Canadian Food Inspection Agency has regulations in place to prevent the introduction and spread of bee pathogens into the country via the import of bee products and live bees. The Northwest Territories does not currently have any regulations or

restrictions on bringing live bees into the territory, although best management practices for beekeeping and pollination services are being developed.

Recommendations:

Although the assessment is Data Deficient, the status report identified a number of potential threats. Based on these, and in the interest of improving information availability over time, we make the following recommendations:

- Additional surveys, especially community-based monitoring and citizen science initiatives, should be undertaken to increase knowledge of the western bumble bee and all pollinators in the Northwest Territories. Surveys should be done systematically over time.
- Education to increase awareness and stewardship should be undertaken.
- Education around best practices for the import of bees and beekeeping should be pursued, especially with respect to responsible management of hives and minimizing the spread of pathogens to wild bees.
- The importation of bees into the Northwest Territories for honey production and pollination services should be tracked. If importation increases substantially in the future, consider options for regulating to manage competition and minimize the potential spread of pathogens to wild bee populations.
- Climate change may be the most important threat for this species in the future, but there are significant gaps in information about the impacts of climate change. The Species at Risk Committee recommends combining monitoring of climate indices and changes in seasonal timing of flowering plants and bumble bee spring emergence; if there are no flowers available to the species upon spring emergence, the effects could be devastating.
- The western bumble bee is susceptible to heat stress. The Species at Risk Committee recommends invastigating the potential severity of this impact in the Northwest Territories, as it relates to climate change, by monitoring weather and climate in the Boreal and Taiga cordilleras.

Assessment of Yellow-banded Bumble Bee

The Northwest Territories Species at Risk Committee met in Fort Simpson, Northwest Territories on April 2, 2019 and assessed the biological status of yellow-banded bumble bee in the Northwest Territories. The assessment was based on this approved status report. The assessment process and objective biological criteria used by the Species at Risk Committee are available at: www.nwtspeciesatrisk.ca.

Assessment: Not at Risk in the Northwest Territories

The species has been evaluated and found to be not at risk of extinction given the current circumstances.

Main Factors:

- The yellow-banded bumble bee has been collected in the south-central and southwest Northwest Territories and is most likely present across a larger area.
- It has been reported in the Northwest Territories since the 1920s. It is one of the most commonly encountered bumble bees and appears to be relatively stable in population.

Additional factors:

- The yellow-banded bumble bee is noted to be in serious decline in areas of southern and central Canada, but it appears to be more stable in northern British Columbia, Yukon, and the Northwest Territories.

Positive influences to yellow-banded bumble bees and their habitat:

- Bumble bees have been the focus of recent studies. Increased sampling is providing more information, demonstrating that the species is still present in regions where it historically occurred.
- There is an emerging awareness of the importance of bumble bees and other pollinators through national and territorial information campaigns.
- The yellow-banded bumble bee has a number of characteristics that reduce its susceptibility to land use changes and other threats, including early emergence in the spring, below-ground nesting, flexible habitat selection, and flexible foraging.
- Conservation planning initiatives and the development of new protected areas may provide safe havens for the species.
- The Canadian Food Inspection Agency has regulations in place to prevent the introduction and spread of bee pathogens into the country via the import of bee products and live bees. The Northwest Territories does not currently have any regulations or

restrictions on bringing live bees brought into the territory, although best management practices for beekeeping and pollination services are being developed.

Recommendations:

Although the assessment is Not at Risk, the status report identified a number of potential threats. Based on these, and in the interest of improving information availability over time, we make the following recommendations:

- Additional surveys, especially community-based monitoring and citizen science initiatives, should be undertaken to increase knowledge of the yellow-banded bumble bee and all pollinators in the Northwest Territories. Surveys should be done systematically over time.
- Education to increase awareness and stewardship should be undertaken.
- Education around best practices for the import of bees and beekeeping should be pursued, especially with respect to responsible management of hives and minimizing the spread of pathogens to wild bees.
- The importation of bees into the Northwest Territories for honey production and pollination services should be tracked. If importation increases substantially in the future, consider options for regulating to manage competition and minimize the potential spread of pathogens to wild bee populations.
- Climate change may be the most important threat for this species in the future, but there are significant gaps in information about the impacts of climate change. The Species at Risk Committee recommends combining monitoring of climate indices and changes in seasonal timing of flowering plants and bumble bee spring emergence; if there are no flowers available to the species upon spring emergence, the effects could be devastating.

Assessment of Gypsy Cuckoo Bumble Bee

The Northwest Territories Species at Risk Committee met in Fort Simpson, Northwest Territories on April 2, 2019 and assessed the biological status of gypsy cuckoo bumble bee in the Northwest Territories. The assessment was based on this approved status report. The assessment process and objective biological criteria used by the Species at Risk Committee are available at: www.nwtspeciesatrisk.ca.

Assessment: Data Deficient in the Northwest Territories

The Species at Risk Committee does not have sufficient information to categorize as Extinct, Extirpated, Endangered, Threatened, Special Concern, or Not at Risk.

Main Factors:

- The status report has fully investigated all the best available information, but there is not enough information to assess the species or assign status.
- The gypsy cuckoo bumble bee has been recorded sporadically in the Northwest Territories since the 1940s; however, a major portion of its range has not been surveyed recently (Mackenzie Delta).
- The proportion of gypsy cuckoo bumble bees caught compared to other bumble bees in any sampling effort has declined over time; however, this does not necessarily indicate a population trend. This could be due to differences in sampling effort and changes in other local species abundance. This species is often hard to detect in surveys because is does not have a worker bee class, which is the class of bee that is most often seen foraging in great numbers in other species.
- They gypsy cuckoo bumble bee is considered a obligate nest parasite of other bumble bee species. Only one host has been confirmed in the Northwest Territories (yellow-banded bumble bee, which has been assessed as Not at Risk in the Northwest Territories); others are unconfirmed but likely (western bumble bee and cryptic bumble bee).

Positive influences to gypsy cuckoo bumble bees and their habitat:

- Bumble bees have been the focus of recent studies. Increased sampling is providing more information, demonstrating that the species is still present in regions where it historically occurred.
- There is an emerging awareness of the importance of bumble bees and other pollinators through national and territorial information campaigns.

- The gypsy cuckoo bumble bee has a number of characteristics that reduce its susceptibility to land use changes and other threats, including below-ground nesting, flexible habitat selection, flexible foraging, and probably multiple host species.
- Conservation planning initiatives and the development of new protected areas may provide safe havens for the species.
- The Canadian Food Inspection Agency has regulations in place to prevent the introduction and spread of bee pathogens into the country via the import of bee products and live bees. The Northwest Territories does not currently have any regulations or restrictions on bringing live bees into the territory, although best management practices for beekeeping and pollination services are being developed.

Recommendations:

Although the assessment is Data Deficient, the status report identified a number of potential threats. Based on these, and in the interest of improving information availability over time, we make the following recommendations:

- Additional surveys, especially in the Mackenzie Delta, and community-based monitoring and citizen science initiatives, should be undertaken to increase knowledge of the gypsy cuckoo bumble bee, including host species, and all pollinators in the Northwest Territories. Surveys should be done systematically over time.
- Education to increase awareness and stewardship should be undertaken.
- Education around best practices for the import of bees and beekeeping should be pursued, especially with respect to responsible management of hives and minimizing the spread of pathogens to wild bees.
- The importation of bees into the Northwest Territories for honey production and pollination services should be tracked. If importation increases substantially in the future, consider options for regulating to manage competition and minimize the potential spread of pathogens to wild bee populations.
- Climate change may be the most important threat for this species in the future, but there are significant gaps in information about the impacts of climate change. The Species at Risk Committee recommends combining monitoring of climate indices and changes in seasonal timing of flowering plants and bumble bee spring emergence; if there are no flowers available to the species upon spring emergence, the effects could be devastating.

Executive Summary

Description

The western bumble bee (*Bombus occidentalis*), has two subspecies in North America, *Bombus occidentalis occidentalis* and *Bombus occidentalis mckayi*. Only the *mckayi* subspecies is found in the Northwest Territories (NWT). It is a medium-sized bumble bee (0.9-2.1 centimetres (cm)) with a short, dark head, a short tongue, a band of yellow hairs in front of the wings, a yellow banding pattern and somewhat variable colours. All individuals in the NWT have banded abdominal patterns, whereas the southern subspecies also has non-banded forms.

The yellow-banded bumble bee (*Bombus terricola*) closely resembles *B. occidentalis mckayi* in size and shape, however, in terms of colour and banding patterns, the second and third abdominal sections are predominantly yellow (some workers have a dark fringe on the second segment), whereas only the third segment is yellow in *B. occidentalis mckayi*.

The gypsy cuckoo bumble bee (*Bombus bohemicus*) is a nest parasite of other bumble bees. It is a medium-sized bumble bee (1.7-1.9 cm) that also has variable colours and patterns, but always has a dark head and a yellow band in front of the wings (in the NWT, most females probably have a black abdomen with a broad white tip). Because they are parasitic, females lack a pollen basket on their hind legs.

Distribution

The western bumble bee occurs only in North America. The northern *mckayi* subspecies occurs in northern Alberta, northern British Columbia, the NWT, Yukon, and Alaska. In the NWT, the western bumble bee has only been collected from five sites; four along the Nahanni River in the Nahanni National Park Reserve and one at Poplar River south of Fort Simpson; however, it could conceivably be present throughout much of the southwestern NWT.

As with the western bumble bee, the yellow-banded bumble bee occurs only in North America. It can be found throughout most of Canada (not recorded in Nunavut to date) and the northeastern and central United States. The yellow-banded bumble bee has been collected primarily in the south-central and southwestern NWT but is likely present across a larger area. The most recent observations were from 2018, near Fort Simpson.

The gypsy cuckoo bumble bee has one of the largest ranges of all bumble bee species in Canada. It occurs in Europe, the Far East of Asia, south into many parts of China, as well as the central and eastern United States, and Canada. It has been collected at various sites along the length of the Mackenzie River valley, and south of Great Slave Lake. The most recent observation of this species in the NWT is from 2018 near Fort Simpson.

Biology and Behaviour

The western bumble bee and yellow-banded bumble bee have three castes in their colonies: a single queen, female workers, and males. Young mated queens emerge from overwintering sites in the spring, locate and modify nest sites, and eventually lay eggs to produce a brood of workers. Workers then assume responsibility for foraging (pollen and nectar) and care of subsequent broods. Males and reproductive females (new queens) are produced in fall, likely late July in the NWT. At the onset of winter, males, old queens, and workers die. The mated new queens hibernate until the following spring.

Gypsy cuckoo bumble bees are obligate nest parasites of other bumble bees. They emerge later in the spring than the other two species. Rather than develop nests of their own, females (there are no queen or worker castes) invade established colonies of their hosts (the yellow-banded bumble bee in the NWT, and likely also the western bumble bee and the cryptic bumble bee, *B. cryptarum*), and the workers of the host colony care for their young. Females and males emerge to mate in late July, and mated females overwinter. Males and the original egg-laying female die before the onset of winter.

Males of all bumble bee species typically leave the nest once they are mature to feed and find mates. They do not generally forage for the colony.

Population

At present, it is not possible to comment on the abundance or population trends of the *mckayi* western bumble bee in the NWT, with only five specimens having been collected (four in 2011 and one in 2018). Evidence from neighbouring jurisdictions (Yukon, Alberta, and northern British Columbia), however, suggests that this subspecies has fairly stable populations.

The yellow-banded bumble bee has been recorded in the NWT since the 1920s, and is the most commonly encountered bumble bee of the three in this report (161 specimens have been collected in the NWT so far). There are no obvious trends in population over time, although it has increased (+0.76%) in relative abundance between historical (pre-2008) and recent (2008-2018) time periods. The species is noted to be in serious decline in areas of southern and central Canada, but it may be more stable in northern British Columbia.

The gypsy cuckoo bumble bee has been recorded sporadically in the NWT since the 1940s (total number of records = 45). Most occurrences were recorded between 1940-1959. In 2018, four specimens were collected near Fort Simpson. There are no obvious trends in population over time, although it has declined (-4.23%) in relative abundance between historical and recent times. Despite being in decline in some parts of Canada, it is still being encountered regularly in the Yukon and Alberta.

Habitat

Bumble bee habitat must include access to flowering plants throughout the active season, suitable overwintering sites, and for western and yellow-banded bumble bees, suitable nesting sites. Parasitic species like the gypsy cuckoo bumble bee require established colonies of their host species.

All three species are considered habitat generalists and can reasonably be expected to use many different types of habitat in the NWT. They are likewise considered generalist pollinators and use a wide variety of flowering plants as food, including thistle, raspberry, goldenrod, asters, gooseberry, cranberry, and blueberry.

Overwintering sites in the NWT are unknown, but it is expected that all three species likely overwinter underground or in decomposing plant matter, as is the general habit of bumble bees. Nesting sites are below ground, usually in the abandoned burrows of small mammals.

The yellow-banded bumble bee is the only confirmed host for gypsy cuckoo bumble bee in the NWT, but western and cryptic bumble bees are likely also parasitized by the gypsy cuckoo bumble bee.

Threats and limiting factors

The main threats to these species relate to climate change as well as competition and potential disease spread from imported honey and bumble bee colonies. Additionally, the gypsy cuckoo bumble bee is threatened by the potential loss or decline of its hosts.

Bumble bees are strongly associated with cool, temperate climates, including those found in boreal, sub-arctic, and arctic regions. Arctic temperatures are rising twice as fast as the global average. The entirety of the NWT is expected to be affected by climate change, with some regions (e.g., the Mackenzie River valley) warming even more quickly than others. The frequency of extreme summer temperatures (>30°C) is expected to increase across the NWT. Heat waves with maximum temperatures not substantially higher than this have been implicated in local bumble bee population extirpations in other areas. Individual heat waves are not expected to be a threat to all bumble bees within their entire distribution. However, because of the *mckayi* western bumble bee's heat intolerance and northern range, the distribution of this species, in particular, is expected to decline. Additional impacts of climate change that may affect NWT bumble bees include changes in seasonal timing, permafrost degradation, and increasing severity of floods, forest fires, and droughts. Changes in seasonality are particularly concerning; a longer active season could be beneficial to bumble bees, but if there are no flowers available when bumble bees emerge in the spring, the effects could be devastating.

There is a strong interest in the pursuit and expansion of beekeeping activities in the NWT for honey production and pollination. Importing non-native bees to the NWT could be problematic, as they are known to compete with native species for nesting sites and floral resources, and can spread diseases to native species. The spread of disease to native species has been widely implicated in the decline of North American bumble bees.

Positive influences

These three bumble bee species have a number of characteristics that reduce their susceptibility to land use changes and other threats, including early emergence in the spring (only western and yellow-banded bumble bees), below-ground nesting, flexible habitat selection, and flexible foraging.

Conservation planning initiatives and the development of new protected areas may provide safe havens for the three bumble bee species.

The Canadian Food Inspection Agency has regulations in place to prevent the introduction and spread of bee pathogens into the country via the import of bee products and live bees. The NWT does not currently have any regulations or restrictions on bringing live bees into the territory, although best management practices for beekeeping and pollination services are being developed.

Technical Summary

Population trends	
Generation time (average age of parents in the population) (indicate years, months, days, etc.).	1 year[1].
Number of mature individuals in the NWT (or give a range of estimates).	Mature individuals not applicable as most bumble bees captured are non-reproductives.
Percent change in total number of mature individuals over the **last** 10 years or 3 generations, whichever is longer.	**Western bumble bee/yellow-banded bumble bee:** Population trend in the NWT is unknown. Anecdotal information from neighbouring jurisdictions suggests populations may be stable. **Gypsy cuckoo bumble bee:** Population trend in the NWT is unknown. Anecdotal information suggests populations may be stable.
Percent change in total number of mature individuals over the **next** 10 years or 3 generations, whichever is longer.	Unknown.
Percent change in total number of mature individuals over any 10 year or 3 generation period which includes **both the past and the future.**	Unknown.
If there is a decline in the number of mature individuals, is the decline likely to continue	Unknown.

[1] Where a species is not specified, the answer applies to all three species.

if nothing is done?	
If there is a decline, are the causes of the decline reversible?	Unknown.
If there is a decline, are the causes of the decline clearly understood?	Unknown.
If there is a decline, have the causes of the decline been removed?	Unknown.
If there are fluctuations or declines, are they within, or outside of, natural cycles?	Unknown.
Are there 'extreme fluctuations' (>1 order of magnitude) in the number of mature individuals?	Unknown.
Distribution trends	
Estimated extent of occurrence in the NWT (in km^2).	**Western bumble bee**: Known extent of occurrence is ~11,730 km^2 but is probably much larger. **Yellow-banded bumble bee**: Known extent of occurrence is ~274,903 km^2 but is probably larger. **Gypsy cuckoo bumble bee**: Known extent of occurrence is ~246,934 km^2 but is probably much larger.
Index of area of occupancy (IAO) in the NWT (in km^2; based on 2 × 2 grid).	**Western bumble bee**: Known index of area of occupancy is 20 km^2 (5 grid cells) but probably much larger. **Yellow-banded bumble bee**: Known index of area of occupancy is 120 km^2 (28 grid cells) but is probably much larger.

	Gypsy cuckoo bumble bee: Known index of area of occupancy is 44 km^2 (9 grid cells) but is probably much larger.
Number of extant locations[2] in the NWT.	If climate change (extreme temperatures and seasonal changes) is considered the most serious plausible threat to bumble bees in the NWT, and using level III ecoregions (classified by vegetation and climate) as proxies for climatic zones within which each species occurs, locations are as follows: • **Western bumble bee** – 2 locations (High Boreal and Mid-Boreal level III ecoregions) • **Yellow-banded bumble bee** – 3 locations (High Boreal, Mid-Boreal, and Low Subarctic level III ecoregions) • **Gypsy cuckoo bumble bee** – 4 locations (Mid-Boreal, Low Subarctic, High Subarctic, and Low Arctic north level III ecoregions) If import of non-native bees (competition and pathogen spillover) is considered the most serious plausible threat, the locations are follows (see *Search Effort* for details on method used): • **Western bumble bee** – 5 locations • **Yellow-banded bumble bee** – exceeds the threshold of 10 locations • **Gypsy cuckoo bumble bee** – 10 locations
Is there a **continuing decline**	Large expanses of natural habitat are available in the NWT.

[2] Extant location – The term 'location' defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the species present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a species is affected by more than one threatening event, location should be defined by considering the most serious plausible threat.

in area, extent and/or quality of habitat?	Climate change may affect habitat in the future.
Is there a **continuing decline** in number of locations, number of populations, extent of occupancy and/or IAO?	**Western bumble bee**: Uncertain. Anecdotal information from neighbouring jurisdictions suggests the population may be stable. **Yellow-banded bumble bee/gypsy cuckoo bumble bee**: Uncertain. Anecdotal information from other jurisdictions suggests the populations of these species may be stable.
Are there extreme fluctuations (>1 order of magnitude) in number of locations, extent of occupancy and/or IAO?	Unknown.
Is the total population severely fragmented (most individuals found within small and isolated populations)?	Locations of individual collected specimens are disjunct, but the degree of isolation between populations in the NWT, if any, is unknown.
Immigration from populations elsewhere	
Does the species exist elsewhere?	**Western bumble bee**: Yes. This species is found elsewhere in Canada (including adjacent Yukon and northern British Columbia) and the United States. **Yellow-banded bumble bee**: Yes. The species is found elsewhere in Canada (including adjacent Yukon, British Columbia, Alberta, and Saskatchewan) and in the United States. **Gypsy cuckoo bumble bee**: Yes. The species is known from elsewhere in Canada (including adjacent Yukon, British Columbia, Alberta, and Saskatchewan) and in the United States. It is also widespread in Europe, part of the Far East of Asia, and China.
Status of the outside population(s)?	**Western bumble bee**: Northern subspecies that is found in the NWT may be stable in northern British Columbia, Yukon, and Alaska. The southern subspecies is in dramatic decline across much of its range.

	Yellow-banded bumble bee: This species may be stable in northern British Columbia. Populations are in dramatic decline in the United States and elsewhere in Canada, south of the NWT. **Gypsy cuckoo bumble bee**: The species has been recorded regularly in the Yukon and Alberta in recent years. It is known to be in dramatic decline in the United States.
Is immigration known or possible?	**Western bumble bee**: Uncertain but possible. Physical barriers (mountain ranges) could make immigration difficult. The *mckayi* subspecies is limited to regions north of 55 degrees latitude. **Yellow-banded bumble bee**: Uncertain but possible. Physical barriers (mountain ranges) could make immigration difficult. **Gypsy cuckoo bumble bee**: Uncertain but unlikely. Physical barriers (mountain ranges) could make immigration difficult. Immigration is also dependent on the availability of suitable hosts.
Would immigrants be adapted to survive and reproduce in the NWT?	Yes.
Is there enough good habitat for immigrants in the NWT?	Yes.
Is the NWT population self-sustaining or does it depend on immigration for long-term survival?	Uncertain, but likely self-sustaining.
Threats and limiting factors	
Briefly summarize negative influences and indicate the magnitude and imminence for each.	Climate change: The frequency of extreme summer temperatures (>30°C) is expected to increase across the NWT. Individual heat wave events are not expected to be a threat to all bumble bees within their entire distribution, but because of their heat intolerance and northern distribution, the distribution of *mckayi* western bumble bee is expected to decline. Additional impacts

	associated with climate change may also impact bumble bees. Changes in seasonal timing are particularly concerning if there is a mismatch with floral resources. Invasive and problematic species, pathogens, and genes: Imported colonies of honey and bumble bees can compete with and spread disease to native species. The spread of disease to native species is widely implicated in the decline of bumble bees in North America. Although beekeeping and pollination activities in the NWT are small and localized at present, there is strong interest in the pursuit and expansion of these activities. An additional threat to the gypsy cuckoo bumble bee is declines in host populations: The only confirmed host (yellow-banded bumble bee) is still present in the NWT and has been collected as recently as 2018. A probable host, cryptic bumble bee (*B. cryptarum*) has stable populations in North America, and is widespread in the NWT.
Positive influences	
Briefly summarize positive influences and indicate the magnitude and imminence for each.	Life history traits: early emergence in the spring (western and yellow-banded bumble bee), below-ground nesting, generalist foragers, nectar-robbing capacity (western and yellow-banded bumble bees), and habitat generalists. Regulatory actions: Over 9% of the NWT is in a protected area; these may preserve natural bumble bee habitats. More protected areas are being planned. The Canadian Food Inspection Agency has regulations in place to prevent the introduction and spread of bee pathogens into the country via the import of bee products and live bees. Best management practices for beekeeping and pollinations services are being developed for the NWT.

SPECIES OVERVIEW

Names and classification

Over 20,000 bee species are found worldwide (Ascher and Pickering 2018), roughly 260 of which belong to the genus *Bombus*, commonly called "bumble bees" (Cameron *et al.* 2007; Williams *et al*. 2014). Approximately 47 *Bombus* species have been described in North America, 45 of which are found in Canada (Williams *et al*. 2014; Williams *et al*. 2016). Recent DNA barcoding efforts suggest that other additional cryptic (visually and morphologically identical, but genetically distinct) species may be present in Arctic regions (Williams *et al*. 2016; Sheffield *et al*. 2017). Specimen records show that 25 recognized species of bumble bees are known in the Northwest Territories (NWT) (Working Group on General Status of NWT Species 2016; Heron 2018; Richardson 2018; Heron unpubl. data 2019).

Common names for bees and bumble bees in NWT indigenous languages include:

- Ineedzit (bee) – Teetl'it and Gwichyah Gwich'in (Gwich'in Language Centre 2005)
- Kw'ıahnǫ dekwoo (bumble bee) – Dogrib (Dogrib Divisional Board of Education 1996)
- Tł'ıstthó / Tł'ıstthóghe (bee) – Chipewyan (South Slave Divisional Education Council 2012, 2014)
- Tth'ıhnǫ detthoı (bumble bee) – South Slavey (South Slave Divisional Education Council 2009)

Bombus contains 15 recognized subgenera (Williams *et al.* 2008). The western bumble bee, *Bombus occidentalis* Greene 1858, and the yellow-banded bumble bee, *B. terricola* Kirby 1837, are members of the subgenus *Bombus sensu stricto*, along with three others in North America (*B. affinis* Cresson 1863, *B. cryptarum* Fabricus 1775 (=*B. moderatus* Cresson 1863; also found in the NWT), and *B. franklini* Frison 1921) (Bertsch *et al*. 2010). The gypsy cuckoo bumble bee, *B. bohemicus* Seidl 1837 (= *B. ashtoni* Cresson 1864 and *Psithyrus ashtoni* Cresson 1864), is one of six cuckoo bumble bees (subgenus *Psithyrus*) in North America. Three other cuckoo bumble bees have been recorded from the NWT: *B. insularis* Smith 1861, *B. suckleyi* Greene 1860, and *B. flavidus* Eversmann 1852 (Williams *et al*. 2014).

Systematic/taxonomic clarifications

Greene published his description of *B. occidentalis* (western bumble bee) in 1858, and *B. terricola* (yellow-banded bumble bee) was first described by Kirby in 1937. Their status as distinct species, or "designatable units", has been the subject of considerable debate since the earliest revision of North American *Bombus* by Franklin (1913). Franklin tentatively listed them as separate species, but expressed uncertainty about the decision given their morphological similarities and geographic co-occurrence in some parts of western Canada. Some authors supported the separate designations (Stephen 1957; Thorp *et al*. 1983), while other authors suggested that *B. occidentalis* (western bumble bee) was either a conspecific or a subspecies of *B. terricola* (yellow-banded bumble bee) (Handlirsch 1888; Milliron 1961; Hobbs 1967; Milliron 1971; Cameron *et al*. 2007).

Table 1. Names and synonymies of the western bumble bee, yellow-banded bumble bee, and gypsy cuckoo bumble bee.

