
AGRICULTURAL
SCIENCE
DECOMPOSE
SUBSISTENCE
ENCOMPASSES
TECHNOLOGICAL
THEORETICAL
ORGANISMS
PRODUCTION
WELLBEING
PRESERVATION
NATURAL
WASTE
MULTIDISCIPLINARY
MODELING
HUMAN
SCIENCES
AREAS
EXCLUDED
ANIMAL
INDUSTRIAL
BEGAN
EXPENDITURES
ARTIFICIAL
REDUCERS
TECHNIQUES
INTEREST
IMPROVING
DEVELOPMENT
YEARS
INCLUDE
DEBATE
LOCAL
MODERN
EIGHTEENTH
DEGRADATION
GENOMICS
IRRIGATION
AGRICULTURE
PRODUCTIVITY
FIELD
SOIL
AGRONOMY
SCIENCE
ECOLOGY
FEED
AVIAN
ENVIRONMENT
NITROGEN
FERTILE
IMMOBILIZED
BIOTECHNOLOGY
RESIDUE
FERTILIZER
EMERGENCE
AGGREGATES
PEOPLE
ECONOMIC
CRISIS
CRISES
SEEK
PEST
NATURE
SCIENTISTS
TECHNOLOGY
SYSTEM
FOOD
INFLUENZA
RESEARCH
DISCIPLINES
CLOSELY
MANAGEMENT
SCIENTIFIC
UNDERSTAND
CONSTITUENTS
INPUTS
PRODUCTS
SIMULATION
OUTPUTS
ENVIRONMENTAL
COW
SOCIAL
GROWTH
ECOLOGICAL
POPULATION
POOREST
VOCATIONAL
SHIFTED
GENETICALLY
CROP
RELATED
GENETIC

Areas of Study in Agricultural Science

Animal, Dairy and
Avian Sciences
Veterinary Medicine

Agricultural and
Resource Economics
Business Management
Agricultural Education

Environmental Science
Environmental Policy
Soil and Water Studies

Nutrition and
Food Sciences
Food Processing

Ag Engineering
Landscape
Architecture

Agronomy
Horticulture
Weed Science
Forestry

Aquaculture
Agroecology
Agricultural Biotechnology

Plant Pathology
Nematology
Entomology
Pest management
Pesticide Sciences

Entomology is a branch of zoology that involves the scientific study of insects and their relatives (ticks, mites, spiders, centipedes, millipedes).

Why are insects important?

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Why are insects important?

Some 900,000 different kinds (species) of living insects are known.

Approximates 80 percent of the world's species.

Largest biomass of the terrestrial animals.

200 million insects for each human on the planet.

300 pounds of insects for every pound of humans.

Why are insects important?

Insect pests feed on food crops, trees, other plants, and wood

Stink Bug Damage

Why are insects important?

Some are parasites that feed on the flesh or blood of animals
Insect vectors of human and animal diseases

Why are insects important?

Some are parasites that feed on the flesh or blood of animals
Insect vectors of human and animal diseases

More than 50% of the world's population is at risk from mosquito-borne diseases, killing more than 1 million people each year.

Why are insects important?

Most insects are beneficial, not harmful

Provide ecological services as pollinators, natural enemies, and decomposers.

Provide the sole food source for many animals, a major ecological service in food webs.

Some produce useful substances, i.e. honey, wax, silk.

Why are insects important?

Insects are used as a major source of protein for humans

Entomology spans a wide range of subdisciplines:

Insect Ecology/Biological Control
Freshwater and Estuarine Entomology
Molecular Biology, Physiology and Molecular Genetics
Arthropod Systematics/Morphology
Evolutionary Biology
Insect Pathology
Medical and Veterinary Entomology
Pesticide Technology, Assessment and Policy
Urban, Structural and Green Industries Pest management
Agricultural Pest Management

The Bee Story:
Facts about Honey Bee Colony Declines

Galen Dively, Emeritus Professor
University of Maryland
College Park, MD

galen@umd.edu

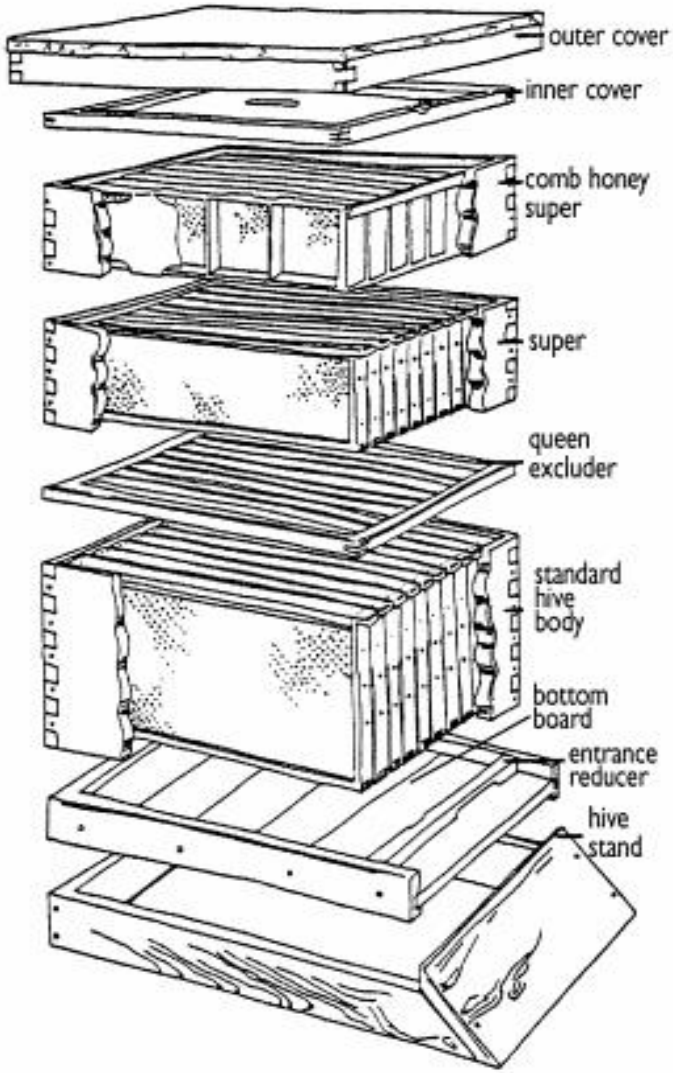


Honey Bee

Apis mellifera

Basic Biology

The Langstroth Hive



Brood chamber

Stores food:
pollen and honey

Stores eggs and
developing larva

http://farm4.static.flickr.com/3079/2547750778_65a366b1b7.jpg

Photo by D. Delaney

Brood frame with capped honey

Bee Types within Colony

Queen Drone Worker

Queen

- Mature female that received abundant amounts of royal jelly while as larva.
- Can live 2 – 4 years.
- Can lay up to 2,000 eggs per day during spring build up. About 250,000 per year.

Queen

- Only one queen in a colony.
- Larger and longer than the worker bee.
- Her major job is to lay eggs – both fertilized (workers) and unfertilized (drones).
- She is groomed and fed by the worker bees.
- She produces pheromones that serve as a social “glue” unifying and helping to give individual identity to a bee colony.
- The quality, size, and temperament of the colony depend largely on the queen’s genetic makeup, and egg-laying and chemical production capabilities.

Photo by Deborah Hautau

Queen Cells

Worker cells are horizontal while queen cells are vertical.

As the queen larva grows, the cell enlarges and becomes peanut-shaped when capped for the pupal stage of development.

