



Diseases & Pesticides Affecting Bee Health



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European honey bee
Apis mellifera

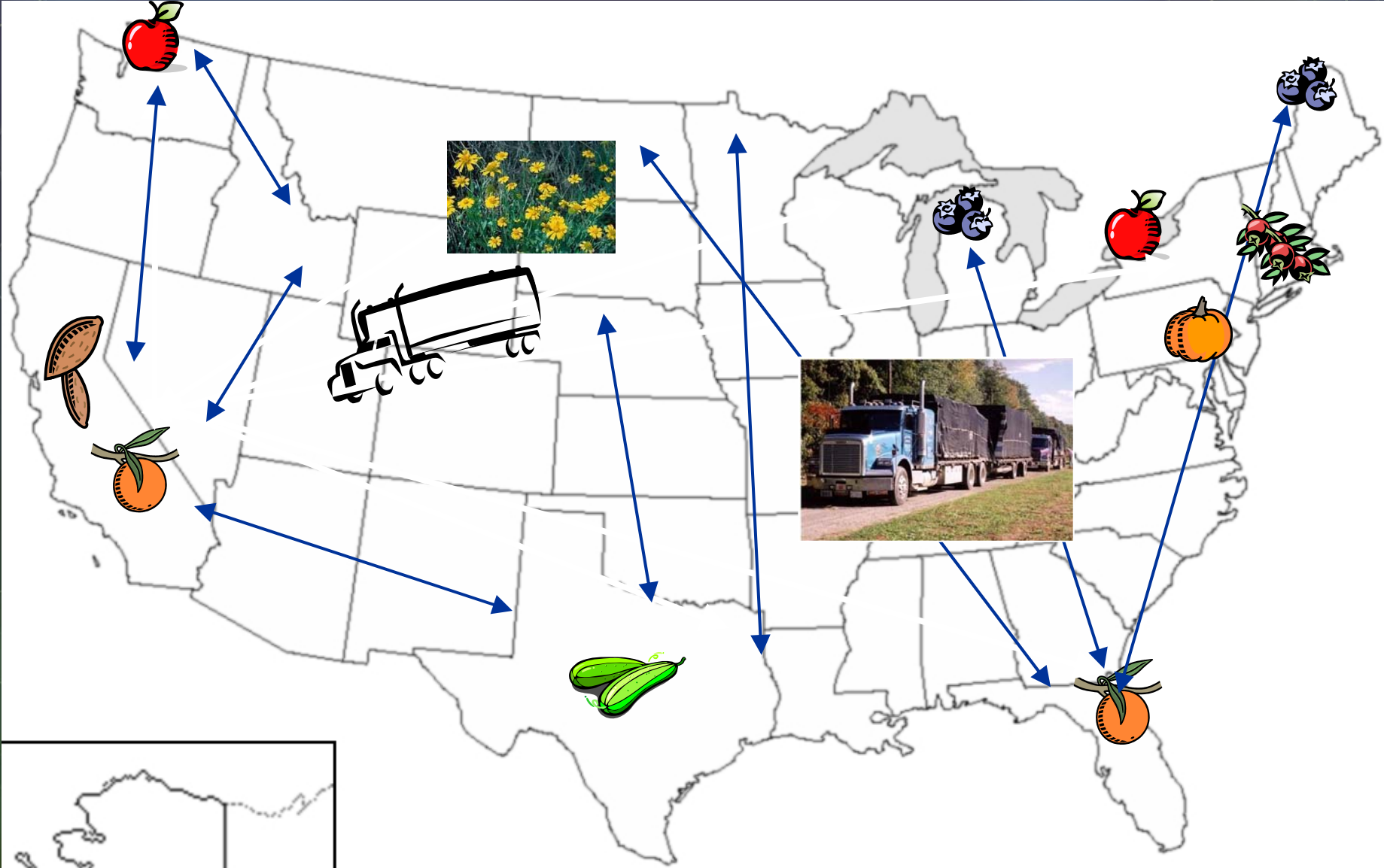




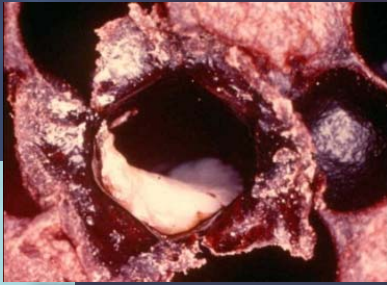
Honey Bees Are a Big Agricultural Business and Commodity