Common Name	Western bumble bee	Yellow-banded bumble bee	Gypsy cuckoo bumble bee
Subgenus	*Bombus* Latreille *sensu stricto*	*Bombus* Latreille *sensu stricto*	*Psithyrus* Lepeletier
Scientific Name	*Bombus (Bombus) occidentalis* Greene 1858	*Bombus (Bombus) terricola* Kirby 1837	*Bombus (Psithyrus) bohemicus* Seidl 1837
Common Name (French)	Bourdon de l'ouest	Bourdon terricole	Psithyre bohémien
(Sub)species	*Bombus o. occidentalis* *Bombus o. mckayi*[3]	None	None
Synonym(s)	*Bombus mckayi* Ashmead 1902 *Bombus proximus* Cresson 1863 *Bombus occidentalis nigroscutatus* Franklin 1913	None	*Bombus ashtoni* Cresson 1864[4] *Psithyrus ashtoni* Cresson 1864
Class	Insecta (insects)	Insecta (insects)	Insecta (insects)
Order	Hymenoptera (sawflies, ants, bees, and wasps)	Hymenoptera (sawflies, ants, bees, and wasps)	Hymenoptera (sawflies, ants, bees, and wasps)
Family	Apidae (bees) – includes, but is not limited to bumble bees, honey bees and stingless bees	Apidae (bees) – includes, but is not limited to bumble bees, honey bees and stingless bees	Apidae (bees) – includes, but is not limited to bumble bees, honey bees and stingless bees
Life Form	Animal, invertebrate, insect, bumble bee	Animal, invertebrate, insect, bumble bee	Animal, invertebrate, insect, cuckoo bumble bee

[3] *Bombus occidentalis mckayi* is the subspecies found in the NWT.
[4] Common name for gypsy cuckoo bumble bee was formerly Ashton's cuckoo bumble bee.

Recent gene sequencing and morphological studies support the status of *B. occidentalis* (western bumble bee) and *B. terricola* (yellow-banded bumble bee) as discrete, separate species (Williams *et al*. 2012; Owen and Whidden 2013; Sheffield *et al*. 2016), and also resulted in the identification of distinct northern and southern subpopulations of *B. occidentalis*, with monophyletic CO1 barcode haplotype groups[5] (Williams *et al.* 2012; Sheffield *et al.* 2016; Williams *et al*. 2016). Thus, *B. occidentalis* (western bumble bee) is now recognized to consist of two subspecies: *B. o. occidentalis* and *B. o. mckayi*. These subspecies are distinct not only genetically and morphologically, but also geographically: only *B. o. mckayi* is found in the NWT. Since the two subspecies designations are relatively new, life history and other data pertaining uniquely to either one is sparse. Throughout this report, the information presented for *B. occidentalis* (western bumble bee) should be interpreted as pertaining to both subspecies, unless expressly stated otherwise.

In recognition of their distinct morphology and parasitic behaviour, cuckoo bumble bees were widely treated as a separate genus (*Psithyrus*). However, the taxon is now considered a monophyletic subgenus of *Bombus* (Cameron *et al.* 2007). The gypsy cuckoo bumble bee was first described in the Old World as *Psithyrus bohemicus* by Seidl in 1837. Cresson described a North American species of cuckoo bumble bee, *Apathus ashtoni*, in 1864, though "Ashton's cuckoo bumblee bee" was later re-assigned to the genus *Bombus*. Genetic analyses (DNA sequences and CO1 barcodes) now strongly suggest that *B. (Psithyrus) bohemicus* and *B. (Psithyrus) ashtoni* are conspecific, leading to the synonymization of the North American *B. ashtoni* under *B. bohemicus* as a single, Holarctic species (Williams *et al*. 2012; Williams *et al*. 2014).

Description

Morphological species descriptions are largely drawn from Williams *et al.* (2014) and supplemented by other sources as indicated. Generalized illustrations of bumble bee anatomy, and of the numbering scheme used for abdominal segments (the tergites), are provided in Figure 1. Microscopic characteristics are described and illustrated in Williams *et al.* (2014).

[5] CO1 is an abbreviation of "Cytochrome c Oxidase subunit 1". CO1 is a gene used by geneticists to distinguish between individuals from closely related species or subspecies, such as the northern and southern subspecies of *B. occidentalis*. Organisms with the same CO1 are considered to have the same haplotype: the same group of inherited genes that makes them distinct from all other (sub)species. When we compare the CO1 haplotypes of individuals of *B. o. occidentalis* against the CO1 haplotypes of individuals of *B. o. mckayi*, we find that all the *occidentalis* haplotypes are more closely related to each other than to any of the *mckayi* haplotypes. This means that all *B. o. occidentalis* individuals have the same common ancestor, and all *B. o. mckayi* individuals have a different common ancestor. Since no other bees have the same ancestor as either *B. o. occidentalis* or *B. o. mckayi*, geneticists use the term monophyletic (mono = "one", phyletic = "ancestor") to describe the two CO1 haplotype groups.

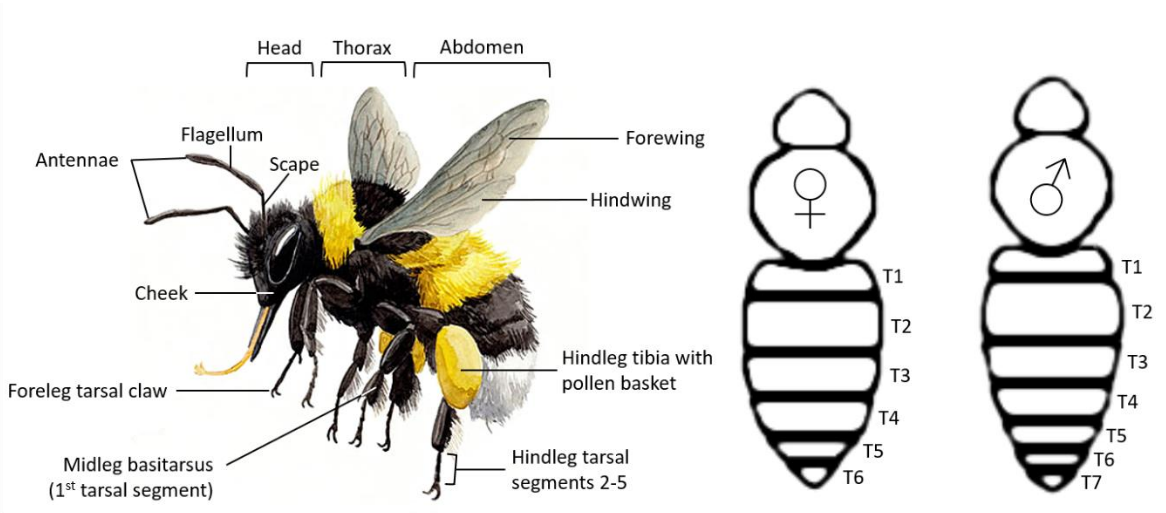

Figure 1. Generalized illustration of key bumble bee anatomy mentioned in this report. *Left*: A lateral (side) view of a female worker. *Center*: The numbering system used for the abdominal segments (tergites) in female bees, including queens (T1-T6). *Right*: The numbering system for male tergites (T1-T7). Worker bee illustration courtesy of the Blooms for Bees website: www.BloomsForBees.co.uk, which is funded by the Heritage Lottery Fund and Coventry University, used and modified by C. Ernst with permission. Line drawings produced by C. Ernst, after illustrations in Williams *et al.* (2014), used and modified with permission.

Western bumble bee

The western bumble bee is a medium-sized bumble bee (queen: 2.0-2.1 centimeters (cm); workers: 0.9-1.5 cm; males: 1.2-1.6 cm). Generally, the pile (the soft, fuzzy hairs covering the entire body) is moderately short and of a uniform length; however, the pile of *B. o. mckayi* (the subspecies found in the NWT) is longer than that of the southern subspecies. The head is short, with a cheek (oculo-malar region) slightly shorter than broad. The first tarsal segment (basitarsus) of the female midleg is rounded at the back far corner (as opposed to coming to a sharp point, as in some other species). The outer surface of the female hind tibia is flat and lacks long hairs but has long fringes at the margins that form a pollen basket. The male antennae are short, with the flagellum slightly more than twice as long as the scape.

Figure 2. Female worker of *B. o. mckayi*, the subspecies found in the NWT, clearly displaying a "banded" abdominal pattern typical of this subspecies. Western bumble bees in the NWT are all banded to some degree, though the shade and extent of the light-coloured regions in T2-4 vary between individuals. Photograph courtesy of Cory Sheffield, used with permission.

Females (both queens and workers) (Figs. 2 and 4) and males (Figs. 3 and 4) have similar colouration and patterns. The head is usually dark to black, with at least some greyish to yellow hairs on the face between the eyes, and on the upper surface of the head. Hairs on the dorsal surface of the thorax (the mid-body section between the head and abdomen) form a yellow band in front of the wings, and between the wings, there is at a minimum, a large black central spot that often forms a full black band between the wings.

The western bumble bee can display a wide range of abdominal colours and patterns (Fig. 4). The dorsal surface of the first abdominal segment (tergum 1, or T1, which is closest to the thorax) is black. The second (T2) is usually black at the front, and if it is predominantly yellow then the head is similarly mostly yellow. Tergum 3 (T3) can be fully yellow, fully black, or partly black with scattered yellow hairs. However, in the NWT, most females have a yellow band in front of the wings and a yellow band on the third tergite, with some pale (whitish or yellowish) hairs on the end of the abdomen. Some individuals have a bit of yellow on the thorax behind the wings (Cannings pers. comm. 2019).

Figure 3. Male specimen of *B. o. mckayi*, the subspecies found in the NWT. Specimen collected along the Dempster Highway in Yukon Territory in July 1991. Photograph courtesy of Laurence Packer, www.discoverlife.org, used with permission.

The abdominal colour patterns of the western bumble bee can be categorized as banded or non-banded. Banded individuals always have at least some yellow hair on T3, and T4 is at least partially black (Figs. 2-4). Individuals with non-banded abdomens are entirely black on *both* T2 and T3, with the terminal segments broadly and extensively white to yellow (Figs. 4 and 5).

Recent genetic and morphological analyses concluded that nearly 100 percent (%) of *B. o. mckayi* found at latitudes of 60°N are of the banded type (Sheffield *et al.* 2016). Therefore, western bumble bee workers in the NWT should consistently have banded abdominal patterns (Williams *et al*. 2012; Sheffield *et al.* 2016). *B. o. occidentalis*, the southern subspecies (Fig. 5), displays both banded and non-banded colour patterns (though the latter is the most common). The southern banded form is more variable with respect to the banding pattern and is geographically disjunct from the northern subspecies (Koch and Strange 2012; Sheffield *et al*. 2016). In the NWT, western bumble bee is most likely to be mistaken for the yellow-banded bumble bee (*B. terricola*) or the cryptic bumble bee (*B. cryptarum*), both of which have similar banding patterns (Williams *et al*. 2014; Environment and Natural Resources [ENR] 2017b), although the yellow-banded bumble bee doesn't display a white-tipped abdomen (ENR 2017b).

The immature stages (egg, larva, pupa) of the western bumble bee have not been formally described in the literature. In general, bumble bee eggs are small (about 3 millimeters (mm)), elongate-oval, and pale yellow or whitish in colour (Alford 1975). Bumble bee larvae are grub-like and pale, with 13 body segments, a head capsule, no eyes, and no legs (Alford 1975). Mature larvae enclose themselves in silk cocoons in which they become pupae. The pupae have all the same body parts as adult bees (eyes, antennae, thorax with legs and wings, abdominal segments, etc.), but they are pale coloured and hairless until they mature into adults.

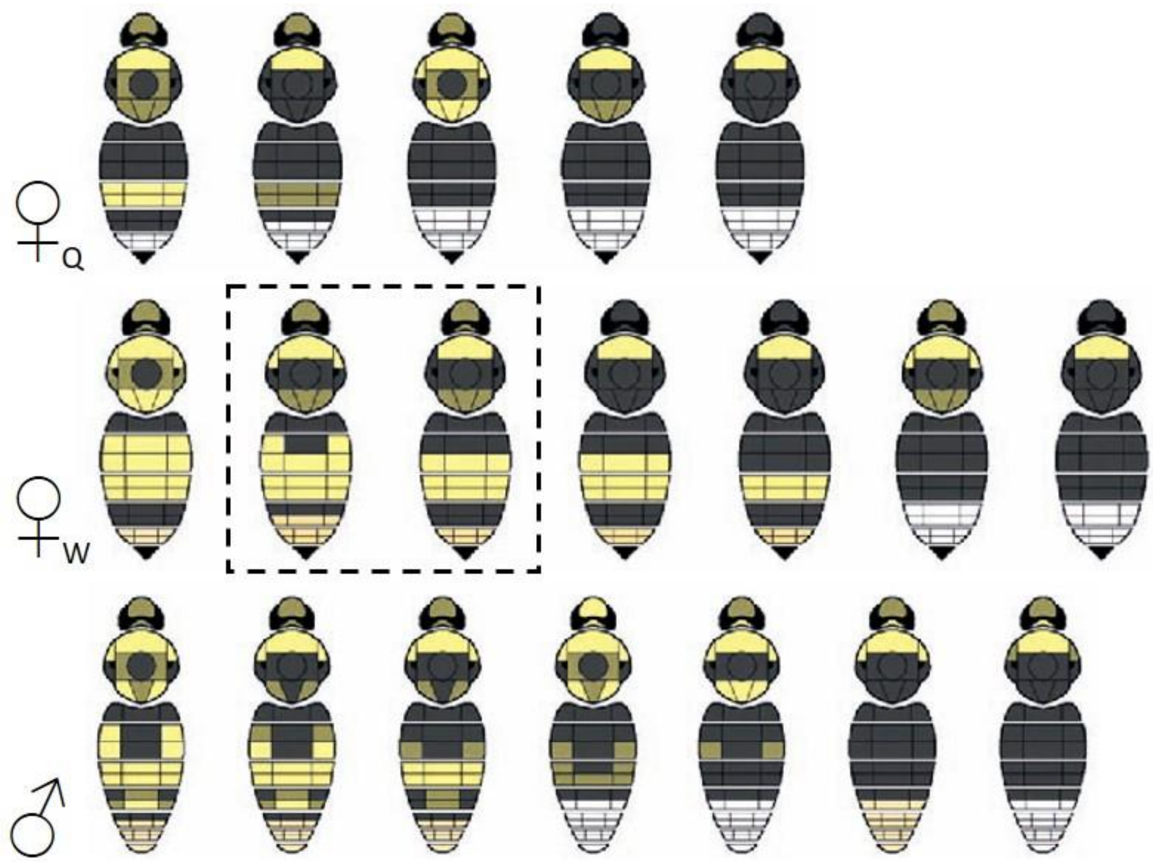

Figure 4. Colours and patterns in the western bumble bee, *B. occidentalis*. Top row: female queens. Middle row: female workers. Bottom row: males. Workers enclosed in dashed box display known banding patterns of *B. o. mckayi*, the subspecies found in the NWT.

Figure 5. A non-banded female worker (L) and male (R) of the southern subspecies of western bumble bee, *Bombus occidentalis occidentalis*. Female specimen collected from unknown location in 1888; male collected from Departure Bay, British Columbia, in August 1928. Photographs courtesy of Margarita Miklasevskaja at (Laurence) Packer Collection of York University (PCYU) with funding from NSERC-CANPOLIN, used with permission.

See *Life Cycle and Reproduction* for more information about the life cycle of bumble bees.

Yellow-banded bumble bee

The yellow-banded bumble bee is a medium-sized bumble bee, with reproductive individuals slightly smaller than those of the western bumble bee (queen: 1.9-2.1 cm; workers: 1.0-1.5 cm; males: 1.3-1.5 cm). The hairs are short and even. The head, cheek, basitarsus, hind tibia, and male antennae are as in the western bumble bee.

Females (both queens and workers) (Figs. 6 and 7) and males (Figs. 6 and 8) have similar colouration and patterns. Wings are slightly brown. Hair on the head is black, but it may be intermixed with some short pale hairs. Males may have more yellow hairs on the head than females. The second abdominal segment (T2) is usually yellow with no black at the front, or with only a narrow black fringe along the front margin. Tergum 2 can less commonly be more extensively black, in which case T4 and T5 are also mostly black. Tergum 3 is usually yellow. Tergum 5 is usually black or yellow-brown. In the NWT, the yellow-banded bumble bee is most likely to be confused with the western or the cryptic bumble bee, although, as noted earlier, the yellow-banded bumble bee lacks a white-tipped abdomen.

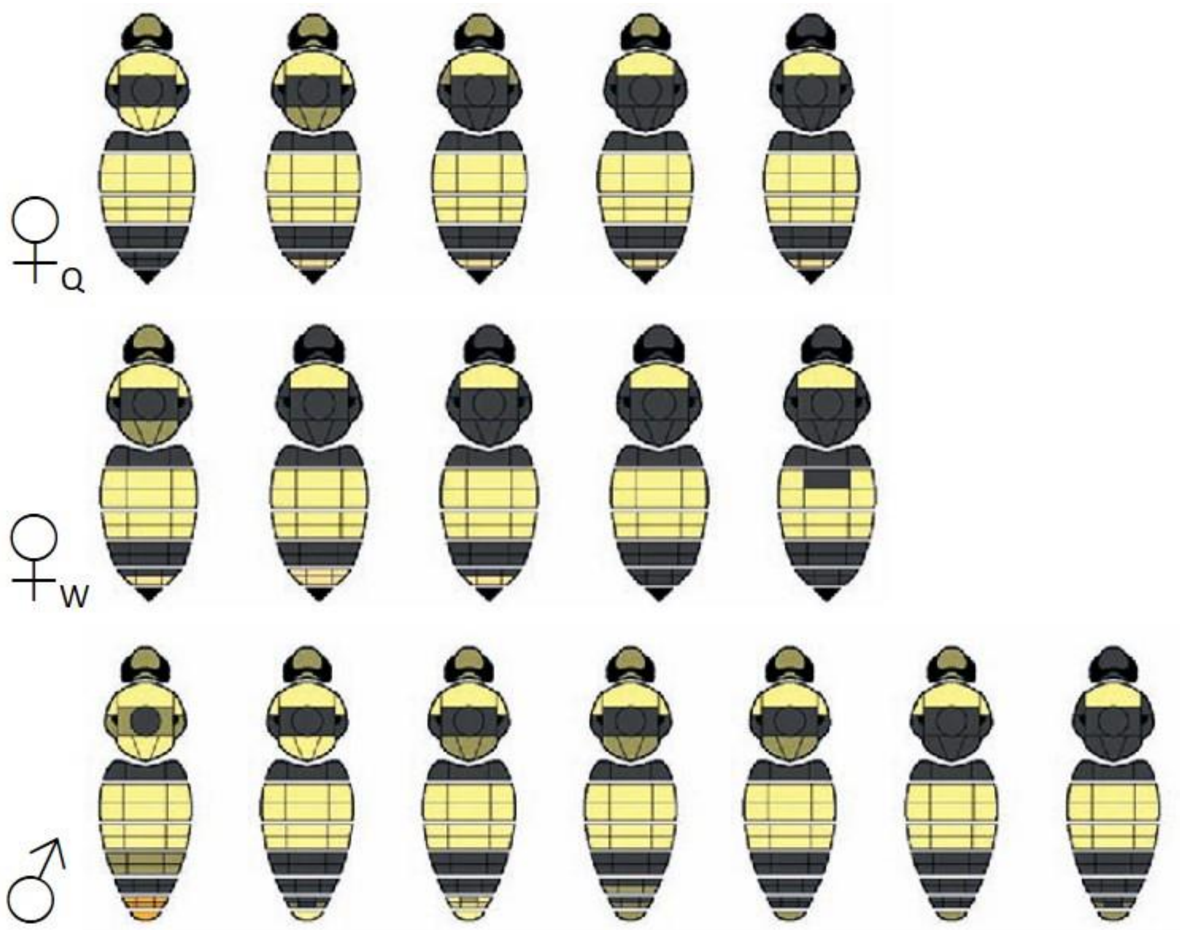

Figure 6. Colours and patterns of the yellow-banded bumble bee, *Bombus terricola*. Top row: female queens. Middle row: female workers. Bottom row: males. Illustrations from Williams *et al.* (2014), used and modified by C. Ernst with permission.

Figure 7. Female yellow-banded bumble bee, *Bombus terricola*. Specimen collected in Caledon, Ontario, in September 2002. Image courtesy of Margarita Miklasevskaja at PCYU with funding from NSERC-CANPOLIN.

Figure 8. Male yellow-banded bumble bee, *Bombus terricola*. Specimen collected in Caledon, Ontario, in August 2013. Image courtesy of Margarita Miklasevskaja at PCYU with funding from NSERC-CANPOLIN.

The appearances of yellow-banded bumble bee eggs, larvae, and pupae are not described in the literature, but they are probably similar to most other immature bumble bees (see the description above). In one study, yellow-banded bumble bee eggs averaged 3.06 mm in length, and 0.94 mm in width (based on 44 eggs) (Fisher and Sampson 1992). It can be difficult to measure bumble bee larvae without fatally disturbing them, but one study of two yellow-banded bumble bee colonies found that mature larvae of workers weighed about 90-300 milligrams (mg), while the mature larvae of queens were much larger and ranged from about 600-800 mg (Plowright and Jay 1968).

Gypsy cuckoo bumble bee

The gypsy cuckoo bumble bee is a medium-sized bumble bee, although smaller than either the western or yellow-banded bumble bee. There are no workers. Reproductive females (Fig. 9) are 1.7-1.9 cm and males (Fig. 10) are 1.1-1.7 cm. The hairs are of a medium length. The outer surface of the female hind tibia is convex, densely covered in hairs, and lacks a pollen basket (corbicula); this characteristic is unique to females of the subgenus *Psithyrus* (i.e., cuckoo bumble bees). The top of the female's abdomen is curved strongly downward (Fig. 9) and the underside of the abdomen has a strong carina (ridge) on either side near the tip.

Figure 9. Female gypsy cuckoo bumblee bee, *Bombus bohemicus*. Specimen collected in Palmer, Alaska, in May 2009. Image courtesy of Margarita Miklasevskaja at PCYU with funding from NSERC-CANPOLIN, used with permission.

Figure 10. Male gypsy cuckoo bumble bee, *Bombus bohemicus*. Specimen collected at Invern, Nova Scotia, in August 2001. Image courtesy of Margarita Miklasevskaja at PCYU with funding from NSERC-CANPOLIN, used with permission.

Colour and patterns differ between the two sexes (Figs. 9-11). On females, the hairs of the face and upper surface of the head are black, occasionally with some yellow hairs at the rear of the head. Head colour is a useful diagnostic field character: other cuckoo bumble bees in the NWT have predominantly pale hairs on the head. The sides of the thorax are predominantly black. Hairs on the third and fourth tergites are variably yellowish-white, but T4 usually has white at least in the middle, and at the back. In the NWT, most females probably have a black abdomen with a white tip (Cannings pers. comm. 2019).

On males (Fig. 10), the fringe of hairs on the first tarsal segment of the hind leg is predominantly black. The sides of the male thorax are extensively black, T2 is entirely black, T4 is yellow with a little black, and T7 is black. Male antennae are of a medium length, with a flagellum about three times longer than the scape.

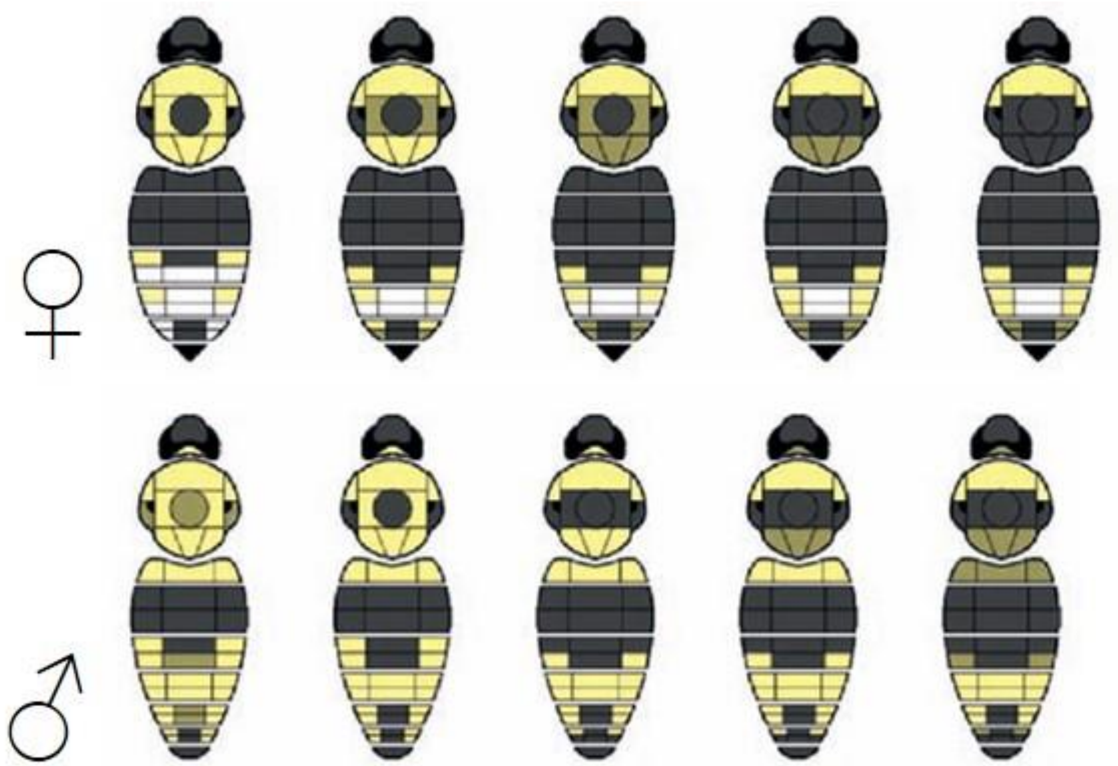

Figure 11. Colours and patterns of the gypsy cuckoo bumble bee, *Bombus bohemicus*. Top row: females (reproductive females only; cuckoo bumble bees do not have a worker caste). Bottom row: males. Illustrations from Williams *et al.* (2014), used and modified by C. Ernst with permission.

In the NWT, the gypsy cuckoo bumble bee is most similar in appearance to the other three cuckoo bumble bees found in the territory: the yellow cuckoo bumble bee (*B. flavidus*), Suckley's cuckoo bumble bee (*B. suckleyi*), and the indiscriminate cuckoo bumble bee (*B. insularis*).