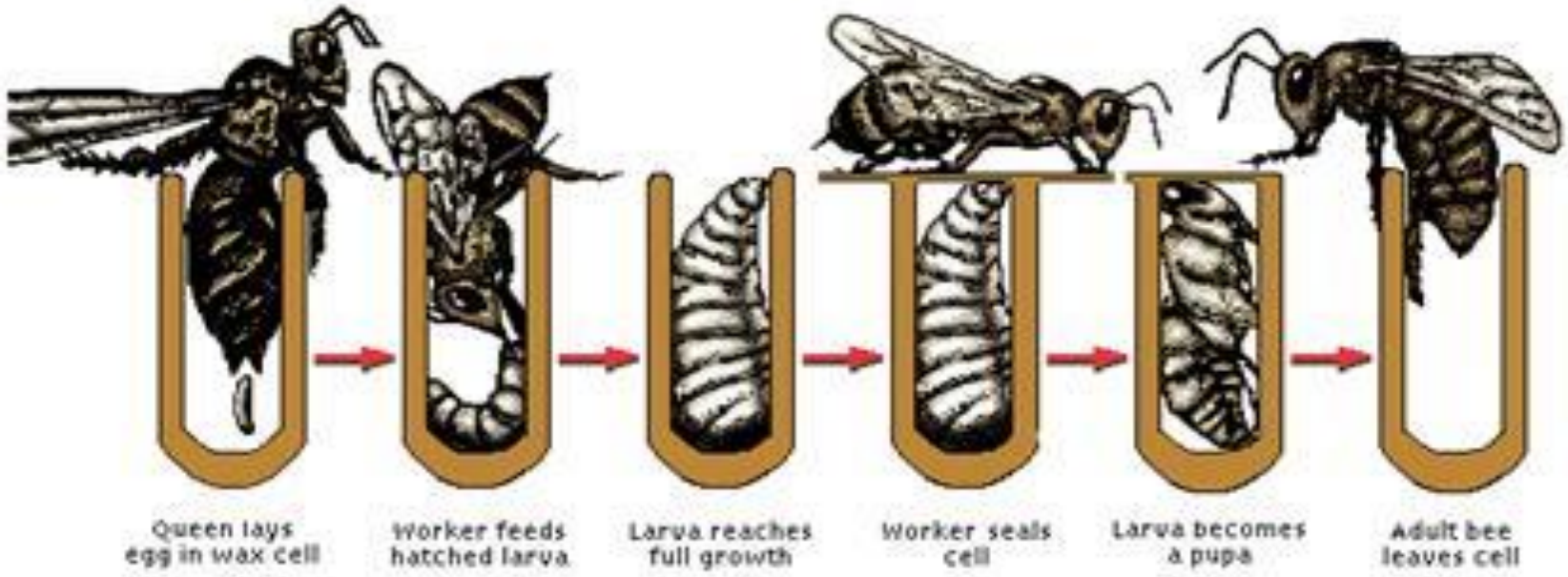
Supersedure Cell

Swarm Cell

What makes a Queen a Queen?

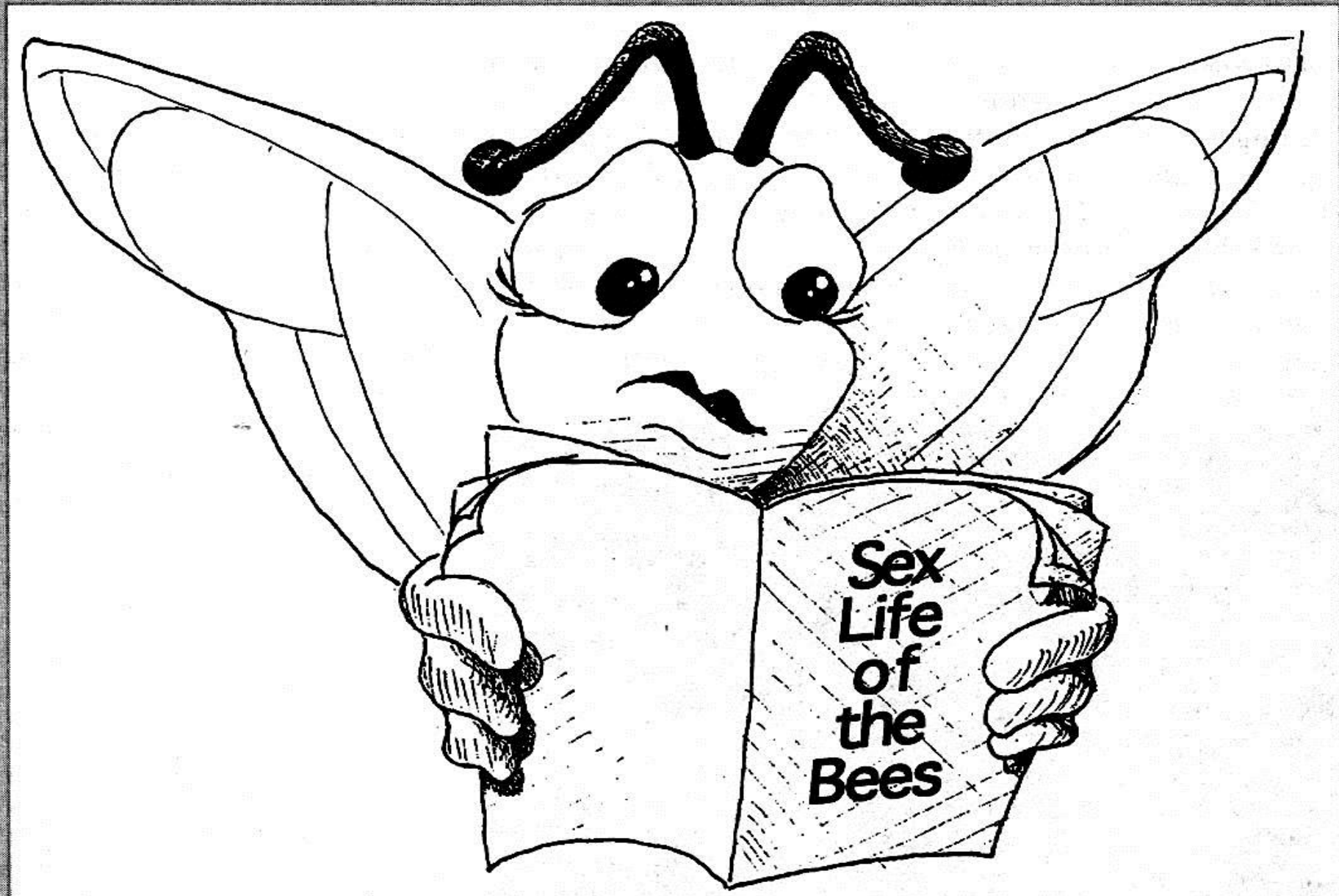
Feeding a female larva Royal Jelly for the entire larval stage.

The Birthing Room – Eggs & Larva


Queen lays egg in wax cell
Worker feeds hatched larva
Larva reaches full growth
Worker seals cell
Larva becomes a pupa
Adult bee leaves cell

The Birthing Room – Pupal Stage

(cell cut-away showing side view)


Sex
Life
of
the
Bees
D. Heskes

Bee Types within Colony

Queen Drone Worker

Drones

- Larger than the worker and is more barrel shaped than the queen.
- Hatched from unfertilized eggs.
- Do not forage for food, or help with the building of comb, nor can defend the hive having no stinger.
- Fed and cared for by the workers.
- When cold weather approaches and food may be scarce, worker bees force the drones out of the hive.

- Mate with virgin queen.
- A virgin queen mates with multiple drones during her mating flight.
- Die after mating

Bee Types within Colony

Queen Drone Worker

Worker Bees (all Females)

About 60,000 in a hive

Worker Life Cycle:

- 3 Days for eggs to hatch
- 5 days as a larval stage (feed by nurse bees):
- 13 days for pupation to adult
- 21 days from egg to adults
- Pupa stage: From Egg to Adult:
- Preform specific jobs which change with age

Just emerged!

