Documented losses of Vermont's wild and managed bees and causes:

- Beekeepers in Vermont have experienced overwintering losses of 30-50% over the last decade.
- In 2017-2018, Vermont beekeepers reported the third highest annual colony losses across all states. (Bee Informed Partnership, 2017).
- Several bumble bee species are in decline (Richardson et al., 2018).
- In March 2015, Vermont Fish and Wildlife listed 2 bumble bees species as state endangered and 1 species as threatened.
- Known threats to bees include: pesticide exposure, nutrition, pests and pathogens. These threats have synergistic effects of bees.
- Pathogens spillover from managed honey bees into wild bumble bees (**Figure 1**) Indicates a need for better disease monitoring and management.

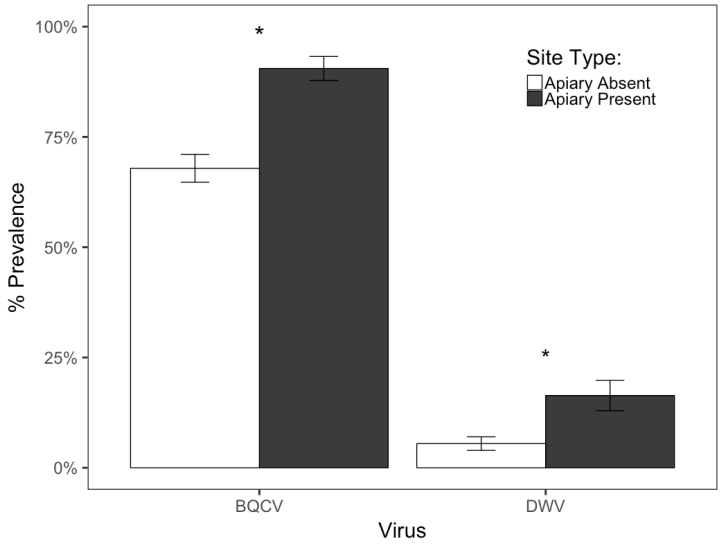

Figure 1. Wild bumble bees are more likely to have viruses when they live near managed honey bees. Bars represent % prevalence in bumble bees for Black Queen Cell Virus (BQCV and deformed wing virus (DWV) at sites either without (white bars) or with (black bars) managed apiaries (Alger et al., in review).

How are bees exposed to neonicotinoids?

- Exposure may be by contact (dust, soil), by ingestion (pollen)
- Water droplets of leaves from seed-treated corn can reach concentrations of up to 100 ppm for thiamethoxam and clothianidin, and up to 200 ppm for imidacloprid (5-6 orders of magnitude higher than levels found in pollen and nectar). Dead bees were found after minutes of consuming these drops (Girolami et al., 2009).
- Untreated plants may absorb residues from the soil (Botías et al., 2015).
- Talc or graphite powder is added to vacuum systems in planters to keep seeds from clumping and this powder is exhausted from the planter and contains neonicotinoids.
- Neonicotinoid residues move well beyond corn fields during sowing through dust and are deposited on non-target lands and waterways and are found at levels lethal to honey bees. Authors documented no benefit of insecticidal seed treatments for crop yield during the study (Krupke et al., 2017).

What are the effects on bees?

- A meta-analysis found that more than 90% of literature published after 2009 directly or indirectly demonstrated the adverse health effects associated with sub-lethal exposure to neonicotinoids (**Table 1**).

Table 1. Effects of neonicotinoids on managed (honey bees) and wild bee species with supporting literature.

	Honey Bees	**Bumble Bees**	**Solitary Bees**
Neonicotinoids known to be highly toxic	Imidacloprid Clothianidin Dinotefuran Thiamethoxam	Imidacloprid Clothianidin	Clothianidin Imidacloprid
Associated Health Effects	abnormal foraging activities, impaired brood development, neurological or cognitive effects, colony collapse disorder and immune suppression, increased worker mortality.	reduced food consumption, reproduction, worker survival rates, reduced ovary development, and foraging activity	increased rates of mortality (alfalfa leafcutter and alkali bees)
Selected Supporting Literature	(Henry et al., 2012; De Almeida Rossi et al., 2013; Colwell et al., 2017; Tsvetkov et al., 2017; Woodcock et al., 2017; Basley & Goulson, 2018; Catae et al., 2018)	(Whitehorn O'Connor, S., Wackers, F. & Goulson, D., 2012; Baron, Raine & Brown, 2014, 2017; Arce et al., 2017; Baron et al., 2017)	(Woodcock et al., 2017)

Vermont's Neonicotinoid usage:

- Neonicotinoid containing products can be purchased by homeowners for tree, lawn and garden care at most hardware stores. Consumers may not have training in pesticide application or understand effects on pollinators.
- A major source of the most harmful neonicotinoids (Imidacloprid, Clothianidin, Thiamethoxam) come from field corn and soybean seed coatings. Soil, water and surrounding plants may become contaminated through exposure of pollen from plants grown from treated seeds and talc dust during seed sowing.

Detection of insecticides in honey bee colonies in Vermont:

- Study conducted by Vermont Agency of Agriculture in 2012 and 2013 tested pollen collected from a total of 3 honey bee colonies for pesticides in 2 field sites. Up to 4 pesticides (including Clothianidan, Thiamethoxam, and Imidacloprid) were detected at low levels the pollen samples. Honey and wax were not tested in this study.
- For the USDA-APHIS National Honey Bee Survey, 10 pollen (2016) and 10 wax samples (2017) were collected from Vermont apiaries and tested for a panel of chemicals including insecticides, fungicides, and herbicides. In 2016, six chemicals were detected in pollen samples, one of which included trace amounts of Acetamiprid. In 2017, 29 different chemicals were detected in the wax samples although no neonicotinoids were detected.

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