The Status of the Bees

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bee diversity

- Worldwide – 20,000 species
- U.S. – 2,500 species
- Florida, Arizona – 700 species
- New York – 450 species
- Massachusetts – 350-400
- Maine – 275 species
where do we stand...

honeybees

Maine brings in almost 85,000 colonies per year just for wild blueberry!
Three Maine research projects on honeybees since 2009

1. National stationary hive project (2009-2013)

2. Effect of fungicide propiconazole (2011-2013)

spring 2009 – spring 2013 colony losses
(all trials and all sites, n = 442 colonies)

• 2009 - 2013 colony loss relative risk

<table>
<thead>
<tr>
<th>Factor</th>
<th>P-value</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year***</td>
<td>P = 0.0006</td>
<td>4.9</td>
</tr>
<tr>
<td>Apiary site***</td>
<td>P &lt; 0.0001</td>
<td>2.1</td>
</tr>
<tr>
<td>Varroa***</td>
<td>P &lt; 0.0001</td>
<td>2.1</td>
</tr>
<tr>
<td>Varroa x site***</td>
<td>P = 0.0003</td>
<td>1.3</td>
</tr>
<tr>
<td>Nosema**</td>
<td>P &lt; 0.007</td>
<td>2.1</td>
</tr>
<tr>
<td>Nosema x site*</td>
<td>P = 0.021</td>
<td>1.3</td>
</tr>
<tr>
<td>IAPV*</td>
<td>P = 0.054</td>
<td>1.3</td>
</tr>
</tbody>
</table>
effect of intensive agriculture?
factors that affect colony loses

- *Varroa destructor* (1986)
- *Nosema ceranae* (1990)
- Viruses – new and old
- Overall geographic location (weather, forage)
- Pesticides – *acute*, but also subtle sublethal effects
what’s new and emerging?

ZOMBIE BEES (2012)
how are the wild bees?

- species declines
- exotics?
- species shifts
- species rebounds

very, very difficult to measure!
another factor that makes it difficult
declines HAVE been documented around the globe
Declines in the Northeast...

Putting numbers to the pollination crisis

44% of bee species are stable

27% of bee species are increasing

29% of bee species are declining

Data reflects relative abundance changes in the northeastern US along the last 100 years
Historical trends in Maine
rusty patch bumble bee

Colla and Packer 2008, images: Xerces Society, Sam Droege
the decline of the yellow banded bumble bee in Maine
2013 survey for the yellow banded bumble bee, *Bombus terricola*

- Observed and confirmed
- **NOT** observed

1. Survey sites in Maine (n=29 confirmed)
2. Percent occurrence = 13.8% (n=29)
3. Relative abundance = 2.4% (n=18), compared to 1-2% from 2009-2012.
2014 survey for the yellow banded bumble bee, *Bombus terricola*

- **Observed and confirmed**
- **Reported, but NOT confirmed**
- **NOT observed**

1. survey sites in Maine and New Brunswick (n=87 confirmed)

2. percent occurrence = 49.4% (n=87)
   0% in NH 2014 survey (9 locations, n = 1349 bees collected, Rehan data)

3. relative abundance = 7.4% (n=18), compared to 1-2% from 2009-2013.

4. occurrence vs *Bombus* richness, ns ($P = 0.13, n=18$)
2015 survey for the yellow banded bumble bee, *Bombus terricola*

- Observed and confirmed
- Reported, but **NOT** confirmed
- **NOT** observed

1. survey sites in Maine and New Brunswick (n=52 confirmed)

2. percent occurrence = 61.5% (n=52)

3. relative abundance = 11.5.4% (n=32), compared to 1-2% from 2009-2013.

4. occurrence vs *Bombus* richness, ns ($P = 0.08$, n=32)
factors affecting declines

• climate change?
• habitat fragmentation and shrinking habitat
• pesticides
• pathogens & parasites
  – native pathogens and new stressors
  – exotic new pathogens?
• genetic diversity (bees – low diversity due to breeding system and inbreeding)
• exotic bees – competition?
pesticides
bumble bees in Maine

Kalyn Bickerman
PhD Student
University of Maine School of Biology and Ecology
bumble bees and imidacloprid revisited (2013 & 2014)
parasites and disease

- native
- exotic ... aka SPILLOVER
a native bumble bee pathogen

- Fungal pathogen
  - *Nosema bombi*
- Spread through spores
- Prevalence species-dependent

No effect - commercial bumble bees

*Bushmann et al. (2013)*

*N. Bombi* spores, 1000X. Bickerman, 2012
Table 5. Percentage of virus-positive *Bombus* sampled from flowers in the vicinity of Stationary Apiaries in Maine, Minnesota, and Washington. Samples were taken in July/August 2010. DWV = Deformed wing virus and BQCV = Black queen shared *Bombus* cell virus.

<table>
<thead>
<tr>
<th>Apiary and Species</th>
<th>Single infection</th>
<th>Single infection</th>
<th>Dual infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>DWV</td>
<td>BQCV</td>
</tr>
<tr>
<td><strong>MAINE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bombus ternarius</td>
<td>26</td>
<td>73.1</td>
<td>38.5</td>
</tr>
<tr>
<td>Bombus vagans</td>
<td>5</td>
<td>80.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Bombus spp.</td>
<td>8</td>
<td>87.5</td>
<td>62.5</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td>79.4</td>
<td>43.6</td>
</tr>
<tr>
<td><strong>MINNESOTA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bombus bimaculatus</td>
<td>5</td>
<td>20.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Bombus impatiens</td>
<td>7</td>
<td>85.7</td>
<td>85.7</td>
</tr>
<tr>
<td>Bombus vagans</td>
<td>5</td>
<td>80.0</td>
<td>100</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td>64.7</td>
<td>76.5</td>
</tr>
<tr>
<td><strong>WASHINGTON</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bombus mixtus</td>
<td>11</td>
<td>81.8</td>
<td>90.9</td>
</tr>
<tr>
<td>Bombus spp.</td>
<td>18</td>
<td>72.2</td>
<td>94.4</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td>75.9</td>
<td>93.1</td>
</tr>
</tbody>
</table>
Pathogen spill-over?
Why the honey bee?

- Only bees (and a few aphids) make honey
- Honey bee stores large quantities of honey
- Stingless bees also store honey in Australia, Asia, Africa, and Central and South America
- In the U.S.

Amy Campbell