Gypsy cuckoo bumble bee eggs are smaller than those of its hosts (around 2.5-2.6 mm long and 0.6-0.7 mm wide), and are narrowed toward the middle (Fisher and Sampson 1992). Egg cells into which eggs are placed are rougher in shape than those of the hosts, and are constructed from wax collected from destroyed host egg cells and nectar pots (Fisher 1988). The larval and pupal stages of this species have not been described in the literature, but they are likely similar to those of other bumble bees, as described above.

Distribution

The distribution data for all three bumble bee species are based on occurrence and/or collection records for individual specimens at specific locations, rather than populations. Occurrence records are displayed on NWT maps as single points (one point per specimen record). For North American range maps, only one record per locality is displayed per species. GPS coordinates were not available for some records in the original datasets (see *Search Effort* for more information about the data sources), so locality descriptions were used to estimate the coordinates when possible.

World distribution

Western bumble bee

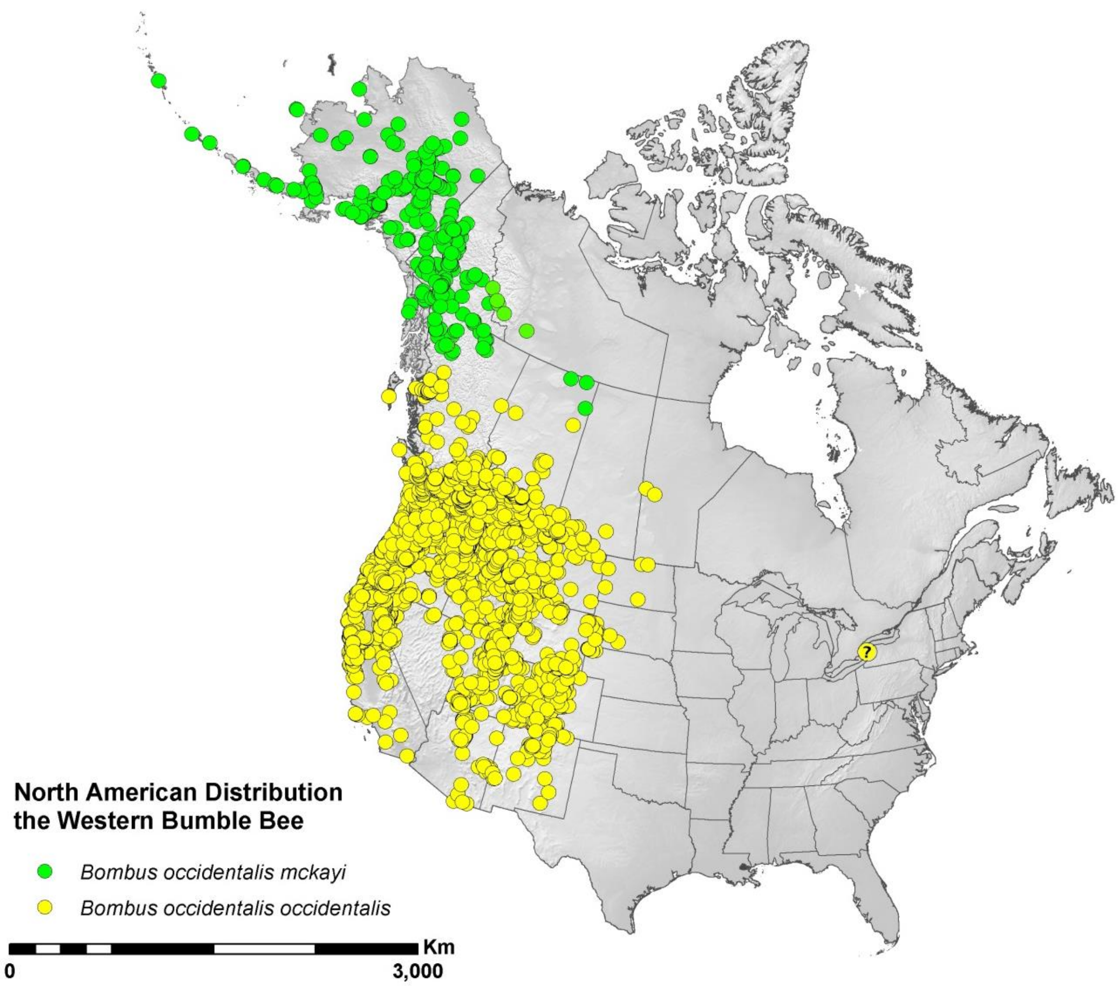

Figure 12. North American distribution of the western bumble bee, *Bombus occidentalis*, including the northern *mckayi* subspecies found in the NWT (green) and the southern *occidentalis* subspecies (yellow). See *Search Effort* for full list of sources from which points were derived. Map courtesy of C. Ernst; updated by B. Fournier, ENR.

The western bumble bee occurs only in North America (although it has historically been imported to Europe and bred commercially there). It has been recorded from the west coast and mountain west regions of North America, from Arizona, New Mexico, and California, north through the Pacific northwest and the tundra/taiga region up to Alaska (Williams *et al.* 2014; Hatfield *et al.* 2015b) (Fig. 12). Its range eastward includes the northwestern Great Plains and southeast Saskatchewan. A single specimen whose identity was confirmed via genetic (mitochondrial DNA) analysis was recently documented in Ontario, Canada (Hatfield *et al*. 2015b). Since this is well outside the species' known range, its presence in eastern Canada must be considered uncertain (perhaps introduced). The two subspecies' populations are distinct, and geographically disjunct.

List of jurisdictions:

- *Bombus o. mckayi*: Canada, at latitudes of approximately 55°N or higher (northern British Columbia, western NWT, Yukon); United States (Alaska).
- *Bombus o. occidentalis*: Canada, at latitudes below approximately 55°N (southern/central British Columbia, Alberta, Saskatchewan, Ontario (uncertain)); United States (Arizona, California, Colorado, Idaho, Montana, Nebraska, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington, Wyoming).

Yellow-banded bumble bee

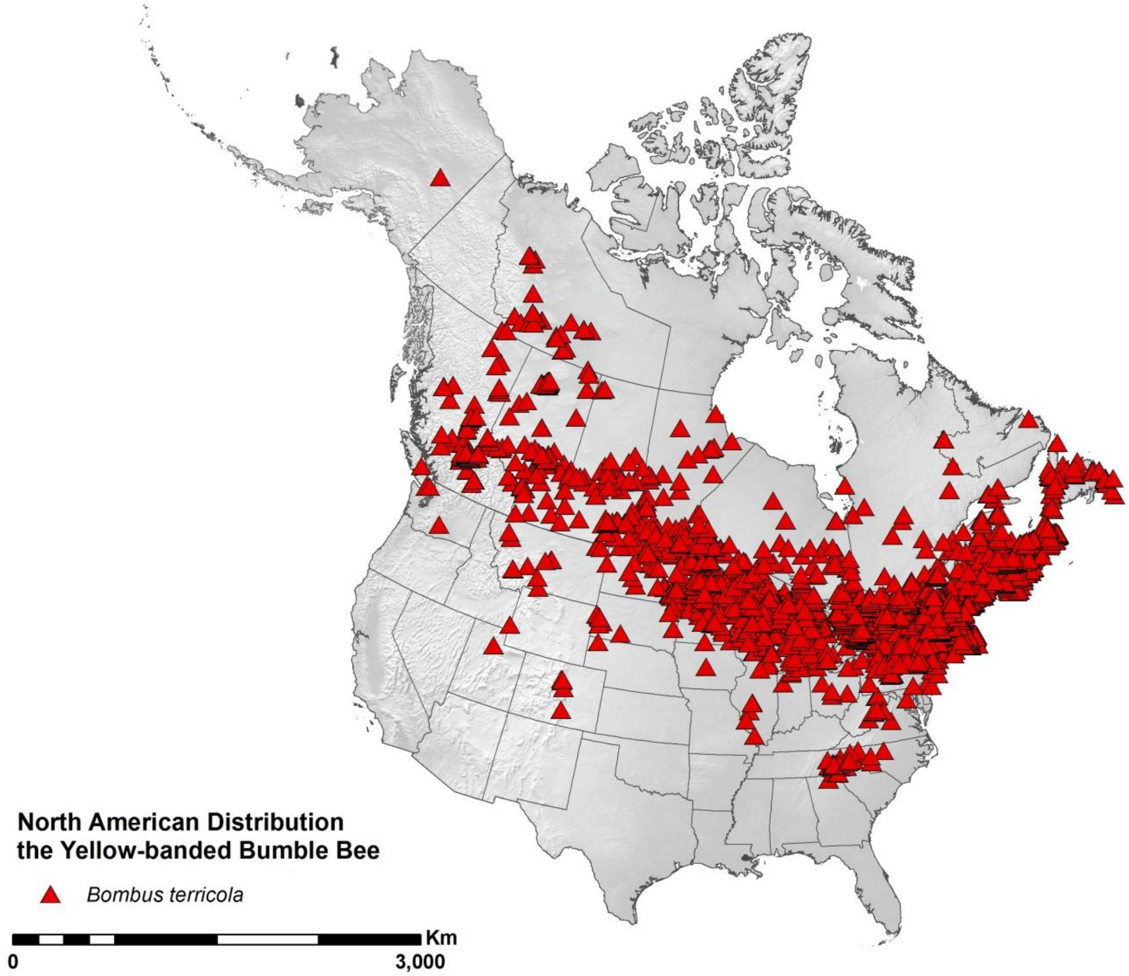

Figure 13. North American distribution of the yellow-banded bumble bee, *Bombus terricola*. See *Search Effort* for full list of sources from which points were derived. Map courtesy of C. Ernst; updated by B. Fournier, ENR. Note that Alaska and Vancouver Island specimens are unconfirmed (Cannings pers. comm. 2019).

The yellow-banded bumble bee is found only in North America (Fig. 13). It has a large range that includes Newfoundland and Labrador, the eastern temperate and boreal forest regions, south along high-elevation regions of the Appalachians, west through North Dakota and the Canadian Great Plains and mountain west, to the tundra and taiga of Canada (Williams *et al*. 2014). Approximately 50-60% of its North American range is within Canada (Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2015).

List of jurisdictions:

- Canada (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, NWT, Nova Scotia, Prince Edward Island, Quebec, Saskatchewan, Yukon); United States (Alaska, Arizona, Colorado, Connecticut, Georgia, Idaho, Illinois (possibly extirpated), Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island, South Dakota, Tennessee, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming) (Hatfield *et al*. 2015a).

Gypsy cuckoo bumble bee

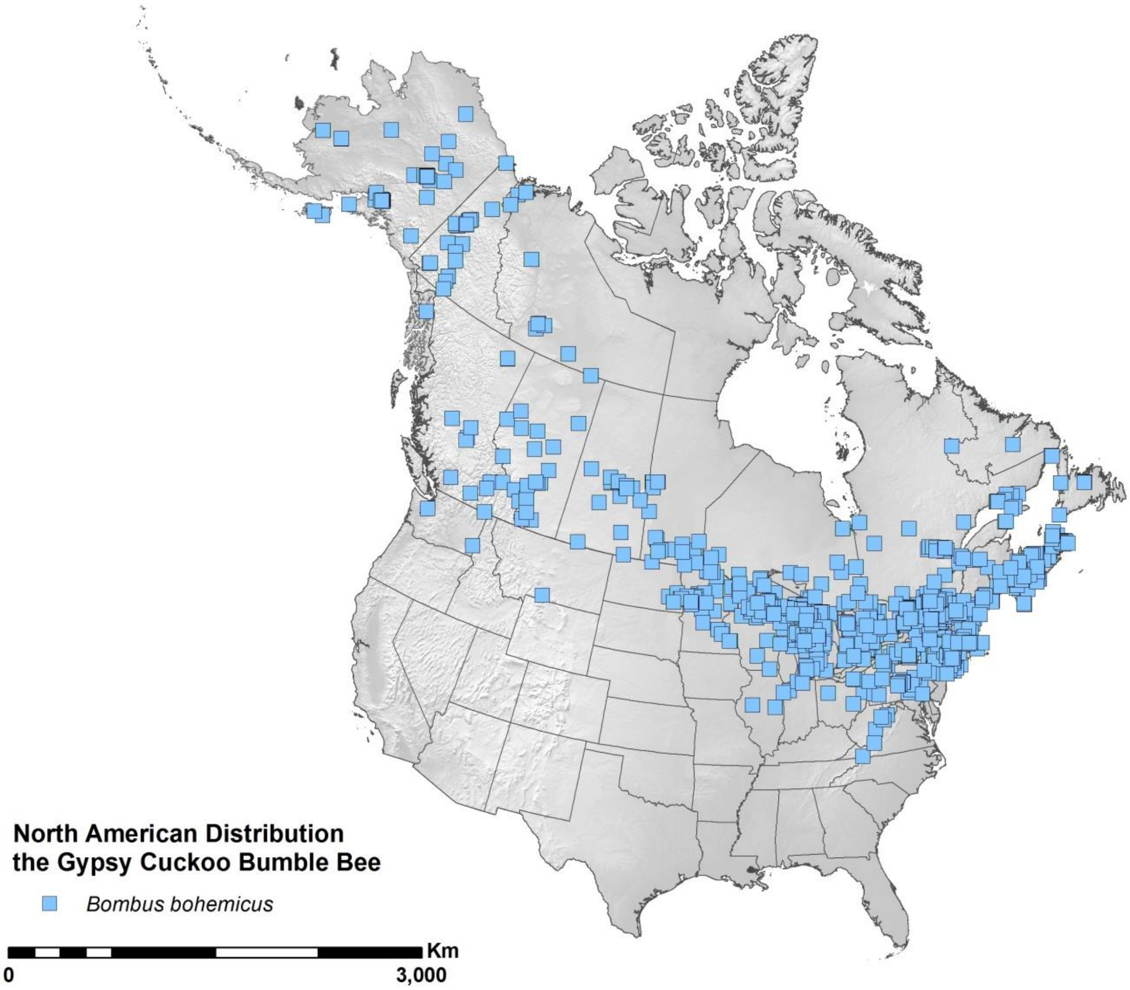

Figure 14. North American distribution of the gypsy cuckoo bumble bee, *Bombus bohemicus*. See *Search Effort* for full list of sources from which points were derived. Map courtesy of C. Ernst; updated and modified by B. Fournier, ENR.

The gypsy cuckoo bumble bee is a Holarctic species. In the Old World, it is found throughout most of Europe (other than Iceland and the extreme southwest): from the north of Spain, the south of Italy and the Balkans in the south, to beyond the Arctic Circle in the north. Its range extends to the Far East of Asia, and south into many parts of China (Hatfield *et al.* 2016).

In North America (Fig. 14), the gypsy cuckoo bumble bee is found in the eastern temperate and boreal forest regions, south along the Appalachians, and northwest through the Great Plains and mountain west to the NWT, Yukon, and Alaska (Williams *et al*. 2014; Hatfield *et al*. 2016). This species has one of the largest ranges of all bumble bee species in Canada (COSEWIC 2014a).

List of jurisdictions:

- Andorra; Austria; Belarus; Belgium; Bulgaria; Canada (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, NWT, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, Yukon); China; Czech Republic; Denmark; Estonia; Finland; France (mainland); Germany; Hungary; Ireland; Italy (mainland); Latvia; Lithuania; Luxembourg; Macedonia; the former Yugoslav Republic; Montenegro; Netherlands; Norway; Poland; Romania; Russian Federation; Serbia; Slovakia; Slovenia; Spain (mainland); Sweden; Switzerland; Ukraine; United Kingdom (Great Britain, northern Ireland); United States (Alaska, Connecticut, Idaho, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, Pennsylvania, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin) (Williams *et al*. 2014; Hatfield *et al*. 2016; Richardson 2018).

NWT distribution and locations

Western bumble bee

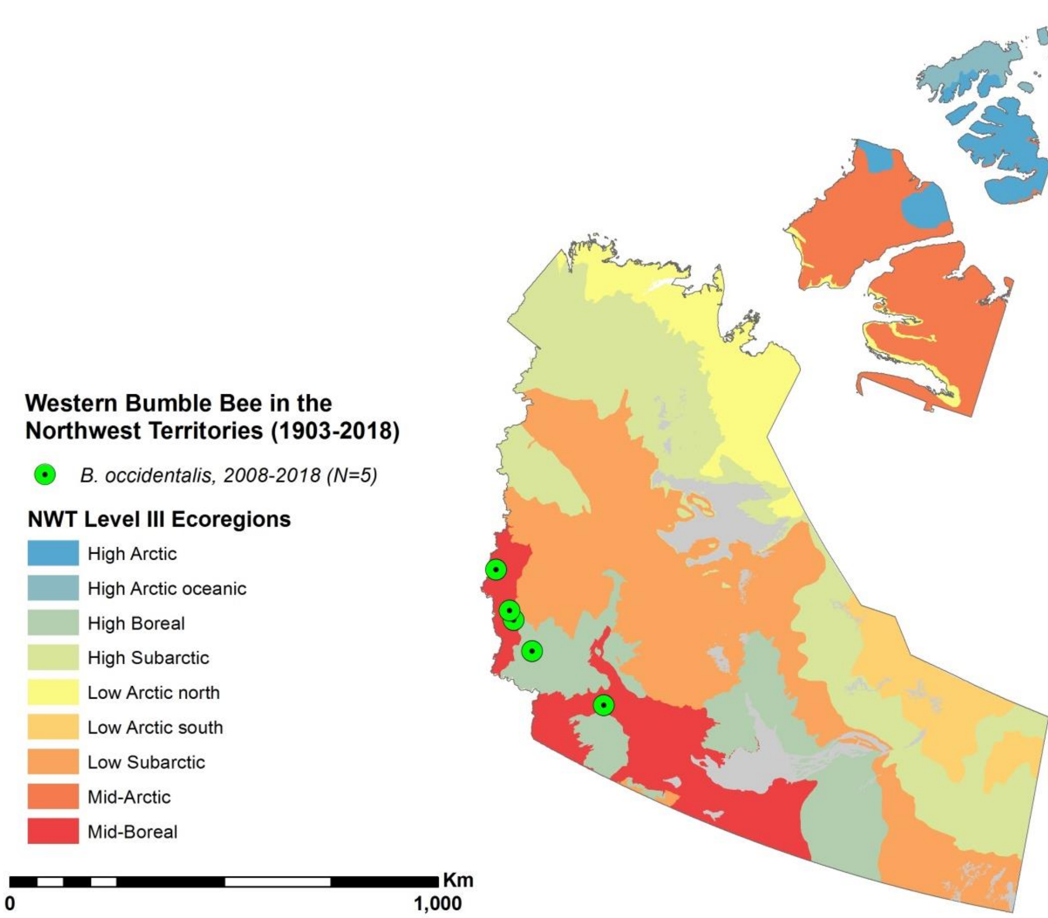

Figure 15. Occurrence records of the northern subspecies of the western bumble bee (*Bombus o. mckayi*) in the NWT. There are no historical records of this species in the NWT (i.e., prior to 2011). Points are derived from 5 records, from a dataset compiled by Leif Richardson (2018) and a 2018 survey effort (Heron unpubl. data 2019). Map courtesy of C. Ernst; updated and modified by B. Fournier, ENR.

In the NWT, the northern subspecies of the western bumble bee (*B. o. mckayi*) has only been collected from five sites in the southwestern NWT (Stotyn and Tate 2012) (High Boreal and Mid-Boreal level III ecoregions; Ecosystem Classification Group [ECG] 2010) (Fig. 15). There is apparently one additional record of the species in the NWT dated August 4, 1944, but the location where this specimen was collected is unknown (COSEWIC 2014b) (see *Appendix A* for occurrence record details).

Yellow-banded bumble bee

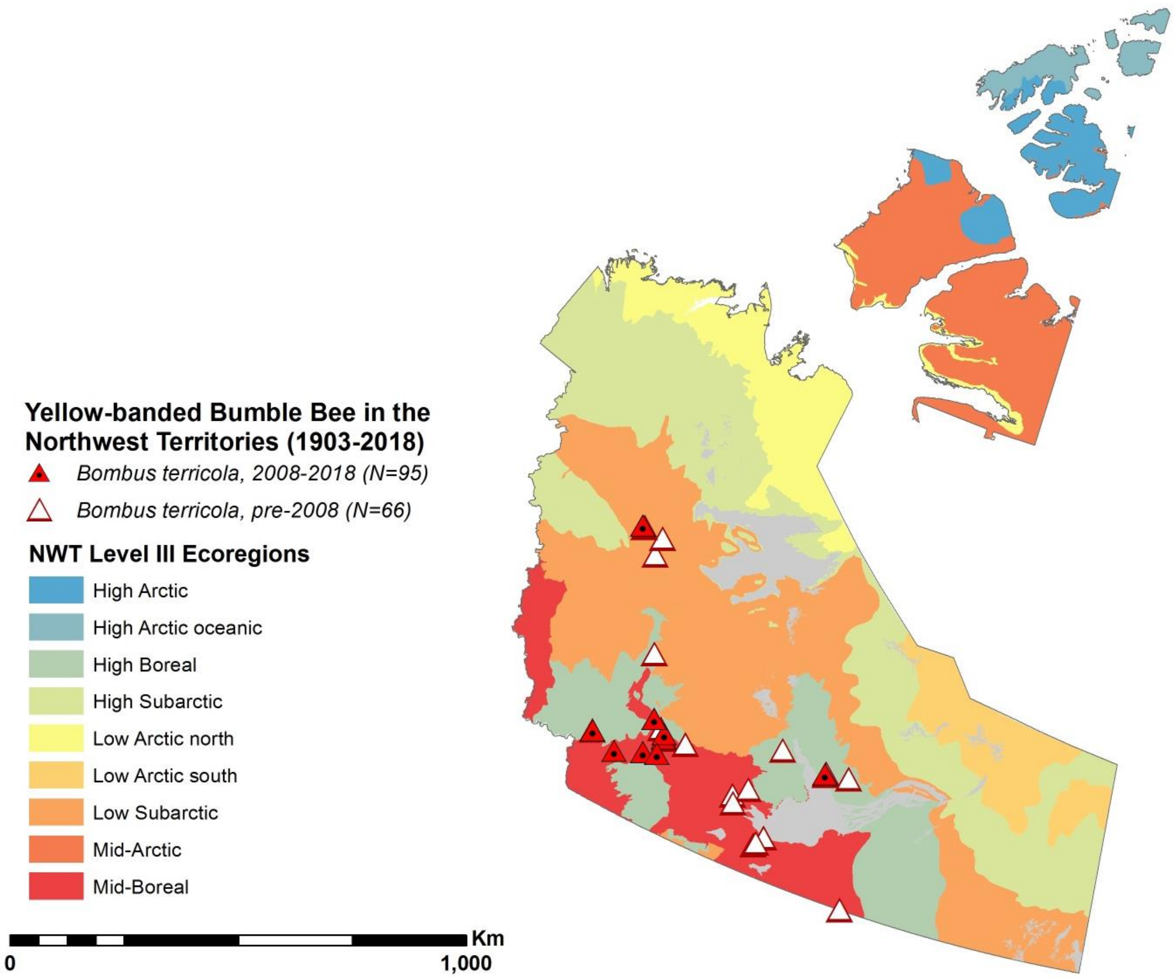

Figure 16. Current (2008-2018) and historical (1903-2007) occurrence records of the yellow-banded bumble bee (*Bombus terricola*) in the NWT. Points are derived from: a dataset compiled by Leif Richardson (2018), a 2017 collection effort contributed by Jennifer Heron (2018), a 2018 survey effort (Heron unpubl. data 2019), and verified sightings or collection events contributed by C. Ernst, using data sourced from www.bumblebeewatch.org. Map courtesy C. Ernst; updated and modified by B. Fournier, ENR.

The yellow-banded bumble bee was first collected in the NWT in 1929 at sites near Fort Norman, Wrigley, and Fort Simpson. The species was most recently collected in 2018 near Fort Simpson (see *Appendix A* for occurrence record details). The yellow-banded bumble bee has been collected primarily in the Mid-Boreal level III ecoregion, with some additional records taken in the Low Subarctic and High Boreal level III ecoregions (ECG 2008, 2009, 2010) (Fig. 16). A total of 161 occurrence records exist for this species (see Table 2).