Major U. S. Migratory Routes--Commercial Honey Bee Colonies



Bacteria



Fungi



Viruses



Movement increases spread of invasive parasites and pathogens



Mites



Insect Pests





U.S. Tour
of Most Common
Diseases and Parasites
of Bee

American Foulbrood of Honey Bees

Bacterial Pathogen
Paenibacillus larvae

First discovered 1907



Invasive Pathogens of Honeybees



Chalkbrood

Fungal pathogen

Ascosphaera apis



Chalkbrood in the Alfalfa Leafcutting Bee



Chalkbrood in Alfalfa Leafcutting Bees: *Ascosphaera* fungi



Healthy, mature
bee larva



Sporulating chalkbrood
cadavers

Nosema Pathogens of Bees

Honey Bee Dysentery, also called nosema disease

Microsporidian Pathogens

Nosema apis

Nosema ceranae



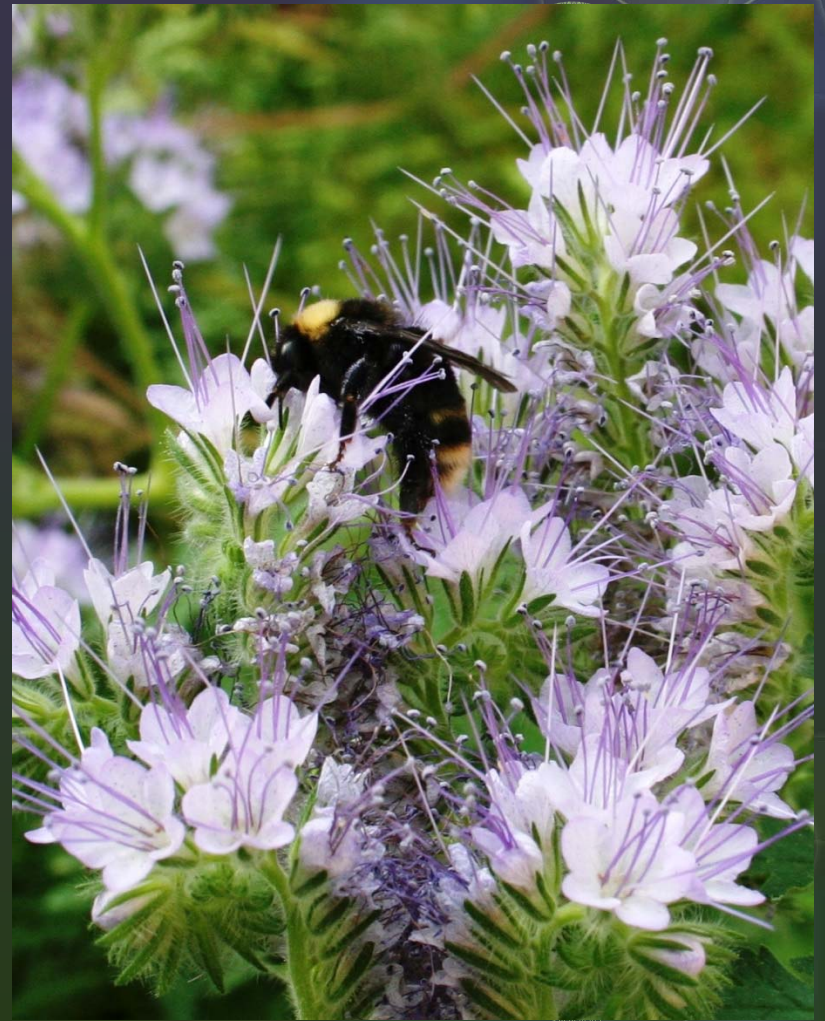
Nosema ceranae

- Invaded from Asian honey bee.
- Causes more serious disease

Nosema Pathogens in Bumble Bees

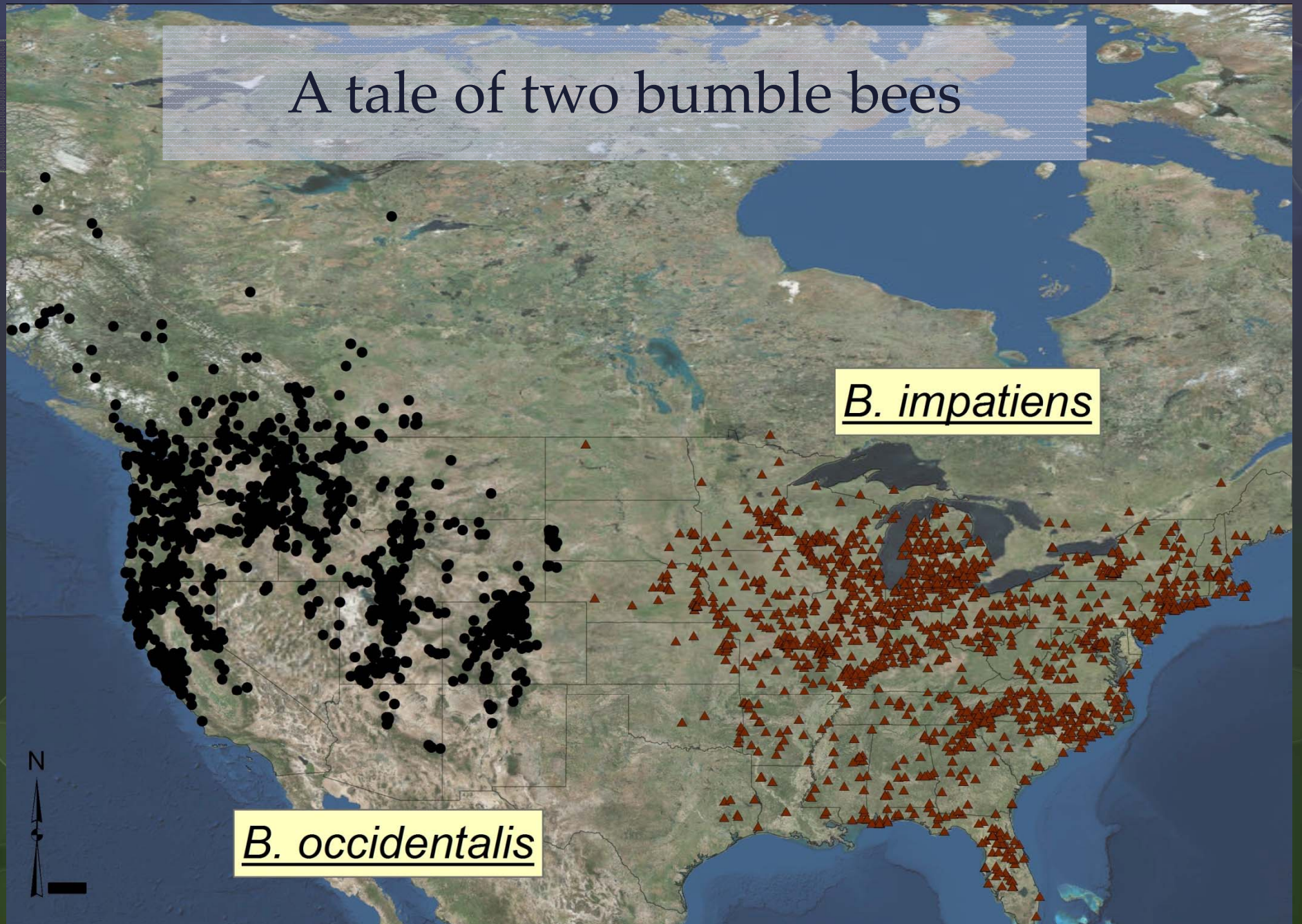
Nosema bombi

- Invasive bumble bee pathogen
- Origin from European bumble bee
- Greenhouse pollination
- Same pathogen infects all bumble bees
- *B. impatiens*, low mortality
- *B. occidentalis*, high mortality



Bombus occidentalis

