Bumblebee Health in Maine's Lowbush Blueberry Fields

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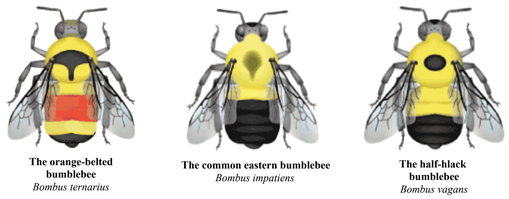
INTRODUCTION

Native bumblebees are important pollinators in the Maine lowbush blueberry (*Vaccinium angustifolium*) system. Compared to commerical honeybees, bumblebees are adapted to local climatic conditions and are able to forage in cooler, more rainy weather, which is often necessary during the spring timing of blueberry bloom[1,2]. In addition, bumblebees display a behavior known as "sonication" during foraging, which allows them to better pollinate deeper flowers, such as the bell-shaped blueberry flower[3].



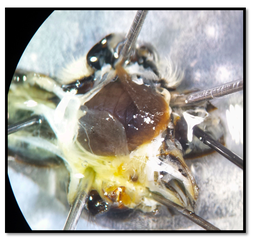
Common bumblebee species found in Maine's lowbush blueberry fields (drawings by Elaine Evans).

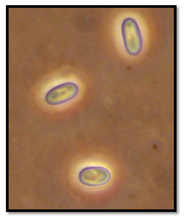
However, troubling evidence has surfaced concerning recent range reductions and declines in some North American bumblebee species[1]. Possible causes include habitat fragmentation, introduced parasites and pathogens from the commercial bumblebee business, and the use of broad-spectrum pesticides on crops and managed areas[2,4]. We assessed parasite and pathogen loads of bumblebee worker, drones, and queens at a variety of blueberry fields with varying crop management strategies, from organic to conventional, to gather current baseline data of the health of bumblebees that forage in the extra floral resources surrounding blueberry fields. Additionally, we examined the effects of different levels of a neonicotinoid pesticide, imidacloprid, on the development of commercially managed bumblebee colonies.

MATERIALS AND METHODS

During the summers of 2012, 2013, and 2014, we collected bumblebee specimens from blueberry fields around Downeast Maine as well as from the University of Maine's Rogers Farm. Bees were collected and marked with the date of capture, field site, and the floral resource the bee was captured on (if available). Bees were then examined to determine species, age (using wing), and the bees were measured. The abdomen was opened and the gut examined for evidence of macroparasites (conopid larvae). The gut was then removed and then examined for the fungal pathogen *Nosema bombi.*

In 2013 and 2014, commercial colonies of the common eastern bumblebee (*B. impatiens)* were fed food dosed with varying levels of imidacloprid and their progress tracked for two weeks in the lab and then for six to eight weeks in six different field sites around Downeast Maine.





Clockwise from top left: A nearly pupated conopid fly dissected from a *B. vagans* worker, commercial colonies in the imidaclopid trial, a field site in Frankfort, ME, and *Nosema bombi* spores (all photos: Bickerman).

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RESULTS

Abundance of species in 2013 (Fig 1). The orange-belted bumblebee *(B. ternaius)* is the most common species in Maine blueberry fields.

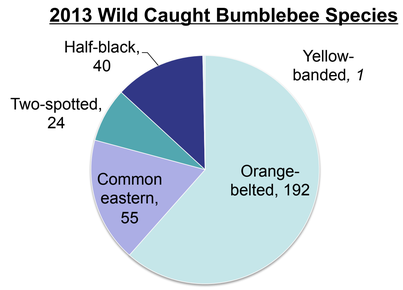

Figure 1. Total number of bees caught per species. Numbers indicate absolute values

Proportion infected with *Nosema* by species in 2012 (Fig 2). Although the sample size is fairly small (N=19), more rare species such as the yellow-banded (*B. terricola)* can be seen as having a higher proportion of infected individuals when compared to a more common species like the orange-belted. So, some species appear to be more susceptible to some diseases than others, which might explain their low numbers.

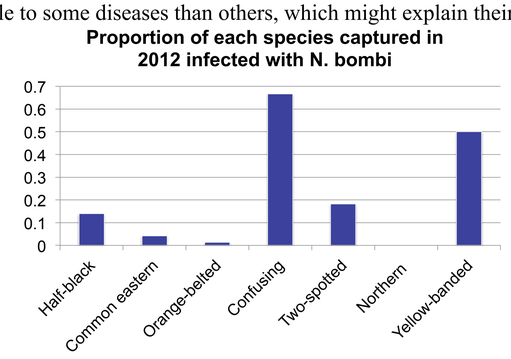

Figure 2. Proportion of each species captured with *Nosema* infection .

Effects of dietary imidacloprid on managed colonies of the common eastern bumblebee (Figs. 3 and 4). The effect of index dose and field management on brood mass at the end of the season in 2014 (Fig 3). The dose of imidacloprid in the colonies' feed affected the amount of weight gained in the lab (Fig 4). Therefore, exposure to imidacloprid appears to have deleterious effects on bumblebees in the field, especially at high doses. This effect seems to be more serious in organic fields compared to conventional fields, although we're not sure why.

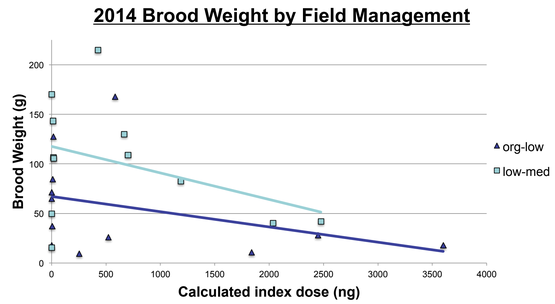

Figure 3. Brood weight at the end of the season is affected by the index dose of imidacloprid fed at the beginning of the season and the type of field management the bees were placed in.

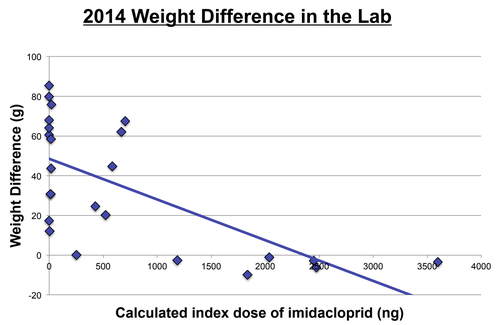

Figure 4. Bees gained less weight when fed more imidacloprid in the lab, and the higher doses even lost weight.

CONCLUSIONS

- The fungal pathogen *N. bombi* infects certain species more often but is generally present low levels.
- We continue to work in blueberry fields in different geographical locations and a range of management strategies to gain insight into field characteristics that may lend themselves to higher or lower rates of *Nosema* and conopid infection
- Colonies exposed to high doses of dietary imidacloprid do not grow as quickly, weigh less, and contain fewer individuals than those colonies exposed to lower doses or the control colonies.

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