Gypsy cuckoo bumble bee

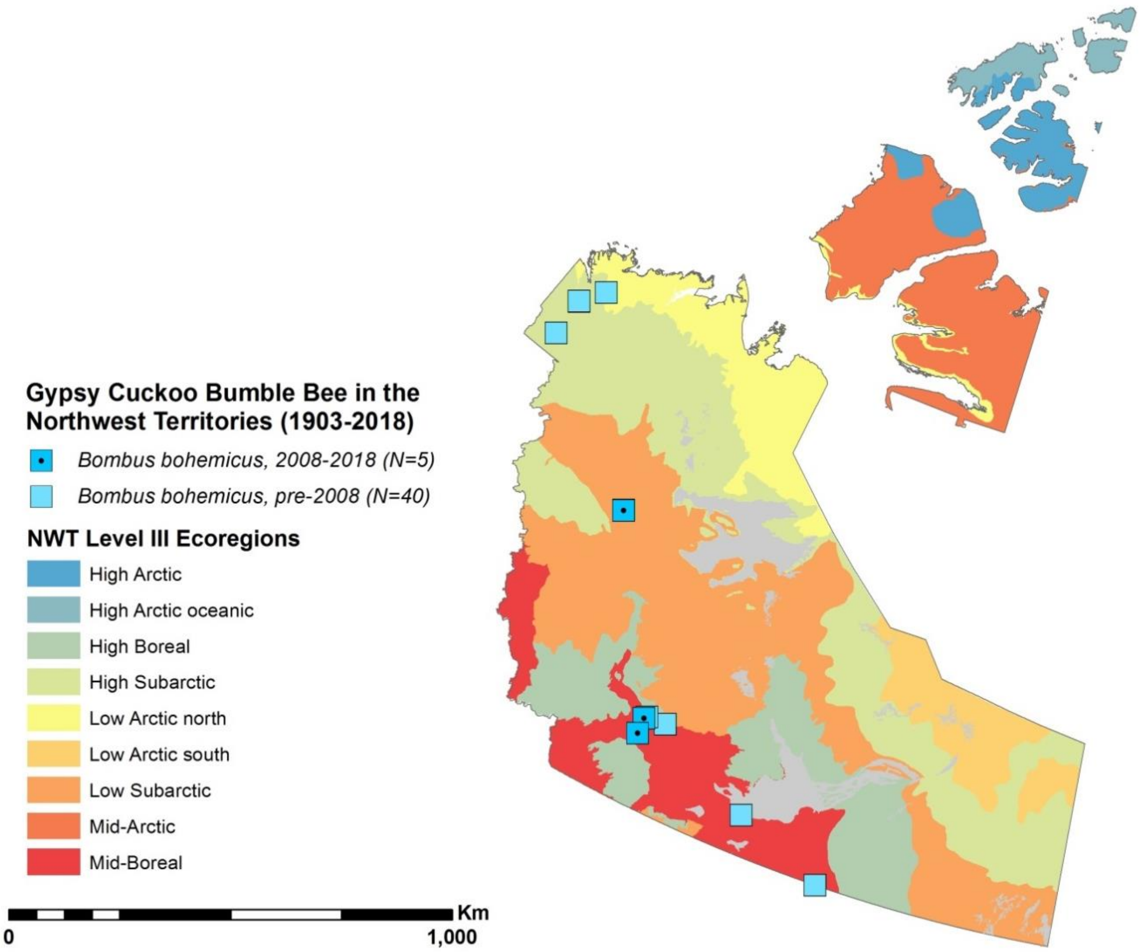

Figure 17. Current (2008-2018) and historical (1903-2007) occurrence records of the gypsy cuckoo bumble bee (*Bombus bohemicus*) in the NWT. Points are derived from: a dataset compiled by Leif Richardson (2018), a 2017 collection effort contributed by Jennifer Heron (2018), a 2018 survey effort (Heron unpubl. data 2019), and verified sightings or collection events contributed by C. Ernst, using data sourced from www.bumblebeewatch.org. Map courtesy of C. Ernst; updated and modified by B. Fournier.

The gypsy cuckoo bumble bee was first collected in the NWT in 1948 at a site along the Mackenzie River delta. The most recent records of this species are from Fort Simpson and Checkpoint in 2018 (Heron unpubl. data 2019) (see *Appendix A* for occurrence record details). This cuckoo bumble bee has been collected at sites along the Mackenzie River in the NWT, within the Mid-Boreal, Low Subarctic, High Subarctic, and Low Arctic north level III ecoregions (ECG 2009) (Fig. 17), although given its dependence on host populations of bumble bees, the ecoregion conditions alone may not be the sole influence on its distribution in the NWT. A total of 45 occurrence records exist for gypsy cuckoo bumble bee in the NWT (see Table 2).

Status of Western Bumble Bee, Yellow-banded Bumble Bee, and Gypsy Cuckoo Bumble Bee in the NWT

Given the scarcity of surveys and occurrence data in the NWT, the lack of records between known occurrence points (positive data) cannot be presumed to indicate that the species are necessarily absent from those areas since surveys were likely not conducted, and appropriate habitat and/or hosts may be present. Similarly, if a species of interest has not been recorded from locations where other bumble bee species were collected, this does not necessarily imply that the species is absent from those locations (i.e., negative data). Depending on a species' commonness, hundreds of bees might have to be collected at a single location before it would be reasonable to draw conclusions about the species' presence/absence (Colla and Packer 2008). Exhaustive searches for all bumble bee species have not been made at any known location in the NWT; rather, collection events were opportunistic and usually yielded small numbers of individual specimens.

Extent of occurrence/area of occupancy

A species' extent of occurrence (EO) is the area contained within the shortest continuous boundary drawn to encompass all the known, inferred, or projected sites of present occurrence of the species, excluding cases of vagrancy. Extent of occurrence was estimated for all three species using the minimum bounding tool in ArcGIS 10.3: this calculates the area within the minimum convex hull circumscribing all sites from which occurrence data (recent and historical) have been obtained for one species. An equal-area map projection (World Cylindrical Equal Area) was used during these calculations to avoid possible bias or distortions (Budic *et al.* 2016).

The area of occupancy (AO) is defined as the area within the EO that is occupied by a species; the precise area of occupancy for these three species could not be determined from the available data. However, an index of area of occupancy (IAO) was calculated for each species. An IAO is defined as the surface area of grid cells that intersect the area occupied by the species (in km^2). In this report, the IAO for each species was determined by overlaying a 2x2 km grid over the species' extent of occurrence, determining the number of grid cells that contained occurrence records, and multiplying that by the area of each cell (4 km^2). IAOs are presented with a caveat: estimated values are likely grossly underestimated because the records are scattered and widespread. They should be viewed as rough approximations at best.

Based on available data, the EO of the *mckayi* western bumble bee in the NWT is approximately 11,730 km^2, and its IAO is 20 km^2 (5 grid cells). However, recent distribution models (COSEWIC 2014b; Sheffield *et al*. 2016) suggest it could be found throughout much of the Boreal Cordillera, and small portions of the Taiga Cordillera (the southernmost reaches) and the Taiga Plains (only in the extreme southwest) (ECG 2010).

The EO for the yellow-banded bumble bee in the NWT is estimated to be 274,903 km^2, and its IAO is approximately 120 km^2 (30 grid cells), based on occurrence records. This species could plausibly be found throughout the south/central regions of the Taiga Plains, and more narrowly to the south in adjacent areas of the Boreal Cordillera and Taiga Shield.

Status of Western Bumble Bee, Yellow-banded Bumble Bee, and Gypsy Cuckoo Bumble Bee in the NWT

Based on available data, the EO for the gypsy cuckoo bumble bee in the NWT is estimated at 246,934 km^2, with an IAO of 44 km^2 (11 grid cells). This species could plausibly be found throughout the Taiga Plains.

Locations

"Location" refers to a distinct area in which a single threatening event could rapidly affect all individuals of the species present. As noted in *Threats and Limiting Factors*, climate change (extreme temperatures and seasonal changes) is considered the most serious threat for western bumble bees. For yellow-banded and gypsy cuckoo bumble bees, both climate change (seasonal changes) and the import of non-native honey and bumble bees (competition and pathogen spillover) represent low-level threats (see *Threats and Limiting Factors*).

If climate change is considered as the most serious plausible threat to bumble bees in the NWT, then locations can be determined for each of the three species using level III ecoregions (classified by vegetation and climate) as a proxy for NWT climatic zones within which each species occurs in the NWT. Following this method, the results are as follows:

- Western bumble bee – 2 locations (High Boreal and Mid-Boreal level III ecoregions) (ECG 2010)
- Yellow-banded bumble bee – 3 locations (High Boreal, Mid-Boreal, and Low Subarctic level III ecoregions) (ECG 2008, 2009, 2010)
- Gypsy cuckoo bumble bee – 4 locations (Mid-Boreal, Low Subarctic, High Subarctic, and Low Arctic north level III ecoregions) (ECG 2009)

Using the import of non-native bees as the most serious plausible threat, with a 1km diameter buffer placed over each occurrence point and overlap eliminated (assuming the possibility of competition/pathogen spread within that arbitrary buffer and then between occurrence points if buffers overlap), then locations are as follows:

- Western bumble bee – 5 locations
- Yellow-banded bumble bee – exceeds the threshold of 10 locations
- Gypsy cuckoo bumble bee – 10 locations

Search effort

With mounting global concern over the health and resilience of wild pollinators, considerable effort has been invested in surveys of bumble bees in North America and elsewhere. Extensive occurrence data are available for wild *Bombus* species compared to many other insect taxa. A compilation of museum and other collection records (see list of all contributors at www.leifrichardson.org/bbna.html) by Leif Richardson (2018) contains over 275,000 North

American specimens identified to the species level, including approximately 1,975 records from the NWT (included in this report). If GPS coordinates for a record were not included in the original dataset, reasonable coordinates were approximated, based on location data (e.g., name of town, landmark, water body, etc.). If a locality could not be reasonably approximated based on available information, the record was excluded from this report (Fig. 18). GPS coordinates were similarly approximated as required for all records of the three species of interest outside of the NWT (i.e., in Canada and the United States) in order to produce North American distribution maps.

According to communications with entomologists and others working in northern Canada, two new field surveys for bumble bees have taken place in the NWT since 2014 (i.e., since the COSEWIC reports were compiled) (see *Contacts*). Sites included in these recent surveys - part of a larger NWT BioBlitz event in 2017[6] and a follow-up survey in the Dehcho in 2018 - were Tuktoyaktuk, Inuvik, Norman Wells, Yellowknife, and Fort Simpson (Heron 2018; Heron unpubl. data 2019). Over 330 specimens were collected during the 2017 survey, including several series of the yellow-banded bumble bee and a single male gypsy cuckoo bumble bee (Heron 2018). In 2018, close to 700 bumble bee specimens were collected, including four gypsy cuckoo bumble bees, one western bumble bee, and 71 yellow-banded bumble bees (Heron unpubl. data. 2019). Together, these surveys represent a very significant contribution to data on NWT bumble bees. Other bumble bee surveys have been conducted in adjacent northern British Columbia and Yukon (Hatten *et al.* 2015; Sheffield *et al*. 2016).

Citizen science initiatives can provide an alternative and scientifically sound source of open-access occurrence data, provided that the identifications are validated by individuals with appropriate taxonomic expertise (Theobald *et al.* 2015; Lukyanenko *et al.* 2016; Sullivan *et al.* 2017). Citizen science may be particularly valuable for recording species over large spatial scales or in locations that are visited infrequently. Citizen science contributions to NWT bee occurrence data are generally scarce, and primarily originate from populated areas such as Yellowknife. Twenty-eight additional records of bumble bee sightings in the NWT were found (either non-target species, or specimens that were not conclusively expert-identified to species), made to citizen science programs[7] between 2012-2017 (Ernst 2018).

[6] http://inaturalist.ca/projects/nwt-tno-bioblitz-canada-2017
[7] Bug Guide or Bumble Bee Watch.

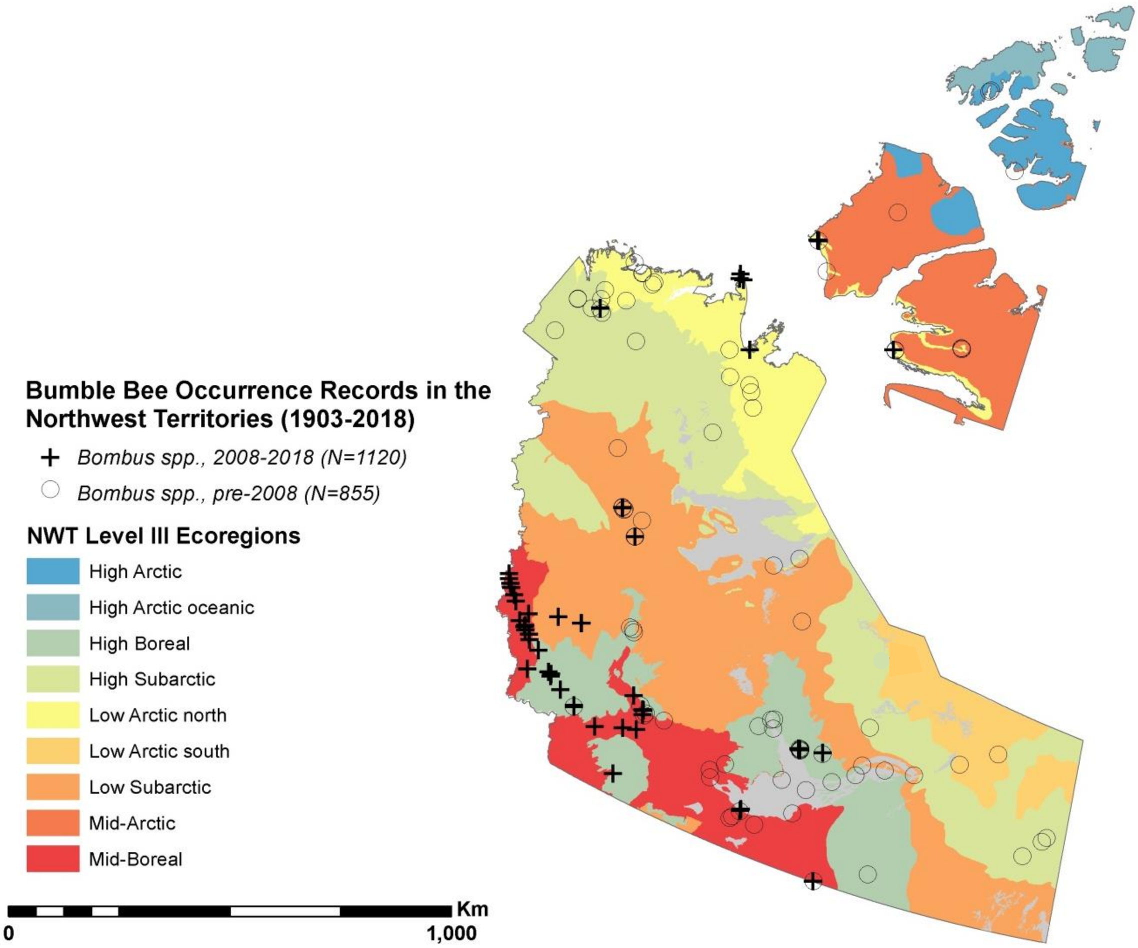

Figure 18. Map of all bumble bee (*Bombus* spp.) occurrence records in the NWT from 1903-2018. Black crosses: current records (2008-2018); black circles: historical records (1903-2007). Points are derived from: a dataset compiled by Leif Richardson (2018), a 2017 collection effort by Jennifer Heron (2018), a 2018 survey effort (Heron unpubl. data 2019), and verified sightings or collection events contributed by C. Ernst (2018). Map courtesy C. Ernst; updated and modified by B. Fournier, ENR.

DNA barcode databases can also be a source of "new" records, when the barcode sequences of older, mis-, or unidentified specimens are clustered within an expected Barcode Index Number (BIN; a grouping with high concordance with species identities) (Ratnasingham and Hebert 2013). A search of DNA barcoded specimens in the Barcode of Life database (Ratnasingham and Hebert 2007) failed to turn up any new reassigned (e.g., cryptic/erroneously identified specimens) records of the species of interest from the NWT.

Approximately 1,975 specimens, representing 25 bumble bee species, have been collected or observed in the NWT between 1903-2018 (Ernst 2018; Heron 2018; Richardson 2018; Heron unpubl. data 2019). Table 2 lists the number of occurrence records for the three species of interest from every decade since 1900, as well as the number of all other bumble bee records combined. For each decade, these data were also used to calculate the relative abundance[8] (RA) of the three species, compared to all other bumble bees recorded in the NWT. One record of the yellow-banded bumble bee and one other bumble bee record are not included in these calculations, as the years during which the specimens were collected are uncertain.

The majority of specimens were collected in the 2010-2018 period (approximately 57%) during the 2017 and 2018 surveys, with about another 26% collected during 1940-1960. The latter specimens may originate from the Northern Insect Survey conducted by the Government of Canada between 1947-1957 (Freeman 2009). No bumble bees were recorded from the NWT between 1980-1999, but this is certainly due to a lack of surveys, rather than the absence of bees.

Table 2. Number of occurrence records and RA (in parentheses, rounded to the nearest decimal) of the western bumble bee (*Bombus occidentalis mckayi*), yellow-banded bumble bee (*B. terricola*), gypsy cuckoo bumble bee (*B. bohemicus*), and number of occurrence records and RA (in parentheses, rounded to the nearest decimal) for other bumble bee (*Bombus*) species recorded from the NWT by decade, from 1900-2018 (total N = 1,975).

Decade	**Western bumble bee**	**Yellow-banded bumble bee**	**Gypsy cuckoo bumble bee**	**Other *Bombus* spp.**	**Total**
1900-1909	0	0	0	11 (100%)	11
1910-1919	0	0	0	3 (100%)	3
1920-1929	0	9 (47.4%)	0	10 (52.6%)	19
1930-1939	0	0	0	69 (100%)	69
1940-1949	0	1 (0.4%)	13 (5.5%)	224 (94.1%)	238
1950-1959	0	25 (9.3%)	24 (8.9%)	221 (81.9%)	270
1960-1969	0	2 (1.2%)	2 (1.2%)	161 (97.6%)	165
1970-1979	0	6 (15%)	1 (2.5%)	33 (82.5%)	40
1980-1989	0	0	0	0	0
1990-1999	0	0	0	0	0
2000-2009	0	22 (57.9%)	0	16 (42.1%)	38
2010-2018	5 (0.5%)	95 (8.5%)	5 (0.5%)	1,015 (90.6%)	1,120
Uncertain	*0*	*1*	*0*	*1*	*2*
Total	5	161	45	1,764	1,975

[8] A species' relative abundance (RA) can tell us how rare or common it is compared to all the members of its community. Here, it measures the proportion of one bumble bee species out of the total number of all bumble bees. For example, in the 1920s, 19 bumble bees were collected and 9 of them were yellow-banded bumble bees. By dividing 9/19, we find that the RA of yellow-banded bumble bees in that decade was 0.474; in other words, 47.4% of all bumble bees were yellow-banded bumble bees. In the 1940s, only one yellow-banded bumble bee was collected out of 238 bees, so its RA was only 0.004, or less than 1%.

Status of Western Bumble Bee, Yellow-banded Bumble Bee, and Gypsy Cuckoo Bumble Bee in the NWT

Compared to other parts of Canada, large expanses of land in northern boreal and arctic regions have been insufficiently sampled for bumble bees in general; most efforts have focused on populated, easily accessible areas (Dennis and Thomas 2000; Funk *et al.* 2005). As a result, we have very little knowledge about historical or current abundances or distributions of any bumble bee species in northern Canada, including the NWT. It is therefore possible that the western bumble bee, yellow-banded bumble bee, and gypsy cuckoo bumble bee have ranges different from those inferred from the sparse data currently available (see estimates in *NWT Distribution*).

BIOLOGY AND BEHAVIOUR

Information in this section is largely drawn from general references on bumble bees (Morse 1982; Benton 2009; Goulson 2010; Williams *et al.* 2014). Other information, including data pertaining specifically to the species of interest where available, is supported by additional citations.

Habitat requirements

Bumble bee habitat must include access to flowering plants throughout the active season, suitable overwintering sites, and for non-parasitic species, suitable nesting sites. Parasitic species like the gypsy cuckoo bumble bee require established colonies of their host species.

Western bumble bee

The western bumble bee is a habitat generalist. Across western North America it can be found at altitudes from sea level to above 2,000 meters, and has been collected from many habitat types: mixed, deciduous, and coniferous forests; open, grassy areas; urban parks and gardens; chaparral and shrub areas; and mountain meadows (Williams *et al*. 2014). The species could reasonably be expected to use many different types of lowland habitat in the NWT.

Records of the northern subspecies (*B. o. mckayi*) in the NWT are located along the South Nahanni River, in the western half of the Boreal Cordillera ecoregion (level II) (ECG 2010) and at Poplar River, in the Taiga Plains Mid-Boreal ecoregion (level III) (ECG 2009). The Boreal Cordillera covers an area of roughly 57,018 km^2 and has some of the tallest and most rugged mountains in the NWT, but there is highly variable topography (ECG 2010). Four records are found in the Mid-Boreal (MB) (level III), an ecoregion with short and cool summers, very cold winters, high levels of precipitation, and a mean annual temperature of -4 to -6°C (ECG 2010). The northernmost record is from the southern half of the Natla Plateau MB (level IV), where lower-elevation plateaus and sloping valleys are dominated by open subalpine spruce-lichen woodlands (ECG 2010). The other two MB records are further south in the Ragged Range Valley MB (level IV); there, the glacial valleys of the South Nahanni are characterized by blankets of till, lodgepole pine (*Pinus contorta*), and trembling aspen (*Populus tremuloides*) amidst mixed-wood and spruce (*Picea* spp.) forests, plus rich wetlands and meadows (ECG 2010). One specimen was collected in the High Boreal (HB) (level III), in the Liard Plateau HB (level IV), where rolling hills and ridges are typically covered with open spruce woodlands and forests (ECG 2010). The Taiga Plains (MB) ecoregion (level III) is the southernmost ecoregion and enjoys the mildest conditions in the NWT. The South Mackenzie Plain (MB) ecoregion (level IV), covers 16,398 km^2 and is a patchwork of productive mixed-wood, deciduous and coniferous forests interspersed with fens. The most recent specimen (2018) was collected from this level IV ecoregion (ECG 2009).

Climatic suitability models show that temperature and precipitation are strong drivers of the subspecies' distribution in northern Canada (Sheffield *et al*. 2016). These models have suggested there may be very little suitable habitat for *B. o. mckayi* in the NWT (they identify a small area in south-central NWT). However, the models are heavily influenced by the much greater number of records from southern provinces, Yukon, and Alaska, and therefore are probably not accurate for the NWT. New models with more NWT specimens would generate a clearer understanding of the habitat and climatic requirements for this species. It is likely that the species is found throughout much of the Boreal Cordillera, at least at latitudes below 65 degrees.

The western bumble bee has been observed from, or could be expected to use the following species as food plants: thistle (*Cirsium* spp.), Richardson geranium (*Geranium richardsonii*), Arctic lupine (*Lupinus arcticus*), raspberry (*Rubus* spp.), and goldenrod (*Solidago* spp.) (Williams *et al*. 2014). Other flowering plant species are probably visited as well.

This species prefers to establish colonies in holes underground, on open slopes bordered by trees, with west-southwest facing entrances and downward-sloping tunnels connecting the belowground chamber to the surface (Hobbs 1967; Richards 1978; Thorp *et al*. 1983; Laverty and Harder 1988). Nest tunnels up to 2.1 meters long have been reported for this species (Macfarlane *et al.* 1994). Western bumble bees do not construct nest chambers themselves. Instead, they use the abandoned burrows of small mammals (squirrels, mice, etc.), or natural cavities such as those formed in rocks (Plath 1927; Hobbs 1967). The western bumble bee will occasionally establish colonies at or above the ground surface: some queens will use artificial "bee houses" attached to tree trunks several feet above the ground as nesting sites (Richards 1978), while another nest was found in logs among railroad ties (Hobbs 1967). In Richards' study (1978), 45% of western bumble bee queens chose nesting sites positioned where open meadows transitioned into aspen groves, 38% opted to nest in forested habitat, and open meadows were selected only 17% of the time.

Western bumble bee hibernacula sites are unknown. Hobbs (1967) described a single western bumble bee hibernaculum found two inches below the ground surface on a steep west-facing hill. It is expected that hibernacula sites are below ground or in decomposing plant matter, as is the case for bumble bees in general.

Yellow-banded bumble bee

The yellow-banded bumble bee is also a habitat generalist. Throughout North America, it has been collected in open coniferous, deciduous, and mixed-wood forests; wet and dry meadows; prairie grasslands; meadows near riparian zones; along roadsides; in taiga adjacent to wooded areas; urban parks; gardens and agricultural areas; subalpine habitats; and others (Williams *et al*. 2014). It has also been recorded in some high-elevation, montane habitats (Tucker and Rehan 2017). The species could reasonably be expected to use a wide variety of habitats in the NWT.

In the NWT, the yellow-banded bumble bee is recorded from the central/southern Taiga Plains Ecoregion (level II), adjacent western Taiga Shield HB (level III) ecoregions, and recently also from the south Nahanni River in the Boreal Cordillera (ECG 2008, 2009, 2010). The Taiga Plains have many waterbodies and extensive peatlands; the Mackenzie River delta occurs mainly in this region (ECG 2009). In the southern third of the Taiga Plains, the climate is quite mild relative to other areas of the NWT (mean annual temperatures of -1 to -4.5°C) with warm, moist summers, and there are species-rich, dense, mixed-wood forests (ECG 2009). The western lower-elevation Taiga Shield HB similarly experiences milder climates, and has discontinuous mixed-wood forests and richly vegetated shorelines around its many ponds and lakes (ECG 2008). Maxent habitat suitability models using the yellow-banded bumble bee's North American distribution suggest there is very little suitable habitat for the species in the NWT (Sheffield *et al*. 2016). However, the models are strongly influenced by the huge number of records from southeastern regions. Refined models using NWT occurrence records would produce different results and possibly provide more insight as to their habitat requirements in the territory.

Like the western bumble bee, the yellow-banded bumble bee nests belowground in abandoned mammal burrows with downward sloping entrances, at depths of 15-45 cm (Plath 1927; Hobbs 1967).

The yellow-banded bumble bee is a generalist floral visitor. In Ontario, it has been recorded from about 90 different flowering plant species, including many introduced species (Colla and Dumesh 2010). Similar food plant diversity was recorded for the species in the northeastern United States (Jacobson *et al.* 2018). In the NWT, the yellow-banded bumble bee is known or expected to visit many species of flowering plants, including asters (*Asteraceae* spp.), gooseberry (*Ribes* spp.), roses (*Rosa* spp.), raspberry (*Rubus* spp.), lowbush cranberry (*Vaccinium vitis-idaea*), and blueberry (*Vaccinium* spp.) (ENR 2017b).

Yellow-banded bumble bee queens overwinter in burrows they construct in loose soil or rotting trees (Benton 2009).

Gypsy cuckoo bumble bee

In the NWT, the gypsy cuckoo bumble bee has been collected throughout the Taiga Plains (level II), from the High Subarctic (HS) (level III) in the north to the Mid-Boreal (MB) (level III) in the south. The HS ecoregion in the north is generally drier and colder than in south/central areas (mean annual temperatures of -5 to -11°C), whereas the MB enjoys the mildest conditions in the NWT (ECG 2009). White spruce (*Picea glauca*)-dominant forests are most common in the Taiga Plains HS; these become more open and shorter at higher latitudes, ultimately transitioning to shrub-dominated tundra (ECG 2009). In the Low Subarctic (LS) (level III), stands of white or black spruce (*Picea mariana*) or regenerating shrub communities are typical of uplands; peatlands with permafrost dominate lowlands (ECG 2009). Mixed-wood forests of aspen (*Populus tremuloides*), balsam poplar (*P. balsamifera*), white spruce, and paper birch (*Betula papyrifera*), containing diverse shrub and herb understories interspersed with fens describe the MB ecoregion (ECG 2009). Forested areas appear to be an important component of gypsy cuckoo bumble bee habitat in the NWT. The gypsy cuckoo bumble bee was found in the Mackenzie Delta HS Ecoregion (level IV) prior to 2008. The most recent specimens were found in the LS and MB (level III) ecoregions.