A tale of two bumble bees



B. impatiens

B. occidentalis

Viruses of Honey Bees

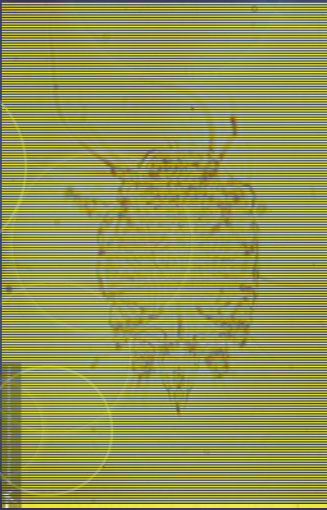
Viruses

- Black Queen Cell Virus
- Chronic Paralysis Virus
- Deformed Wing Virus
- Kashmir Bee Virus
- Sacbrood Virus
- Israeli Acute Paralysis Virus



Invasive Parasites of Honey Bees

Tracheal Mite *Acarapis woodi*



- First discovered on the Isle of Wight, England 1919
- Instigated the Federal Honey Bee Act of 1922
- First found in the United States: 1984 (from Mexico)
- Spread throughout the country in by 1990



Invasive Parasites of Honey Bees

Varroa mite *Varroa jacobsoni*



- First found in the United States: 1987
- U.S.–wide by early 1990's
- The most destructive pest worldwide
- Originated from *Apis cerana* in Asia



Wild bees have parasites, too



SB Nov, 2005 7
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THE SPEEDY BEE

Volume 34, Number 1 (Mailed 02/11/05) January 2005 Jesup, Georgia 31598 USA Single Copy: \$1.75

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Colonies Reeling from Coast-to-Coast; Varroa Blamed for Massive Bee Die-Off

By TROY FORE

As beekeepers began to prepare their colonies for the California almond orchards in January, many found empty hives or weak, faltering colonies.

Estimates have placed the losses at 50 percent of the bees in California, with some beekeepers losing as many as 75-80 percent of their bees — beekeepers who operate thousands of hives and have decades years of experience.

The death of so many colonies has created a shortage of bees to pollinate the almond crop. Desperate for bees, almond growers have bid up the pollination fee. Fees of \$85-95 were frequently reported, up 50% from last year, and some reports had charges of \$120 or more.

Beekeepers have responded by searching harder for bees to bring in. Semi-loads that had not been destined

other treatments — not yet registered for use — are reportedly being used.

USDA-ARS researchers have been seeking clues to the situation in California. Bart Smith from the Beltsville Bee Lab went to get a first-hand look at the problem. He visited seven beekeeping operations and took samples of adult bees. A team from the Weslaco Bee Lab were set to go to California in mid-February to follow-up on studies they have been making over the past

least through the 2005 season."