Clean out dirty honeycomb

1 week

Feed larvae

Build honeycomb

2 weeks

Receive food from incoming foragers

Guard the hive

3 weeks

Remove corpses

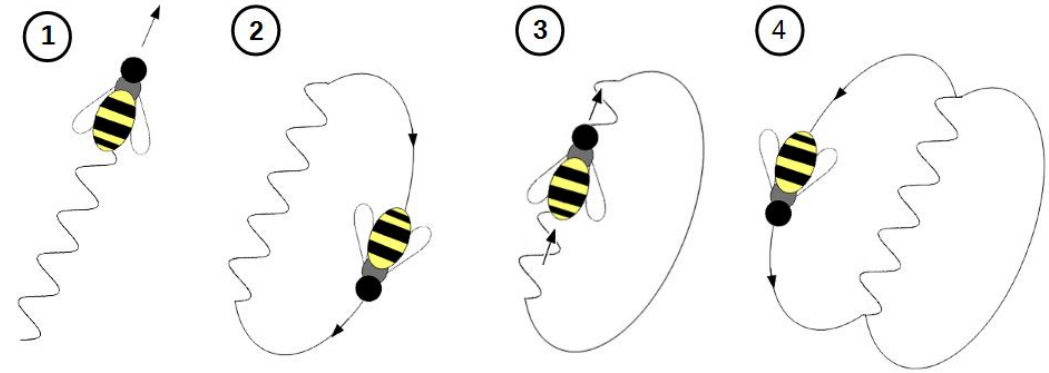
Forage for nectar, pollen, water

Dies at 5-7 weeks

Colony Requirements

- Nectar
- Pollen
- Water
- propolis

Honeybees communicate the distance, direction, and quality of nectar sources with a series of movements known as a “waggle dance”.



Honey bees can survive the winter as a colony by forming a tight compact cluster around the queen.

Brood and the queen are kept at the correct temperature by the surrounding workers.

The outermost layers of the cluster form the densest portion, whereas bees in the core are able to move freely and carry out the regular chores of brood rearing and caring for the queen.

During the winter when no brood is present, the core temperature is kept somewhat less than 85°F; but brood needs to be kept warmer—at a constant temperature of about 93°F.

To warm the cluster, workers vibrate their wing muscles, which burns calories and gives off heat. The temperature is further regulated by the expansion or contraction of the cluster.

What is the most important contribution by honey bees?

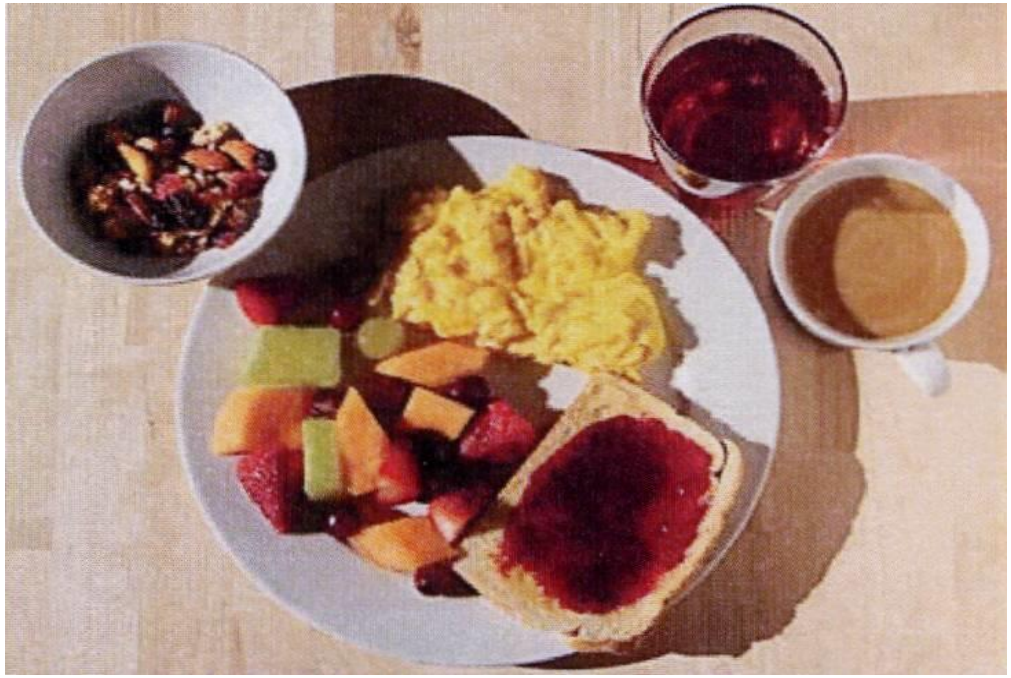
Products from the Hive

- Honey
- Beeswax
- Bee pollen
- Royal jelly
- Propolis

Honey bees are the primary insect pollinator used in agriculture


The value of honeybees to commercial agriculture is estimated at $15-$20 billion annually.
Honey bees are the most important managed pollinators in North America

With Pollinators

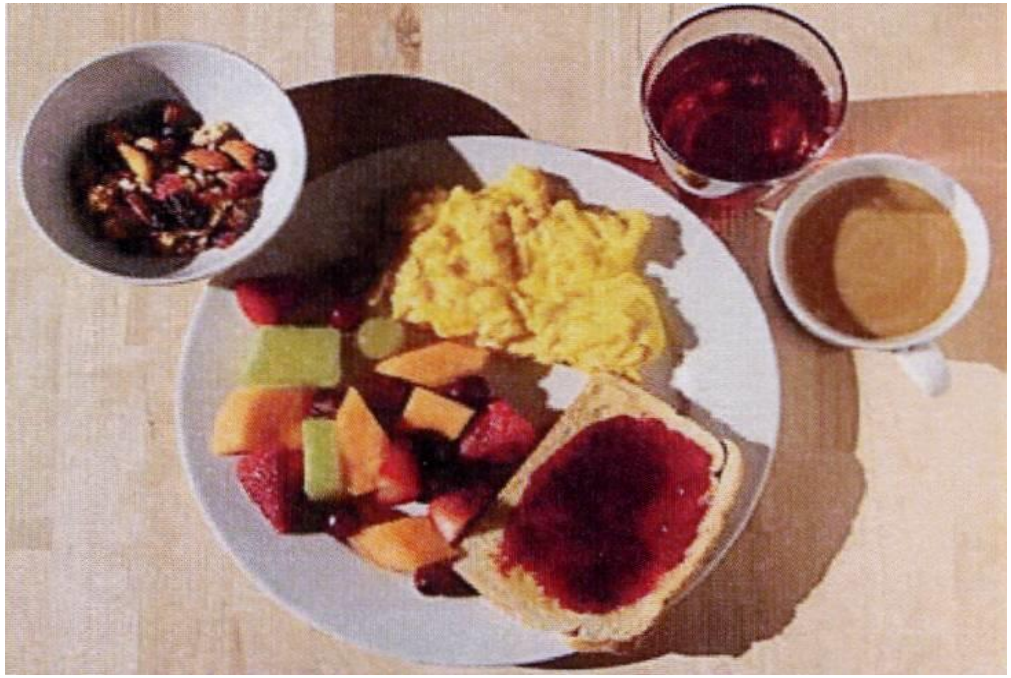


About 1/3 of our diet directly or indirectly benefits from honey bee pollination.

Many tree nuts, berries, fruits and vegetables are dependent on pollinated by honey bees.

33% of the human diet comes from insect pollinated plants and the honey bee is responsible for 80% of that pollination.

With Pollinators



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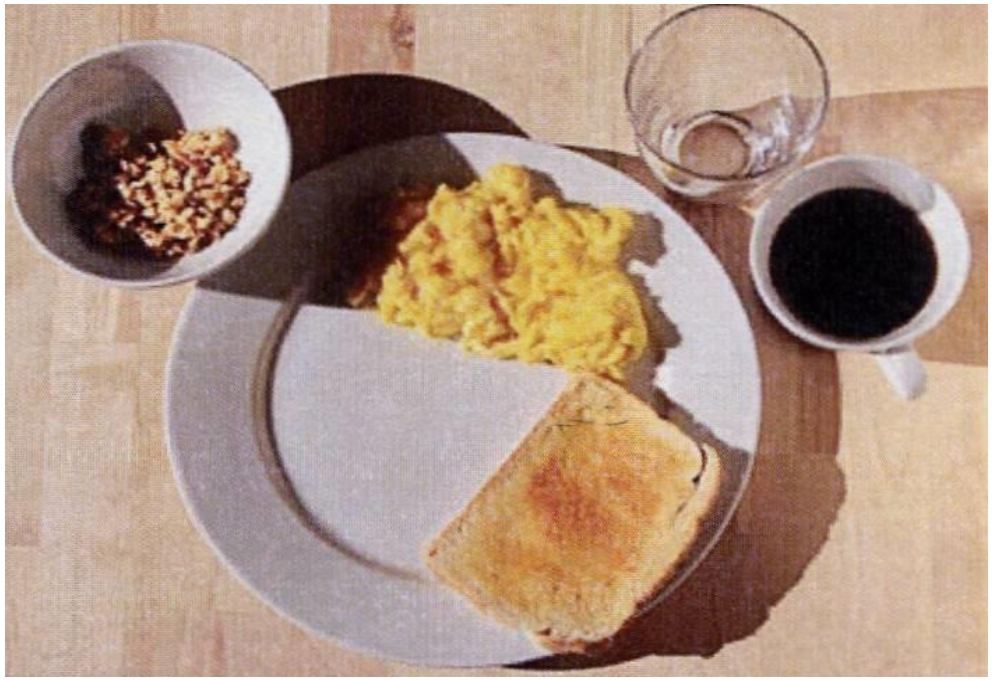
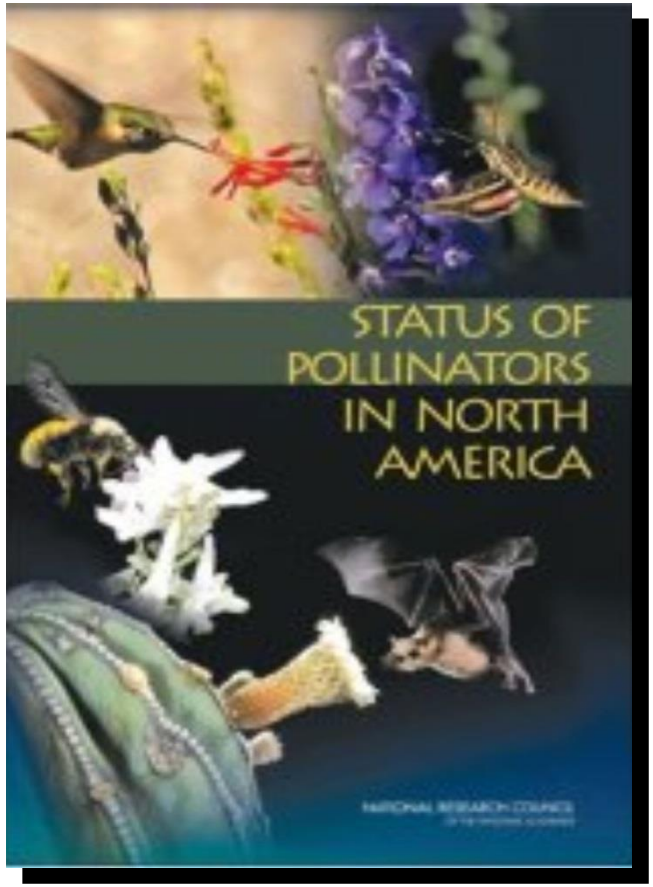
Without Pollinators



Bees are in trouble

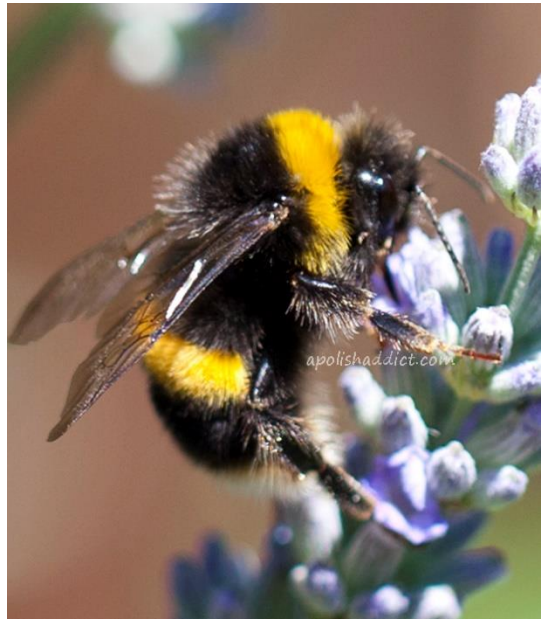
North America Pollinators



- National Academies of Science
- *Status of Pollinators in North America*
- 2007
- **Pollinators are in decline**

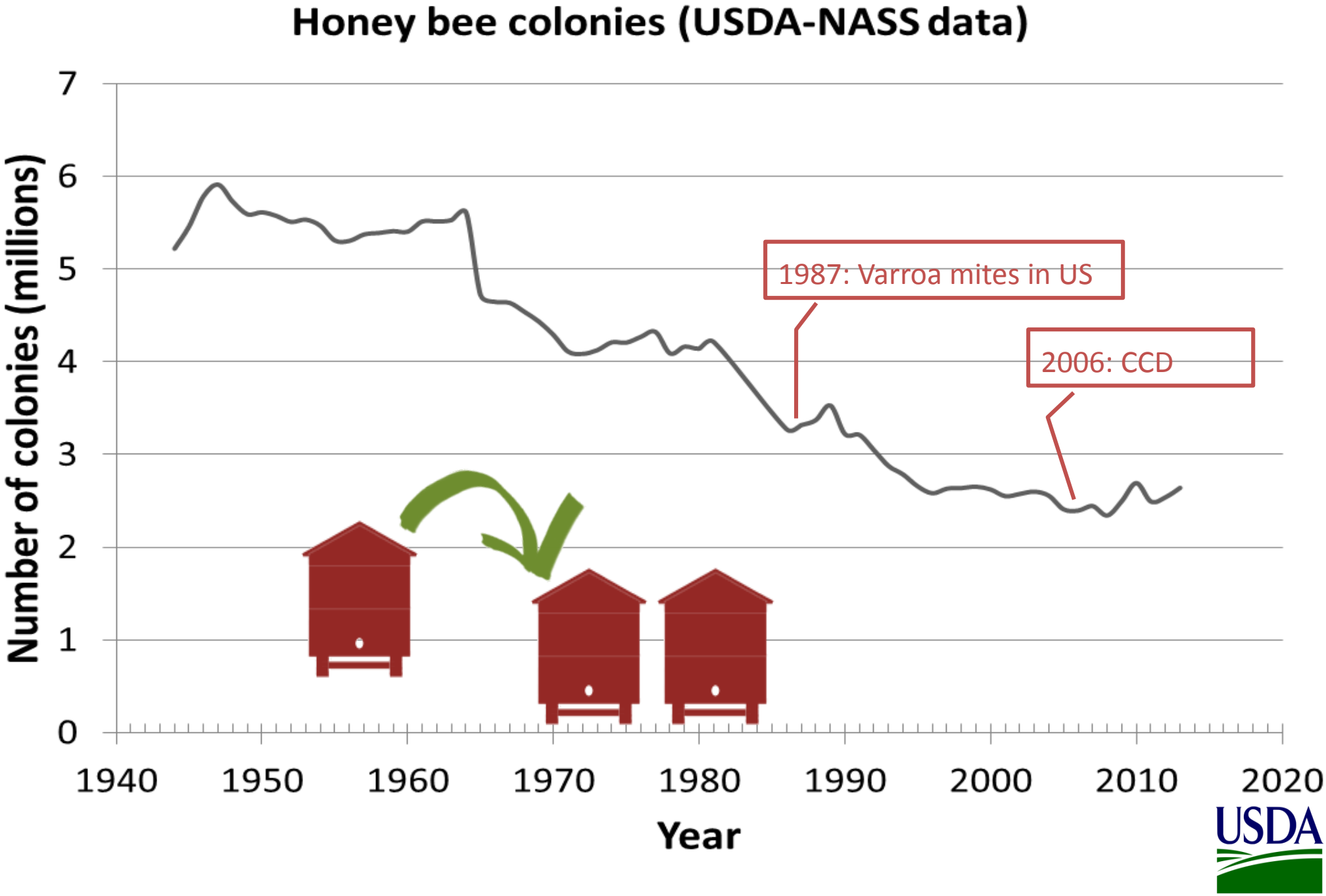
http://www.nap.edu/catalog/11761.html

Bumble Bees

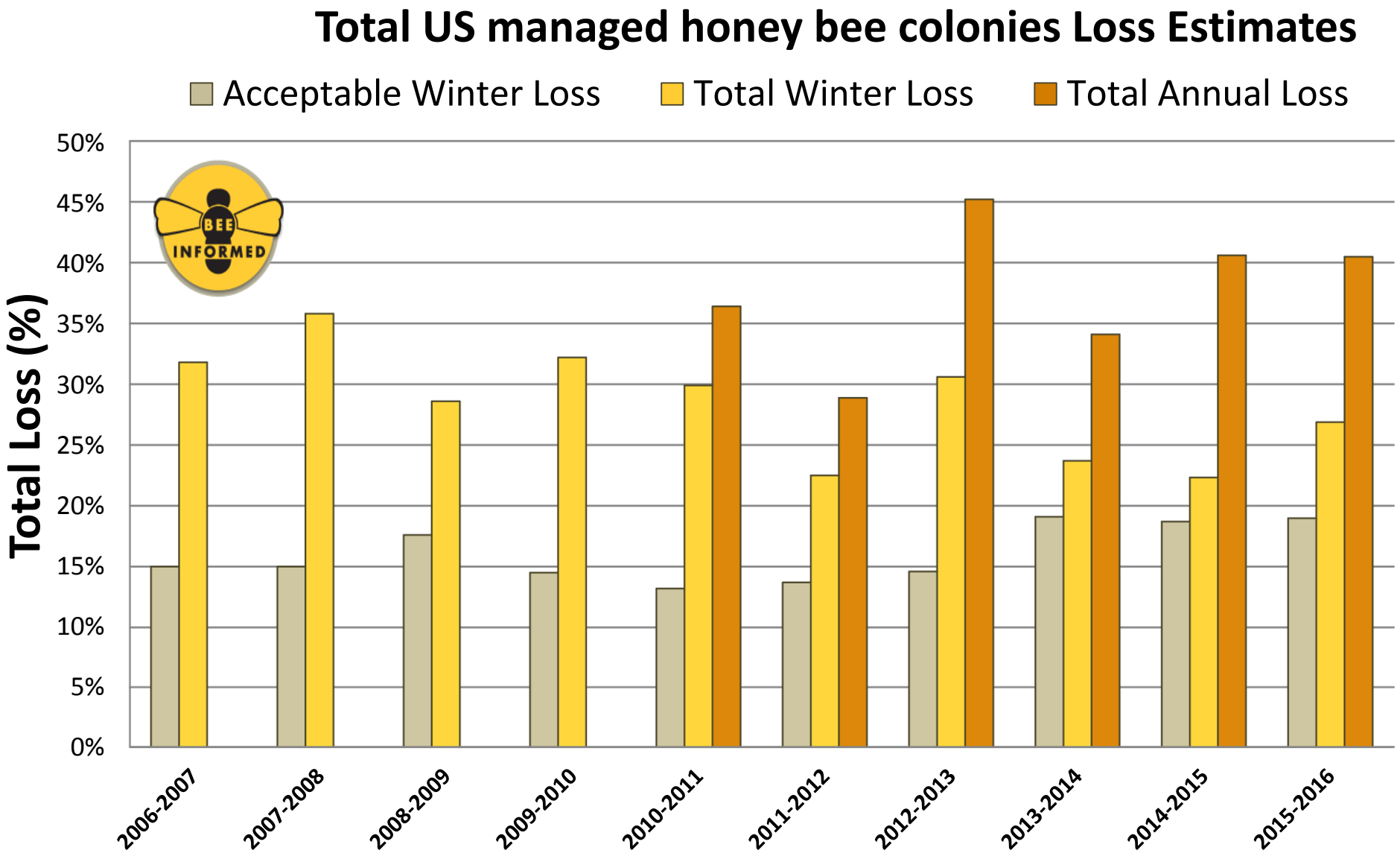


Squash Bees

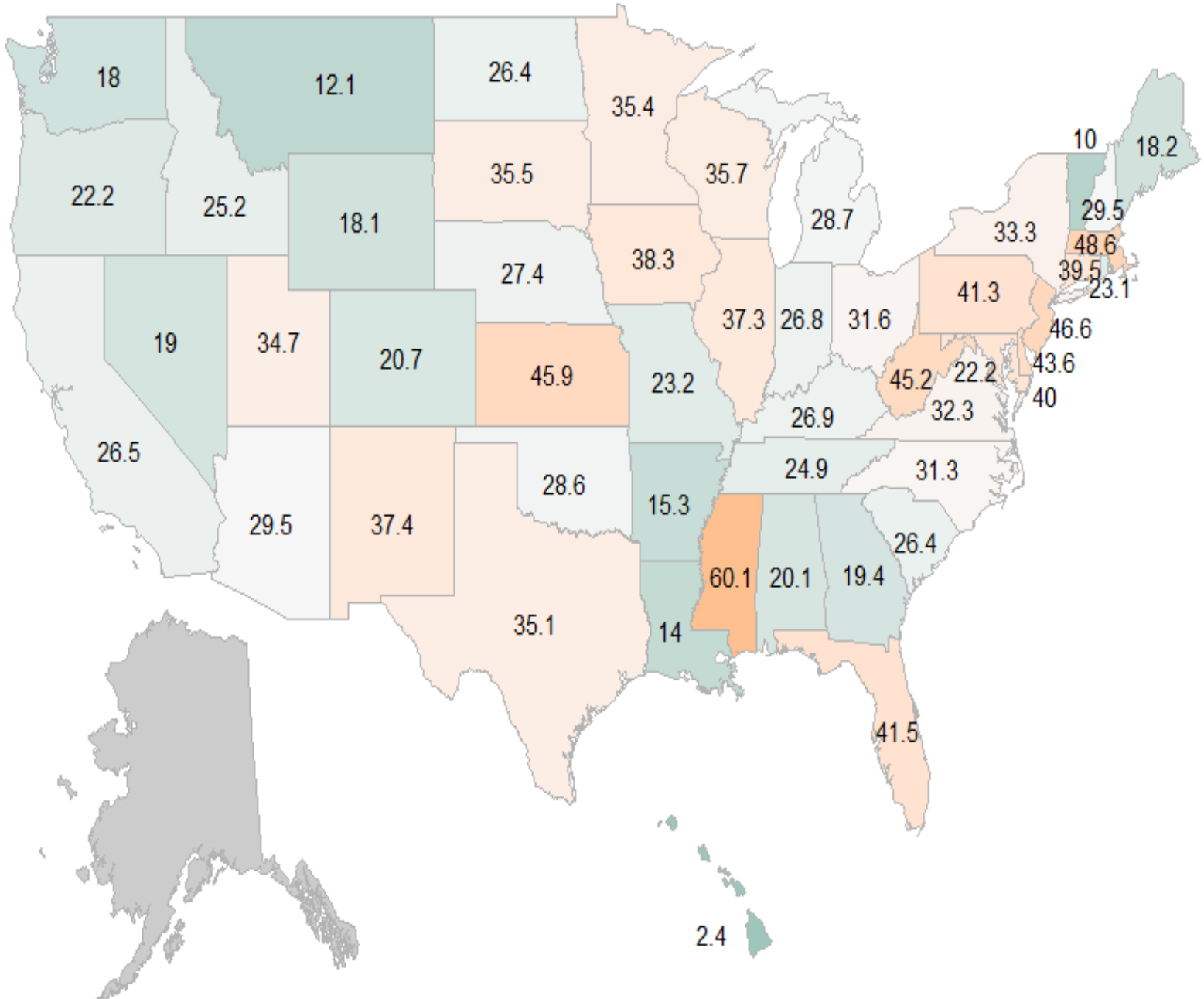
Leafcutter Bees


Honey bee colonies (USDA-NASS data)
Number of colonies (millions)
7
6
5
4
3
2
1
0
1940
1950
1960
1970
1980
1990
2000
2010
2020
Year
1987: Varroa mites in US
2006: CCD
USDA

10 years of Loss Data



Loss Estimates



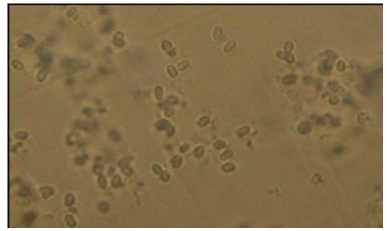
Total Winter Loss by State 2015/16

BEE INFORMED

Total Winter Loss (%)

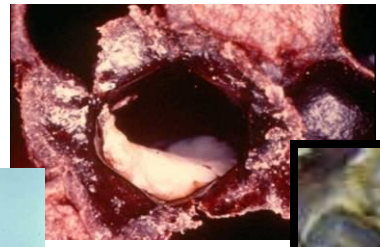
75
50
25
0

Nosema

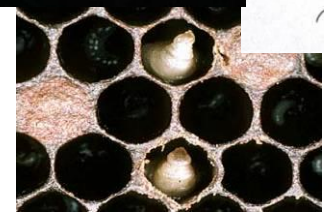


Fungi

Bacteria



Viruses



Parasitic mites

Other Insects

CCD Symptoms

- Rapid loss of adult worker bees
- Small cluster with queen is always present
- Few or no dead bees in or at the entrance of hive
- Presence of excess brood and food stores
- Higher pathogen loads (bacteria, viruses, fungi) in CCD colonies.
- No pattern of exposure or association with pesticide levels
- No single stress factor found

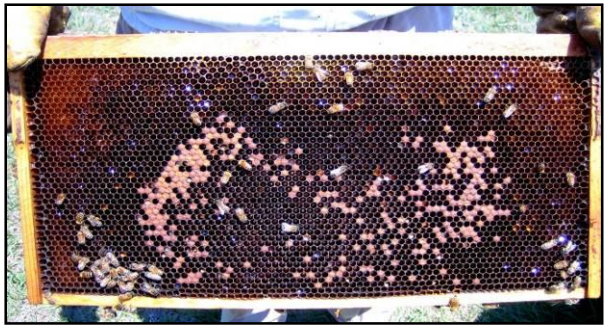
Stress Factors contributing to Bee Declines

Management and Nutrition

Varroa Mites

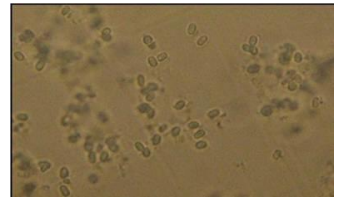
Pesticides

Secondary Pathogens



Viruses

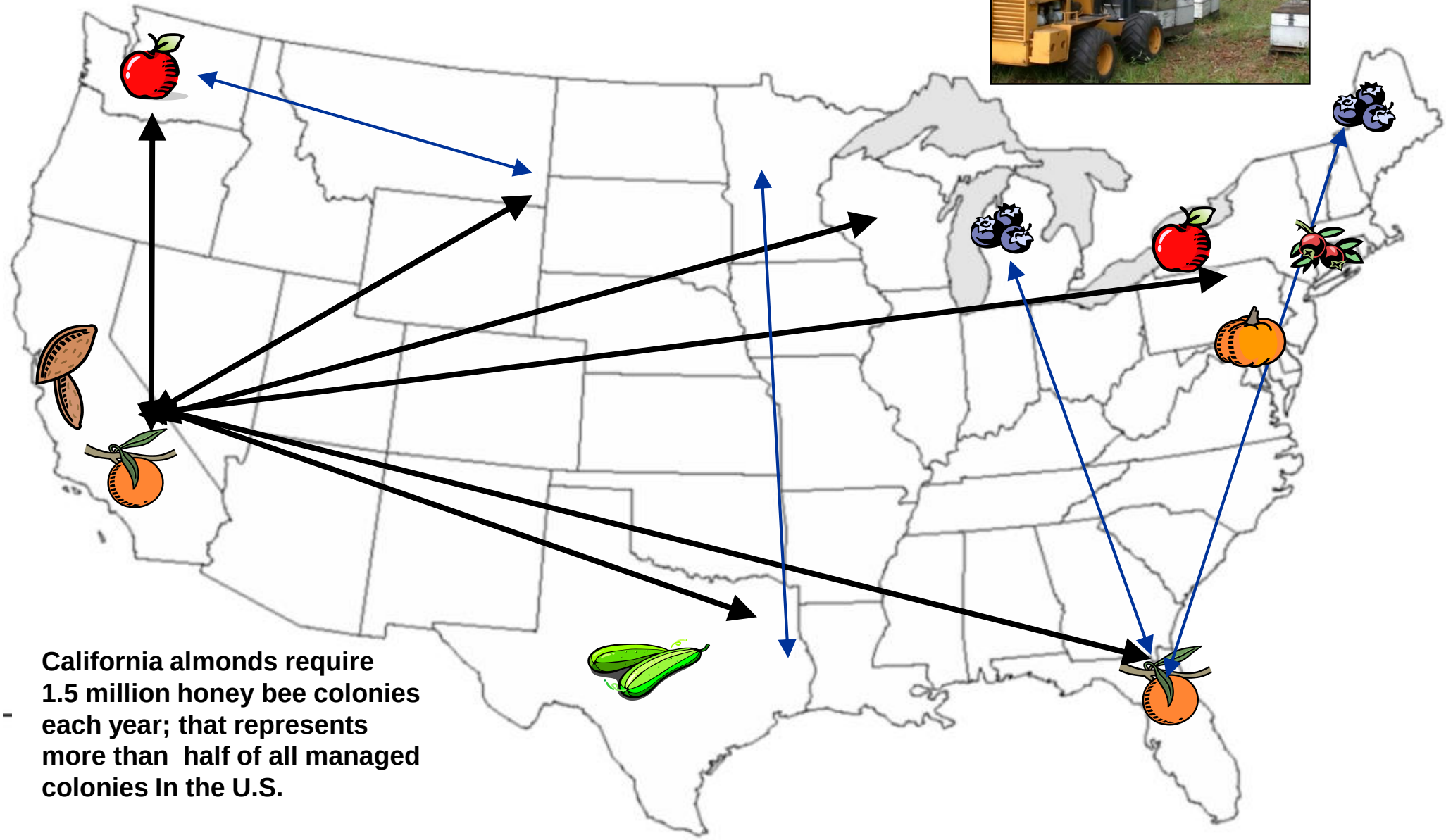
Nosema



Fungi

Varroa Mites

Management and Nutritional Stress



- **California almonds require 1.5 million honey bee colonies each year; that represents more than half of all managed colonies In the U.S.**

Monocultures

POLLEN

EXPOSURE via NECTAR/PLANT EXUDATES

EXPOSURE via CONTAMINATED WATER

Herbicides

Carbamates

Organophosphates

Pyrethroids

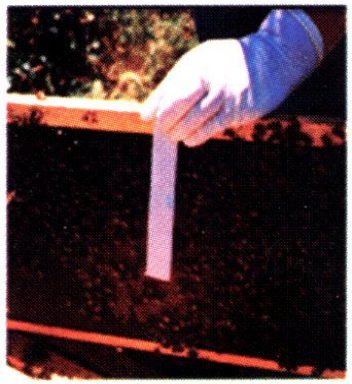
Fungicides

COLONY HEALTH

Pesticide Interactions?

Sublethal Effects?

Interactions With Other Stressors?



MITE CONTROL

Fluvalinate

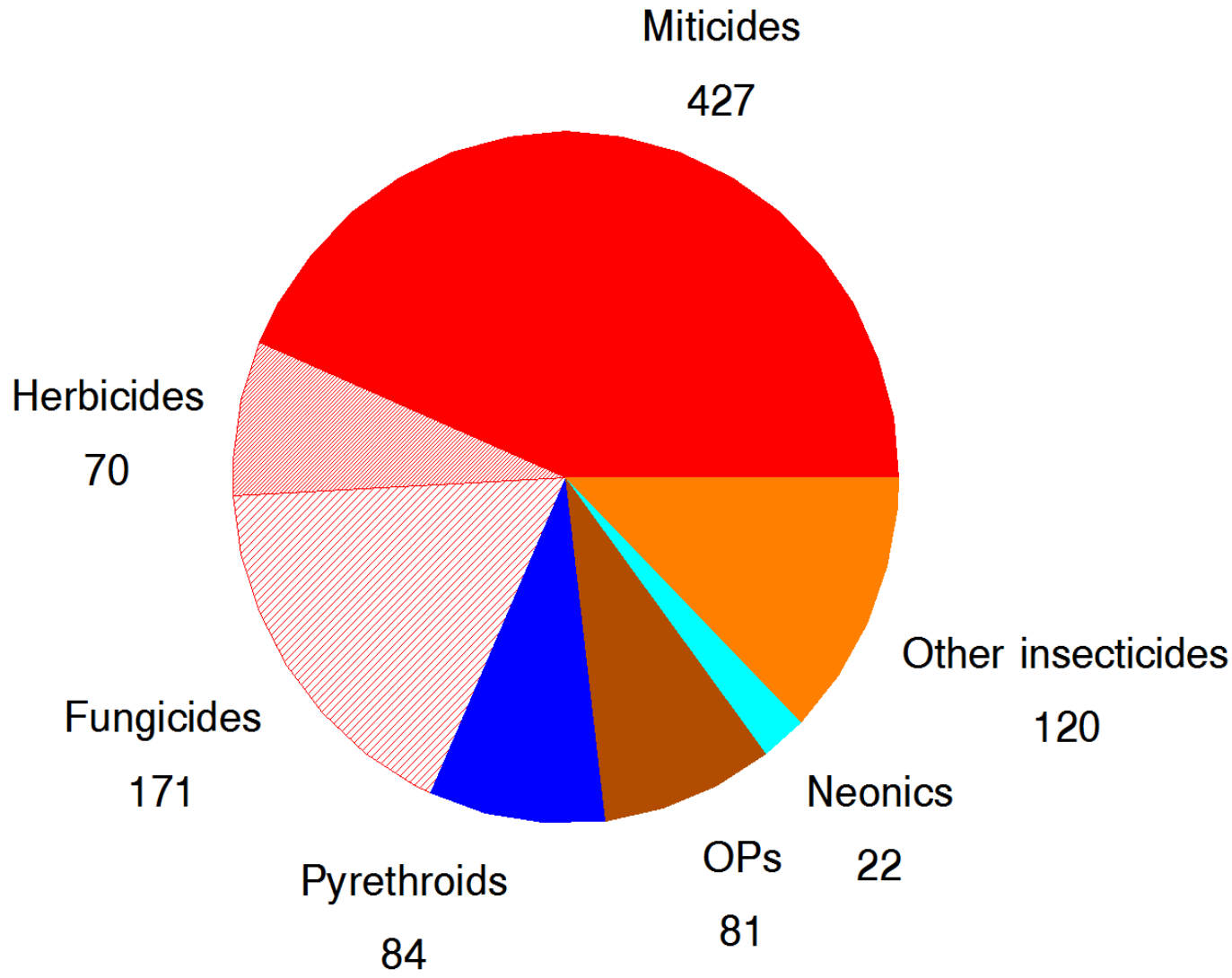
Coumaphos

Neonicotinoids – systemic insecticides

Honey Bees ……. Flying Dust Mops

Foraging area - 2 mile radius or 8,000 acres

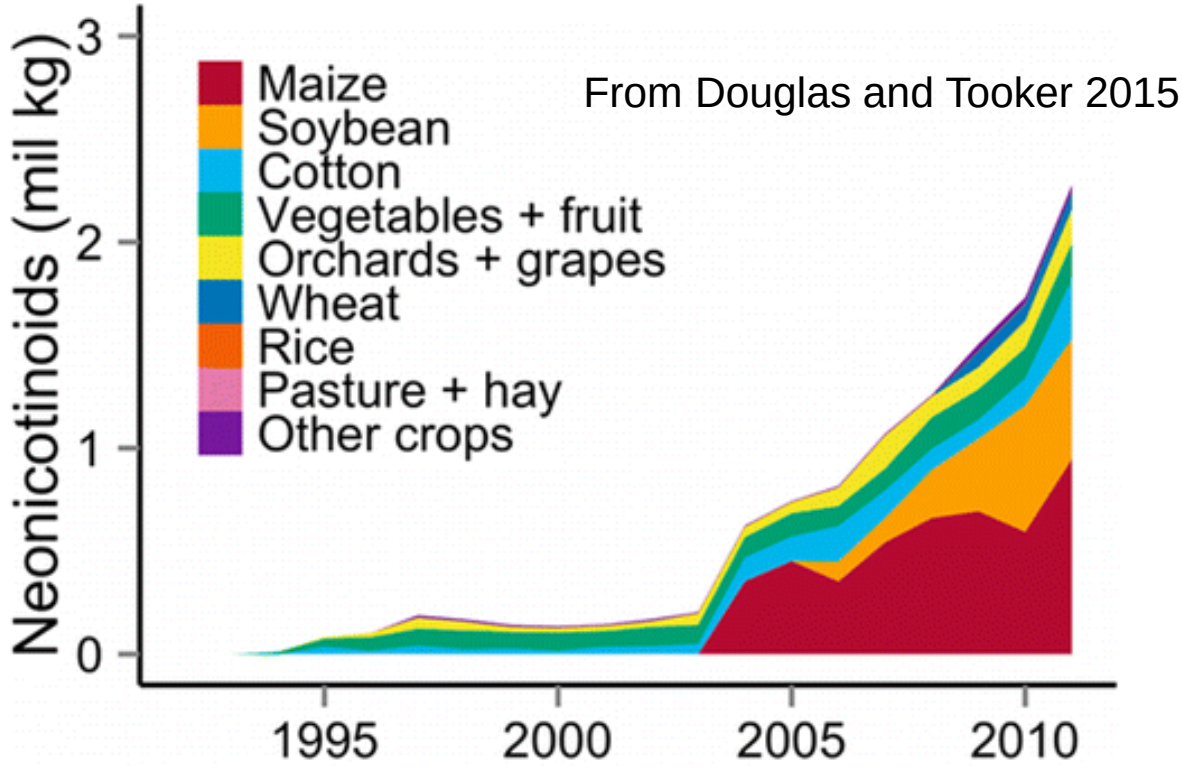
Pesticides found in hives (beebread samples)



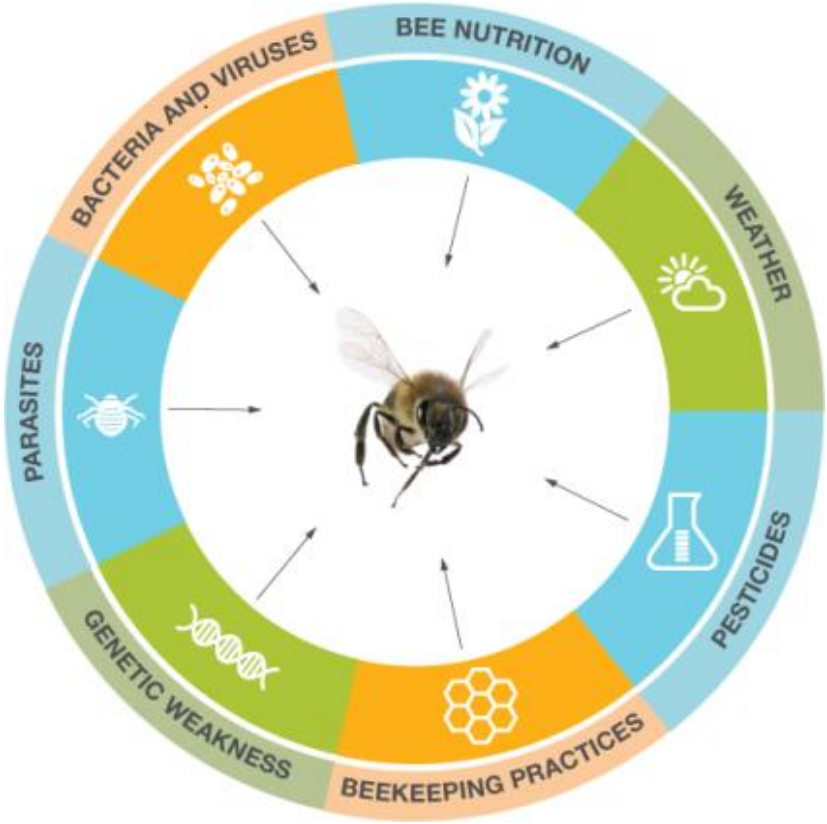
Source: National Honey Bee Disease Survey

Residues in nectar and pollen represent a major route of systemic neonicotinoid exposure to bees

Major focus on seed treatments



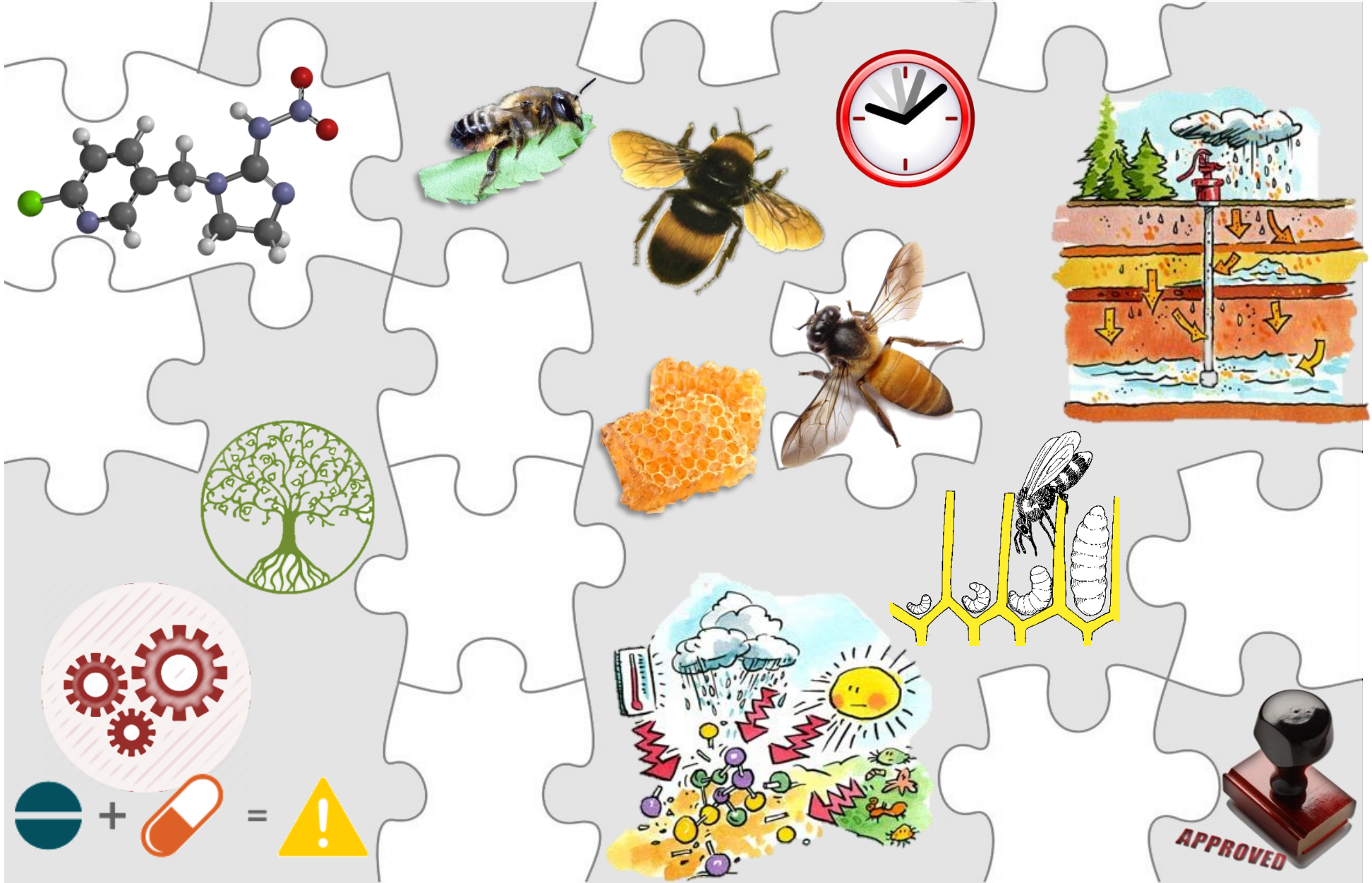
Multiple stress factors affecting honey bee health



Scientists are focusing on the **interaction** of factors:

- **Parasites (*Varroa* mites)**
- **Diseases (*Nosema*, bacteria, viruses)**
- **Poor bee nutrition**
  - **Lack of varied diet**
  - **Lack of suitable habitats**
- **Beekeeping management stresses**
- **Pesticides (used in hives as well as in agriculture)**
- **Weather patterns and changing climate**
- **Lack of genetic diversity leads to weakened resistance to pests and diseases**
- **Queen failure**

Still Lots of Knowledge Gaps



Bees are Dying
What You can Do

Become a beekeeper

Eat local honey

Thank you …. Questions

Thanks to the USDA-ARS Bee Lab and EPA for funding