As a social parasite, the gypsy cuckoo bumble bee does not require nesting habitat per se, but it does need the nests of suitable bumble bee hosts to reproduce. Most cuckoo bumble bee species are quite specialized and parasitize only one bumble bee host; more rarely, they can have as many as five hosts (Williams 2008). The gypsy cuckoo bumble bee is one of these rare generalists at a global scale, parasitizing bumble bees of the subgenus *Bombus senso stricto*. Although its only confirmed host in the NWT is the yellow-banded bumble bee, the cryptic bumble bee and western bumble bee are also likely hosts (COSEWIC 2014) (Fig. 19).

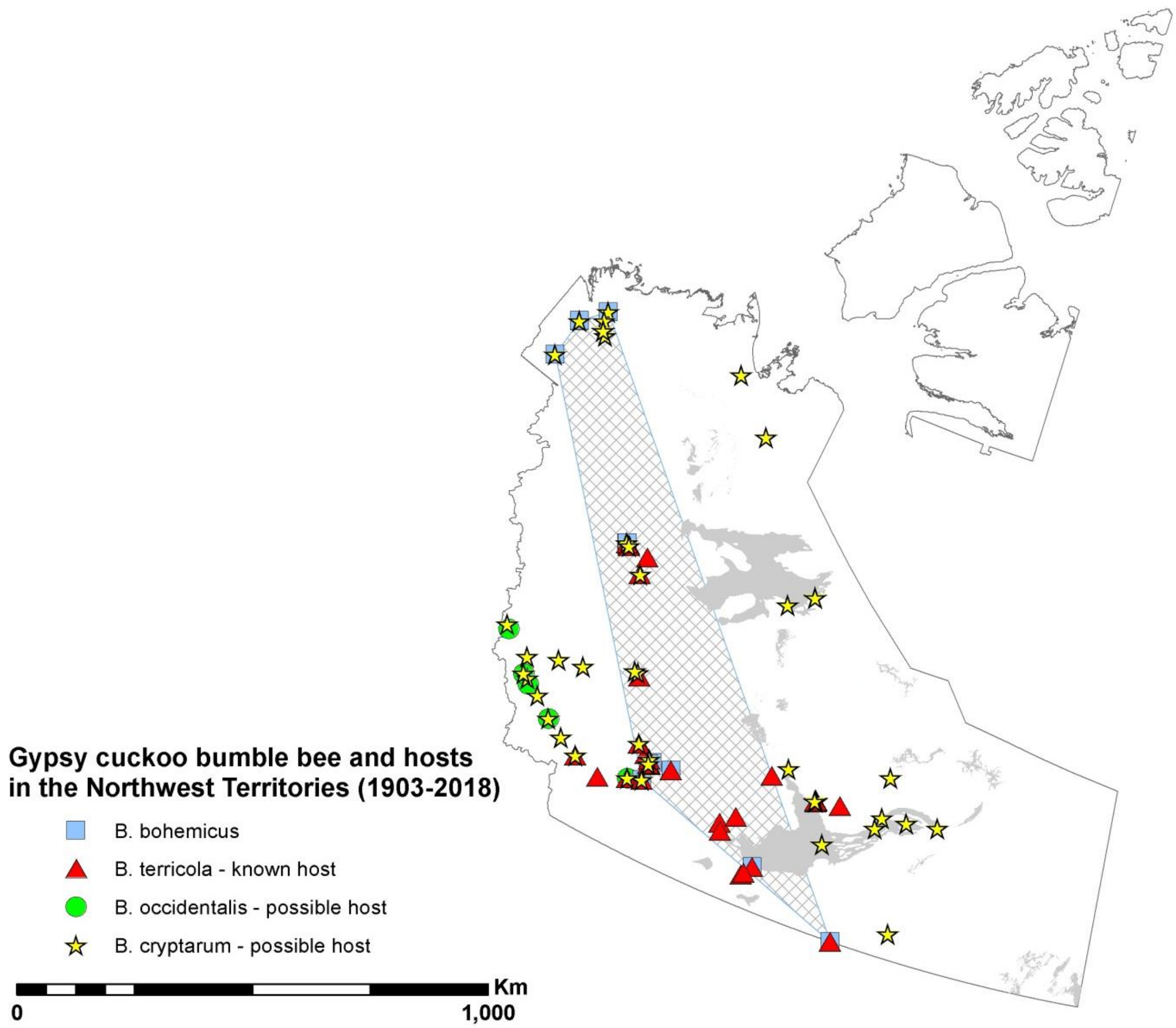

Figure 19. Occurrence records of the gypsy cuckoo bumble bee (*Bombus bohemicus*; blue), its known host the yellow-banded bumble bee (*B. terricola*; red) and two potential hosts, the cryptic bumble bee (*B. cryptarum*; yellow) and the western bumble bee (*B. occidentalis*; green), in the NWT from 1903-2018. Shaded region enclosing gypsy cuckoo bumble bee records illustrates the extent of occurrence for this species, based on historic and recent records. Points are derived from: a dataset compiled by Leif Richardson (2018), a 2017 collection effort contributed by Jennifer Heron (2018), a 2018 Dehcho survey (Heron unpubl. data 2019), and verified sightings or collection events contributed by C. Ernst (2018). Map courtesy of C. Ernst; updated and revised by B. Fournier, ENR.

Floral visitation records from other provinces suggest that the gypsy cuckoo bumble bee is a generalist forager, but it may be more selective about its nectar sources than western and yellow-banded bumble bees, as it tends to be associated with plants that flower close to wooded areas (Colla and Dumesh 2010). In the NWT, the gypsy cuckoo bumble bee is thought to visit thistle, raspberry, goldenrod, blueberry, cranberry, and Nahanni aster (*Symphyotrichum nahanniense*) (ENR 2017b).

The gypsy cuckoo bumble bee's overwintering sites are unknown, but it most likely uses hibernacula situated below the soil surface or in decomposing plant matter, as is the general habit of bumble bees.

Movements

Bumble bees are capable of flying distances of at least several kilometers (Rau 1924; Heinrich 2004; Hagen *et al.* 2011); for example, males of the buff-tailed bumble bee (*B. terrestris* Linnaeus 1758) can fly up to 9.9 km from their colony (Kraus *et al.* 2009). New queens disperse to establish new colonies after emerging from their hibernacula in the spring. Dispersal capabilities for the three species of interest are not known. Queens of other bumble bee species have been observed to establish new nests at distances ranging from 400 meters to 9.9 km from their hibernacula (see Owen *et al.* 2011 and references therein). Estimates of different species' dispersal rates vary from 0.3 km to 10 km per generation (i.e., per year) (Stout and Goulson 2000; Owen *et al*. 2011). Potential geographic barriers for dispersal include mountain ranges and large water bodies, although individual species vary considerably in their ability to overcome such barriers (Benton 2009).

Female workers are generally thought to forage close to their nests, perhaps within 300-600 meters, likely because the time and energetic costs of the flight are high (see review by Dramstad 1996). Mark-recapture studies suggest that workers faithfully use the same forage patch throughout their lifetime. Assuming a maximum foraging distance of 600 meters, a forage patch could be as large as 1.13 km^2 (Dramstad 1996). Bumble bees will forage much further from their nests (up to 1,750 meters in one case) if there is a particularly abundant food source, but these instances are generally known only from agricultural systems with dense monocultures of flowering crops and high nectar rewards (e.g., Walther-Hellwig and Frankl 2000), and these are uncommon in the NWT.

Gypsy cuckoo bumble bee dispersal must be contingent upon and limited by the movements of its host(s).

Life cycle and reproduction

Bumble bees are eusocial[9] insects that live in nests, or colonies, usually consisting of a single queen and female workers. Colonies are annual, with a single generation produced per year, and consist of three adult castes (specialized groups with different behaviours and roles): a queen (the reproductive female), workers (typically the non-reproductive female offspring of the queen), and males (reproductive). Cuckoo bumble bees are the exception; as parasites, they have only

[9] Eusocial animals live in groups and have highly advanced social structures. Individuals cooperate and take care of the young, they have overlapping generations of adults (in bumble bee colonies, new queens and males live with the original queen when they are young), and different groups of individuals (called "castes") have different behaviours and roles in the colonies.

reproductive females and males, with no queen or worker castes (more information about the cuckoo bumble bee life cycle is provided later in this section).

Western and yellow-banded bumble bees

New bumble bee colonies are established by young queens each spring. Queens seeking new nesting sites will fly low over the ground, inspecting different objects and landscape features that might serve as an adequate location. When a suitable site is located, western bumble bee queens will drag dead grass or soil into and around the tunnel entrances, apparently to disguise or reduce the size of the entrances (Hobbs 1967). Queens will also generally rearrange any nesting materials (grass, leaves, hair, etc.) already present in the cavity before starting to produce egg cells and storage pots for honey production, using slivers of wax she produces from glands on her abdomen. She will then forage for nectar and pollen before laying eggs, which hatch in about four days. The larvae have four instars[10], and take roughly two weeks to fully develop. The larvae initially feed on pollen, and may also be directly fed honey by the queen, a role later assumed by workers. The western bumble bee is a "pollen-storing" species, meaning that each larva is fed pollen individually ("pocket-making" species distribute food rather unevenly across clumps of egg cells) (Hobbs 1967). Pollen-storers may need more pollen than pocket-making bumble bees to initiate worker production. Mature larvae spin cocoons and pupate[11], and develop for an additional two weeks, making the total development time approximately 5 weeks. The new adult female workers emerge from the pupae and begin foraging and feeding for the queen and subsequent broods.

In temperate and arctic environments, the maximum size a bumble bee colony can reach is largely limited by food availability, which is closely tied to the length of the active season and weather conditions. Despite challenging climatic conditions, northern bumble bees develop relatively large colonies, perhaps because they tend to establish early in spring and produce reproductives[12] quite late in the fall (Hobbs 1967) (likely late July in the NWT (Cannings pers. comm. 2019)). Established western bumble bee colonies can contain up to 1,685 workers and produce up to 360 new queens (Macfarlane *et al*. 1994). In the NWT, active western bumble bee workers were observed in mid-July, while yellow-banded bumble bee workers have been encountered from early June until early September (Fig. 20). Assuming that it takes about five weeks for the first worker brood to develop and begin foraging, some yellow-banded bumble bee queens must be active by late April/early May, and western bumble bee queens must be active by early June. More data are required from the NWT to fully understand the timing of emergence and development of these species.

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[10] An instar is a growth stage of a larva. Between each growth stage, the larva sheds its skin (this is called "molting"), revealing the larger instar beneath. This is how the larva grows and gets bigger over time.
[11] When a larva pupates, it has its final molt (skin shed) and becomes a pupa. While the larva feeds and is active, the pupa is an inactive form. It is the final stage before becoming an adult.
[12] "Reproductive" or "reproductives" refers to female and/or male individuals capable of producing offspring.

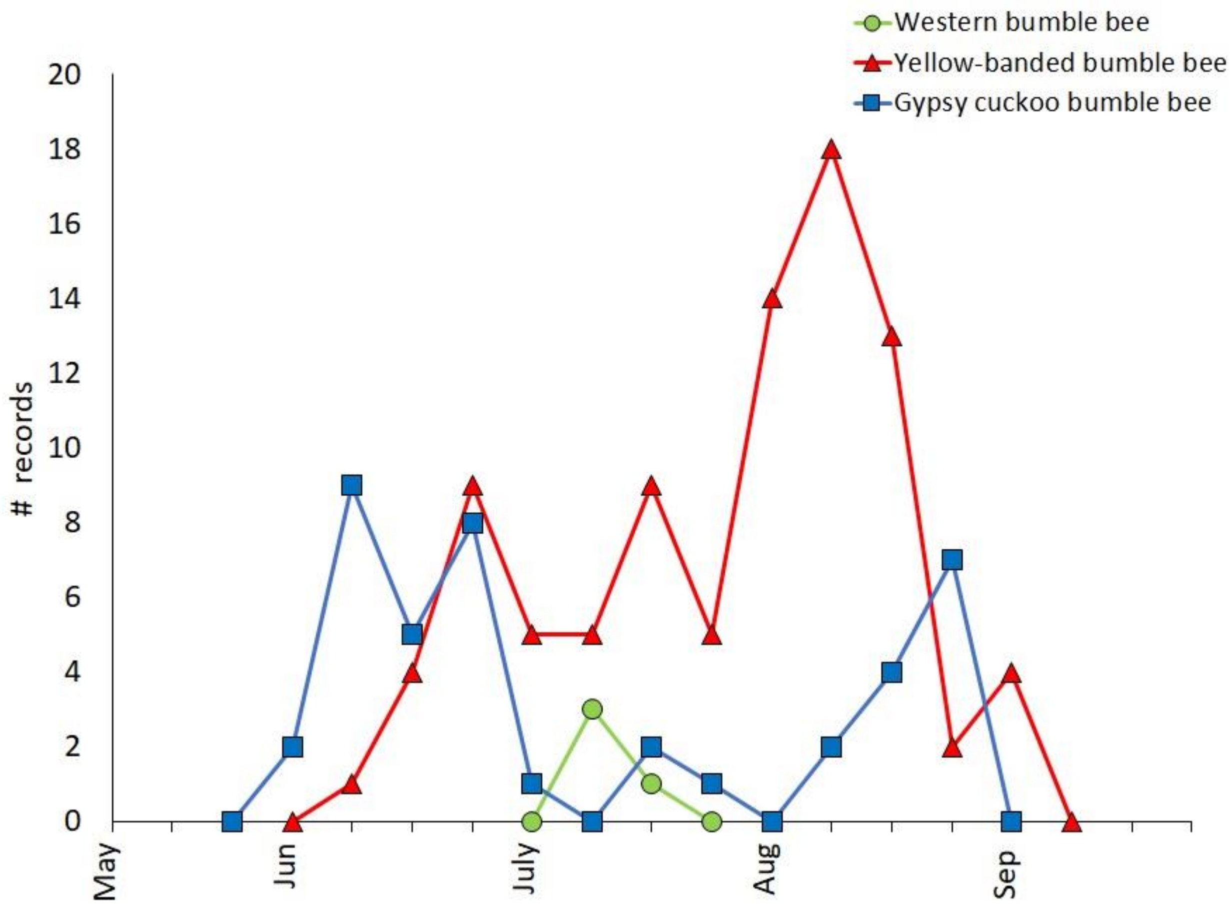

Figure 20. Seasonal activity patterns from May to September of the western bumble bee (*Bombus occidentalis*), yellow-banded bumble bee (*B. terricola*), and gypsy cuckoo bumble bee (*B. bohemicus*) in the NWT. Reported values are the total number of specimens (all castes) collected during each quarter of each month (all years combined). The observation date for one record of the yellow-banded bumble bee was not available, so it was omitted from this analysis. In instances where observation dates were recorded as a date range (i.e., when passive traps were deployed for multiple days), the median day was used as an approximation. Data are derived from: a dataset compiled by Leif Richardson (2018), a 2017 collection effort contributed by Jennifer Heron (2018), and verified sightings or collection events from www.bumblebeewatch.org (Ernst 2018). Figure courtesy of C. Ernst.

The queen produces reproductive males and new reproductive females at the end of the active season. Males patrol established territorial circuits daily in search of mates, depositing species-specific pheromone scent-markers at what have been variously termed "stopping places" or "buzzing places" along the route. It is assumed that females are attracted to these marked sites, and that mating occurs when males revisit them the following day (Hobbs 1967), but there is little evidence to support this assumption.

All workers die at the onset of winter, along with the old queen and males. Only the young, mated females survive the cold winter temperatures by hibernating in sheltered overwintering sites (hibernacula). Mated young females may begin constructing their hibernacula as early as the same day as copulation.

Gypsy cuckoo bumble bee

Because cuckoo bumble bees have no pollen baskets on their legs, they cannot collect pollen. The gypsy cuckoo bumble bee is thus an obligate social parasite, and has a different reproductive strategy than non-cuckoo bumble bees. Like the birds of the same name, cuckoo bumble bees do not construct nests or rear workers on their own. Rather, they invade and deposit their eggs in the nests of other bumble bees and rely on the hosts' workers to rear their young (Fisher 1984). The gypsy cuckoo bumble bee is a parasitic generalist, and uses many different species of bumble bees as hosts across its global range (Benton 2009; Bunk *et al.* 2010). Its confirmed hosts in North America are the rusty-patched bumble bee (*B. affinis*; not found in the NWT) and the yellow-banded bumble bee. Possible hosts also include the western bumble bee and cryptic bumble bee (the gypsy cuckoo bumble bee parasitizes the latter species in Europe and it is also present in the NWT) (Bunk *et al.* 2010; Williams *et al*. 2014). Compared to other cuckoo bees that take over or kill the host queen, the gypsy cuckoo bumble bee takes a relatively passive approach to invasion, avoiding conflict with the host queen or antagonizing the workers: a gypsy cuckoo bumble bee female can often be found "peacefully" incubating cocoons alongside the host queen within minutes of the parasite's arrival in the nest (Fisher 1984).

Female cuckoo bumble bees emerge later in the spring than their host species (Suhonen *et al.* 2015), then seek colonies to invade. Gypsy cuckoo bumble bees in the NWT have been observed in late May – earlier in the active season than their known host, the yellow-banded bumble bee (Fig. 19). This is a good indication that gypsy cuckoo bumble bees probably use at least one other early-emerging species as a host. Several NWT species have been observed in late April and early May, including the cryptic bumble bee.

Female cuckoo bumble bees detect host colonies by species-specific scent marks deposited by host workers at the nest entrance (Foster and Gamboa 1989; Fisher *et al.* 1993; Bunk *et al*. 2010; Martin *et al*. 2010). Upon entry in a host nest, the female gypsy cuckoo bumble bee is typically met by attacking workers attempting to bite and sting the intruder bee; the cuckoo bee will in turn remain motionless, move slowly to the outer edges of the comb, or hide under the comb or host queen (Fisher 1984). Female gypsy cuckoo bumble bees rarely retaliate with stinging, opting instead to threaten workers by grabbing and positioning them as if to sting before releasing them, and very few host workers are killed in these interactions (Fisher 1984). The intensity and duration of the host worker attacks increase with the size of the colony (in large colonies the female cuckoo bumble bee may be entirely engulfed in a ball of attacking workers), and the likelihood of a successful invasion correspondingly decreases with host colony size (Fisher 1984, 1987). It is perhaps unsurprising that female gypsy cuckoo bumble bees are generally more likely to try invading small colonies rather than large ones. If she is not attacked, the invading female will groom herself for several minutes, then follow the host queen and/or rub her own body against the comb (this probably reduces or masks scents that make it obvious she is an intruder) (Fisher 1984; Kreuter *et al.* 2012).

The female cuckoo bumble bee deposits her eggs in egg cells made of wax salvaged from damaged host egg cells. She helps the host workers care for her brood by defending them from attacks, as well as by feeding and incubating them (Fisher 1988). Like the western bumble bee and yellow-banded bumble bee, gypsy cuckoo bumble bee reproductives are produced at the end of the active season. Male gypsy cuckoo bumble bees also patrol scent-marked routes to locate female mates. Interestingly, the pheromones they leave on stopping places seem to cause males to gather together (Kullenberg 1956 *in* Goulson 2010), possibly to give females a better opportunity to select a high quality mate among multiple candidates.

Physiology and adaptability

Bumble bees are most diverse and most strongly associated with cool, temperate habitats in the northern hemisphere (Williams *et al*. 2014), including arctic, subarctic, and boreal regions (Martinet *et al*. 2015). Generally, their bodies are adapted for living under these relatively cool conditions: they have large and densely hairy bodies (both reduce heat loss), dark heat-absorbing colours, and are able to fly in temperatures close to 0°C because they have the ability to shiver the muscles in the thorax, which brings their internal temperature up to the 30°C needed for flight (Heinrich 2004; Goulson 2010). Northern bumble bee species tend to have larger bodies, shorter legs, and longer hair compared to their southern counterparts, all of which help them preserve heat and prevent heat loss (Peat *et al*. 2005). The northern *mckayi* subspecies of the western bumble bee has longer hair than the southern subspecies.

Physiological heat tolerance limits have not been identified at northern latitudes or for the three species being considered in this report. In general, however, the maximum thoracic temperature bumble bees can tolerate is roughly 44°C; anything higher is probably fatal for most bees (Goulson 2010). In natural conditions, bumble bees can cool themselves by ceasing flight, staying in shade, and/or going underground, but these behavioural changes are energetically costly (Sunday *et al.* 2014), as they prevent bees from foraging.

Extended exposure to high ambient temperatures can result in a phenomenon called "heat stupor", where the bumble bee falls on its back, becomes immobilized, and loses its normal reflexes; heat stupor is often followed by death shortly after (Martinet *et al*. 2015). The time it takes for a bumble bee to experience heat stupor is probably species-specific. Martinet *et al.* (2015) assessed the time it took six European bumble bee species to reach heat stupor (time before heat stupor; THS) after being placed in an incubator at 40°C. The white-tailed bumble bee (*Bombus lucorum*) is a close relative of western and yellow-banded bumble bees. The median THS for the white-tailed bumble bee was higher than all other species in the study (242 minutes), but only 26% of them survived the experience (Martinet *et al*. 2015). On the other hand, Fernald cuckoo bumble bees (*B. flavidus*) in the same study had a median THS of only 82 minutes, but 48% of them survived (Martinet *et al.* 2015). In the study, the lowest THS (31 minutes) was associated with two true arctic species of the subgenus *Alpinobombus*; their survival rates were between 52 and 56% (Martinet *et al.* 2015). The two *Alpinobombus* species also had the largest body sizes out of the six species in the study (the largest bumble bee species are typically found in the far north) (Peat *et al.* 2005). Animals with large bodies have small surface area to volume ratios, which makes them lose heat more slowly (this is why larger animals are common in the far north) (Blackburn *et al.* 1999). The few bumble bees found in the tropics are, unexpectedly, the largest, but they also have long extremities and short hair, which must adequately permit them to thermoregulate even in hot ambient temperatures (Peat *et al.* 2005).

Large-bodied bees in North America are more likely to have declined in abundance in the last 140 years (Bartomeus *et al.* 2013). There are some reports by residents of the NWT that bumble bee body size has changed during their lifetime; that they are now "much bigger than years ago" (Ellen Firth *in* Benson 2012).

Female gypsy cuckoo bumble bees have adaptations that may help them successfully invade a host colony and defend against attacks by host workers. They have large, well-muscled mandibles (jaws); bodies with extra-thick exoskeletons[13]; and long, broad, and strongly curved stingers through which large amounts of venom can be pumped (Fisher and Sampson 1992). Additionally, female gypsy cuckoo bumble bees have twice as many ovarioles[14] as at least one of their hosts (the yellow-banded bumble bee), and their eggs are much smaller (Fisher and Sampson 1992). These differences might allow gypsy cuckoo bumble bee females to produce more offspring than their hosts, and increase the chances that their offspring will receive a greater share of the colony's resources (food, protection) and improve their chances of survival.

As short-tongued species, western and yellow-banded bumble bees forage at open flowers with short corollas (the part of the flower where petals are fused into a tube that leads to the nectar). While reaching its tongue into a flower's corolla to collect nectar, a bumble bee gathers or deposits pollen: short-tongued bees are therefore pollinators of flowers with short corollas. However, both western and yellow-banded bumble bees are known to be primary nectar-robbers, meaning that they can avoid the obstacle of long corollas by chewing holes at the base of the tube to access the nectar ("robbed" flowers are not pollinated by the bees as a result) (Miller 1978; Laverty and Harder 1988; Goulson 2010). The western bumble bee is one of only two bumble bee species that have mandibles with distinct teeth (Goulson 2010); this rather unique adaptation makes nectar-robbing even more efficient.

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[13] The exoskeleton is the hard outer body covering that provides protection and support. Bees and other insects have no bones or internal skeletons.

[14] Ovarioles in bees are like ovaries in mammals: this is where eggs are produced in females.

Interactions

Pollination ecology

Bumble bees depend on a wide variety of flower species for nectar and pollen and are important generalist pollinators of flowering plants. Plants in the NWT either known or assumed to be visited and pollinated by the three bumble bee species of interest are listed previously (see *Habitat Requirements*). The two nectar-robbing species may have a negative effect on the reproductive success of some flowering plants with long corollas, but the effects of nectar-robbing on fruit and seed production probably varies by plant species (Ledbetter 2017). The yellow-banded bumble bee is an important pollinator of commercially-grown lowbush blueberry and cranberry (Evans *et al.* 2008). Neither blueberries nor cranberries have been commercialized in the NWT, but wild blueberry and cranberry (*Vaccinium*) species are widely harvested for personal consumption (Murray and Boxall 2002; Wohlgemuth 2012). Wild *Vaccinium* are likely pollinated by all three species. The gypsy cuckoo bumble bee has been recorded on the Nahanni aster (NWT Species at Risk [NWT SAR] 2018), a rare endemic plant known only from the Nahanni National Park Reserve in the NWT (Working Group on General Status of NWT Species 2016). It is unknown how much, if at all, this rare species depends on the gypsy cuckoo bumble bee for pollination. All three bumble bee species likely forage alongside each other where their distributions overlap (perhaps competitively), and they would also compete for pollen and nectar resources with many types of bees, flies, beetles, and other insect pollinators.

Interactions with parasitoids and parasites

Parasitoids are insects that lay eggs inside the bodies of other insects, ultimately killing the hosts. Known insect parasitoids are flies in the families Conopidae and Phoridae, and wasps in the familiar Brachonidae. Conopids do parasitize western bumble bees and other species in some parts of North America (James and Li 2012), but conipids are absent north of 50° of latitude and are not a concern in the NWT (Burt 2015). Brachonids (Stahlhurt *et al*. 2013) and phorids are unusually abundant and diverse in the north, including in the high Arctic. Species lists for the latter two families are not available for the NWT, but it is reasonable to assume that bumble bee parasitoids are present among the territory's fly and wasp fauna.