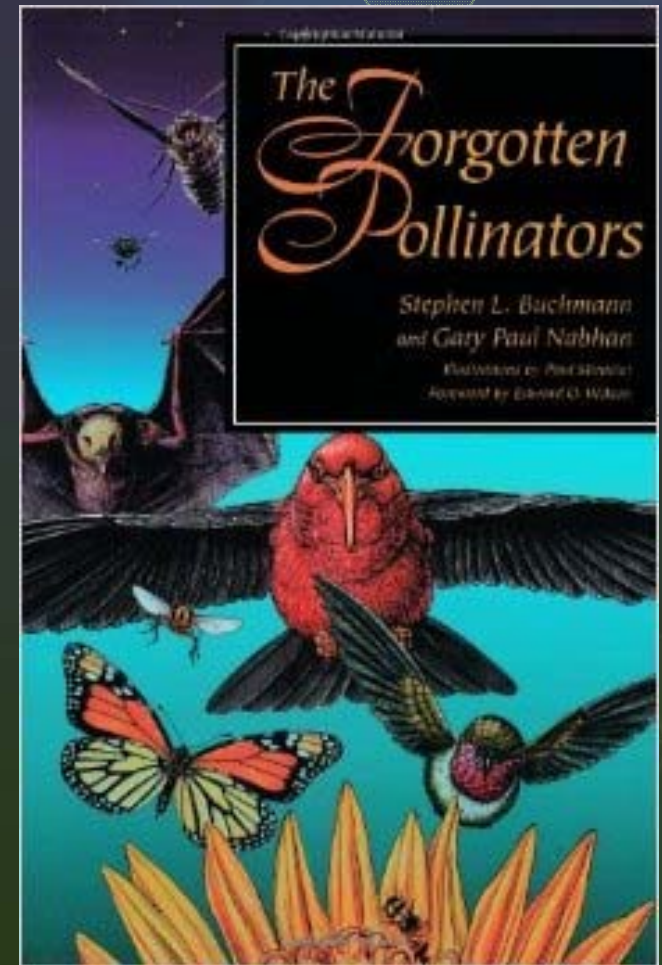
Already reports are coming from beekeepers across the country, from Texas, to Florida, to Virginia —



Varroa mites enter the brood cells before the cells are capped and attach themselves to the larvae, above, and grow alopng with the pupa, bwlow.

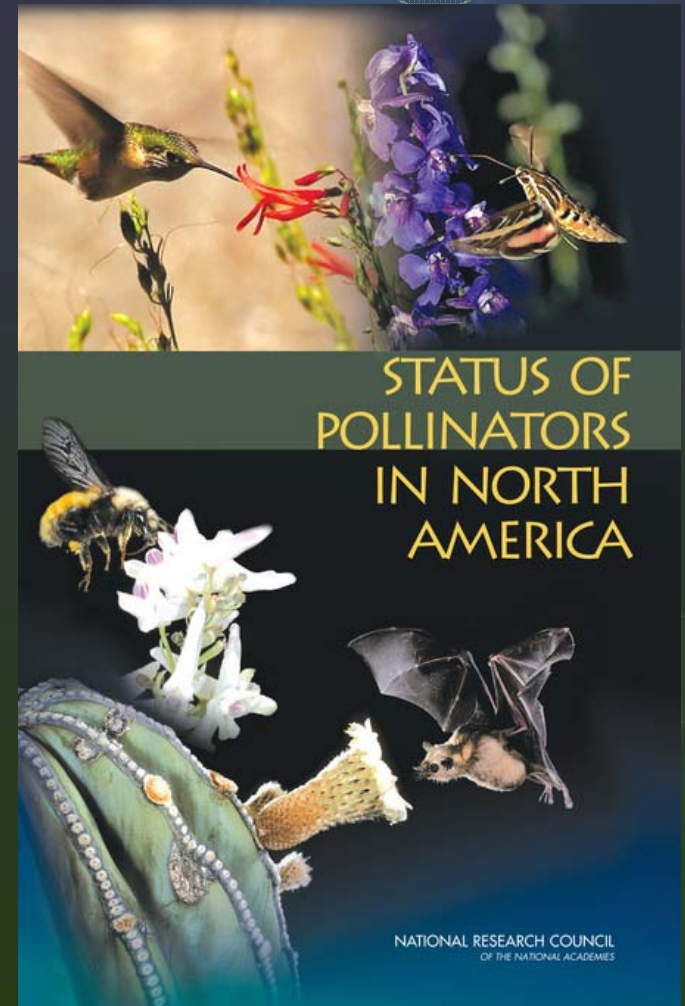
Historical View of Bee Declines

- 1996 International Convention on Biodiversity (Buenos Aires, Argentina)
- Pollinators -- priority for conservation due to their importance to agricultural biodiversity
- 1996 The Forgotten Pollinators



