



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)

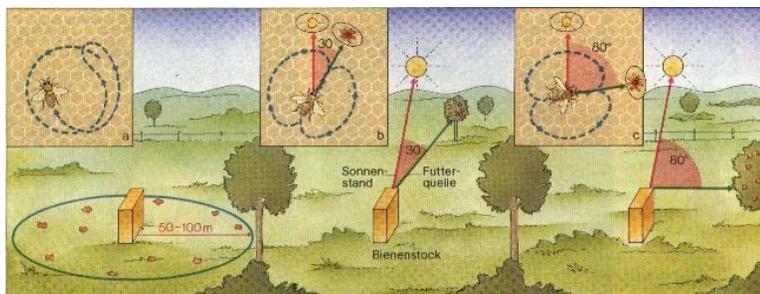
Large colony size for servicing extensive monocultures

Elaborate communication system to promote flower fidelity

Extremely broad diet

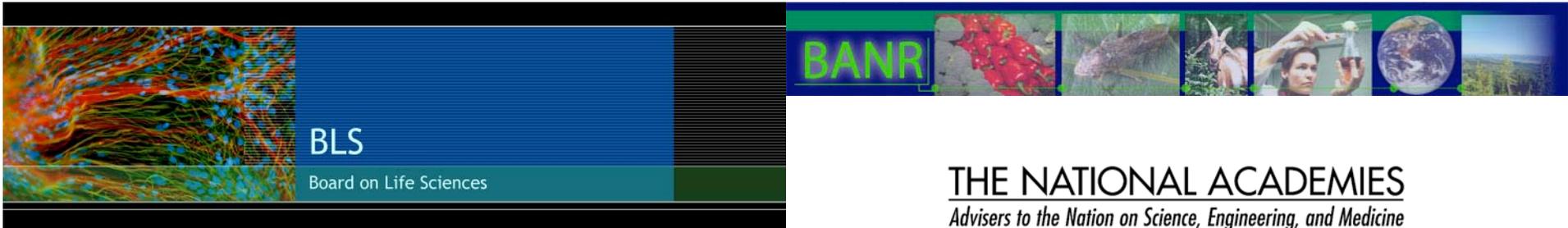
Ability to learn to handle many kinds of flower types

Cavity-nesting habit well-suited to management purposes



1 Schema des Bientanzes (a Rundtanz, b und c Schwänzeltanz)

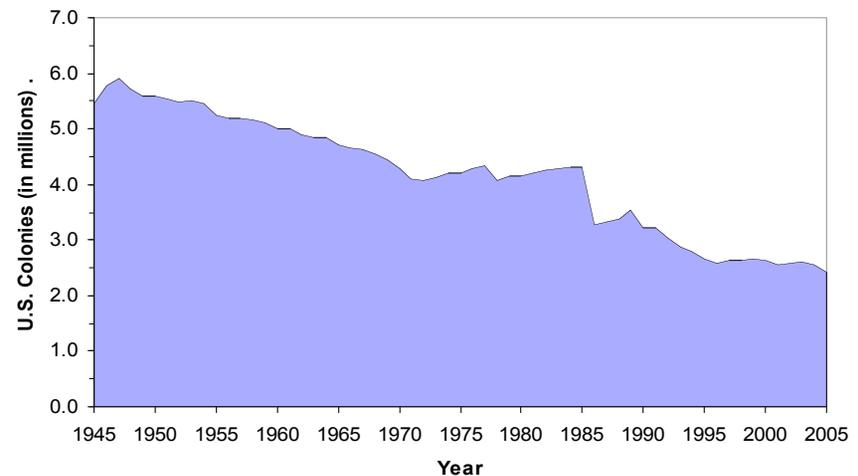




# National Academy of Sciences report on the Status of Pollinators in North America (2006)

## *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

# CRS Report for Congress

## Recent Honey Bee Colony Declines

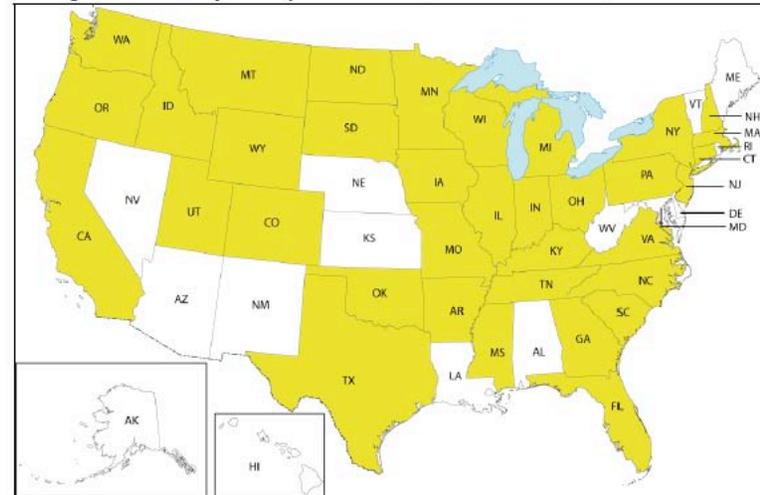
Updated June 20, 2007

Renée Johnson  
Analyst in Agricultural Economics  
Resources, Science, and Industry Division

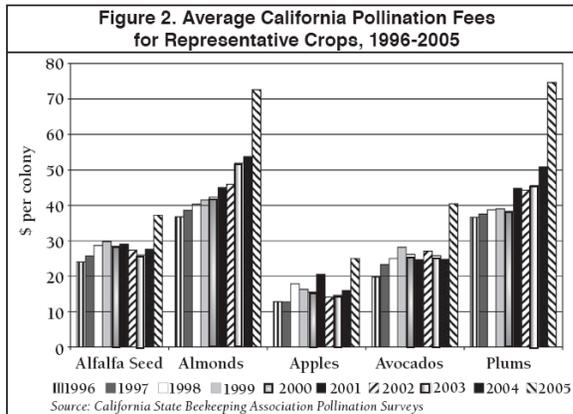
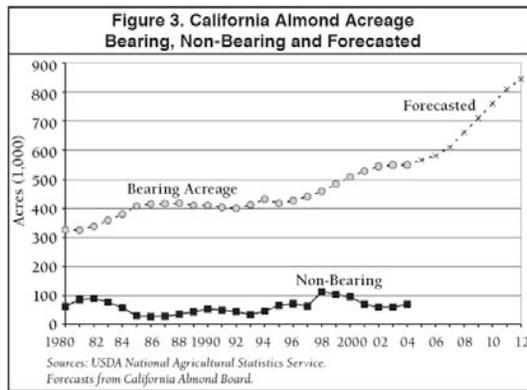
On June 20, 2007, the Congressional Research Service updated its report on Colony Collapse Disorder; by this point, CCD had been reported in 35 states; an estimated one-quarter of America's honey bees had vanished

CRS-5

Figure 1. Colony Collapse Disorder, Affected States, June 2007



Source: Bee Alert Inc., [<http://www.beealert.info/>]. Shaded areas show reported affected states.



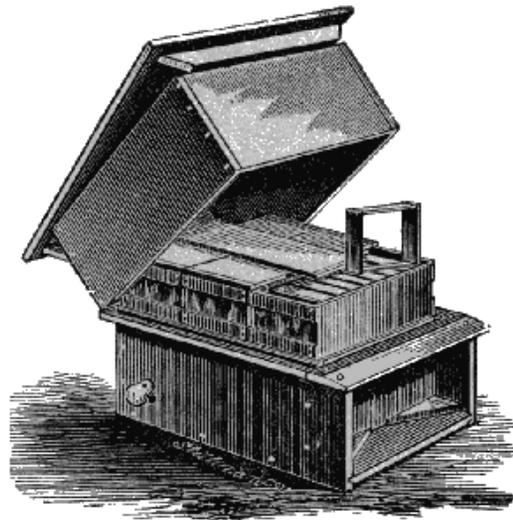
544 hives on the truck,



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.



<http://www.indiansummerhoneyfarm.com/slide1.jpg>  
<http://boxer.senate.gov/news/photos/features/farmbill/>



The original Langstroth hive.



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**

Diana L. Cox-Foster,<sup>1</sup> Sean Conlan,<sup>2</sup> Edward C. Holmes,<sup>3,4</sup> Gustavo Palacios,<sup>2</sup> Jay D. Evans,<sup>5</sup> Nancy A. Moran,<sup>6</sup> Phenix-Lan Quan,<sup>2</sup> Thomas Briese,<sup>2</sup> Mady Hornig,<sup>2</sup> David M. Geiser,<sup>7</sup> Vince Martinson,<sup>8</sup> Dennis vanEngelsdorp,<sup>1,9</sup> Abby L. Kalkstein,<sup>1</sup> Andrew Drysdale,<sup>2</sup> Jeffrey Hui,<sup>2</sup> Junhui Zhai,<sup>2</sup> Liwang Cui,<sup>1</sup> Stephen K. Hutchison,<sup>10</sup> Jan Fredrik Simons,<sup>10</sup> Michael Egholm,<sup>10</sup> Jeffery S. Pettis,<sup>5</sup> W. Ian Lipkin<sup>2\*</sup>

**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.**

Agent	Number of positive samples n (% positive of samples tested)			Positive Predictive Value (%)	Sensitivity (%)	Specificity (%)
	CCD (n = 30)	non-CCD (n = 21)	Total (n = 51)			
IAPV	25 (83.3%)	1 (4.8%)	26 (51.0%)	96.1	83.3	95.2
KBV	30 (100%)	16 (76.2%)	46 (90.2%)	65.2	100	23.8
<i>N. apis</i>	27 (90%)	10 (47.6%)	37 (72.5%)	73.0	90.0	52.4
<i>N. ceranae</i>	30 (100%)	17 (80.9%)	47 (92.1%)	63.8	100	19.0
All 4 agents	23 (76.7%)	0 (0%)	23 (45.0%)	100	76.7	100

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**