Cuckoo bumble bees are obligate social parasites of other bumble bees. Western bumble bees and yellow-banded bumble bees are known to be parasitized by Suckley's cuckoo bumble bee, and they are probably also hosts for the indiscriminate cuckoo bumble bee and the Fernald cuckoo bumble bee. The gypsy cuckoo bumble bee is known to parasitize bumble bees of the subgenus *Bombus sensu stricto*. The yellow-banded bumble bee is the only confirmed host of the gypsy cuckoo bumble bee in the NWT, but it also likely parasitizes western bumble bees and cryptic bumble bees.

Interactions with predators

Foraging worker bumble bees are thought to have few "true predators", and as such, their activities may not be greatly affected by predation (Goulson 2010). The bright yellow/white/orange and black stripe patterns displayed by all three species are classic examples of warning colouration[15] (Williams 2007), but some animals are apparently willing to overlook the implied threat. Spiders, robber flies (family Asilidae), and songbirds are probably the main true predators of bumble bees worldwide (Goulson 2010). Crab spiders are ambush hunters that wait on flowers for prey. Large crab spiders are capable of catching bumble bees (Plath 1934), and do so more effectively than web-spinning spiders. In the NWT, there are approximately 15 species of crab spider large enough to prey on bees, including the widespread goldenrod crab spider (*Misumena vatia*), and numerous *Xysticus* species (WG-GSNWTS 2016). At least seven species of robber flies are known from the NWT (Cannings 1994). Robber flies snatch bees out of the air while in flight, as do birds. Robins (*Turdus migratorius*, Turdidae), flycatchers (Tyrannidae) including the olive-sided flycatcher (*Contopus cooperi*), northern shrikes (*Lanius exubitor*, Laniidae), and summer tanagers (*Piranga rubra*, Cardinalidae) are birds present in the NWT known to prey on bumble bees elsewhere.

Bumble bee nests may also be predated by mammals, including foxes, skunks, mink, bears, shrews, voles, and mice, but none of these animals specialize in bumble bee predation. Since they all nest below the ground, the three bee species are likely protected from most mammal predators most of the time.

STATE AND TRENDS

Population

Abundance

The absolute abundance of any bee species cannot easily be determined. Most bumble bee records result from opportunistic collections or observations instead of from repeatable, standardized sampling regimes: sampling efforts cannot be quantified. Any estimates of absolute abundance, either historical or recent, would be excessively speculative. Established colonies can produce hundreds of workers and dozens of queens per year, so an individual specimen collection event is probably indicative that at least hundreds of other individuals (from the same colony) are present in approximately the same location (see *Movements* for discussion on foraging and dispersal ranges) during the year the specimen was collected.

[15] Warning colouration tells predators an animal is dangerous to eat: it may be venomous, poisonous, or otherwise toxic or painful.

Status of Western Bumble Bee, Yellow-banded Bumble Bee, and Gypsy Cuckoo Bumble Bee in the NWT

While absolute abundances cannot be determined, proxies can be used to assess trends over time. The relative abundance (RA) of one bumble bee species is one such proxy, and it can be calculated by dividing the number of records for that species by the total number of bumble bees collected (Colla and Packer 2008). The RA of western bumble bees, yellow-banded bumble bees, and gypsy cuckoo bumble bees in the NWT are shown for each decade since 1900 in Table 2.

Trends and fluctuations

Information from the Gwich'in Settlement Area, collected during 2004 Mackenzie Gas Project information collection, suggests that bumble bees are 'generally always around' (Benson 2012: 1) and are 'plentiful' in the spring (Pierre Benoit [Tsiigehtchic] *in* Benson 2012: 1). However, John Jerome of Inuvik noted that, "bumblebee numbers have dropped drastically" (*in* Benson 2012: 1).

Only five western bumble bees have been collected in the NWT; four in 2011 and one in 2018. During the most recent decade (2010s), the western bumble bee has had an RA of less than 1%. It is impossible to comment on changes in the species' absolute abundance or the stability of the NWT population over time. Some researchers suggest the southern subspecies (*B. o. occidentalis*) is suffering the most significant declines in the western bumble bee's North American range (Sheffield *et al.* 2016). Evidence from northern British Columbia, Yukon, and Alaska suggests that *B. o. mckayi* has comparatively stable populations (Koch and Strange 2012; COSEWIC 2014b; Pampell *et al*. 2015; Sheffield *et al.* 2016), while populations of *B. o. occidentalis* in southern British Columbia are declining (Colla and Ratti 2010).

An examination of changes in the RA of the yellow-banded bumble bee in the NWT reveals no obvious temporal trends. Its RA has fluctuated between a low of 0% and a high of approximately 58% in the 2000s (22 of 38 occurrence records). Recent (2010-2018) records place its RA at about 8.5% (95 of 1,120 occurrence records) (Table 2). Although this species is in serious decline throughout southern and central Canada, it may be more stable in northern British Columbia (COSEWIC 2014b).

The gypsy cuckoo bumble bee's RA in the NWT was 0% from 1900 until the 1940s, when it first appeared in collection records with an RA of about 5.5%. Its RA during the last decade is less than 1%, and reached a maximum of 8.9% in the 1950s when 24 individuals were noted out of 270 NWT bumble bee observations. Only six specimens were collected in the NWT between 1970-2018. This species has been recorded regularly in the Yukon and Alberta since the 2014 COSEWIC assessment of this species (COSEWIC 2014; ECCC 2019).

It is difficult to draw sound conclusions about temporal changes in RA for the yellow-banded bumble bee and the gypsy cuckoo bumble bee, because the total number of bumble bee records in the NWT is quite low and varies considerably from decade to decade (N = 0 to 1,120 individuals). Decades when larger numbers were recorded (N > 150) might be more meaningful (i.e., more likely to reflect something close to the "true" RA). However, RAs are highly variable even in these "high collection" decades: the yellow-banded bumble bee's RA ranges from 0.4-9.3%, while that of the gypsy cuckoo bumble bee's is between 0.5 and 8.9% (Table 2).

Given the low number of observations year-to-year, longer-term trends in RA might be evident by treating records as either "recent" (2008-2018) or "historical" (2007 or earlier), and pooling the data accordingly before calculating each species' RA (Fig. 21). It is impossible to comment meaningfully on long-term changes in the western bumble bee's RA; it has only been recorded from two areas in two separate years (2011 and 2018). Yellow-banded bumble bee has increased in relative abundance between the two time periods (by approximately 0.76%) while gypsy cuckoo bumble bee appears to have declined in relative abundance by approximately 4.23% (Fig. 21). Even with pooled data, the RAs are based on very small sample sizes and should be interpreted with caution. There are insufficient data to determine whether these apparent differences in RA are statistically significant.

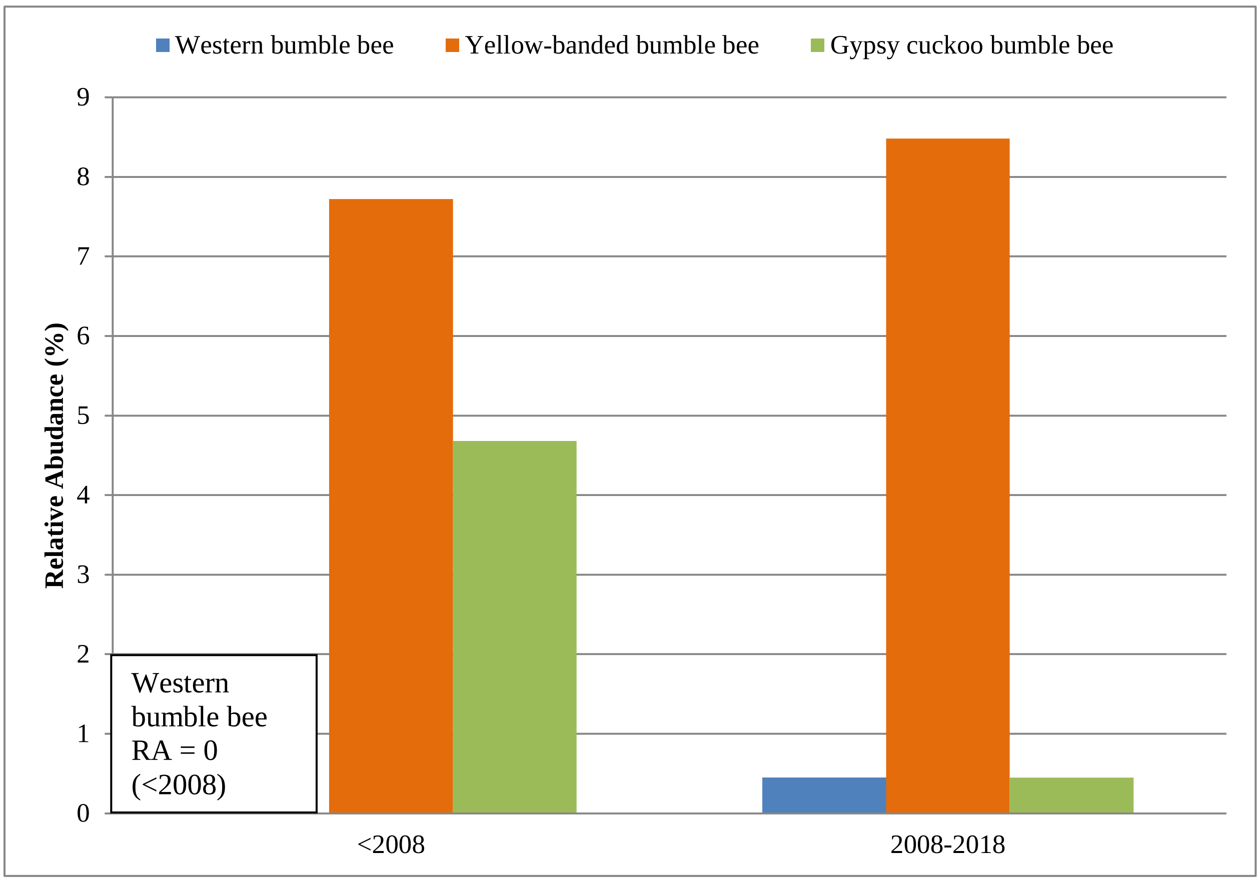

Figure 21. Relative abundance (RA) of the western bumble bee (*Bombus occidentalis mckayi*), yellow-banded bumble bee (*B. terricola*), and gypsy cuckoo bumble bee (*B. bohemicus*) in the NWT in the last decade (2008-2018; total number of *Bombus* collected = 1,120), compared to historical NWT records (2007 and earlier; total number of *Bombus* collected = 855). Data were derived from: a dataset compiled by Leif Richardson (2018), a 2017 collection effort contributed by Jennifer Heron (2018), verified sightings or collection events contributed by C. Ernst, using data sourced from www.bumblebeewatch.org (Ernst 2018), and unpublished data from a 2018 Dehcho collection

event (Heron unpubl. data 2019).

Population dynamics

Information on the population dynamics of these species (birth and death rates, immigration and emigration rates, demographic trends) is not available.

Possibility of rescue

The western bumble bee (*mckayi* subspecies) is present in northern British Columbia and the Yukon, and populations in those regions appear to be stable. However, large mountain ranges in the southwest of the NWT could impede the dispersal of rescuers into the territory.

The yellow-banded bumble bee is known from adjacent areas of northern Alberta, northern Saskatchewan, and northern British Columbia. Once very common throughout North America, this species is in serious decline throughout southern and central Canada, but it may be more stable in northern British Columbia (Hatfield *et al*. 2015a). Immigration from this small potential pool of rescuers in British Columbia may be impeded by large mountain ranges in southwestern NWT.

The gypsy cuckoo bumble bee is also recorded from adjacent areas of northern British Columbia, northern Alberta, and from the Yukon. However, the species can only disperse from areas outside the NWT if there are sufficient hosts available along the way. Its known host, the yellow-banded bumble bee, occurs in adjacent areas of northern British Columbia, northern Alberta, and northern Saskatchewan, but populations are probably only stable in British Columbia. The yellow-banded bumble bee has not been recorded from the Yukon, but the cuckoo bumble bee's presence in the territory indicates that a suitable host must be present. The cryptic bumble bee is a likely host, and it remains very common with stable populations throughout North America, including in the NWT (Hatfield *et al.* 2014).

Habitat

Habitat availability

In the south, all three species face considerable habitat loss and fragmentation due to agricultural intensification, and land use changes associated with natural resource exploitation (logging and hydroelectricity), recreation, and human habitation (Javorek 2011). At this time in the NWT, habitat availability is not thought to be a limiting factor. The scale of these kinds of activities is generally low.

Although certain site characteristics are preferred to an extent, they all display considerable flexibility in choosing nesting and foraging habitats. Underground nesting sites are preferred by these species, and by many other bumble bees in the NWT. Niche overlap, or competition for suitable nesting sites from other species, is a potential stressor for these bumble bees (Richards 1978), but the distribution or number of nesting sites are unknown.

Habitat fragmentation

Habitat fragmentation can potentially restrict the movement of foraging bumble bees. Foraging, nesting, and overwintering sites need to be relatively close to each other, although bumble bees can travel long distances if needed. Their capacity for flight aids with dispersal between habitat fragments, even if unsuitable habitat or physical barriers (e.g., water bodies) are present.

Habitat trends

Information on the smaller-scale habitat requirements (e.g., at the local or microhabitat level) of the three species in the NWT specifically is not available. The large-scale habitats from which the species have been recorded in the NWT (i.e., level III and IV ecoregions) have been described in *Description* and *Habitat Requirements*. All three species are found in natural habitats that vary considerably in terms of topography, precipitation, forest/vegetation types, etc. Yellow-banded and gypsy cuckoo bumble bees are also known to occupy many habitat types in urbanized or otherwise heavily modified landscapes in the NWT, as does the western bumble bee elsewhere in North America, suggesting that all three species may be able to persist even if some or many types of their natural habitats were fragmented or destroyed.

These species' natural (non-urban/unmodified) habitats are still extensive in the NWT, since human populations, developments, and activities are all quite low. However, natural habitats are expected to change considerably in the next 50 years, due to changes in temperature and precipitation regimes (see detailed discussion on climate-related change in *Threats and Limiting Factors*). It is unknown if these changes will have positive or negative effects on the three bumble bee species.

Distribution trends

Distribution trends for the three bumble bee species cannot be meaningfully assessed from the sparse and temporally disparate occurrence data available.

THREATS AND LIMITING FACTORS

Across the entire North American extent of the three species' known distributions, multiple factors are likely working in concert to directly threaten their persistence or increase their susceptibility to risk. Threats at the continental scale include pathogens, land use changes, and resulting losses of habitat and food sources, agricultural chemicals including pesticides, invasive species, pollution, and climate change (International Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] 2016).

Large expanses of the NWT have not been surveyed for bumble bees: waterways and locations in and around city centers are overrepresented in the records, but this is almost certainly just an artifact of selective sampling (many parts of the NWT are extremely difficult to access). As such, threats should be assessed for areas where the species have recently been recorded, but not exclusively: threats should probably also be assessed or considered in areas where they *may* exist. The area contained within the extent of occurrence is probably the best proxy for this at present. However, the scope and severity of the majority of threats are unknown, as very little baseline or current data are available in the NWT.

An International Union for Conservation of Nature (IUCN) and Conservation Measures Partnership (CMP) threats calculator (Salafsky *et al.* 2008; Master *et al*. 2009; NatureServe 2014; CMP 2018) was used to identify and evaluate 11 categories of possible threats to the three species. With this tool, the impact level (Very High, High, Medium, Low, or Negligible) of each threat is determined by cumulatively considering the scope[16], severity[17], and timing[18] of different aspects of the threat. For example, a threat rated Very High is one that is already destroying or reducing most of a species' population, or is likely to do so in the very near future. A Negligible threat is one that currently has very little to no impact on the species and is unlikely to impact the species in anything other than the distant future. An overall threat impact level for each species is determined by considering the impacts of all 11 threats. All 11 threat categories are listed and examined in *Appendix A*. Any threats determined to have a Low, Medium, High, or Very High impact on the three bumble bee species are discussed below.

Climate change and severe weather – threat level Medium (but uncertain) for western bumble bee / Low (but uncertain) for yellow-banded and gypsy cuckoo bumble bees

This section considers threats from long-term climate change that may be linked to global warming, and weather events more severe than what is typical for the region.

Heat waves

Bumble bees are most diverse and most strongly associated with cool and temperate areas of the northern hemisphere, including arctic, subarctic, and boreal regions (Rasmont and Iserbyt 2012; Williams *et al*. 2014; Martinet *et al.* 2015). Such species are, in general, expected to show population declines with increased annual temperatures, even in the northern latitudes of Canada

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[16] The proportion (%) of the population or occurrence likely to be affected by the threat over the next 10 years.

[17] How likely the threat is to destroy, degrade, or reduce the number of occurrences or habitat, or how much the threat will reduce the population.

[18] Considers if the threat is ongoing/current, likely to happen in the future, or has only happened in the past.

and Europe, given energetically costly behavioural responses to temperature extremes and a strong lag in northward range expansion (i.e., lack of climate refugia) (Goulson *et al*. 2015; Kerr *et al*. 2015). Habitat suitability models for the yellow-banded bumble bee and the western bumble bee show that temperature is a key determinant of the species' distributions in northern Canada (Sheffield *et al.* 2016).

Arctic temperatures are rising twice as fast as the global average, with associated shifts in vegetation zones, habitat, and species range (Arctic Climate Impact Assessment [ACIA] 2004; International Panel on Climate Change [IPCC] 2014; ENR 2016b). Temperatures in the NWT have generally been warmer in the past 15 years compared to all years recorded prior to 1990, both in winter and summer (ENR 2016b). The entirety of the NWT is expected to be affected by climate change, although some regions (for example, the Mackenzie River valley) may be warming even more quickly than others (ENR 2008). There have been a number of extended heat waves in the NWT in the past decade, and temperature fluctuations are generally less predictable than in the past (ENR 2008, 2016b). The frequency of extreme summer temperatures (>30°C) is expected to increase across the NWT (ENR 2016a), and heat waves are becoming more frequent and more intense (ENR 2016a, b).

High temperatures have been implicated in local bumble bee population extirpations in Europe. For example, density declines were observed in Finland following a heat wave with a maximum temperature of 33°C. The lethal effects of heat waves may be the result of a number of factors, including the severity of the heat wave, the duration of the heat wave, water loss, or starvation (Rasmont and Iserbyt 2012).

Heat waves usually affect some parts of the NWT more than others, so individual heat wave events are not expected to be a threat to all bumble bees within their entire distribution. Bumble bees whose active seasons end in early or mid-summer are most likely to escape the negative effects of heat waves (since heat waves are most likely to occur in July/August). However, yellow-banded and gypsy cuckoo bumble bees are both active at least until the end of August, so they are not protected from heat waves by their phenology. The western bumble bee is likely active during the same period.

Because of their heat intolerance and limited northern distribution, we can probably expect to see the distribution of *B. o. mckayi* decline. However, yellow-banded and gypsy cuckoo bumble bees have widespread distributions in North America that extend down into the north/central east coast of the United States (Williams *et al.* 2014). Presumably, these two species are more likely to tolerate periods of heat and wider temperature ranges than the western bumble bee, which is the largest of the three species and the only one with a truly northern distribution.

Habitat changes

Other impacts that are being seen in the NWT as a result of climate change that are relevant to bumble bees include shifts in seasonal timing and vegetation, permafrost degradation, and increasing severity of floods, forest fires, and droughts.

With climate warming, summers begin earlier and end later, extending the length of the active season for bees. A longer active season could be positive for bumble bees if food resources are available when queens emerge to establish new colonies in spring, but if there is a timing mismatch with floral resources, the effects could be devastating.

Loss of permafrost could impact habitat through, for example, changes to water regimes/storage, vegetation cover, and soil drainage (Quinton *et al*. 2011; Bring *et al.* 2016; Sniderman and Baltzer 2016; Chasmer and Hopkinson 2017). As temperatures have warmed in the NWT, low shrub cover above the treeline has expanded and become more robust (Pearson *et al.* 2013; ENR 2016b).

Since the three bumble bee species of interest appear to have affinities for habitat adjacent to forests, changes to forest habitat will likely have an impact on them. These effects may be positive or negative, depending on whether forests expand or contract, create or reduce forest edge habitat, and whether they enhance or displace flowering plant communities. Encroachment is likely occurring fairly rapidly and effects are expected to continue in the next 10 years.

Droughts may have an impact on bumble bees' water availability and floral resources (Rasmont and Iserbyt 2012; Thomson 2016). Drought is also associated with increased forest fires, the number and intensity of which are expected to increase in the NWT (Flannigan *et al.* 2008; ENR 2016b), and changes to soil moisture and other properties, which could affect quality or availability of nesting and hibernacula sites. Drought conditions have been a problem in parts of the NWT in recent years, leading to dropping river and lake water levels (e.g., Great Slave Lake), and low water tables generally (CBC News 2015). Conversely, flooding may directly impact ground-nesting bees in floodplains or other low-elevation areas, either from immersion or increased susceptibility to mold (Harder 1986). Some large-scale flooding has taken place in the Mackenzie River valley, Aklavik, and Fort Good Hope (ENR 2012), as well as near Fort Providence and in the Slave River delta in the last 5 years (Olesinski and Brett 2017).

Invasive and problematic species, pathogens, and genes – threat level Low

This section includes threats related to non-native (alien) and native animals and diseases that could have a negative effect on the species if introduced to the NWT, whether by human activities or natural range expansions.

Beekeeping and pollination services

Non-native honey bees (*Apis mellifera*) are present in the NWT (Working Group on General Status of NWT Species 2016). Honey bees are managed throughout North America and worldwide for pollination services, and the production of honey, wax, and related products

(National Research Council 2007). They have been imported into the NWT by businesses and hobbyists, but the total number of colonies in the territory, their origins, and their current distribution is unknown. No formal surveys of beekeepers or colonies in the NWT have been performed.

Some level of beekeeping either has or is currently taking place in Hay River, Yellowknife, Fort Smith, Fort Simpson, Inuvik, and Norman Wells (ITI 2017b; Carrière pers. comm. 2018; Cooper pers. comm. 2019; Ecology North 2019), and citizen science platforms show one honey bee record in Gamètì (www.inaturalist.org), indicating the presence of colonies in that region as well. Other locations are possible. There appears to be a fairly strong interest in the NWT in beekeeping activities. A Bee Health Symposium hosted in Yellowknife in February 2019 saw over 100 attendees, with additional live streams from the symposium receiving over 600 views on social media (Fenton pers. comm. 2019). Increased media coverage of declining bee populations worldwide has probably generated public interest in beekeeping as a hobby. Additionally, the GNWT has named honey as a potential commercial opportunity (ITI 2017a).

While the desire to increase pollinator populations is admirable, importing non-native bees into the NWT could be problematic. Honey bees are known to compete directly with native bumble bees including the western bumble bee (Thomson 2004), reducing the foraging and reproductive success of the native species. Generally, managed bee colonies have the potential to create problems for native species: they can compete with native species for nesting and floral resources, alter plant communities, and spread diseases to native species (Mallinger *et al*. 2017).

A potentially problematic species not native to the NWT is the common eastern bumble bee (*Bombus impatiens* Cresson 1863). This species is widely used elsewhere in greenhouses and field crops for pollination services (National Research Council 2007). If they escape and establish populations, they can out-compete native bumble bees for habitat, or act as disease vectors (Mallinger *et al*. 2017; Jacobson *et al*. 2018). According to the COSEWIC status report on yellow-banded bumble bee, the common eastern bumble bee may already be used in the NWT for commercial pollination services (COSEWIC 2015), but no substantiating documentation was available when this report was prepared. The greenhouse in Inuvik has been bringing in bees for pollination each year, but these appear to be blue orchard mason bees (*Osmia lignaria*) and it appears as though reproduction has not be successful (no new cocoons) (Solotki pers. comm. 2019).

Pathogen spillover

Pathogens (fungi, bacteria, viruses, and other microorganisms that cause disease) are widely implicated in the decline of North American bumble bees, and it is presumed that "pathogen spillover" is to blame (Power and Mitchell 2004). Pathogen spillover is when pathogens spread from a heavily infected bee population to unaffected populations, and is strongly associated with commercially reared honey and bumble bee colonies (Colla *et al.* 2006; Cameron *et al.* 2011;

Szabo *et al*. 2012; Murray *et al.* 2013; Goulson *et al*. 2015; McArt *et al*. 2017).

Nosema bombi is a fungal pathogen that can infect and harm tissues throughout a bumble bee's body (James and Li 2012). An aggressive and virulent strain of this fungus is found in many declining bumble bee species, including wild and commercially-reared colonies of yellow-banded and western bumble bees (Whittington and Winston 2003; Cameron *et al*. 2016; Arbetman *et al*. 2017). It has long been assumed that this problematic strain was introduced to North America via reared colonies imported from Europe, and that it subsequently spread to wild populations (Cameron *et al.* 2016). However, recent genetic analyses suggest that the strain of *N. bombi* wreaking havoc in North America was present and established before the commercial colony trade (Cameron *et al.* 2016). Although its origins may not be exotic, the fungus' high rate of transmission and impacts are nevertheless likely significant. Commercially-reared bumble bee colonies of several species have been found to harbour other parasites, including *Crithidia bombi* (a single-celled gut parasite) and *Locustacarus buchneri* (a mite that lives in the airways of bumble bees) (James and Li 2012). There are no studies to confirm if these pathogens are present in the NWT.

Declining bumble bee populations are more commonly affected by pathogens than those that are stable (Cameron *et al.* 2011). Interestingly, we see a different trend in western bumble bees: both subspecies of the western bumble bee have similar levels of parasitism (about 40%) (Koch and Strange 2012; Pampell *et al*. 2015; Sheffield *et al.* 2016), but *B. o. mckayi* populations are probably more stable than those of *B. o. occidentalis*. Since commercial bumble bee colonies are not widely used in the north, these relatively high levels of infection may be natural and not caused by pathogen spillover (McHugh and Sikes 2016). If these infection levels are indeed natural, *N. bombi* and other pathogens may not have the same effect on northern bumble bee populations as they do in the south, perhaps because other factors that increase the susceptibility to infections are not concurrent or as prevalent in the north. It is also possible that some pathogens are less likely to survive in cold climates; a close relative of *N. bombi* (*N. ceranae*, which affects honey bees), is known to be more cold-sensitive and more commonly found in warmer climates (James and Li 2012).