Historical View of Bee Declines

- 2004 ALARM Project
 - Assessing Large Scale Risks for Biodiversity with Tested Methods
 - European assessment of pollinator declines
- ~2004 Dr. Robbin Thorp: Bumble bees going extinct in the US
- 2006 National Academy Science Status of Pollinators in North America



Then arrival of Colony Collapse Disorder

Symptoms of CCD

- Few adult bees in the hive (“small cluster”)
- Brood present (shows queen was present)
- No signs of starvation
- Lack of typical symptoms associated with disease or parasite infestations
- Few or no dead bees in colony



Colony Collapse Disorder

Bad news

- Actual cause has not been determined
- Scientists cannot induce the disorder experimentally
- Many possible causes have been identified

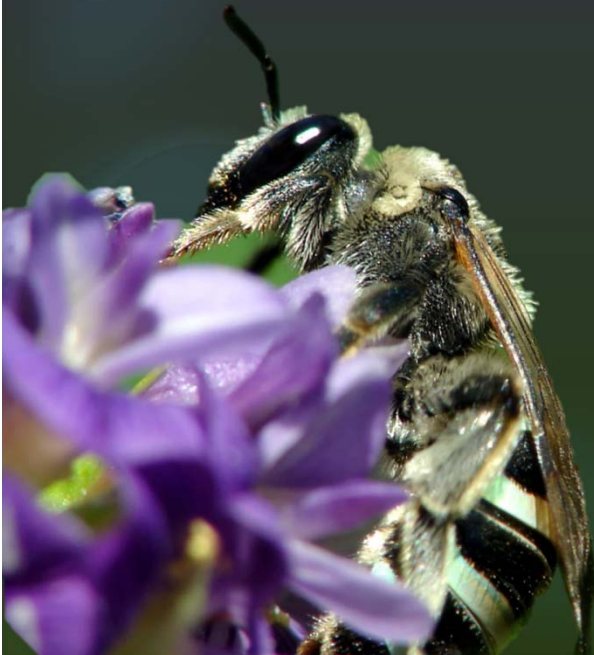
Good news

- Appears to have declined
- Brought needed attention to the plight of pollinators



Current State of Knowledge Regarding Bee Declines

- Loss of habitat: flowers and nesting areas
- Pathogens and Parasites
- Pesticides
- Genetic bottle necks
- Old disease issues exacerbated by environmental factors



Disease Triangle



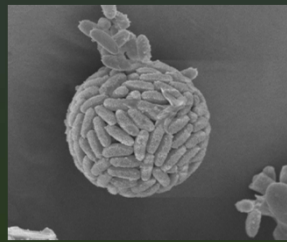
ENVIRONMENT

- temperatures
- humidity
- sun
- food availability
- nest availability
- environ. toxins



HOST

- susceptibility
- pop. density
- health
- behavior



PATHOGEN

- virulence
- transmission
- survival outside
- alternate hosts
- ease of control

Impacts of Pesticides on Bees

- Purpose of insecticides: kill insects.
- Some insecticides are less toxic to bees than others.
- Need a better understanding of pesticides and bees
- Pesticide labels not intuitively clear regarding bee toxicity
- Example: bumble bee kills in Oregon from linden trees sprayed with dinotefuran

GROUP	4A	INSECTICIDE
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Safari

20 SG INSECTICIDE

FOR FOLIAR AND SYSTEMIC INSECT CONTROL IN ORNAMENTAL PLANTS, VEGETABLE TRANSPLANTS IN ENCLOSED STRUCTURES.

