# Reversing the North American bumblebee decline:

# Looking at farming practices could be a solution

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**Abstract**

Wild bee declines have been documented worldwide, particularly in bumblebees, with some species in Nort America declining over 90% in the last 20 years. Climate change, land-use change from agriculture, pesticide use, and apiculture are the main drivers. The 2.2-hectare farm *La ferme de l'Aube* is the research site of a larger 3,082-hectare biodiversity reserve. The study area saw a 340% increase in the bumblebee population from 2018-2024, demonstrating that veganic practices of cultivation including low-till, non-toxic spraying, cultivation of flowering plants that bloom throughout the season, permanent ground cover and re-wilding the adjacent forest and edge could have contributed to the increase.

**Introduction**

Wild bee declines have been documented worldwide (Jacobson et al 2018), particularly in bumblebees, with some species in North America declining over 90% in the last 20 years (Cameron et al 2011). Climate change affects their hibernation cycle and nesting temperatures in the late spring and early summer (Jackson et al 2022); land-use change from agriculture and development destroys nesting and wintering sites underground—especially vitally important abandoned mice and vole holes— (Jackson et al 2022); pesticides, especially neonicotinoids, toxify the flowers that then kill the bees (Janousek et al 2023; Nicholson et al 2023), and apiculture practices breed viruses that commercial honeybees will pass on to wild bees (Furst et al 2014).

Farming practices have historically had a negative impact on bumblebee survival. Constant tillage, herbicide and pesticide usage, and elimination of wild lands have all been the normal. Considering that farming methods may be the biggest driver in the decline of bumblebees, discovering how one study farm could be reversing the decline is of foremost importance.

Understanding the placement of any agricultural area and its relationship to the complete bumblebee cycle is particularly important as it has been researched that forests may play an open role in bumblebee life history (Mola et al. 2021).

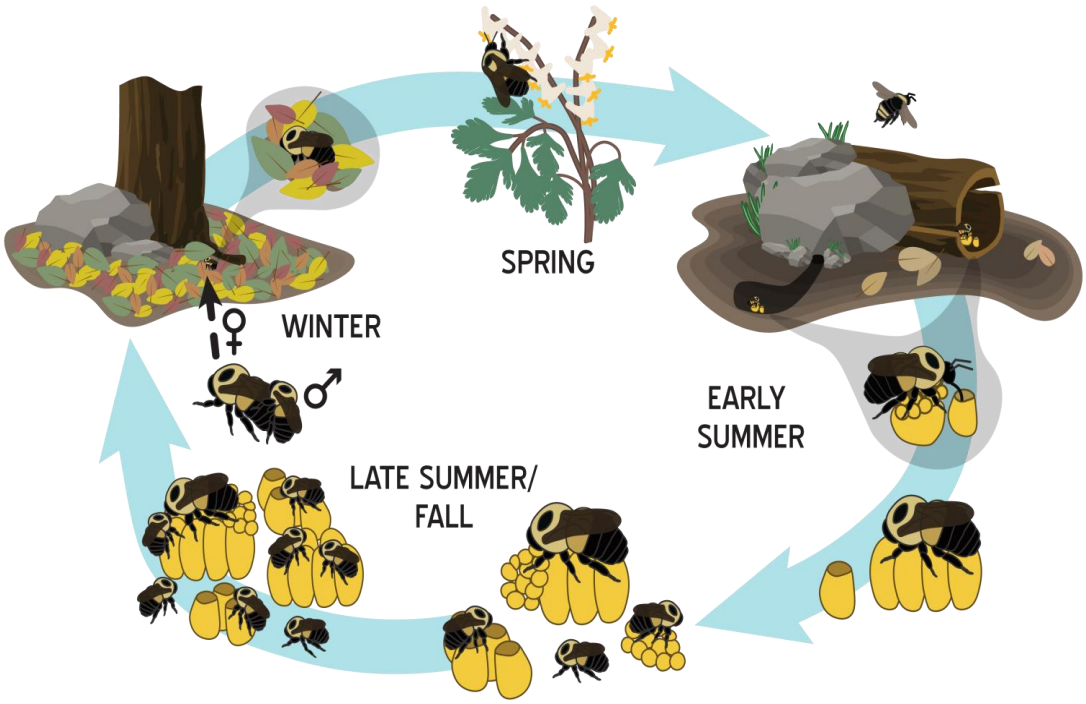


*Image credit: Bumblebees of Wisconsin life cycle, University of Wisconsin-Madison*

In the spring the queens emerge and begin to actively forage on the earliest flowering bushes and trees. By early summer, the queens find a suitable nest site creating wax pots and laying their eggs. Two-to-three-weeks after the first babies (workers) hatch, they take over the duties looking for nectar and taking care of the rest of the brood. By mid-summer, the colonies are at their maximum size. The reproductive cycle begins, where the Gynes are mated, who are those that are destined to become queens (University of Wisconsin 2024). As important as places to nest are to all bumblebee species, is the availability of high-quality forage, especially in September, before the bumblebees begin seeking hibernation sites (Timberlake et al. 2020). Almost all the rest of the colony will die off before the year is out and the newly mated Gynes will find a suitable hibernation site until emerging the following spring to start the cycle again.

## Methods

### *Landscape Characterization of the Study Site*

The 2.2-hectare (6-acre) study site of *La ferme de l'Aube* (45.945648, -74.807059) established in 2014, is representative of a larger 3,082-hectare (7,615-acre) biodiversity reserve. The middle section of the research area is where the no-spray, low-till, .135 hectare (1/3$^{rd}$ of an acre) veganic

farm *La ferme de l'Aube* lies. 3,500 square feet have been designated for survey that include annual and perennial species of: *agastache, allium, asclepias, bellis, borago, brassica, centaurea, coriandrum, cosmos, cucurbita, echinacea, fagopyrum, helianthus, lactuca, lavandula, liatris, lonicera, medicago, monarda, ocimum, origanum, phacelia, phaseolus, raphanus, stachys,* and *zea*.

The farm practices veganic agriculture which is defined as:

*The cultivation and production of food and fiber crops with a minimum amount of exploitation of all animal and plant species. Veganic methods do not use animal products or byproducts, such as blood meal, bone meal, manure, urea, fish meal, fish emulsion, or any other animal-derived materials, because the production of these products specifically harms animals or is related to the exploitation and subsequent suffering of these beings.*

*Veganics disallows the use of organic pesticides and fungicides, as fumigation upsets the balance of the native flora, fauna, and insect communities of the growing systems. Furthermore, farms cultivated in this manner attempt to keep the ground covered all year and let garden plants decompose in place to provide over-wintering habitat (NAVCS 2024).*

The rest of the terrain and the surrounding lands has been allowed to re-wild.

To the north the forest edge gives way to a mature mixed forest, including coniferous species of: *Abies balsamea, Picea glauca, Pinus strobus, and Thuja occidentalis* and deciduous: *Acer rubrum, Acer saccharum, Betula alleghaniensis, Betula pendula, Fagus grandifolia, and Populus tremuloides*.

The eastern edge is bordered by *Amelanchier sp. and Prunus virginiana*. To the west, the farm gives way to a dense forest of *Alnus incana* with some mature *Pinus strobus*.

Following the terrain in the southern direction there are three granite, quartz crystal protrusions, with species of: *Acer rubrum, Malus sylvestris, Tilia americana, and Ulmus americana,* and a regenerating forest of: *Abies balsamea, Pinus resinosa, and Populus tremuloide*. The understory of the southern section is primarily *Pteridium aquilinium, Rubus sp., and Solidago canadensis*. At the southern edge, a permanent creek follows the entirety of the southern border with *Tsuga canadensis* among the *Alnus incana*. The creek curls back northwest creating a seasonal marsh and courses its' way through a deepening canyon that is densely

foliated. Between the farm and the southern creek is a vast wildland dominated by *Solidago canadensis*.

Over 550 species of flora and fauna had been identified in the reserve as of September 2024 with over 30 species deemed at-risk, including two bumblebee species (*B.fervidus* and *B.terricola)* important to our discussion.

### *The Study Methods*

To assess the highest population of bumblebees possible, a late July to early August period was chosen, to correlate with worker bumblebees leaving the nest site. It would correlate with peak cultivated flower diversity, but before the vast wildlands of *Solidago canadensis* bloom. For once it does, the bees disburse widely to feed on the native, perennial source of pollen.

The count was partaken in the afternoon on days of low wind velocity and partial to full sun, with temperatures below 30C. The survey was conducted by walking transects within the 3,500 square feet and counting numbers and species.

## Results

### *The Study Results*

***Annual Bumblebee (Bombus sp.) Survey La Ferme de l'Aube:***
***3,500 square feet of cultivated annuals and perennials***

| Dates | HB | TC | NA | CE | GN* | YB* | Con | BB | TS | Totals |
|---|---|---|---|---|---|---|---|---|---|---|
| Aug. 8, 2018 | 58 | 6 | 7 | 7 | 2 | n/a | n/a | n/a | n/a | ***80*** |
| Aug. 7, 2022 | 125 | 19 | 21 | 13 | 4 | n/a | n/a | n/a | n/a | ***182*** |
| Aug. 9, 2023# | 90 | 25 | 15 | 7 | 3 | n/a | n/a | n/a | n/a | ***140*** |
| July 29, 2024 | 185 | 51 | 8 | 10 | 2 | 8 | 2 | 2 | 4 | ***272*** |

*Legend: HB=Half-black (B.vagans); TC=Tri-colored (B.ternarius); NA=Northern Amber (B.borealis); CE=Common Eastern (B.impatiens); GN=Golden Northern (B.fervidus); YB=Yellow-banded (B.terricola); Con=Confusing (B.perplexus); BB=Brown-belted (B.grisecollis); TS=Two-spotted (B.bimaculatus)*

**-indicates a species listed as vulnerable by IUCN Red-list*

*#-believed to be a low count due to abundant rainfall damaging flower heads*

## Discussion

The numbers tell the story. In 2018 perennials were still being established and the farmers were cultivating biointensively for market selling. Four years later when the perennials were older, the total number of bumblebees increased 227%. In 2023, due to an abundance of perceived rainfall during peak flower season, numbers were lower, but still 175% above the baseline year. In 2024 the count was up 340%. The number of species observed increased from five to nine, and one new species discovered, the Yellow-banded bumblebee *Bombus terricola,* is listed as vulnerable (IUCN 2024) and of special concern in Québec (Government of Québec 2024). Finding this species shows that veganic growing practices are working to potentially eliminate declines of bumblebees in the region.

The importance of *Solidago canadensis* left to re-wild cannot be understated. This incredible food source for all wild pollinators buzzes with activity in the reserve. In the fall when the rains and snows flatten the plants, they become a thick ground cover where mice and voles burrow. It is these abandoned burrows that bumblebee species utilize for both winter hibernation and summer nesting (Liczner & Colla 2019).

**Conclusions**

Bumblebee survival depends on a variety of factors. As important as climate change is in affecting their hibernation and nesting cycles, land-use change from agriculture, herbicide and pesticide use may be the most crucial factors to consider. When bumblebees have multiple habitats and extensive ground cover, underground sites can be well insulated from even the harshest air temperatures. When the flowers necessary for their survival are not exposed to herbicide and the land area is not permeated with pesticides, including neonicotinoids, they can forage and fly free of toxification. This is where long-term veganic farming practices can be of great benefit. Like all studies, more are needed at agricultural sites wherever there are regional bumblebee declines.

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