Pollination: process by which pollen grains arrive at female reproductive structures

For about 80% of the planet’s 240,000+ species of flowering plants, the process depends on animal partners, which deliver pollen with greater precision than wind.
Apis mellifera
The western honey bee, is the world’ premier managed pollinator
Attributes of honey bees conducive for use as managed pollinators (contributing $14 billion annually to US agriculture)

Large colony size for servicing extensive monocultures

Elaborate communication system to promote flower fidelity

Extremely broad diet

Ability to learn to handle many kinds of flower types

Cavity-nesting habit well-suited to management purposes

**Status**

- Long-term population trends for honey bee in the United States are demonstrably downward (mites, diseases, other pests)
- Similar data are not available for other managed pollinators.

U.S. honey bee colonies, 1945-2005. Data compiled from USDA-NASS
On June 20, 2007, the Congressional Research Service updated its report on Colony Collapse Disorder; by this point, CCD had been reported in 35 states; an estimated one-quarter of America’s honey bees had vanished.
Increasing demand for pollination services is pushing the limits of the system in an unprecedented way. If almond acreage continues to expand, by 2012 every honey bee in America will be needed to pollinate just that crop; however, demand for pollination services is increasing for other crops as well.
Beekeeping technology is for the most part unchanged since the 19th century. For an industry that contributes about $15 billion annually, it’s remarkably unimproved.
A Metagenomic Survey of Microbes in Honey Bee Colony Collapse Disorder

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In colony collapse disorder (CCD), honey bee colonies inexplicably lose their workers. CCD has resulted in a loss of 50 to 90% of colonies in beekeeping operations across the United States. The observation that irradiated combs from affected colonies can be repopulated with naive bees suggests that infection may contribute to CCD. We used an unbiased metagenomic approach to survey microflora in CCD hives, normal hives, and imported royal jelly. Candidate pathogens were screened for significance of association with CCD by examination of samples collected from several sites over a period of 3 years. One organism, Israeli acute paralysis virus of bees (IAPV), was strongly correlated with CCD.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Number of positive samples (positive of samples tested)</th>
<th>Positive Predictive Value (%)</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CCD (n = 30)</td>
<td>non-CCD (n = 21)</td>
<td>Total (n = 51)</td>
<td></td>
</tr>
<tr>
<td>IAPV</td>
<td>25 (83.3%)</td>
<td>1 (4.8%)</td>
<td>26 (51.0%)</td>
<td>96.1</td>
</tr>
<tr>
<td>KBV</td>
<td>30 (100%)</td>
<td>16 (76.2%)</td>
<td>46 (90.2%)</td>
<td>65.2</td>
</tr>
<tr>
<td>N. apis</td>
<td>27 (90%)</td>
<td>10 (47.6%)</td>
<td>37 (72.5%)</td>
<td>73.0</td>
</tr>
<tr>
<td>N. ceranae</td>
<td>30 (100%)</td>
<td>17 (80.9%)</td>
<td>47 (92.1%)</td>
<td>63.8</td>
</tr>
<tr>
<td>All 4 agents</td>
<td>23 (76.7%)</td>
<td>0 (0%)</td>
<td>23 (45.0%)</td>
<td>100</td>
</tr>
</tbody>
</table>

Using a viral metagenomics approach, Cox-Foster et al. 2007 demonstrated that Israeli Acute Paralysis Virus is associated with colony collapse; other factors appear to affect its impact.
Curing CCD/IAPV won’t

• protect bees against future pests or pathogens (increasingly likely with globalization of trade)
• provide “crop insurance” in the form of alternative pollinators
• maintain wild populations of pollinators to insure the vitality of both managed and natural plant communities
It’s unlikely that honey bees will go extinct (there are close to two dozen races across the globe), but the beekeeping industry in the U.S. might not survive; prospects for survival of wild pollinators are impossible to assess without baseline data.

Unlike sunshine, pollination is not an inexhaustible resource.