For Greenhouse, Nursery, Interior Plantscape and Outdoor Landscape Use Only

Active Ingredient:
 Dinotefuran, [N-methyl-N'-nitro-N''-(tetrahydro-3-furanyl)methyl] guanidine) 20%
 Other Ingredients 80%
 Total 100%

EPA Reg. No. 86203-11-59639 EPA Est. 67545-AZ-01

KEEP OUT OF REACH OF CHILDREN
CAUTION
SEE BELOW FOR ADDITIONAL PRECAUTIONARY STATEMENTS.

FIRST AID

If on skin or clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for further treatment advice.

If swallowed: Call poison control center or doctor immediately for treatment advice. Do not induce vomiting unless told to do so by the poison control center or doctor. Have person sip a glass of water if able to swallow. Do not give anything by mouth to an unconscious person.

If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for further treatment advice.

(continued)

FIRST AID (continued)
If inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.

HOT LINE NUMBER
 Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact **1-800-892-0099** for emergency medical treatment information.

PRECAUTIONARY STATEMENTS:
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION
 Harmful if swallowed or absorbed through skin. Causes moderate eye irritation. Do not allow contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT
 Applicators and other handlers must wear:
 • Long-sleeved shirt and long pants
 • Chemical-resistant gloves made of any waterproof material such as polyethylene or polyvinyl chloride
 • Shoes plus socks

USER SAFETY REQUIREMENTS
 Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions exist for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS
Users should:
 • Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
 • Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
 • Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS
 This pesticide is toxic to shrimp. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated areas may be hazardous to aquatic organisms in water adjacent to treated areas. Do not dispose equipment washwaters or rinseate into a natural drain or water body.

Safari 20 SG Insecticide
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This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

Dinotefuran and its degradate, MNG have the properties and characteristics associated with chemicals detected in ground water. The high water solubility of dinotefuran, and its degradate, MNG, coupled with its very high mobility, and resistance to biodegradation indicates that this compound has a strong potential to leach to the subsurface under certain conditions as a result of label use. Use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in ground-water contamination. Periodic

(continued)

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 12 hours.

EXCEPTION: If product is drenched or soil-injected, workers may enter the area at any time if there will be no contact with anything that has been treated.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil or water is:

- Coveralls
- Chemical-resistant gloves made of any waterproof material such as polyethylene or polyvinyl

Bees and Pesticides: What have we learned since 2007

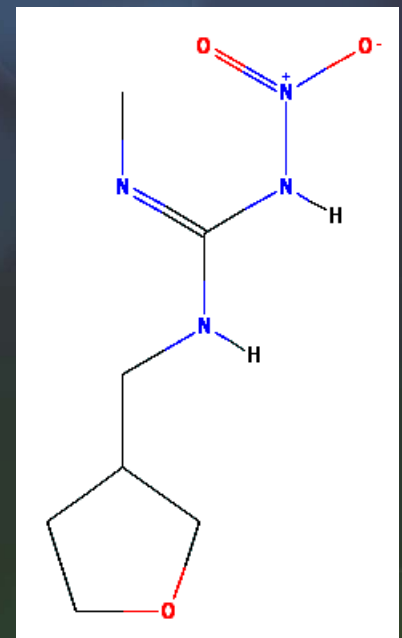
- Some *fungicides* are toxic to bees

Examples: Captan, Rovral (iprodione),
Pristine (pyraclostrobin+boscalid)

- Some pesticides affect bee behavior or bee reproduction

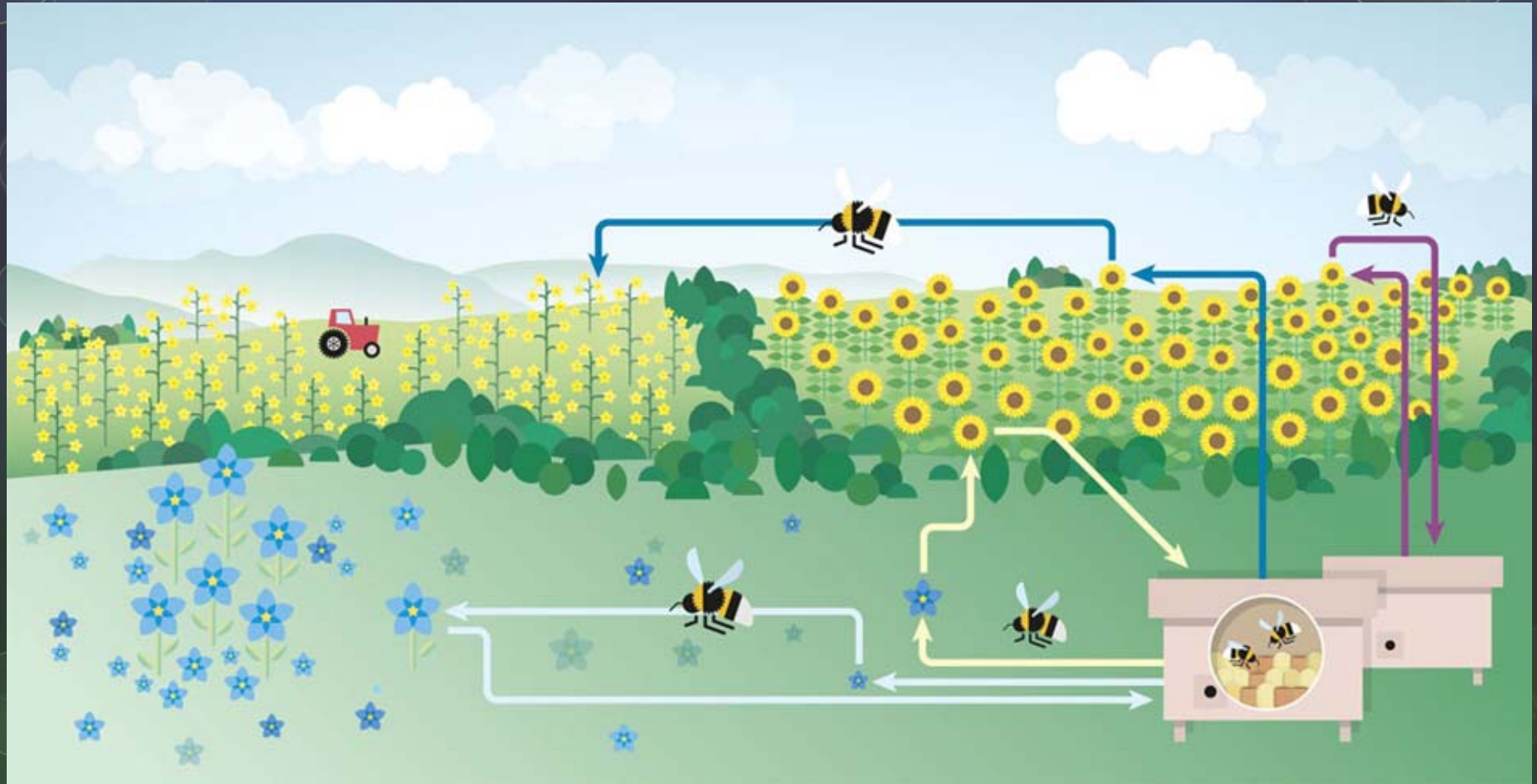
Example: Rimon (novaluron) affects reproduction in the alfalfa leafcutting bee

- For bees: even minor changes in behavior can affect nest survivorship
- The concept of the Pesticide Landscape



dinotefuran

The Pesticide Landscape for Pollinators



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Nature, Vol 491, pg. 44 ©2012

What can we do to reverse bee declines?

- Need new technologies/methods to improve disease management
- Introduction of new germplasm
- Revitalized degraded habitats (especially habitat corridors)
- Improve communications regarding pesticide toxicities to applicators
- Reduce pesticide exposures:
 - what , when, how