Many other bee pathogens exist worldwide, and the potential of these to cause additional disease epidemics in bumble bees is uncertain (James and Li 2012; Brown 2017). Small, isolated bumble bee populations with lower genetic diversity could be more affected by new diseases than large populations with high genetic diversity (Brown 2017). The genetic diversity and isolation of bumble bee populations in the NWT is uncertain at this time.

High rates of fungal infections in bumble bees are associated with large-scale agricultural or commercial fungicide use (McArt *et al.* 2017); this is not a significant factor in the NWT (Statistics Canada 2016). Although beekeeping and commercial pollination activities in the NWT are small and localized at present, there is a strong interest among the public in beekeeping for honey and pollination, and support from the GNWT to pursue these activities under the NWT

Agriculture Strategy (ITI 2017a). Beekeeping, especially increased use of commercial bee colonies in the NWT, if it occurs, could increase the chances of this potential future threat.

Overall threat impact

With two Low level threats for yellow-banded and gypsy cuckoo bumble bees, the overall threat impact for these two species is estimated to be Low (NatureServe 2014).

With one Low and one Medium level threat, the overall threat impact for western bumble bee is estimated to be Medium (NatureServe 2014).

Other limitations and considerations

Host availability

The most serious threat to the gypsy cuckoo bumble bee in the NWT is the potential loss or decline of its hosts. While the *rate* of decline of parasitic bumble bees seems to be about the same as for nonparasitic species (Bartomeus *et al.* 2013), the *risk* of decline is probably higher because they are so dependent on their hosts. Stressors such as climate change or habitat loss directly affect gypsy cuckoo bumble bees, and those effects could be amplified if their hosts are also threatened by the same stressors (Koh *et al*. 2004; Suhonen *et al*. 2015). All three bumble bee species are likely to be affected by many of the same stressors.

One of the known hosts of the gypsy cuckoo bumble bee, the yellow-banded bumble bee, is in decline in North America, but its populations appear to be relatively stable in northern provinces (and presumably also in the NWT) (see *Population*). The yellow-banded bumble bee has historically been present throughout the south/central aspects of the gypsy cuckoo bumble bee's extent of occurrence, but it has not been found in the High Subarctic (Fig. 21). Recent collections (2017 and 2018) in the Mid-Boreal captured 82 specimens (Heron 2018; Heron unpubl. data 2019).

The cryptic bumble bee is probably a host of the gypsy cuckoo bumble bee in the NWT, at least in the High Subarctic (since yellow-banded bumble bees are not known from that ecoregion). The cryptic bumble bee is present in the Mackenzie River valley in the north and coincides with gypsy cuckoo bumble bee records in that area (Fig. 21). Similarly, cryptic bumble bees were collected in the Mid-Boreal ecoregion (76 specimens in 2017 and 2018), coinciding with gypsy cuckoo bumble bee records (Heron 2018; Heron unpubl. data 2019). The cryptic bumble bee has been assigned a general status rank of Secure (not at risk nor sensitive) in the NWT (Hatfield *et al.* 2014; Working Group on General Status of NWT Species 2016) and Secure nationally as well (NatureServe 2018).

The western bumble bee may also be a suitable host, but until 2018, no gypsy cuckoo bumble bees had been collected in locations from which *B. o. mckayi* had been recorded (Heron unpubl.

data 2019). There is now a clear area of potential overlap in the level III Mid-Boreal ecoregion in the southwest of the NWT. The southern subspecies of western bumble bee (*B.o. occidentalis*) is in decline in North America, although the northern *mckayi* subspecies appears relatively stable (see *Population*).

POSITIVE INFLUENCES

Life history traits

Bumble bees with late-season colony initiation and development are associated with greater susceptibility to land use changes (Williams and Osborne 2009). All three species emerge and begin to establish colonies shortly after spring thaw, so they should be less susceptible. Bees that nest below ground are less affected by agricultural intensification and recent fires (Williams *et al.* 2009; Williams and Osborne 2009; Williams *et al.* 2010).

Pollinators that are specialist floral visitors may be more susceptible to decline (Williams *et al.* 2010). All three bumble bee species of interest are generalist foragers. Despite having short tongues, western and yellow-banded bumble bees use a nectar-robbing strategy to exploit additional sources. Arbetman *et al*. (2017) found that tongue length is not significantly related to declines in bumble bee species, suggesting that changes in floral resources might not be a major driver for at least some species.

Yellow-banded bumble bee larvae can survive short periods without eating, and temporary shortages of food have little effect on their adult size, although it can influence their development time (Plowright and Pendrel 1977). This trait would be beneficial if normal foraging activities were disrupted (e.g., by extreme weather, or sudden loss of floral resources from part of their foraging territory).

Because these bumble bees are largely reliant on existing mammal burrows for nest sites, the composition and habits of rodent fauna can influence the relative and absolute abundance of bumble bees (Harder 1986). Existing mammal burrows are not common in intensively modified habitats (Williams *et al.* 2010), but modified habitats make up a small proportion of the total land area of the NWT. Mice, voles, lemmings, and shrews are considered Secure under the general status ranking program throughout the NWT, in forested areas and on the tundra (WG-GSNWTS 2016). Their populations experience natural cycles of high- and low-density years but their abundances are stable when this is taken into consideration (ENR 2016b). Underground nesting sites should be widely available for bees in the foreseeable future.

Regulatory actions

Approximately 9.2% of the NWT's land falls within one of 14 established terrestrial protected areas (ENR 2016a). Existing protected areas may provide safe havens for the three bumble bee species (e.g., Nahanni National Park Reserve harbours *B. o. mckayi*), and additional protected land may help conserve bumble bee habitat.

The Canadian Food Inspection Agency has regulations in place to prevent the introduction and spread of bee pathogens into the country via the import of bee products and live bees (CFIA 2011). Many provinces similarly regulate the import of live bees from other provinces and territories. The NWT does not currently have any regulations or restrictions on bringing live bees into the territory, although best management practices for beekeeping and pollination services are being developed (Fenton pers. comm. 2019).

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Status of Western Bumble Bee, Yellow-banded Bumble Bee, and Gypsy Cuckoo Bumble Bee in the NWT

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Status and ranks

Western bumble bee (*Bombus occidentalis mckayi*)

Region	Coarse filter (Ranks) To prioritize	Fine filter (Status) To provide advice	Legal listings (Status) To protect under species at risk legislation
Global	G4T4 (2014)	Vulnerable (2015)	No legal tools exist.
Canada	NNR (2017)	Special Concern (2014)	Under consideration
Northwest Territories	**Sensitive (2016)**	**Data Deficient (2019)**	**n/a**
Adjacent Jurisdictions			
United States			
Alberta			
British Columbia	SNR – NatureServe		
Yukon Territory	S3S4 – NatureServe		

Yellow-banded bumble bee (*Bombus terricola*)

Region	Coarse filter (Ranks) To prioritize	Fine filter (Status) To provide advice	Legal listings (Status) To protect under species at risk legislation
Global	G3G4 (2017)	Vulnerable (2015)	No legal tools exist
Canada	N5 (2017)	Special Concern (2015)	Special Concern (2018)
Northwest Territories	**Sensitive (2016)**	**Not at Risk (2019)**	**n/a**
Adjacent Jurisdictions			
United States	NU		
Alberta	S5		
British Columbia	S3S4		
Yukon Territory	S3 – Conservation Data Centre		

Gypsy cuckoo bumble bee (*Bombus bohemicus*)

Region	Coarse filter (Ranks) To prioritize	Fine filter (Status) To provide advice	Legal listings (Status) To protect under species at risk legislation
Global	G4 (2015)	Data Deficient (2016)	No legal tools exist
Canada	N1 (2017)	Endangered (2014)	Endangered (2018)
Northwest Territories	**At Risk (2016)**	**Data Deficient (2019)**	**n/a**
Adjacent Jurisdictions			
United States	NU		
Alberta	SH		
British Columbia	SH		
Yukon Territory	S1S2 – Conservation Data Centre		

Collections examined

No collections were examined firsthand. See *Search Effort* for information about the sources of the data.

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Appendix A

NWT RECORDS

This table includes all records of the species of interest from the NWT used in this report. Records are listed in alphabetical order by species, and then by year of collection (oldest to newest). Records are from Richardson (2018), Heron (2018), and Heron (unpubl. data 2019). For some entries in the Richardson dataset, the dates were not completed and/or GPS coordinates were not provided. An effort was made to search other online databases (e.g., museum holding records, etc.) to complete missing data when possible, and generic locality (latitude/longitude) was used when precise records were not available (primarily for older specimens).

Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
CNC[19]	*B. bohemicus*	J.R. Vockeroth	Reindeer Depot, Mackenzie Delta	68.7	-134.1333	Aug. 10, 1948	
CNC	*B. bohemicus*	J.R. Vockeroth	Reindeer Depot, Mackenzie Delta	68.7	-134.1333	Aug. 13, 1948	
CNC	*B. bohemicus*	J.R. Vockeroth	Reindeer Depot, Mackenzie Delta	68.7	-134.1333	Aug. 17, 1948	
CNC	*B. bohemicus*	J.R. Vockeroth	Reindeer Depot, Mackenzie Delta	68.7	-134.1333	Aug. 19, 1948	
CNC	*B. bohemicus*	W.R.M. Mason	Norman Wells	65.2833	-126.8333	June 9, 1949	
CNC	*B. bohemicus*	W.R.M. Mason	Norman Wells	65.2833	-126.8333	June 9, 1949	
CNC	*B. bohemicus*	W.R.M. Mason	Norman Wells	65.2833	-126.8333	June 9, 1949	
CNC	*B. bohemicus*	W.R.M. Mason	Norman Wells	65.2833	-126.8333	June 12, 1949	
CNC	*B. bohemicus*	W.R.M. Mason	Norman Wells	65.2833	-126.8333	June 12, 1949	
CNC	*B. bohemicus*	W.R.M. Mason	Norman Wells	65.2833	-126.8333	June 14, 1949	
CNC	*B. bohemicus*	W.R.M. Mason	Norman Wells	65.2833	-126.8333	June 20, 1949	

[19] Canadian National Collection

Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
CNC	*B. bohemicus*	W.R.M. Mason	Norman Wells	65.2833	-126.8333	June 29, 1949	
CNC	*B. bohemicus*	W.R.M. Mason	Norman Wells	65.2833	-126.8333	June 30, 1949	
CNC	*B. bohemicus*	W.G. Helps	Fort Smith	60	-111.8833	June 4, 1950	
CNC	*B. bohemicus*	J.B. Wallis	Fort Smith	60	-111.8833	June 9, 1950	
CNC	*B. bohemicus*	J.B. Wallis	Fort Smith	60	-111.8833	June 13, 1950	
CNC	*B. bohemicus*	J.B. Wallis	Fort Smith	60	-111.8833	June 13, 1950	
CNC	*B. bohemicus*	D.P. Whillans	Fort Simpson	61.8666	-120.35	July 20, 1950	
CNC	*B. bohemicus*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 7, 1950	
CNC	*B. bohemicus*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 7, 1950	
CNC	*B. bohemicus*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 9, 1950	
CNC	*B. bohemicus*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 17, 1950	
CNC	*B. bohemicus*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 17, 1950	
CNC	*B. bohemicus*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 19, 1950	
CNC	*B. bohemicus*	P.R. Ehrlich	Hay River	60.8166	-115.7833	July 21, 1951	
CNC	*B. bohemicus*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12, 1951	
CNC	*B. bohemicus*	E.F. Cashman	Aklavik	68.2166	-135	June 18, 1956	
CNC	*B. bohemicus*	E.F. Cashman	Aklavik	68.2166	-135	June 18, 1956	
JBWM[20]	*B. bohemicus*	D.H. Pengelly	Aklavik	68.227	-135.003	June 18, 1956	Georef by LLR
CNC	*B. bohemicus*	R.E. Leech	Aklavik	68.2166	-135	June 22, 1956	
CNC	*B. bohemicus*	R.E. Leech	Aklavik	68.2166	-135	June 28, 1956	
CNC	*B. bohemicus*	R.E. Leech	Aklavik	68.2166	-135	July 6, 1956	
CNC	*B. bohemicus*	R.E. Leech	Norman Wells	65.2833	-126.8333	Aug. 20, 1956	
CNC	*B. bohemicus*	R.E. Leech	Norman Wells	65.2833	-126.8333	Aug. 20, 1956	
CNC	*B. bohemicus*	S.D. Hicks	Fort McPherson	67.4333	-134.8833	June 26, 1957	
CNC	*B. bohemicus*	R. Hurley	Fort McPherson	67.4333	-134.8833	June 26, 1957	

[20] Wallis Roughley Museum of Entomology

Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
CNC	*B. bohemicus*	S.D. Hicks	Fort McPherson	67.4333	-134.8833	June 26, 1957	
CNC	*B. bohemicus*	G.E. Shewell	Norman Wells	65.2833	-126.8333	June 27, 1969	
CNC	*B. bohemicus*	D. Frechin	Norman Wells	65.282	-126.829	June 27, 1969	Georef by LLR
CNC	*B. bohemicus*	B.V. Peterson	Fort Simpson	61.8315	-121.1955	June 7, 1972	No Name Creek, #2, E side Mackenzie River, 3 mi. SE Fort Simpson
J. Heron	*B. bohemicus*	J. Heron	Norman Wells	65.281	-126.828	July 31, 2017	Date approximate, as per J.H. In town.
J. Heron	*B. bohemicus*	N. Larter	Fort Simpson	61.77724	-121.29051	May 16-22, 2018	10km gravel pit. Blue Vane Trap.
J. Heron	*B. bohemicus*	N. Larter	Fort Simpson	61.77724	-121.29051	May 16-22, 2018	10km gravel pit. Blue Vane Trap.
J. Heron	*B. bohemicus*	N. Larter	Fort Simpson	61.77724	-121.29051	May 16-22, 2018	10km gravel pit. Blue Vane Trap.
J. Heron	*B. bohemicus*	N. Larter	Fort Simpson	61.44776	-121.24789	July 6-18, 2018	Checkpoint (to W). Blue Vane Trap.
PCYU[21]	*B. o. mckayi*	S. Stotyn	South Nahanni River	62.656	-129.1348	July 9, 2011	
PCYU	*B. o. mckayi*	S. Stotyn	South Nahanni River	62.0876	-127.5872	July 13, 2011	
PCYU	*B. o. mckayi*	S. Stotyn	South Nahanni River	61.9634	-127.1992	July 16, 2011	
PCYU	*B. o. mckayi*	S. Stotyn	South Nahanni River	61.6065	-125.7560	July 18, 2011	
J. Heron	*B. o. mckayi*	N. Larter	Fort Simpson	61.34861	-121.80025	May 31-June 5, 2018	Poplar River Fuel Cache. Blue Vane Trap.
INHS[22]	*B. terricola*	C.H. Czickmay	Fort Norman	64.9	-125.58	Aug. 6, 1922	
USDA-ARS	*B. terricola*	O. Bryant	Wrigley	63.1860	-123.3615	July 18, 1929	Original entry recorded as "Fort Wrigley"
USDA-ARS	*B. terricola*	O. Bryant	Wrigley	63.1860	-123.3615	July 18, 1929	Original entry recorded as "Fort Wrigley"
USDA-ARS	*B. terricola*	O. Bryant	Fort Simpson	61.7787	-121.2327	Aug. 6, 1929	Original entry recorded as "Simpson"
USDA-ARS	*B. terricola*	O. Bryant	Fort Simpson	61.7787	-121.2327	Aug. 16, 1929	
USDA-ARS	*B. terricola*	O. Bryant	Fort Simpson	61.7787	-121.2327	Aug. 16, 1929	

[21] L. Packer Collection York University
[22] Illinois Natural History Survey

Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
USDA-ARS	*B. terricola*	O. Bryant	Fort Simpson	61.7787	-121.2327	Aug. 16, 1929	
USDA-ARS	*B. terricola*	O. Bryant	Fort Simpson	61.7787	-121.2327	Aug. 16, 1929	
USDA-ARS	*B. terricola*	O. Bryant	Fort Simpson	61.7787	-121.2327	Aug. 16, 1929	
LACM[23]	*B. terricola*	Unknown	Norman Wells	65.2741	-126.6983	June 30, 1949	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	June 12, 1950	
CNC	*B. terricola*	W.G. Helps	Fort Smith	60	-111.8833	June 29, 1950	
CNC	*B. terricola*	W.G. Helps	Fort Smith	60	-111.8833	June 29, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	July 2, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	July 12, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	July 12, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	July 20, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	July 20, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	July 20, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	July 30, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 7, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 12, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 17, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 18, 1950	
CNC	*B. terricola*	D.P. Whillans	Fort Simpson	61.8666	-120.35	Aug. 18, 1950	
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 11, 1951	
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12, 1951	
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12, 1951	
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12 1951	
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12, 1951	
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12, 1951	

[23] Natural History Museum of Los Angeles County

Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12, 1951	
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12, 1951	
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12, 1951	
CNC	*B. terricola*	P.R. Ehrlich	Hay River	60.8166	-115.7833	Aug. 12, 1951	
SanF	*B. terricola*	Unknown	Fort Providence	61.3538	-117.6548	Aug. 27, 1960	
USDA-ARS[24]	*B. terricola*	E.L. Kessel	Fort Providence	61.3538	-117.6548	Aug. 27, 1960	
C. Sheffield	*B. terricola*	K.C. Herrmann	Fort Simpson	61.925	-121.578	July 3, 1972	Martin River
C. Sheffield	*B. terricola*	P.J. Skitsko	Fort Simpson	61.925	-121.578	Aug. 1, 1972	Martin River
C. Sheffield	*B. terricola*	P.J. Skitsko	Fort Simpson	61.925	-121.578	Sept. 6, 1972	Martin River
C. Sheffield	*B. terricola*	P.J. Skitsko	Fort Simpson	61.925	-121.578	Sept. 6, 1972	Martin River
C. Sheffield	*B. terricola*	P.J. Skitsko	Fort Simpson	61.925	-121.578	Sept. 6, 1972	Martin River
C. Sheffield	*B. terricola*	P.J. Skitsko	Fort Simpson	61.925	-121.578	Sept. 6, 1972	Martin River
PCYU	*B. terricola*	A. Gunn	Yellowknife	62.466	-114.3499	July 1, 2001	Willow flats
PCYU	*B. terricola*	A. Gunn	Yellowknife	62.466	-114.3499	July 1, 2001	Willow flats
PCYU	*B. terricola*	A. Gunn	Yellowknife	62.45	-114.3300	July 23, 2002	
PCYU	*B. terricola*	A. Gunn	Yellowknife	62.45	-114.333	Aug. 1, 2002	Lakeside, Great Slave Lake
PCYU	*B. terricola*	A. Gunn	Yellowknife	62.45	-114.333	Aug. 1, 2002	Lakeside, Great Slave Lake
PCYU	*B. terricola*	A. Gunn	Yellowknife	62.466	-114.3499	July 9, 2003	Willow flats
PCYU	*B. terricola*	A. Gunn	Enterprise	60.6	-116.0670	Aug. 7, 2004	Gravel pit
PCYU	*B. terricola*	A. Gunn	Behchokǫ̀	62.583	-116.4670	Aug. 8, 2004	Gravel pit (location originally entered as Rae)
PCYU	*B. terricola*	A. Gunn	Yellowknife	62.533	-113.3499	Aug. 14, 2004	Tibbett Lake
RSM[25]	*B. terricola*	T.V. Cole	Yellowknife	62.53	-113.35	Aug. 14, 2004	Tibbett Lake
PCYU	*B. terricola*	C. Sheffield and A. Gunn	Fort Providence	61.583	-117.1490	June 21, 2005	Hwy 3, near Fort Providence

[24] United States Department of Agriculture, Agricultural Research Service
[25] Royal Saskatchewan Museum

Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
PCYU	*B. terricola*	C. Sheffield and A. Gunn	Hay River	60.652	-115.9940	June 22, 2005	"Paradise Garden", near Hay River
ROM[26]	*B. terricola*	Unknown	Yellowknife	65.254	-126.6875	June 22, 2005	
PCYU	*B. terricola*	C. Sheffield and A. Gunn	Kakisa	61.216	-117.5100	June 23, 2005	N of Kakisa, Hwy 3
PCYU	*B. terricola*	D.C. Currie and R. Popko	Norman Wells	65.254	-125.6880	June 29, 2005	
PCYU	*B. terricola*	D.C. Currie and R. Popko	Norman Wells	65.254	-125.6880	June 29, 2005	
ROM	*B. terricola*	L. Masner	Norman Wells	65.254	-126.6875	June 29, 2005	
ROM	*B. terricola*	L. Masner	Norman Wells	65.254	-126.6875	June 29, 2005	
ROM	*B. terricola*	L. Masner	Norman Wells	65.254	-126.6875	June 29, 2005	
ROM	*B. terricola*	L. Masner	Norman Wells	65.254	-126.6875	June 29, 2005	
PCYU	*B. terricola*	A. Gunn	Yellowknife	62.433	-114.3499	July 3, 2005	Negus Pt.
PCYU	*B. terricola*	R.A. Layberry	Nahanni River	61.25	-124.07	July 9, 2005	Kraus Hot Spring
PCYU	*B. terricola*	Unknown	Yellowknife	62.44	-114.38		Date unknown. Assumed pre-2007.
PCYU	*B. terricola*	L. Packer	Yellowknife	62.458	-114.3560	July 10, 2010	
PCYU	*B. terricola*	S. Stotyn	South Nahanni River	61.2554	-124.0596	July 24, 2011	Original entry recorded as "Fort Simpson; Sth. Nahanni R.")
PCYU	*B. terricola*	S. Stotyn	South Nahanni River	61.2554	-124.0596	July 24, 2011	Original entry recorded as "Fort Simpson; Sth. Nahanni R.")
PCYU	*B. terricola*	S. Stotyn	South Nahanni River	61.2554	-124.0596	July 24, 2011	Original entry recorded as "Fort Simpson; Sth. Nahanni R.")
PCYU	*B. terricola*	S. Stotyn	South Nahanni River	61.1016	-122.8819	July 26, 2011	Original entry recorded as "Fort Simpson; Sth. Nahanni R.")
PCYU	*B. terricola*	S. Stotyn	South Nahanni River	61.10162	-122.8819	July 26, 2011	Original entry recorded as "Fort Simpson; Sth. Nahanni R.")
BBW[27] (Bee-12830)	*B. terricola*	Z. Guile	Yellowknife	62.4530	-114.3757	July 27, 2016	Downtown
J. Heron	*B. terricola*	N. Larter	Fort Simpson	62.0408	-122.0194	July 12-26,	Blue Vane Trap. Day approximated

[26] Royal Ontario Museum
[27] Bumble Bee Watch

Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
						2017	by CE. Km 581 Mackenzie Highway
J. Heron	*B. terricola*	J. Heron	Norman Wells	65.2770	-126.8135	Aug. 1, 2017	Note from J.H. "Although not databased, there were at least half a dozen YBBB[28] at Norman Wells (River Beach)". The preparer added 6 records from this location as a conservative approximation.
J. Heron	*B. terricola*	J. Heron	Norman Wells	65.2770	-126.8135	Aug. 1, 2017	Note from J.H. "Although not databased, there were at least half a dozen YBBB at Norman Wells (River Beach)". The preparer added 6 records from this location as a conservative approximation.
J. Heron	*B. terricola*	J. Heron	Norman Wells	65.2770	-126.8135	Aug. 1, 2017	Note from J.H. "Although not databased, there were at least half a dozen YBBB at Norman Wells (River Beach)". The preparer added 6 records from this location as a conservative approximation.
J. Heron	*B. terricola*	J. Heron	Norman Wells	65.2770	-126.8135	Aug. 1, 2017	Note from J.H. "Although not databased, there were at least half a dozen YBBB at Norman Wells (River Beach)". The preparer added 6 records from this location as a conservative approximation.
J. Heron	*B. terricola*	J. Heron	Norman Wells	65.2770	-126.8135	Aug. 1, 2017	Note from J.H. "Although not databased, there were at least half a dozen YBBB at Norman Wells (River Beach)". The preparer added 6 records from this location as a conservative approximation.
J. Heron	*B. terricola*	J. Heron	Norman Wells	65.2770	-126.8135	Aug. 1, 2017	Note from J.H. "Although not databased, there were at least half a dozen YBBB at Norman Wells (River

[28] Yellow-banded bumble bee

Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
							Beach)". The preparer added 6 records from this location as a conservative approximation.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.8639	-121.3541	July 28-Aug. 17, 2017	Nic Larter residence. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.8639	-121.3541	July 28-Aug.17, 2017	Nic Larter residence. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.8639	-121.3541	July 28-Aug. 17, 2017	Nic Larter residence. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.8639	-121.3541	July 28-Aug. 17, 2017	Nic Larter residence. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.8639	-121.3541	July 28-Aug. 17, 2017	Nic Larter residence. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.8639	-121.3541	July 28-Aug. 17, 2017	Nic Larter residence. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.8639	-121.3541	July 28-Aug. 17, 2017	Nic Larter residence. Blue Vane Trap.
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J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.8639	-121.3541	July 28-Aug. 17, 2017	Nic Larter residence. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.77724	-121.29051	May 16-22, 2018	10km gravel pit. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.77724	-121.29051	May 16-22, 2018	10km gravel pit. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.77724	-121.29051	May 16-22, 2018	10km gravel pit. Blue Vane Trap.
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J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.77724	-121.29051	May 16-22, 2018	10km gravel pit. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.77724	-121.29051	May 16-22, 2018	10km gravel pit. Blue Vane Trap.

Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.86393	-121.35409	May 16-June 5, 2018	Nic Larter residence. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	62.04181	-122.02317	May 24-31, 2018	Km518 gravel pit set w/i a strawberry patch. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	62.04181	-122.02317	May 24-31, 2018	Km518 gravel pit set w/i a strawberry patch. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	62.04181	-122.02317	May 24-31, 2018	Km518 gravel pit set w/i a strawberry patch. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	62.04181	-122.02317	May 24-31, 2018	Km518 gravel pit set w/i a strawberry patch. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	62.04181	-122.02317	May 24-31, 2018	Km518 gravel pit set w/i a strawberry patch. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	62.04181	-122.02317	May 24-31, 2018	Km518 gravel pit set w/i a strawberry patch. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.44819	-121.2463	May 25-31, 2018	Checkpoint (to W). Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.44819	-121.2463	May 25-31, 2018	Checkpoint (to W). Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.44819	-121.2463	May 25-31, 2018	Checkpoint (to W). Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.44819	-121.2463	May 25-31, 2018	Checkpoint (to W). Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.44819	-121.2463	May 25-31, 2018	Checkpoint (to W). Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.44819	-121.2463	May 25-31, 2018	Checkpoint (to W). Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.44819	-121.2463	May 25-31, 2018	Checkpoint (to W). Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.34864	-121.80025	May 31-June 5, 2018	Poplar River Fuel Cache. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.34864	-121.80025	May 31-June 5, 2018	Poplar River Fuel Cache. Blue Vane Trap.
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Data Source	Species	Collector	Location	Latitude	Longitude	Date	Notes
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.34864	-121.80025	May 31-June 5, 2018	Poplar River Fuel Cache. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.34864	-121.80025	May 31-June 5, 2018	Poplar River Fuel Cache. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.34864	-121.80025	May 31-June 5, 2018	Poplar River Fuel Cache. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.44776	-121.24789	July 6-18, 2018	Checkpoint (to W). Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	61.44776	-121.24789	July 6-18, 2018	Checkpoint (to W). Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	62.04181	-122.02317	Aug. 10-22, 2018	Km518 gravel pit set w/i a strawberry patch. Blue Vane Trap.
J. Heron	*B. terricola*	N. Larter	Fort Simpson	62.04181	-122.02317	Aug. 10-22, 2018	Km518 gravel pit set w/i a strawberry patch. Blue Vane Trap.
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THREAT CLASSIFICATION TABLE

Threat classification table for the western bumble bee (*Bombus occidentalis mckayi*), yellow-banded bumble bee (*B. terricola*), and gypsy cuckoo bumble bee (*B. bohemicus*) in the NWT, based on the IUCN-CMP unified threats classification system version 3.2. Impact calculations for Level 1 and 2 threats were performed using the NatureServe Threat Calculator (NatureServe 2014). Scope, severity, timing, and impact of Level 1 threats (in **bold**) are based on estimates of scope, severity, and timing of each Level 2 threat in that category. Level 1 threats with non-negligible impact levels (in **red**) are discussed in the main body of the report. Estimates were performed during the preparation of this report by C. Ernst, based on available data and informed by similar assessments performed for each species at the national level, and reviewed and revised by the Species at Risk Committee on April 2, 2019. For a detailed description of this system and the threats, see the *Open Standards for the Practice of Conservation* website (CMP 2018).

Threat		**Calculated Impact**	**Scope[29]**	**Severity[30]**	**Timing[31]**	**Comments**
1	**Residential & Commercial Development**	**Negligible**	**N**	**S**	**H**	**There are large areas of natural habitat with no ongoing or likely future development. The human population of the NWT is very small (~44,000 in 2016), and may be in a slow decline (Department of Finance [DOF] 2015). Housing, commercial, tourism developments likely to display slow rates of growth over the next 10 years, but it is ongoing (DOF 2015).**
1.1	Housing & urban areas	Negligible	N	S	H	Urban development can lead to natural bumble bee habitat loss, but private/public gardens and green spaces in developed areas can provide resources for bees, especially when large and containing native plant species (e.g., Banaszak-Cibicka and Żmihorski 2012; Kaluza *et al*. 2016).
1.2	Commercial & industrial areas	Negligible	N	S	H	Commercial development (factories and other commercial centers) can lead to natural bumble bee habitat loss; these are typically located within urban areas, and are considered along with threat 1.1.

[29] Key to scope coding: U = unknown, N = negligible (<1%), S = small (1-10%), R = restricted (11-30%), L = large (31-70%), P = pervasive (71-100%).
[30] Key to severity coding: U = unknown, Nu = neutral or potential benefit, N = negligible (<1% population decline), S = slight (1-10% population decline), M = moderate (11-30% population decline), Se = serious (31-70% population decline), E = extreme (71-100% population decline).
[31] Key to timing coding: U = unknown, I = insignificant/negligible (past or no direct effect), L = low (long-term), M = moderate (short-term), H = high (continuing).

1.3	Tourism & recreation areas	Negligible	N	S	H	Recreation developments (ski areas, golf courses, campgrounds, resorts, etc.) can lead to natural bumble bee habitat loss. These types of developments are considered along with threat 1.1 as they are typically located in urban areas (and most are also uncommon in the NWT).
2	**Agriculture & Aquaculture**	**Negligible**	**N**	**N**	**H**	**There are large areas of natural habitat with no agricultural land use/practices in the NWT. Land use for agriculture is minimal (Statistics Canada 2016).**
2.1	Annual & perennial non-timber crops	Negligible	N	N	H	Non-timber agriculture is a small sector of NWT commerce and does not involve large commercial monocultures in the NWT (Statistics Canada 2016). Land use for agriculture is minimal in the NWT, and thus has had minimal impact on wildlife and wildlife habitat to date (Statistics Canada 2016). The number of farms/amount of farm land used in the NWT is relatively stable but may gradually increase in the future (Industry, Tourism and Investment [ITI] 2017a). The GNWT recently produced a strategy for growing this sector, but it is long term (>10 years) and focused on smaller-scale local food production, and production in greenhouses, so is unlikely to have a major impact (ITI 2017a).
2.2	Wood & pulp plantations					Not applicable. Zero hectares of forest were replanted/seeded in 2016 (Natural Resources Canada 2017).
2.3	Livestock farming & ranching	Negligible	N	N	H	Livestock can modify habitat by reducing floral resources and cause soil compaction. Livestock farming or ranching is very uncommon in the NWT (Statistics Canada 2016).
2.4	Marine & freshwater aquaculture					Not applicable. Not a known threat to bumble bees in the NWT.
3	**Energy Production & Mining**	**Negligible**	**N**	**S**	**H**	**All energy sectors have the potential to cause considerable damage to natural habitats, but mostly on a local scale (Cuddigy *et al.* 2005). Timing is high for oil/gas and mining/quarrying as they are established and ongoing with a possibility of intensifying, but moderate for renewable energy as this sector is currently being investigated for exploitation opportunities (GNWT 2013; Geological Survey 2018).**
3.1	Oil & gas drilling	Negligible	N	S	H	A number of shale gas and oil wells were drilled in the central Mackenzie Valley between 2012-2015, but no commercial production resulted, and there has been no activity since 2015 (National Energy Board [NEB] 2017b). Natural gas production is limited to Norman Wells and Ikhil and accounts for <1% of national production (NEB 2017b).

3.2	Mining & quarrying	Negligible	N	S	H	Mining and quarrying could cause considerable local damage to bumble bee habitat, by altering topography, removing native plants, and fragmenting landscapes (Sengupta 1993). Diamond and gold mining are historically important industries in the NWT, and other minerals/elements are mined as well. The vast majority of mines and deposits are located in the central/southeast, though other major projects are found along the western border (Geological Survey 2018). Although mining has been fairly stable, it might be expected to grow in the future (Geological Survey 2018).
3.3	Renewable energy	Negligible	N	N	M	The construction of wind and solar energy farms and geothermal plants can damage bumble bee habitat. Wind turbines are known to cause significant insect mortality (Corten and Veldkamp 2001), but the proportion of bees affected relative to other insects is not known. The colour of wind turbines can be an attractant for many pollinators, including bees (Long *et al*. 2011). Renewable energy is not currently a significant sector in the NWT: solar and wind power generation is largely limited to personal use or for powering individual buildings (ENR 2012). Wind energy is currently only 4% of the NWT's energy use but the government is actively seeking opportunities to expand wind, solar, and geothermal energy use in the territory (GNWT 2017b). Solar and wind farms could potentially add or replace usable habitat for bumble bees: floral resources could be affected if terrain is covered with gravel, but land clearing could provide open nesting habitat.
4	**Transportation & Service Corridors**	**Negligible**	**N**	**Nu**	**H**	**There are large areas of natural habitat where transportation and service corridors are not present, and although additional development of roadways and utility corridors is underway or anticipated, disturbance will be localized and traffic volumes will remain low. Roadsides may also be of benefit to bumble bees in the NWT.**

4.1	Roads & railroads	Negligible	N	Nu	H	In general, roads represent sources of habitat fragmentation and disturbance. They can isolate population, disrupt natural ecological process, and cause avoidance behaviour, in addition to resulting in road kills where vehicles are present. For insects, it is clear that roadways can result in localized mortality (as evidenced by the state of vehicle windshields) (Baxter-Gilbert *et al.* 2015) and there is some indication that roadways can result in some degree of avoidance behaviour (although this is associated with species that do not fly; Foreman and Alexander 1998). On the other hand, roadsides are often rich sources of plant species and may serve to create additional forest edge habitat. Foreman and Alexander (1998) note that species that move along roadways (versus across) are likely benefitted by higher road density. In the NWT, the total extent of existing roads in the NWT is not significant (Department of Transportation [DOT] 2014). Additional projects are underway or anticipated. These activities will add to the total length of roadways in the NWT, which may have some impact on bumble bees (Williams *et al.* 2010). However, the disturbances caused by corridors will be fairly localized and the amount of undisturbed land nearby will remain significant. Roadways will also increase the risk of bees being killed by moving vehicles, but traffic volumes are expected to be low (DOT 2011, 2016), and it is uncertain what impact road kills might have on bumble bee populations.
4.2	Utility & service lines	Negligible	N	Nu	H	In general, linear disturbance represents a source of habitat fragmentation and disturbance. It can isolate population, disrupt natural ecological process, and cause avoidance behaviour. However, most utility corridors are placed along existing roadways/right-of ways.
4.3	Shipping lanes					Not applicable. Not a known threat for bumble bees in the NWT.
4.4	Flight paths					Not applicable. Not a known threat for bumble bees in the NWT.
5	**Biological Resource Use**	**Negligible**	**N**	**M**	**H**	**There are large areas of natural habitat with no biological resource use/exploitation practices. Hunting/gathering for personal use is of minimal concern. Timber harvesting poses a bigger threat to natural habitat.**
5.1	Hunting & collecting terrestrial animals	Negligible	N	S	L	Bumble bees collected for scientific surveys are not collected in numbers sufficient to disturb natural population dynamics or cause local extirpations/extinctions, and collections are important for documenting species presence and distributions (Pohl 2009; Sikes *et al.* 2017). Hunting of other terrestrial animals is done on a small, local scale and mostly for personal or community consumption (ENR 2015d), with minimal impact to natural habitats, other than some trampling or damage of terrain along access routes (on foot, by ATV, etc.).

5.2	Gathering terrestrial plants	Negligible	N	M	L	Berry plants and others are harvested by residents, but not at a scale expected to impact bee populations (ENR 2015d). As generalists, many alternative nectar sources are available in the unlikely event that a food plant species is locally extirpated from over-harvesting. Natural plant resources are traditionally well managed and not over-exploited.
5.3	Logging & wood harvesting	Negligible	N	S	H	Timber harvesting can disturb or fragment habitat. Logging in the NWT is mostly small scale, family-run and local: individual operations harvest 500-10,000 m^3 per year, and total annual yields of lumber have been stable for the past decade (ENR 2015e). The most productive areas are along flood plains of major rivers (Bohning *et al*. 1997). There are some new initiatives to develop the wood pellet industry; some communities may explore this as an option for employment opportunities (BW McCloy & Associates 2009; ENR 2017a). Five-year timber harvesting permits have recently been issued in the Fort Providence and Fort Resolution areas, with expected harvests of 1,000-1,200 hectares/year (ENR 2015a, b, e).
5.4	Fishing & harvesting aquatic resources					Not a known threat to bumble bees in the NWT.
6	**Human Intrusions & Disturbance**	**Negligible**	**N**	**S**	**H**	**Most potentially threatening human disturbances are associated with development, and are treated under section 1.**
6.1	Recreational activities					Not applicable. Not a threat in the NWT.
6.2	War, civil unrest & military exercises					Not applicable. Not a threat in the NWT.
6.3	Work & other activities					Relevant aspects of this threat have been covered in Threat 6 and 7.
7	**Natural System Modifications**	**Negligible**	**S**	**N**	**H**	**Habitat modification by unmanaged wildland fires is a potential future threat since fire frequency and intensity is expected to increase over time with climate change.**

7.1	Fire & fire suppression	Low	S	N	H	Fires are extremely common in NWT forests (about 274/year between 1988-2008), with 600,000 hectares affected annually (ENR 2015c). The annual total area burned fluctuates each year, but a weak trend indicates a slight reduction in both total area burnt and the number of fires larger than 200 hectares between 1988 and 2008 (ENR 2015c). It is predicted that climate change will result in an increase in the frequency and intensity of fires, due to hotter, drier summers that provide a longer fire season (Soya *et al.* 2007). All three species are known to nest near forests, and open areas by forest edges may be particularly valuable habitat. Fires can reduce available nesting habitat for ground-nesting bumble bees 20 years or more after a burn and fires often lead to dense regrowth of shrubs and grasses, reducing the amount of unvegetated (open) nesting habitat (Williams *et al.* 2010). Gypsy cuckoo bumble bees would be similarly negatively affected, due to the loss of nesting habitat for their hosts. As such, unmanaged wildland fires could be a potential future threat for all three species, since fire frequency and intensity is expected to increase over time with climate change (Flannigan *et al*. 2008). However, all three species are also known to display considerable flexibility in choosing nesting and foraging habitats and are able to travel considerable distances; they could therefore reasonably be expected to adapt to the use of alternate habitats after a fire in a particular locality.
7.2	Dams & water management/use	Negligible	N	N	H	There are 3 major hydroelectric facilities in the NWT: Snare Group, Bluefish, and Taltson (GNWT 2017a). Flooding has occurred around dams in the NWT and can destroy wildlife habitat (CBC News 2017), but the bumble bees' habitat is not generally associated with land adjacent to water bodies.
7.3	Other ecosystem modifications					Not applicable. No other management actions are identified as problematic.
8	**Invasive & Problematic Species, Pathogens & Genes**	**Low**	**S**	**Se**	**H**	**Although beekeeping and commercial pollination activities in the NWT are small and localized at present, there is a strong interest among the public in beekeeping for honey and pollination, and support from the GNWT to pursue these activities (ITI 2017a).** **There are probably large areas of natural habitat where problematic species/pathogens do not exist in the NWT. However, invasive species have the potential to spread rapidly. Pathogens currently appear not to have a significant effect on native bumble bee populations.**

8.1	Invasive non-native/ alien plants & animals	Low	S	Se	H	Non-native honey bees (*Apis mellifera*) are present in the NWT (Working Group on General Status of NWT Species 2016). The total number of colonies in the territory, their origins, and their current distribution is unknown. No formal surveys of beekeepers or colonies in the NWT have been performed. There is some level of beekeeping taking place in Hay River, Yellowknife, Fort Smith, Inuvik, and Norman Wells (ITI 2017b; Carrière pers. comm. 2018; Cooper pers. comm. 2019; Ecology North 2019), and perhaps also Gameti (www.inaturalist.org). There is a strong interest in beekeeping in the NWT based on attendance and interest in a recent Bee Health Symposium in Yellowknife (Fenton pers. comm. 2019). Additionally, the GNWT has named honey as a potential commercial opportunity (ITI 2017a). Honey bees are known to compete directly with native bumble bees, including *B. occidentalis* (Thomson 2004), reducing the foraging and reproductive success of the native species (Mallinger *et al.* 2017). A potentially problematic non-native species is the common eastern bumble bee (*Bombus impatiens* Cresson 1863). This species is used in greenhouses and field crops for pollination (National Research Council 2007). Escaped colonies compete with native bumble bees for habitat, or spread disease (Mallinger *et al*. 2017; Jacobson *et al*. 2018). According to the COSEWIC report on *B. terricola*, *B. impatiens* may already be used in the NWT for commercial pollination services (COSEWIC 2015), but no substantiating documentation was available when this report was prepared. The greenhouse in Inuvik has been bringing in bees for pollination each year, but these appear to be blue orchard mason bees (*Osmia lignaria*) and it appears as though reproduction has not be successful (no new cocoons) (Solotki pers. comm. 2019). Although beekeeping and commercial pollination activities in the NWT are small and localized at present, there is a strong interest among the public in beekeeping for honey and pollination, and support from the GNWT to pursue these activities under the NWT Agriculture Strategy (ITI 2017a).
8.2	Problematic native plants and animals					No native plants or animals are known to be problematic (e.g., as predators, disease vectors, etc.) for bumble bees in the NWT. There is little evidence that predators are responsible for bumble bee population declines (Williams and Osborne 2009).
8.3	Introduced genetic material					Not applicable. No record of this threat in the NWT.

8.4	Pathogens & microbes	Low/ Uncertain	N	N	M	Fungal and other pathogens are widely implicated in the decline of North American bumble bees. It is presumed that "pathogen spillover" is to blame (Power and Mitchell 2004). Pathogen spillover is strongly associated with commercially reared honey and bumble bee colonies (Colla *et al.* 2006; Cameron *et al.* 2011; Szabo *et al.* 2012; Murray *et al.* 2013; Goulson *et al.* 2015; McArt *et al*. 2017). An aggressive and virulent strain of the microsporidian pathogen *Nosema bombi* is found in many declining bumble bee species, including wild and commercially-reared colonies of *B. terricola* and *B. occidentalis* (Whittington and Winston 2003; Cameron *et al*. 2016; Arbetman *et al.* 2017). The fungus' high rate of transmission and impacts are nevertheless likely significant. Commercially-reared bumble bee nests of several species have been found to harbour other parasites, including *Crithidia bombi* and *Locustacarus buchneri*. There are no studies to confirm if these pathogens are present in the NWT. Declining bumble bee populations tend to have a high prevalence of pathogens (Cameron *et al.* 2011). Interestingly, both subspecies of *B. occidentalis* have similar levels of parasitism (about 40%) (Koch and Strange 2012; Pampell *et al.* 2015; Sheffield *et al.* 2016), but *B. o. mckayi* may be more stable than *B. o. occidentalis*. Since commercial bumble bee colonies are not widely used in the north, these relatively high levels of infection may be natural and not caused by pathogen spillover (McHugh and Sikes 2016). If these infection levels are indeed natural, *N. bombi* and other pathogens may not have the same effect on northern bumble bee populations as they do in the south, perhaps because other threats that increase their susceptibility to infections are not concurrent or as prevalent in the north. Fungal pathogen prevalence in bumble bees is associated with large-scale agricultural/commercial fungicide use (McArt *et al.* 2017); this is not a significant factor in the NWT. Many other microsporidian pathogens exist worldwide, and the potential of these to cause additional disease epidemics in bumble bees is uncertain (Brown 2017). Small, isolated populations with less genetic diversity could be more affected by new diseases than large populations with high genetic diversity (Brown 2017). Beekeeping, especially increased use of commercial bee colonies in the NWT, if it occurs, could increase the chances of this potential future threat.

9	**Pollution**	**Negligible**	**N**	**N**	**H**	**Pollution levels are very low compared to other regions (ENR 2008) and are very localized. Large-scale oil spills would be a larger concern if pipelines were operational. Agricultural pollutants, which are widely implicated in bumble bee declines globally, are not a significant threat in the NWT.**
9.1	Household sewage & urban waste water					Not applicable. This is the most common type of waste spilled in the NWT, in frequency of spills and in volume (93%) (ENR 2016b). Effects on bumble bees, if any, are unknown. Probably not a threat.
9.2	Industrial & military effluents	Negligible	N	N	H	Petroleum products degrade slowly and can be hazardous to plants and wildlife. Most communities in the NWT rely on fuel for heating and energy, which they receive via tanker trucks if they are accessible by roadway (ENR 2016b). Oil spills are a concern. The Enbridge Norman Wells Pipeline, which runs alongside the Mackenzie River from Norman Wells to Alberta, was shut down in 2016 because slope instability created concerns about pipe failure and environmental contamination (NEB 2017a). It has not been repaired and the line remains closed. Until very recently, there were concerns about the effects of the Mackenzie Valley Pipeline project on natural habitats. Although the project was approved by federal cabinet in 2011, it was abandoned by Imperial Oil in late December 2017. Regardless, it is not inconceivable that the project could be revived. Most oil spills in the NWT are small (<100 litres). In the mining industry, discharges from tailing ponds, waste rock, exposed rock, and accidental mill tailings spillage are pollutants that can be taken up by plants and animals (ENR 2016b). The effects of effluent on bumble bees is unknown, but they are a continuous threat.
9.3	Agricultural & forestry effluents					Not a current threat. In the NWT, permits are required for non-domestic pesticide or herbicide use. There may be active permits in Fort Simpson, within the range of all three species; however, pesticides are generally only used in buildings. Herbicides are occasionally used; for example, along railway corridors and at certain locations along the Enbridge pipeline (Martin pers. comm. 2012 *in* SARC 2014). Agricultural effluents with the greatest potential threat to bumble bees are pesticides, particularly neonicotinoids as they are harmful to wild bumble bees even at small concentrations (Goulson 2015; Goulson *et al.* 2015; Arce *et al.* 2017). These pesticides are systemic and spread through the plant to pollen and nectar. Pesticides have been globally implicated in pollinator declines (Szabo *et al.* 2012; Williams *et al.* 2014; Goulson *et al.* 2015; IPBES 2016). However, agriculture in general and plant production in particular is an extremely small sector in the NWT so this is not expected to be a threat.
9.4	Garbage & solid waste					Not applicable. Not a known threat in the NWT.
9.5	Air-borne pollutants					Not applicable. Not a known threat in the NWT.

9.6	Excess energy					Not applicable. Not a known threat in the NWT.
10	**Geological Events**					Geological events are not a threat in the NWT.
10.1	Volcanoes					Not applicable. Not a threat in the NWT.
10.2	Earthquakes/ tsunamis					Not applicable. Not a threat to bumble bees in the NWT.
10.3	Avalanches/ landslides					Not applicable. Not a threat to bumble bees in the NWT.
11	**Climate Change & Severe Weather**	**Western bumble bee = Medium/Uncertain** **Yellow-banded and gypsy cuckoo bumble bees = Low/uncertain**	**L**	**Se**	**H**	**Arctic temperatures are rising twice as fast as the global average, with associated shifts in vegetation zones, habitat, and species ranges (ACIA 2004; IPCC 2014; ENR 2016b). The entirety of the NWT is expected to be affected, although some regions (for example, the Mackenzie River valley) may be warming even more quickly than others (ENR 2008). Climate change is a potentially significant threat to bumble bees worldwide and probably in the NWT. Severity is could be serious but is highly uncertain for many factors. Timing is high as the threat is ongoing, and accelerating.**
11.1	Habitat shifting and alteration	Low/uncertain	L	U	H	With climate warming, summers begin earlier and end later, extending the length of the active season for bees. A longer active season could be positive for bumble bees if food resources are available when queens emerge to establish new colonies in spring, but if there is a timing mismatch with floral resources, the effects could be devastating. Loss of permafrost may also impact bumble bee habitat, through changes to water regimes/storage, vegetation cover, and soil drainage (Quinton et al. 2011; Bring et al. 2016; Sniderman and Baltzer 2016; Chasmer and Hopkinson 2017). Also, as temperatures have warmed, low shrub cover above the treeline has expanded and become more robust (Pearson et al. 2013; ENR 2016b). Since the three bumble bee species of interest appear to have affinities for habitat adjacent to forests, changes to forest habitat will likely have an impact on them. These effects may be positive or negative, depending on whether forests expand or contract, create or reduce forest edge habitat, and whether they enhance or displace flowering plant communities. Encroachment is likely occurring fairly rapidly and effects are expected to continue in the next 10 years.

11.2	Droughts	Negligible/uncertain	U	N	U	Droughts may have an impact on bumble bees' water availability and floral resources (Rasmont and Iserbyt 2012; Thomson 2016). Drought is also associated with increased forest fires, the number and intensity of which are expected to increase in the NWT (Flannigan *et al.* 2008; ENR 2016b), and changes to soil moisture and other properties, which could affect quality or availability of nesting and hibernacula sites. Drought conditions have been a problem in parts of the NWT in recent years.
11.3	Temperature extremes	WBBB = Medium/uncertain YBBB + GCBB = Low/uncertain	L	WBB = M YBBB + GCBB = S	H	Bumble bees are generally considered adapted to cool temperate climates in the northern hemisphere, including arctic, subarctic, and boreal regions (Rasmont and Iserbyt 2012; Williams *et al.* 2014; Martinet *et al.* 2015). Arctic temperatures are rising faster than the global average (ACIA 2004; IPCC 2014; ENR 2016b). The entirety of the NWT is expected to be affected by climate change, although some regions may warm more quickly than others (ENR 2008). There have been a number of extended heat waves in the NWT in the past decade, and the frequency and intensity of extreme summer temperatures (>30°C) is expected to increase across the NWT (ENR 2016a, b). High temperatures have been implicated in local bumble bee extirpations in Europe, including in Finland following a heat wave with a maximum temperature of 33°C. The lethal effects of heat waves may be the result of a number of factors, including the severity of the heat wave, the duration of the heat wave, water loss, or starvation (Rasmont and Iserbyt 2012). Individual heat waves are not expected to be a threat to all bumble bees within their entire NWT distribution. Because of their heat intolerance and limited northern distribution, we can probably expect to see the distribution of *B.o.mckayi* decline. However, yellow-banded and gypsy cuckoo bumble bees have widespread distributions in North America that extend down into the north/central east coast of the United States (Williams *et al*. 2014). Presumably, these two species are more likely to tolerate periods of heat and wider temperature ranges than the western bumble bee.
11.4	Storms and flooding	Uncertain	R	U	H	Flooding may directly impact ground-nesting bees in floodplains or other low-elevation areas, either from immersion or increased susceptibility to mold (Harder 1986). Some large-scale flooding has taken place in the Mackenzie River valley, Aklavik, and Fort Good Hope (ENR 2012), as well as near Fort Providence and in the Slave River delta in the last 5 years (Olesinski and Brett 2017).
11.5	Other impacts					

NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE