UNIVERSITY of FLORIDA Honey Bee Research & Extension LABORATORY

UF | IFAS Extension
UNIVERSITY of FLORIDA

2018 UF/IFAS
Bee College

COURSE MATERIALS

Gainesville, Florida

Session 1: October 12 & 13, 2018
Session 2: October 15 & 16, 2018

Table of Contents

Course Materials (in alphabetical order)

African & Africanized Honey Bees

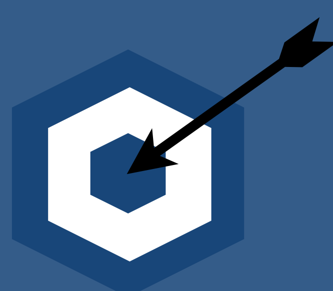
Beekeeper Continuing Education Program

Florida Department of Agriculture and Consumer Services

Learning Objectives

After completing this module, you should be able to:

- » distinguish between the terms African, Africanized, and European as they relate to honey bees,
- » recognize how African honey bees came to Florida,
- » differentiate between the behaviors of African and European honey bees,
- » identify what to do if you encounter African honey bees, and
- » recognize what can be done to reduce the further spread of African honey bees.



Apis mellifera
Western Honey Bee

There are nine honey bee species, eight of which occur exclusively in Asia.

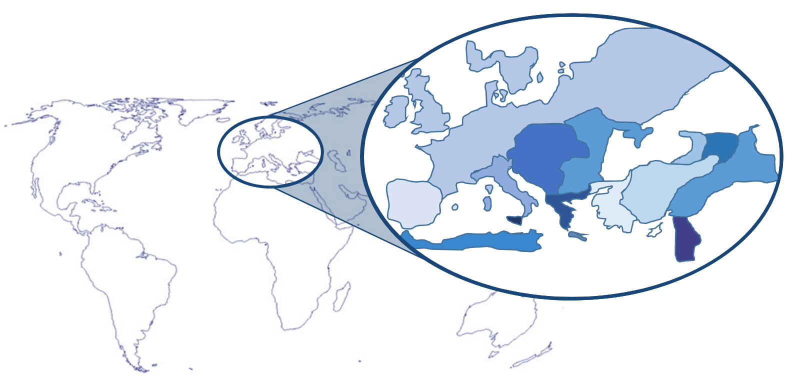
The western honey bee (*Apis mellifera)* naturally occurs in Europe, Africa, and the Middle East.

No honey bee species are native to the Americas. Instead, honey bees were brought to the Americas by humans.

There are ~25 – 30 subspecies (or "races") of western honey bee. They are distributed across their respective native ranges.

Map image from d-maps.com (http://d-maps.com/carte.php?num_car=3267&lang=en)

Subspecies of the
European Honey Bee



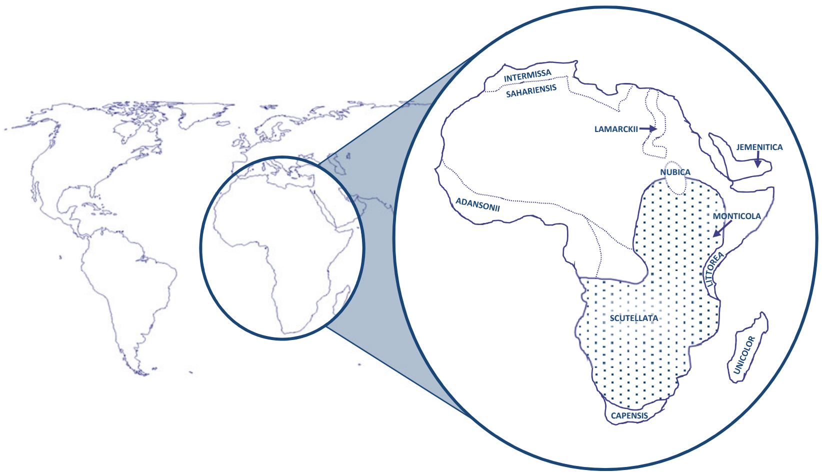
The western honey bee subspecies found in Europe are known as European Honey Bees (EHBs).

As early as the 1600s, many of these subspecies were brought to the United States for human use.

The honey bee stocks most commonly found in the U.S. today are the result of the interbreeding of many of these European subspecies.

Credit: World Map image from d-maps.com (http://d-maps.com/carte.php?num_car=3267&lang=en and). Europe Map from UF/IFAS Honey Bee Lab photo by Mary Bammer.

Subspecies of the **African Honey Bee**



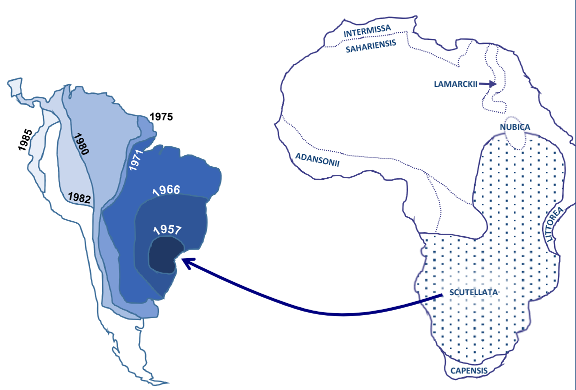
Africa is also home to a number of honey bee subspecies.

These subspecies are broadly referred to as African Honey Bees (AHBs).

AHBs tend to prefer warm climates like those common across Africa.

Credit: World Map image from d-maps.com (http://d-maps.com/carte.php?num_car=3267&lang=en and). Africa Map from UF/IFAS Honey Bee Lab photo by Mary Bammer.

The Spread of **African Honey Bees**



EHB colonies are adapted for use in temperate climates, like those found in much of North America.

EHBs that were used in South America were not performing well there.

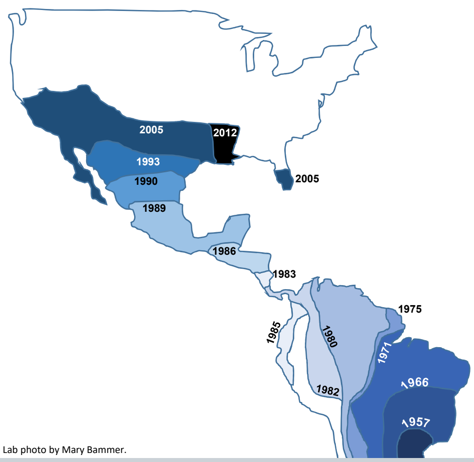
In the late 1950's, a Brazilian scientist brought an African honey bee subspecies (*Apis mellifera scutellata*) from Africa to Brazil, believing he could improve honey production in Brazil by using a bee more suited to Brazil's climate.

Before plans to breed gentleness into this African stock could be completed, the relocated bees swarmed and escaped the research apiary.

Over the next 30 years, AHBs quickly spread throughout Brazil and South America.

Credit: UF/IFAS Honey Bee Lab photo by Mary Bammer.

The Spread of **African Honey Bees**



Credit: UF/IFAS Honey Bee Lab photo by Mary Bammer.

By the mid-1980s, AHBs had spread into Central America, eventually entering the United States through Texas by the early 1990s.

By 2005, they had spread through Texas into many of the southwestern states and separately into Florida.

As of 2012, AHBs could be found in parts of Texas, California, New Mexico, Arizona, Oklahoma, Louisiana, Arkansas, Alabama, and Florida.

Hybridization: **“Africanized” Bees**

Credit: UF/IFAS Honey Bee Lab photo

All subspecies of *Apis mellifera* can interbreed or hybridize.

AHB hybridization with EHBs became frequent as AHBs moved into areas previously occupied by EHBs.

The bees resulting from the hybridization of African and European honey bees are known as “Africanized” honey bees.

Although “African” and “Africanized” are often used interchangeably, the former really refers to the pure subspecies and the latter to the hybrid.

AHB vs. EHB **Behaviors**

Credit: UF/IFAS Honey Bee Lab photo

There are many differences between AHBs and EHBs.

AHB colonies typically are smaller than EHB ones.

The bees and queens of AHB colonies are more agitated on their combs than are bees and queens of EHB colonies.

AHBs tend to produce less honey than do EHBs.

AHBs colonies produce proportionally more brood than do EHB colonies.

AHBs tend to be more resistant to pest pressures, particularly those from *Varroa* and small hive beetles.

Both bees are great pollinators.

AHB vs. EHB **Behaviors**

Credit: UF/IFAS Honey Bee Lab photo

EHB colonies typically swarm 1-2 times per year whereas AHB colonies often swarm >2 times per year.

- AHB colonies produce more bees in a shorter period of time than do EHB colonies.

AHBs are also much more likely to abscond, where the colony completely relocates to a new nest.

AHBs have a heightened defensive behavior, making them much more likely to sting.

- AHBs typically defend a larger area around their nest than do EHBs.
- Furthermore, they respond to smaller stimuli, and in greater numbers than do EHBs.
- AHBs can chase victims to distances >¼ mile.

Concerns for **Beekeepers**

Credit: UF/IFAS File Photo

High absconding and swarming frequencies result in a large number of feral AHB colonies in environments where they are found.

Higher AHB swarming frequencies require more strict and regular swarm management.

Heightened AHB defensiveness requires stronger safety precautions when working around the bees.

- More smoke is used during colony inspections.
- Beekeepers must wear more personal protective equipment.
- Extra precautions must be taken to keep the public away from AHB colonies.

Concerns for **Beekeepers**

Credit: UF/IFAS Honey Bee Lab photo by Geena Hill

AHB colonies can usurp or take over EHB colonies, eventually replacing the original European queen with an African(ized) queen.

EHB queens and colonies can become hybridized when EHB queens mate with AHB drones.

Feral AHB colonies compete with managed EHB colonies for resources.

Public fear of “killer bees” can cause worsened public perceptions of all honey bees and other bees.

AHB in Florida

Credit: UF/IFAS Honey Bee Lab photo

Due to these concerns, it is illegal to manage colonies of AHBs in Florida except with a special permit granted by the Florida Department of Agriculture and Consumer Services.

Beekeepers should take steps to ensure that they are maintaining EHB colonies.

- Purchase mated queens only from breeders of European queens.
- Use swarm prevention practices.
- Maintain strong, healthy colonies.
- Mark your queens.

All Floridians, particularly those who work outside, should be aware of the possible threat of AHBs.

- AHBs are regularly found in water meter and valve boxes, within roof soffits, in hollow trees and other cavities, and as aerial nests in trees, among other places.

Make your property "Bee Proof"

Credit: UF/IFAS Honey Bee Lab photo

Fill or screen holes >1/8-inch in trees, structures, walls, foundation, and roof.

Screen attic vents, irrigation boxes, and water meter box holes.

Remove trash or debris that might shelter honey bees.

Fill or cover animal burrows.

Secure window screens to fit tightly.

Close shed doors tightly and keep in good repair.

Inspect your property regularly for bees.

Have any feral colonies removed or eradicated by a trained professional (either a pest control operator or a registered beekeeper).

Reacting to **AHB**

Credit: UF/IFAS Honey Bee Lab photo

For both AHBs and EHBs, honey bee foragers (away from the hive) and swarm clusters are mostly docile.

Honey bees only become defensive when they have a colony to defend.

If attacked by honey bees, particularly AHBs:

- Cover your face with your shirt.
- Run away from the scene as quickly as you can.
- Get inside a closed vehicle or structure.
- Do NOT jump into water.
- Once safely away from the threat, remove all stingers from one's body.

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You have reached the end of this presentation.

This presentation was created June, 2018 for the Beekeeper Continuing Education Program run by the Florida Department of Agriculture and Consumer Services. This presentation was created by Mary Bammer, and narrated by Dr. Jamie Ellis of the UF/IFAS Honey Bee Research and Extension Laboratory.

Florida Department of Agriculture and Consumer Services

All About Queens

University of Florida
Entomology and Nematology Department

Learning Objectives for this Lesson

After completing this lesson, you should be able to:

1. Distinguish between “good” and “spotty” brood patterns.
2. Recognize common queen care techniques: clipping and marking.
3. Recognize when to requeen a colony.

Importance of the Queen

Her egg-laying performance; e.g., colony population

The genetics she confers to her progeny

Her non-genetic effects on workers

Her productive longevity

Requeening success

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Queen Egg-Laying Performance

1,500 fertilized eggs/day

175,000 - 200,000 eggs/annually

Stores enough sperm for months of egg-laying (~5-6 million sperm)

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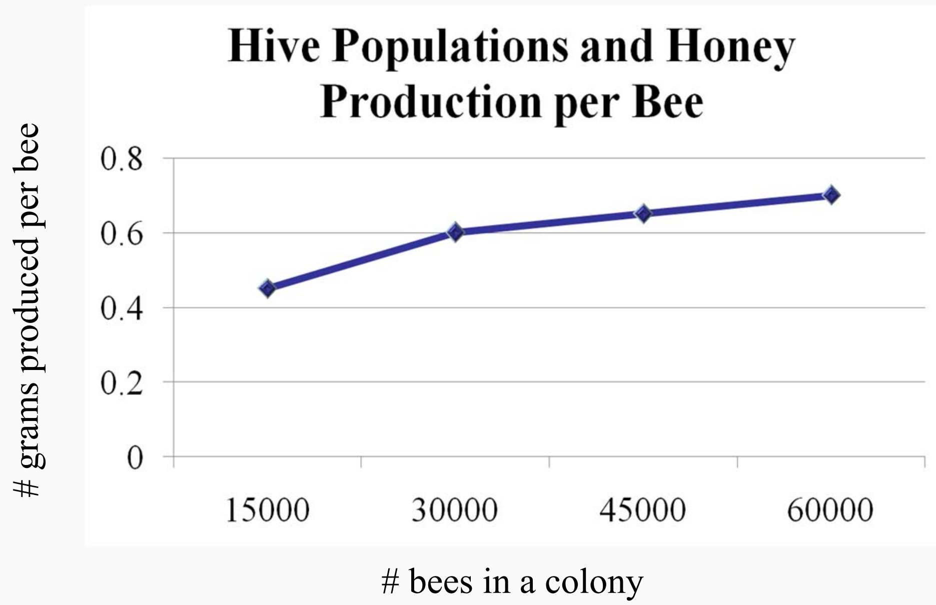
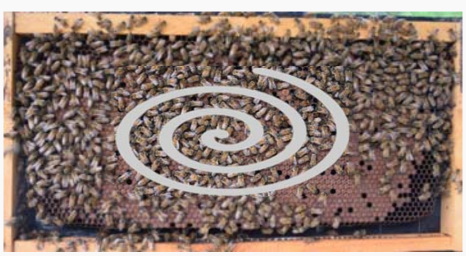
Queen Egg-Laying Performance



Farrar's Principle

Queen Egg-Laying Performance: Brood Pattern



Brood pattern is the presence, shape and density of capped brood on a given comb.

Queens begin laying eggs in the center of an empty frame then radiate out in a spiral.

A healthy queen can fill one side of a frame per day.

Combs in the middle of the hive tend to have more brood than do the outer combs.

Queen Egg-Laying Performance: Brood Pattern

Ideally most brood on one side of a frame should be about the same age (within a few days).

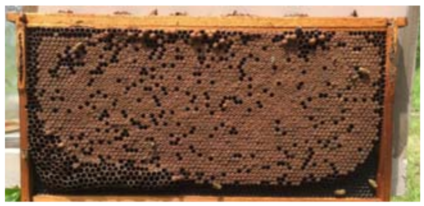
Brood of the same age should also be capped at about the same time.

This means that a queen's laying pattern can be judged based on frames of capped brood.

solid brood pattern ⟷ *spotty brood pattern*

There are very few empty cells scattered among many cells with brood. The queen has missed few cells.

The overall shape remains similar, but there are more empty cells.

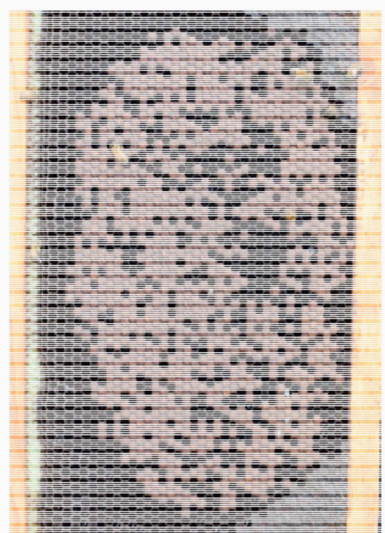


This is an undesirable brood pattern as its edge is irregular and there are many empty cells among the capped cells.

Queen Egg-Laying Performance: Brood Pattern

Spotty brood pattern can be caused by:

- a poor/poorly mated queen,
- combs containing pesticide residues,
- pests and pathogens, or
- inbred queens.



Conferred Genetics: Mating Behavior

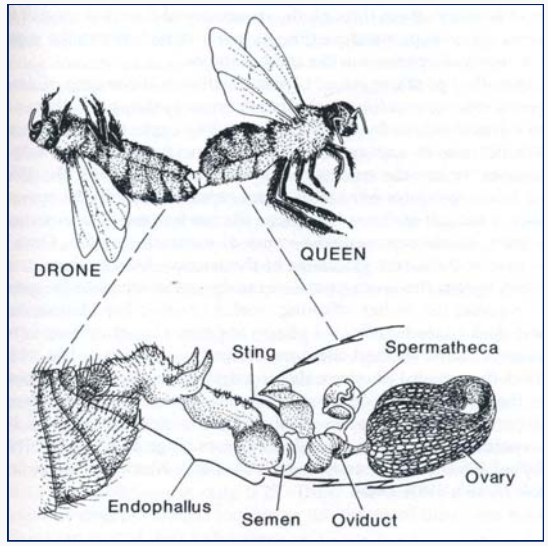
A virgin queen leaves the colony to go on mating flights the first 10-14 days of her life.

Queens mate with an average of ~17 or more drones, polyandry.

The sperm she collects will be used for the rest of her life.

Collected in the spermatheca.

The queen can control the fertilization of eggs.



Conferred Genetics: Mating Behavior

QUEEN + 5♂'s

Sub1 Sub2 Sub3 Sub4 Sub5

The queen receives different genetic information from all the males with which she mates.

Because of this, only one matriline is represented in the colony while multiple patrilines are represented.

Colony Traits Inherited from the Queen

Honey production

Hygienic behavior

Swarming tendency

Gentleness

Pollen hoarding

Pollen preference

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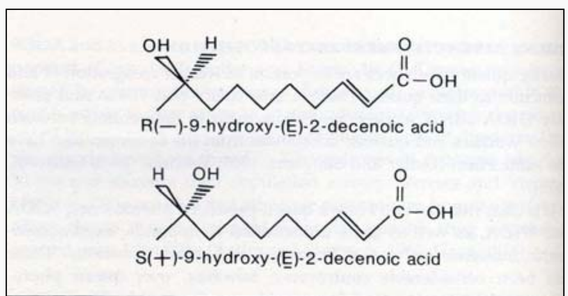
Non-genetic Queen Effects on the Colony

Queen Substance (90DA):

- inhibits queen rearing and worker ovarian development,
- attracts workers,
- attracts drones,
- stabilizes swarm clusters, and
- stimulates worker foraging.



The enantiomers of 9-hydroxy-(*E*)-2-decenoic acid, showing the two chiral forms of the molecule.

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Queen Productive Longevity

Queens can live for many months if healthy.

If queen begins failing, the colony will construct supercedure cells in an attempt to replace the queen.

Typically, beekeepers should requeen once a year with marked/clipped queens to maintain colony vigor.

Requeening Success

Queens can be purchased from credible queen breeders.

- Beekeepers can choose what kind of queen they want to use (she will influence a colony's genetics).

- Most purchased queens are open mated and can be purchased clipped and marked for an additional fee.

Workers may take up to a week to accept a new queen.

Clipping and Marking Queens

Many beekeepers mark their queens with a dot of paint to facilitate finding them.

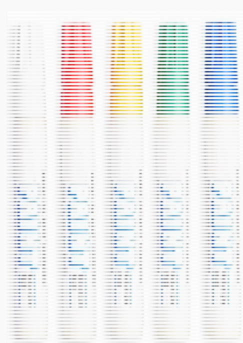
They may also clip their queens' wings to keep them from flying.

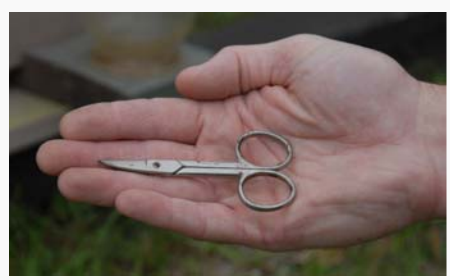
Queen Color Marking Code

Color	Year ending in:
White/gray	1 or 6
Yellow	2 or 7
Red	3 or 8
Green	4 or 9
Blue	5 or 0

Mnemonic to remember the order:
*W*hen *Y*ou *R*aise *G*ood *B*ees

Clipping and Marking Queens





Supplies

Clipping and Marking Queens

Ways to catch/hold the queen:

- By the wings, legs, or thorax (between thumb and index fingers)
- Gently
- Let her walk onto your fingers
- Queen Clip or Cage device
- Never by the abdomen!

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Clipping and Marking Queens

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Clipping and Marking Queens

Clip off 1/3 of one forewing

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Questions?

Presentation created by: Mary Bammer, Jamie Ellis, Emily Helton, Gary Van Cleef, and Rob Horsburgh

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Apiary Pest Control

Dr. Bill Kern

UF | UNIVERSITY of FLORIDA
Institute of Food and Agricultural Sciences
Fort Lauderdale Research and Education Center

Pests in the Apiary

- Ants
- Wasps and Hornets
- Bears
- Skunks
- Frog and toads
- Lizards and snakes
- Weeds

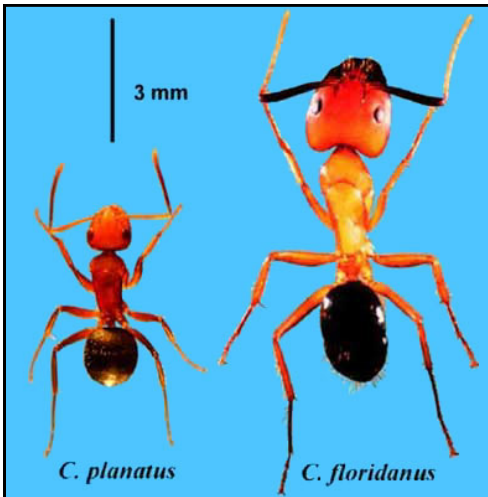
Ants

Predators of bees

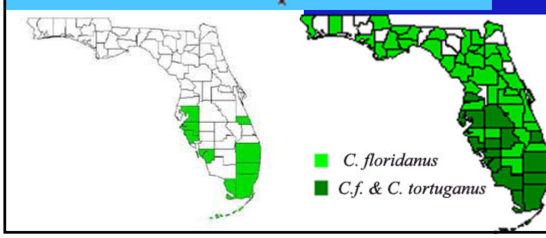
Colony robbers

Irritants

Ants

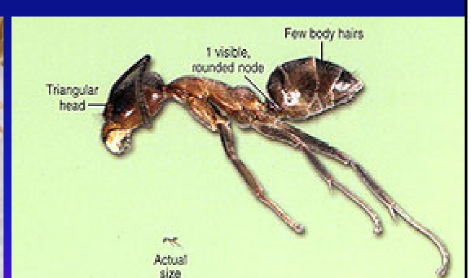


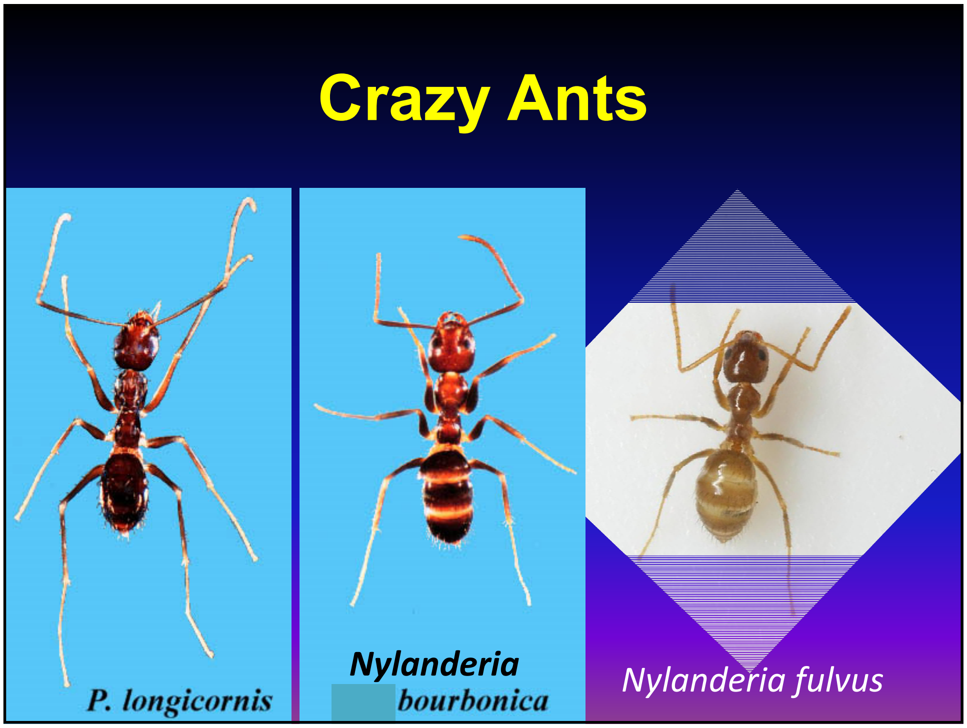
Camponotus planatus **the compact carpenter ant, and** ***Camponotus floridanus*** **, the Florida carpenter ant**

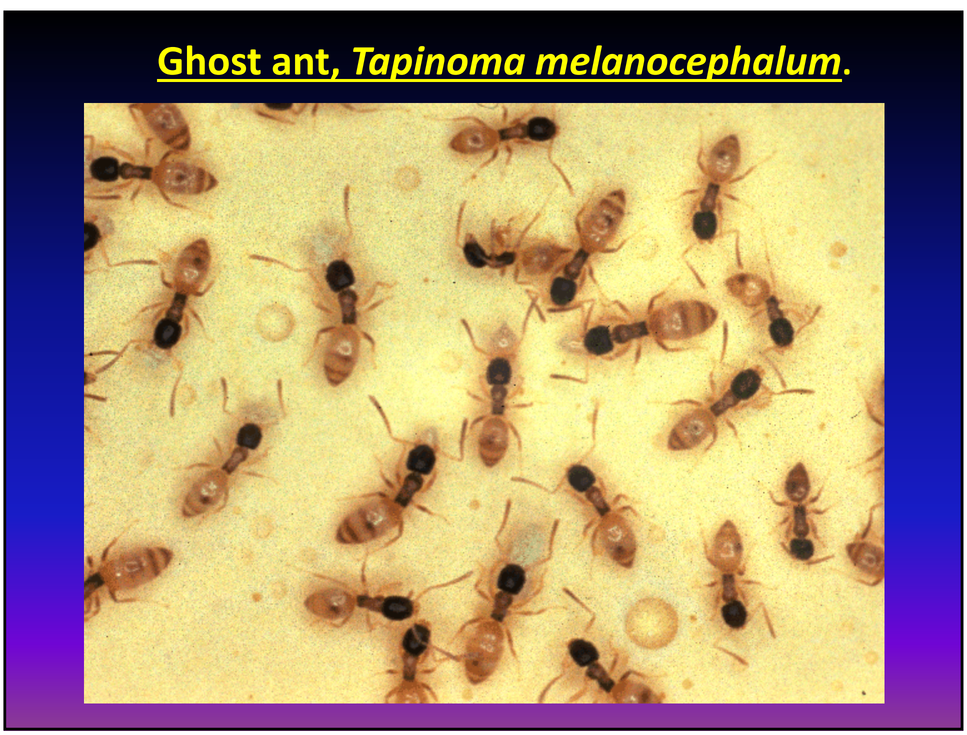


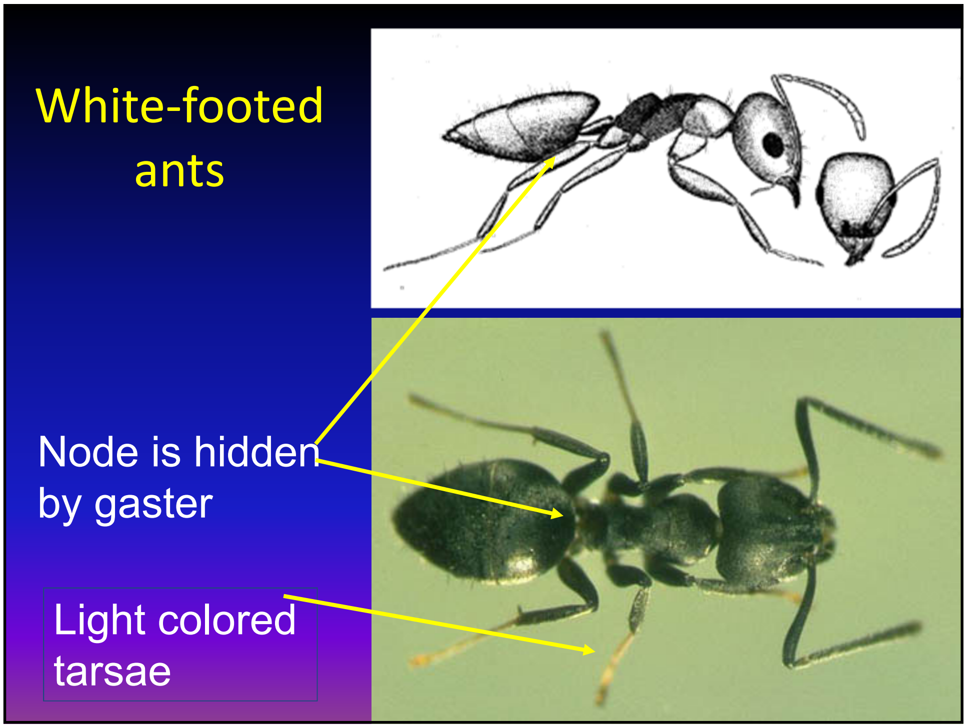
Argentine ant

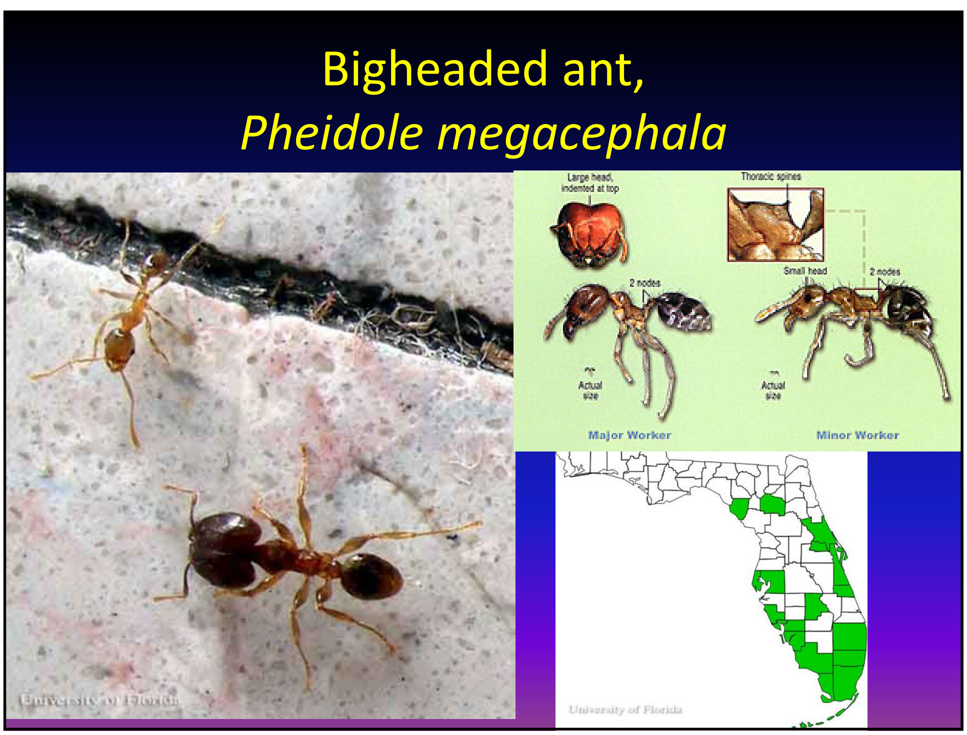
(*Linepithema humile*)




Crazy Ants
P. longicornis
Nylanderia
bourbonica
Nylanderia fulvus


Ghost ant, Tapinoma melanocephalum.


White-footed ants
Node is hidden by gaster
Light colored tarsae

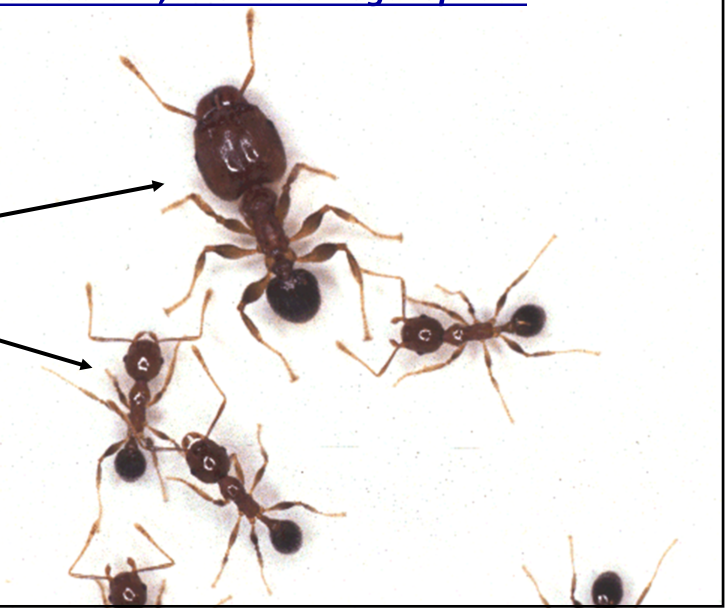

Bigheaded ant,
Pheidole megacephala
Large head, indented at top
Thoracic spines
2 nodes
Small head
2 nodes
Actual size
Actual size
Major Worker
Minor Worker
University of Florida
University of Florida

Bigheaded ant, *Pheidole megacephala*.

Dimorphic Workers

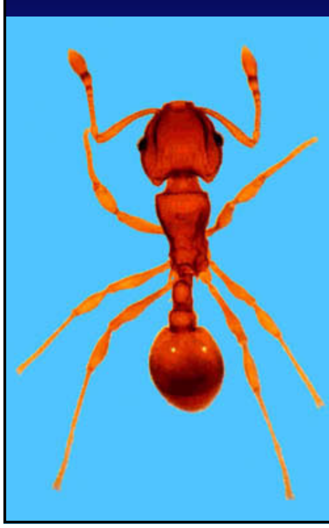
major worker

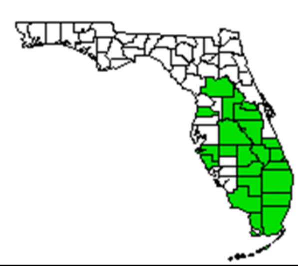
minor worker



Little Fire Ant

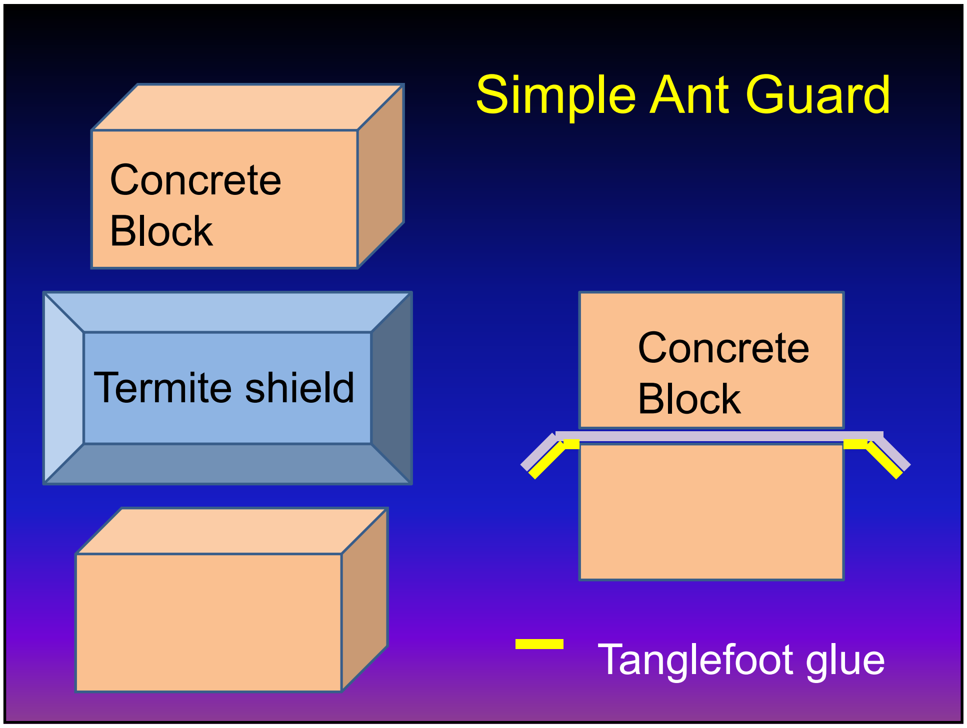
Wasmannia auropunctata

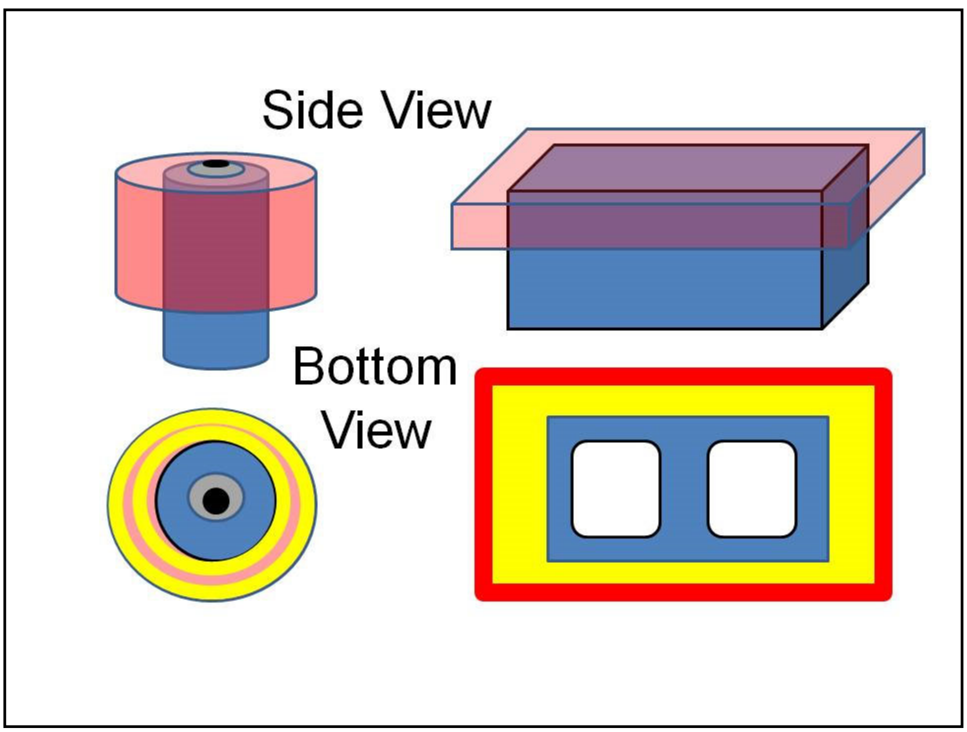





Ant Stands
Bee Hive Stand for Ground Little Fire Ant (LFA)
Control from (UH Hilo)


TREE TANGLEFOOT
Pest Barrier
TANGLE GUARD
BANDING MATERIAL
Tree Tanglefoot

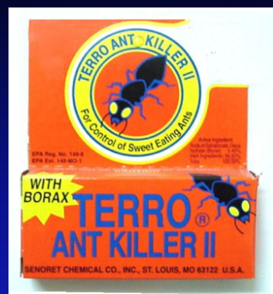

Simple Ant Guard
Concrete Block
Termite shield
Concrete Block
Tanglefoot glue


Side View
Bottom View


Bait for ant control


Cover scatter baits with a board

Ant Liquid and Gel Baits



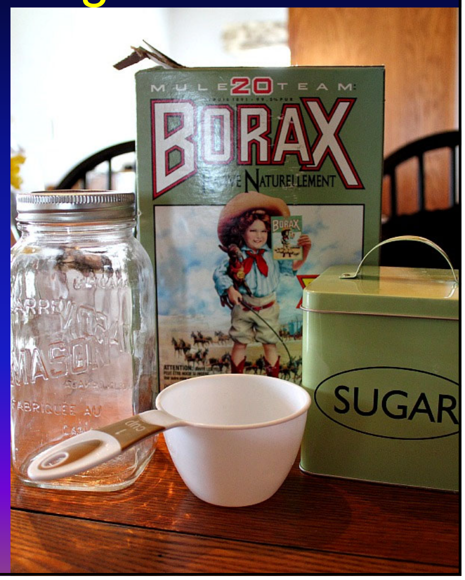
Ant Liquid and Gel Baits


optigard
MAXFORCE
Carpenter Ant Bait Gel
MAXFORCE
Carpenter Ant Bait Gel


Granular Ant Baits
ADVANCE
Carpenter Ant Bait
CAUTION
MAXFORCE

Homemade Ant Bait for Sugar-loving Ants

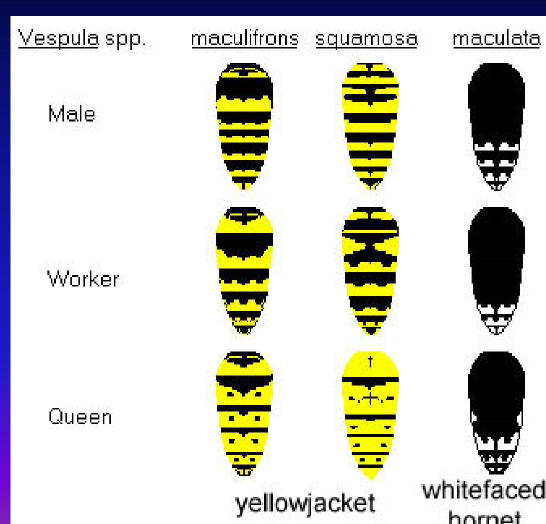
- 1 cup of sugar
- 1/2 cup of water
  (I prefer 1 cup)
- 1 Tablespoon of Borax or Boric acid



GardStar® 40% EC

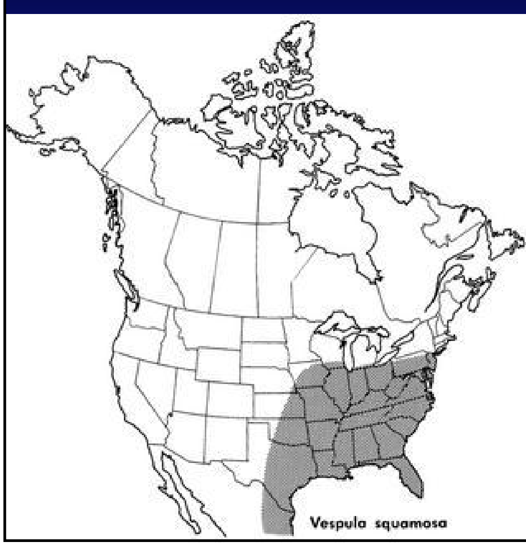
YELLOW JACKETS AND HORNETS

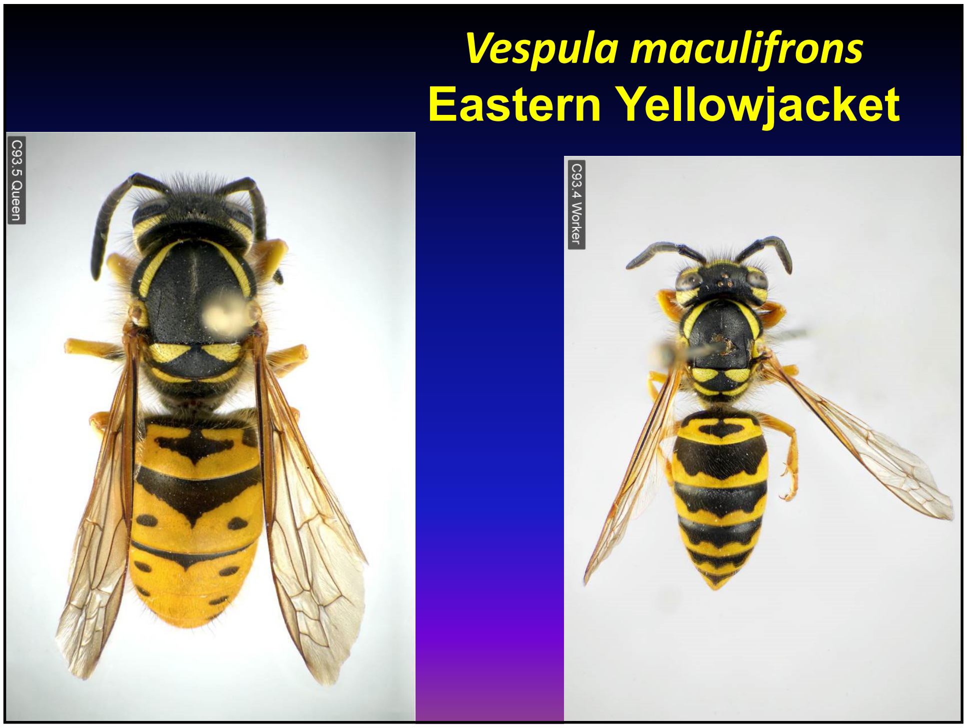
Key to Florida yellowjackets

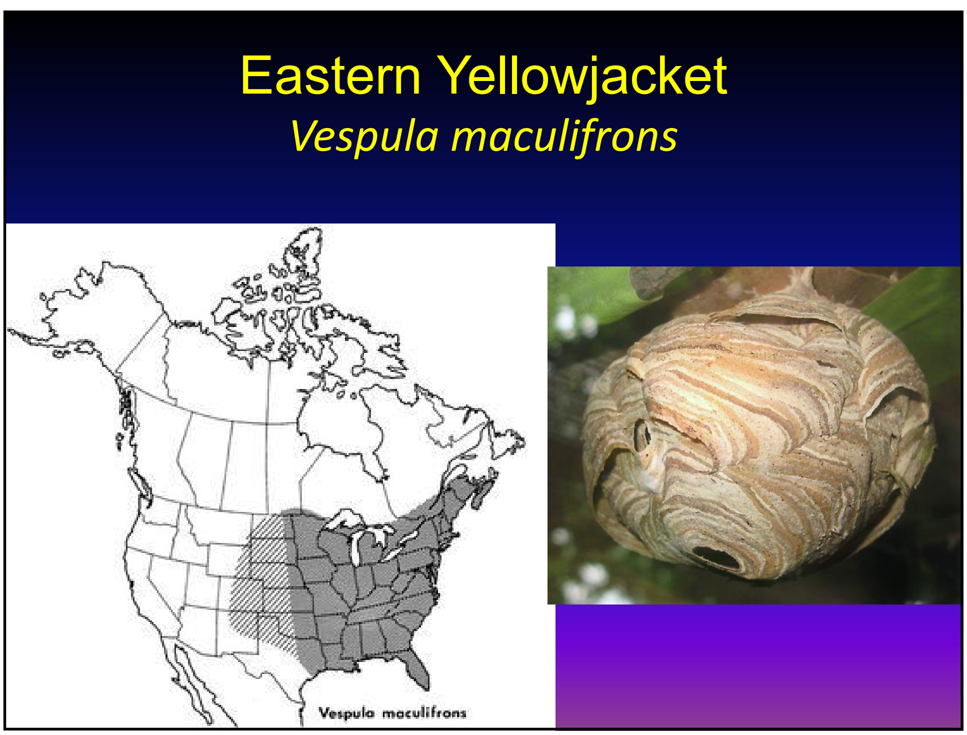


Southern Yellowjacket
Vespula squamosa (Vespidae)

Vespula squamosa **(Drury, 1773)**
Southern yellowjacket

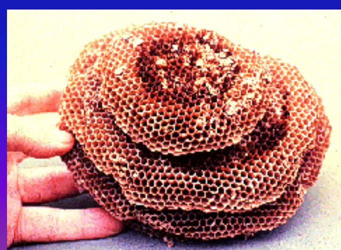


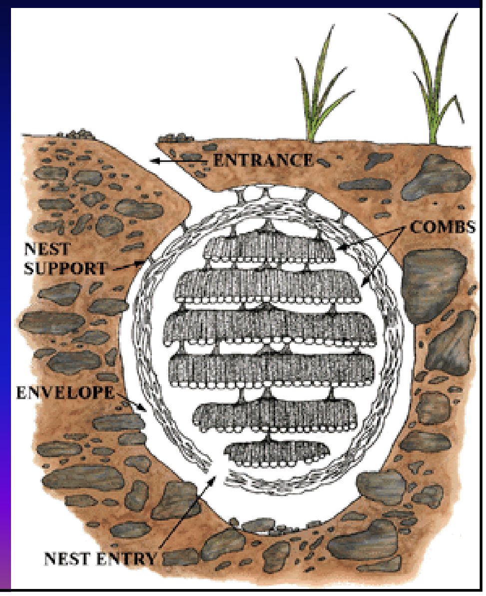

Vespula maculifrons
Eastern Yellowjacket
C93.5 Queen
C93.4 Worker


Eastern Yellowjacket
Vespula maculifrons
Vespula maculifrons

Yellowjacket nests

- Nests are built entirely of wood fiber and are completely enclosed except for a small opening (entrance)

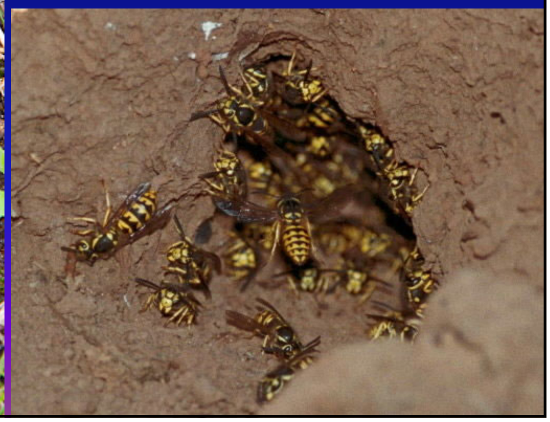




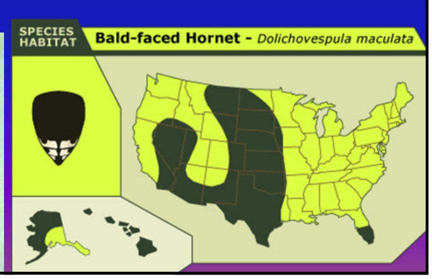
Results of a Yellow Jacket Attack

Yellow jacket Nests in the ground

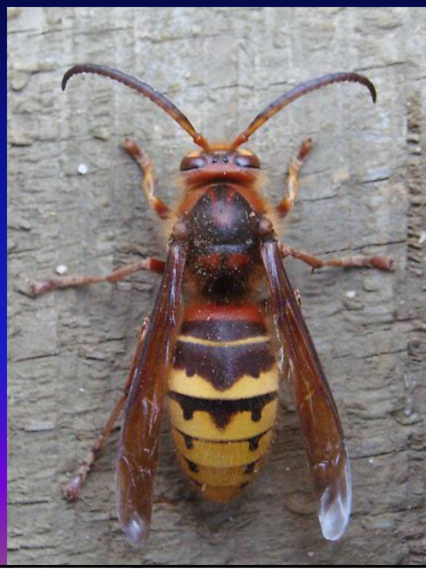
- Dust entrance with Sevin, Deltadust, etc.
- Do Not Use Gasoline



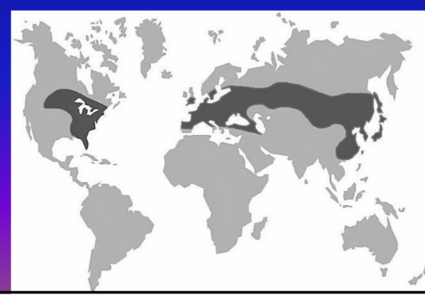
Dolichovespula maculata



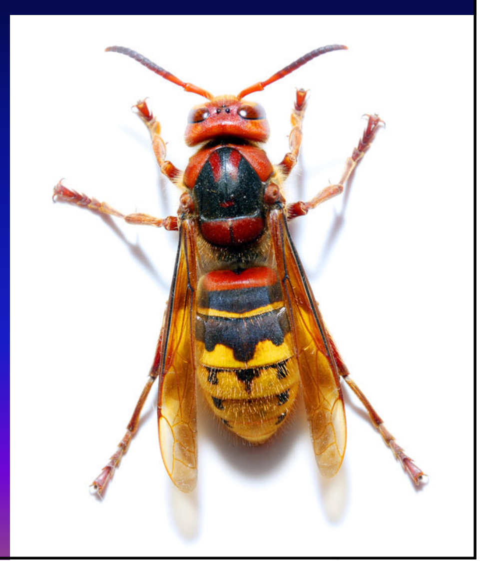
European or giant hornet
Vespa crabro (Vespidae)



- has expanded its range throughout the Eastern U.S since 1840 to finally reach Florida.



European Hornet
Vespa crabro



Apis cerana overheating a Japanese Hornet

http://maarec.psu.edu/pest&disease/sl63.html

Bear Damage

I Think I know the Culprit


Bear Fence

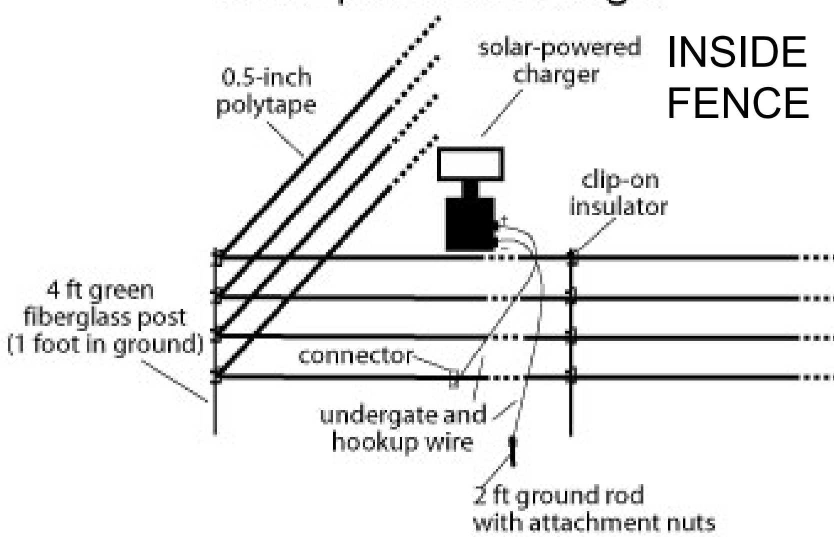

Bear Fence Around Apiary

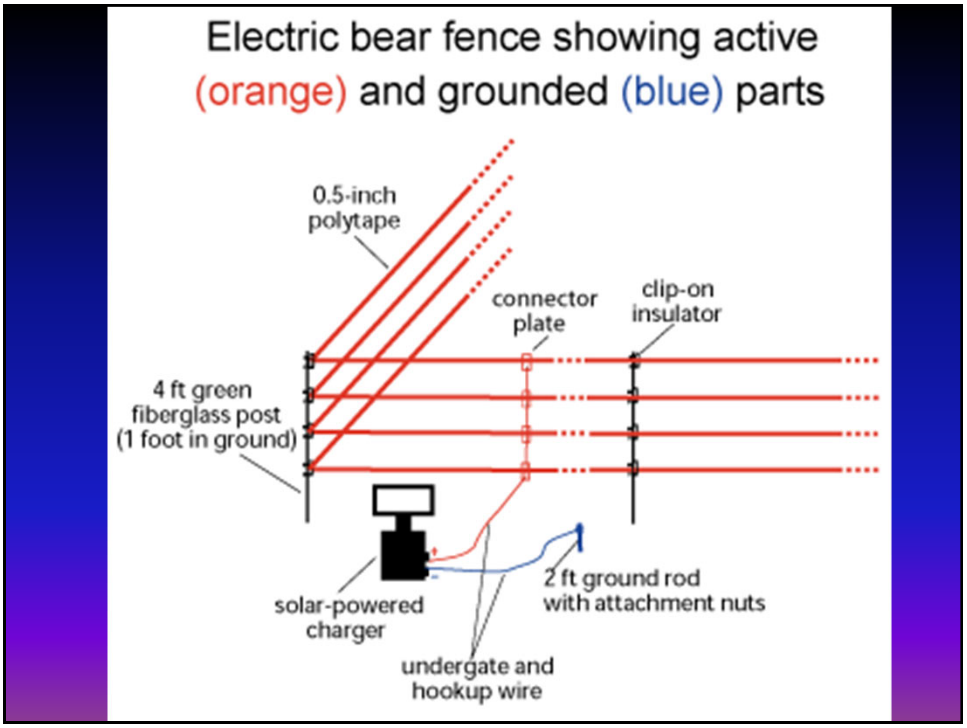
- An apiary can be protected from bears by a sturdy electric fence. Such a fence must be dependable, relatively cheap to construct, and capable of operating in remote locations.
- Fences are totally ineffective if not installed and managed properly.
- Avoid a site with overhanging trees, as limbs might fall across the wires . It is also quite common for bears to climb trees and then drop down inside the fence.
- Control grass and weeds along the fence so that they will not contact the charged wires and short them out.

Electric Fencer Units

Solar Array

Bear fence for apiaries with solar-powered charger




Electric bear fence showing active
(orange) and grounded (blue) parts
0.5-inch
polytape
connector
plate
clip-on
insulator
4 ft green
fiberglass post
(1 foot in ground)
solar-powered
charger
2 ft ground rod
with attachment nuts
undergate and
hookup wire

Ngong Forest Sanctuary, Africa
Womens Beekeeper Training Program

Baboons

Skunks

- Chewed up and spat out bee cuticle
- Droppings full of chewed bee cuticle

Eastern Spotted Skunk

Striped Skunk (*Mephitis mephitis*)

- To capture bees, skunks scratch at the hive entrance and guard bees that come out to investigate the disturbance. A successful skunk will repeat the process several times and may feed at the hive entrance for an hour or more to rapidly depleting the bee population.
- Colonies visited by skunks may become defensive since skunks usually return night after night.
- Skunk predation can be detected by the front of the hive being scratched and muddy and the vegetation in front of the hive packed down or torn up.

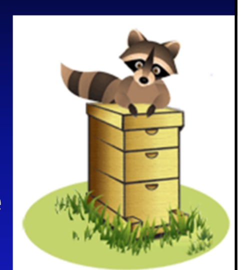
- Strong bee colonies sometimes put up a good fight against skunks and other hive visitors, but weaker colonies usually fall victim. Therefore, maintaining strong colonies is a partial deterrent to animal predation.
- Skunks and mice may be discouraged by screens or queen excluders attached to the hive entrance. These devices hamper the skunk's efforts to scratch at the front entrance and if it climbs up the screen over the entrance, its belly becomes vulnerable to stings.
- Elevating the hives on stands (blocks, bricks, etc.) may also serve the same purpose.
- Fencing the bee yard or placing the colonies on stands is also an effective technique but more costly.
- Moving your bees to a new location is another option.

Live Trapping Skunks Has Its Own Hazards

- Besides Rabies

Skunk Boards

Raccoons



- Signs of predation: Raccoons are smart animals and can figure out how to take the cover off of your hive to get at the bees/brood/honey/pollen inside.
- Prevention: place heavy rocks or bricks on top of the hive to prevent the raccoon from lifting the cover off.


Mice
• Strictly a winter problem.
• Or problem in stored supers.


Minor Predators

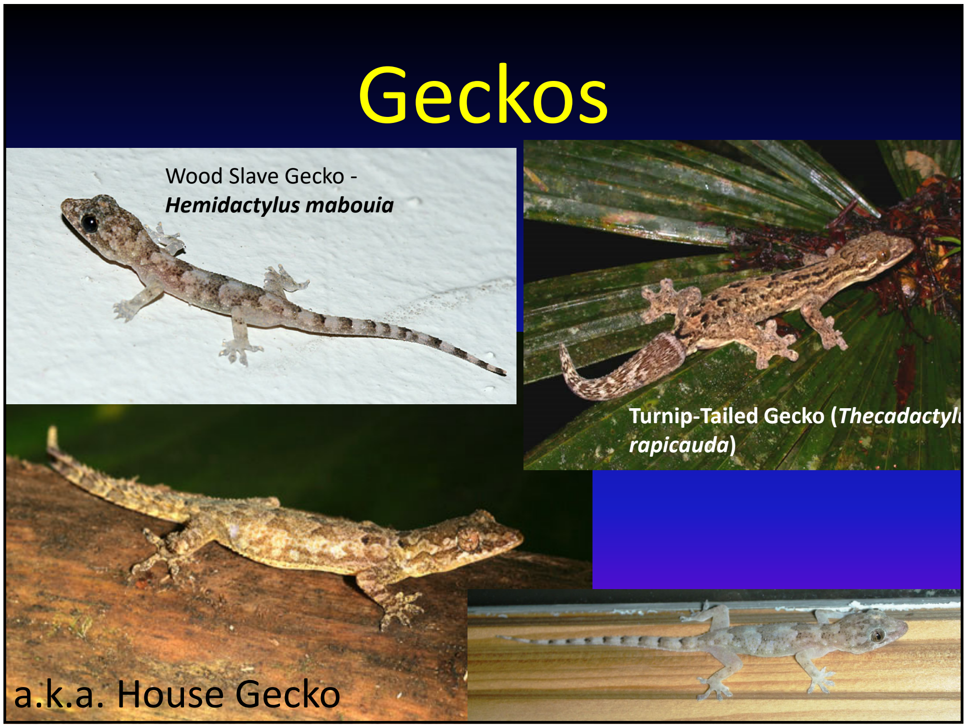
Giant Toads

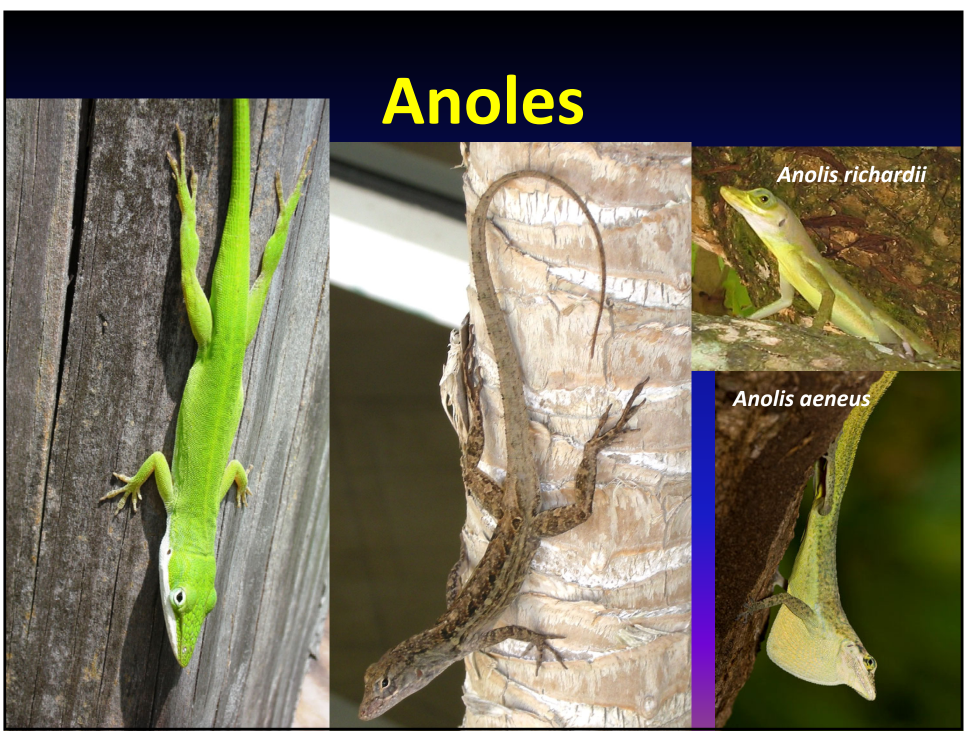
Rhinella marina = Bufo marinus

- Marine toads
- Cane toads

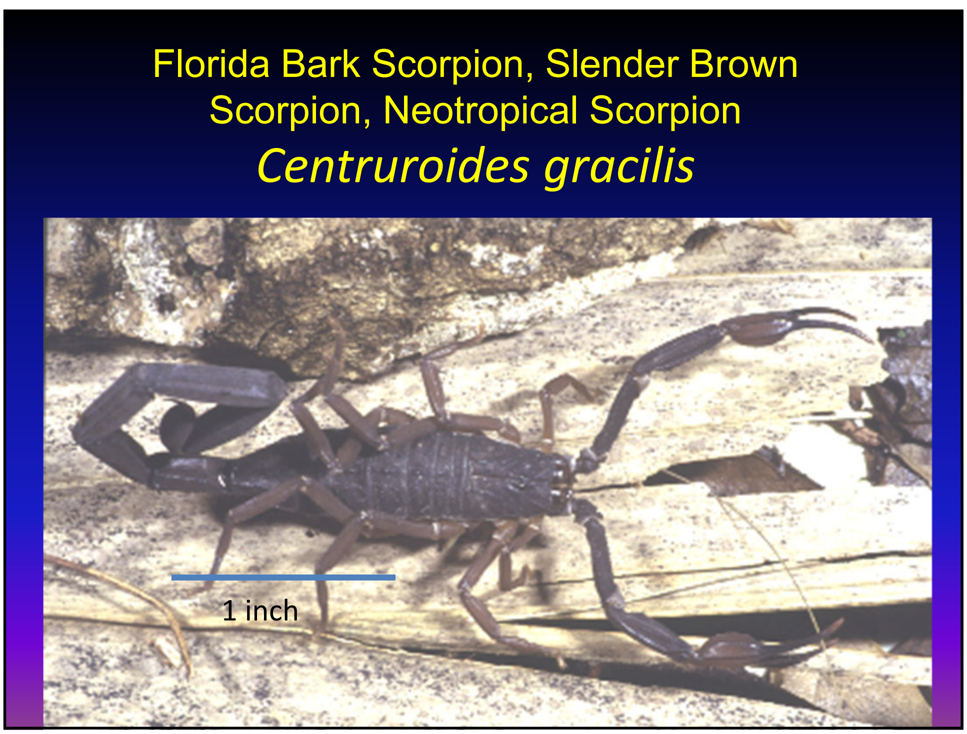
Giant or Marine Toad

Bufo marinus


Geckos
Wood Slave Gecko -
Hemidactylus mabouia
Turnip-Tailed Gecko (Thecadactyl
rapicauda)
a.k.a. House Gecko


Anoles
Anolis richardii
Anolis aeneus


Brown Basilisk


Florida Bark Scorpion, Slender Brown Scorpion, Neotropical Scorpion
Centruroides gracilis
1 inch

Hentz's Centruroides
Centruroides hentzi

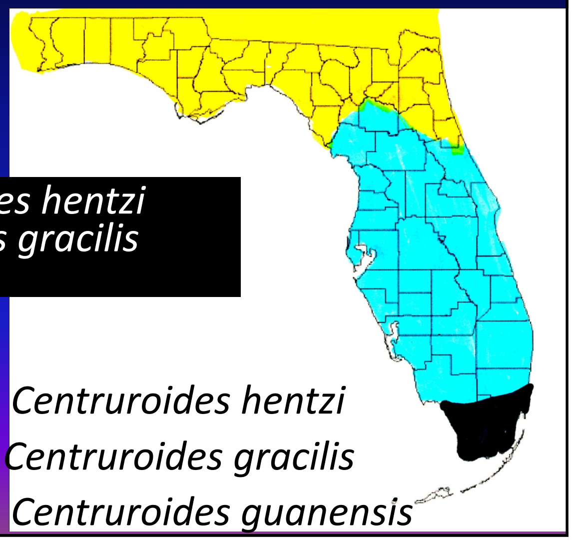
Key's Striped Scorpion
Centruroides guanensis

Fig. 4.—*Centruroides keysi* new species, female and male (about 2.2 times life size).

Scorpion Distributions

Centruroides hentzi

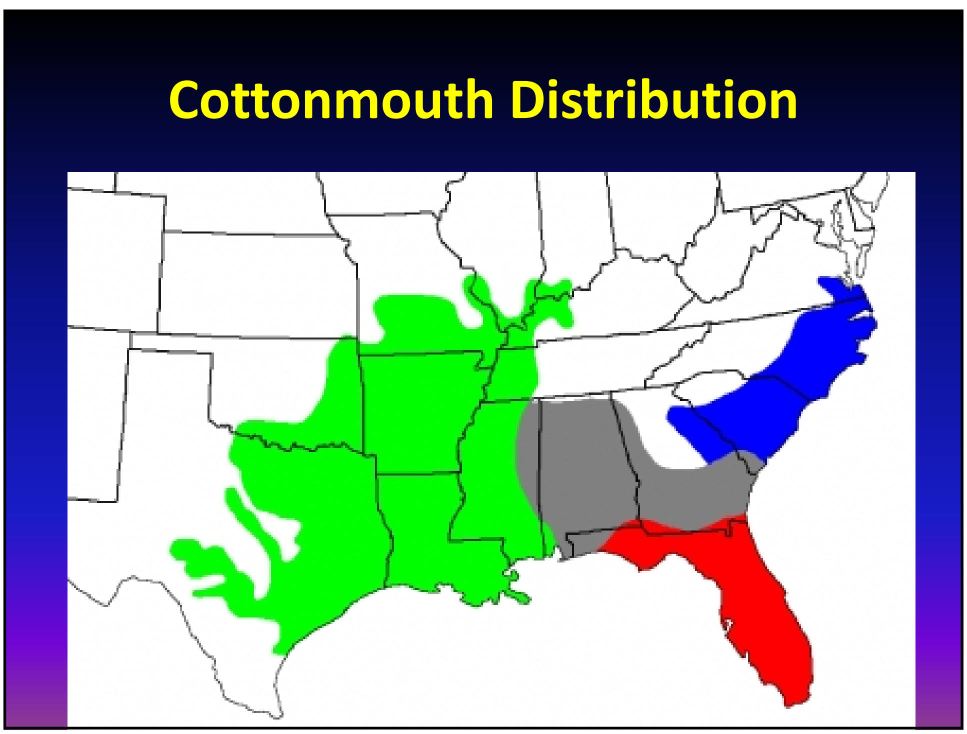
Centruroides hentzi
Centruroides gracilis

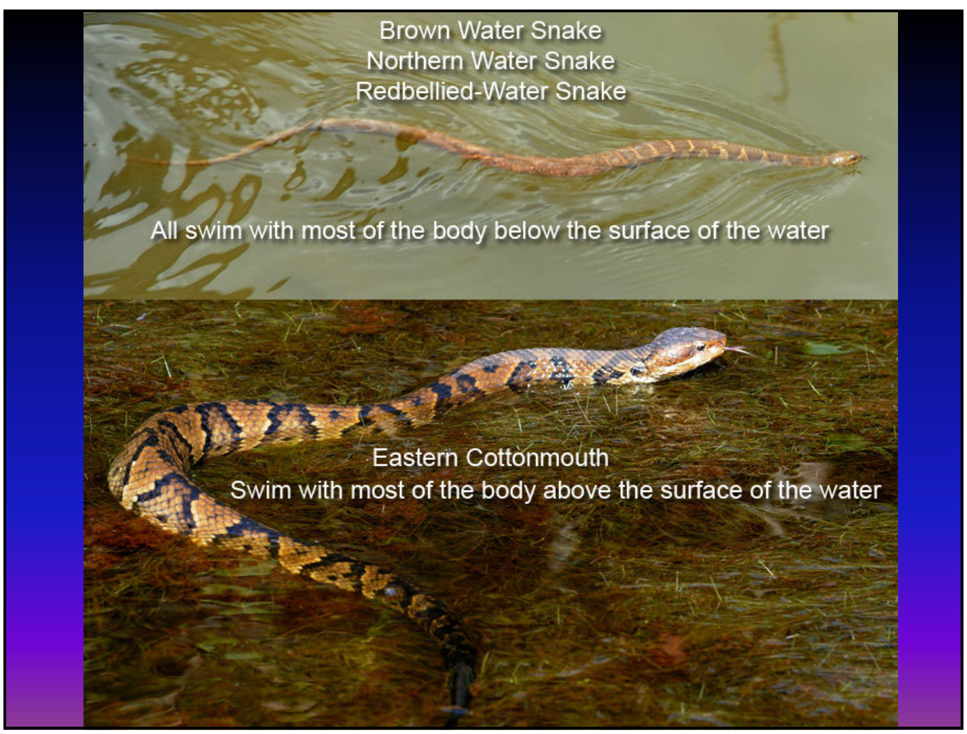


Centruroides hentzi
Centruroides gracilis
Centruroides guanensis

Venomous Snakes


Cottonmouth

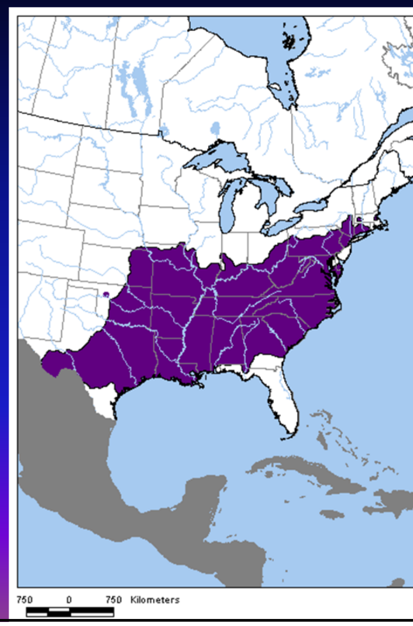

Cottonmouth Distribution


Brown Water Snake
Northern Water Snake
Redbellied-Water Snake
All swim with most of the body below the surface of the water
Eastern Cottonmouth
Swim with most of the body above the surface of the water

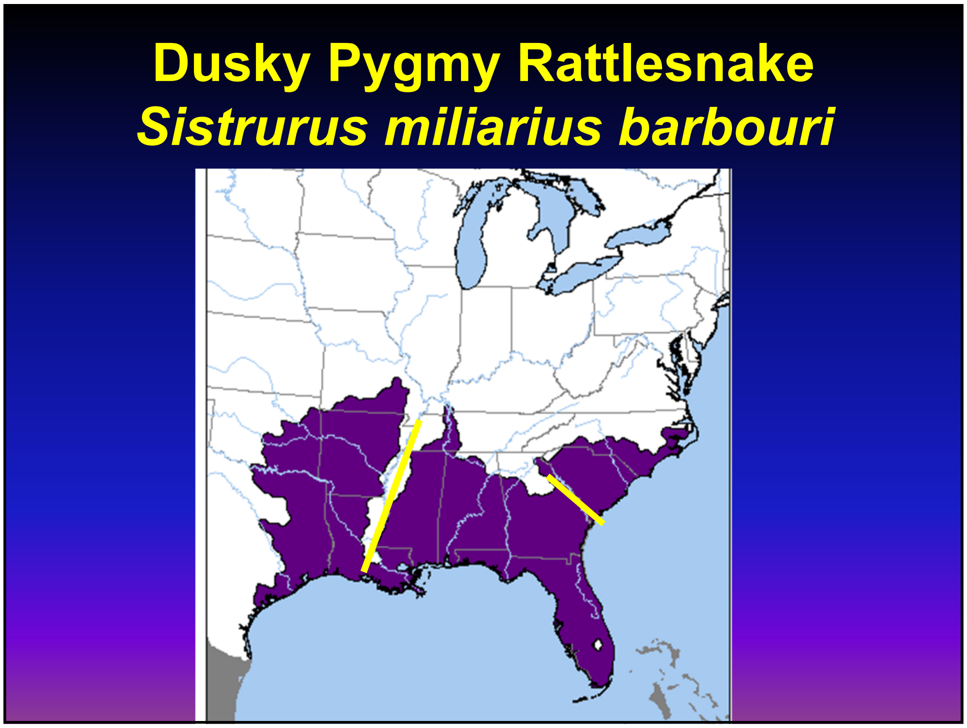

12.22.2009

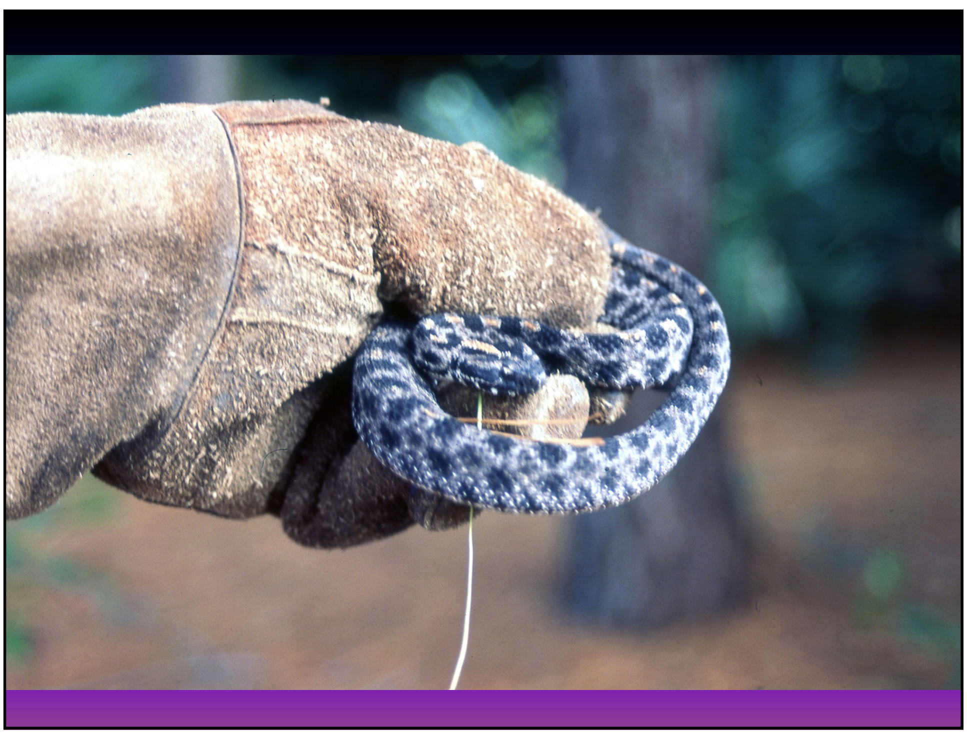

Southern Copperhead

Copperhead Distribution

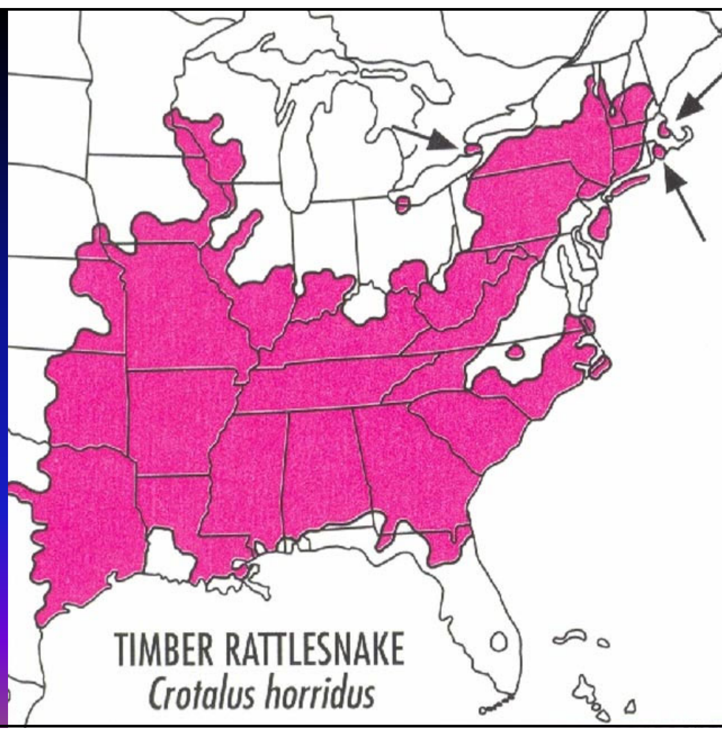


Dusky Pygmy Rattlesnake


Dusky Pygmy Rattlesnake
Sistrurus miliarius barbouri

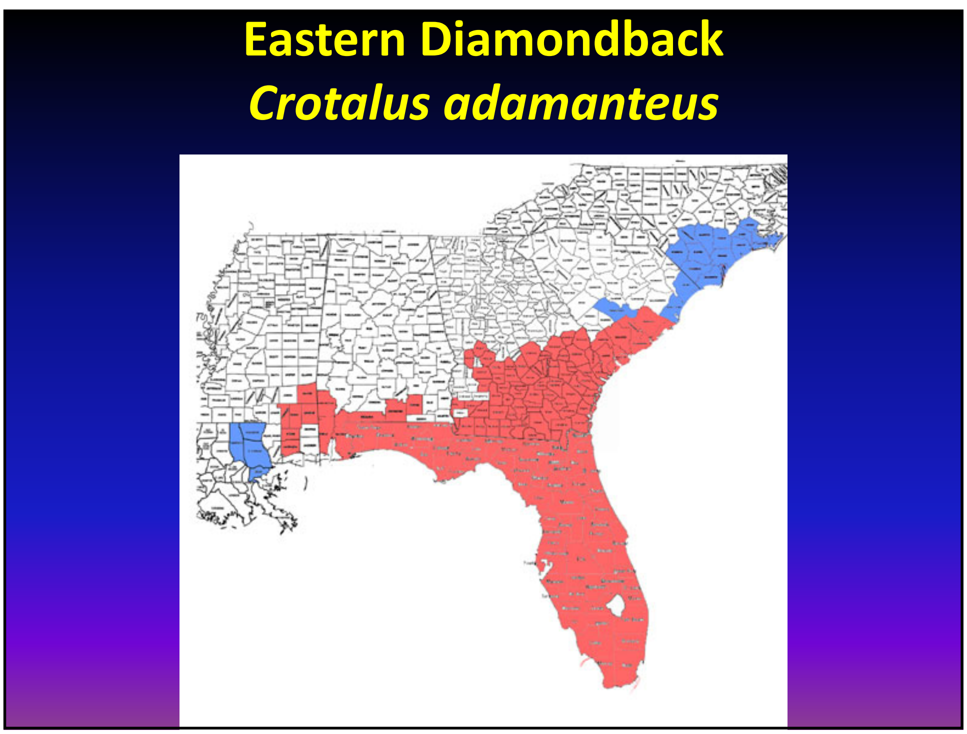


Southern Timber Rattlesnake



Canebrake Rattlesnake
Crotalus horridus atricaudatus


Eastern Diamondback
Crotalus adamanteus


Eastern Diamondback
Crotalus adamanteus


Eastern Coral Snake

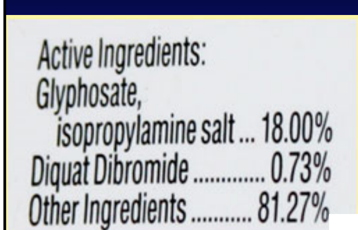

CORAL SNAKES IN THE US
MAP REDRAWN FROM THE AUDUBON SOCIETY FIELD GUIDE TO NORTH AMERICAN REPTILES AND AMPHIBIANS


(Conant 1958)
Eastern Coral Snake (venomous)
Scarlet King Snake (non-venomous)

Weed Control in the Apiary

- Herbicides
- Mowing and Cutting
- Burning

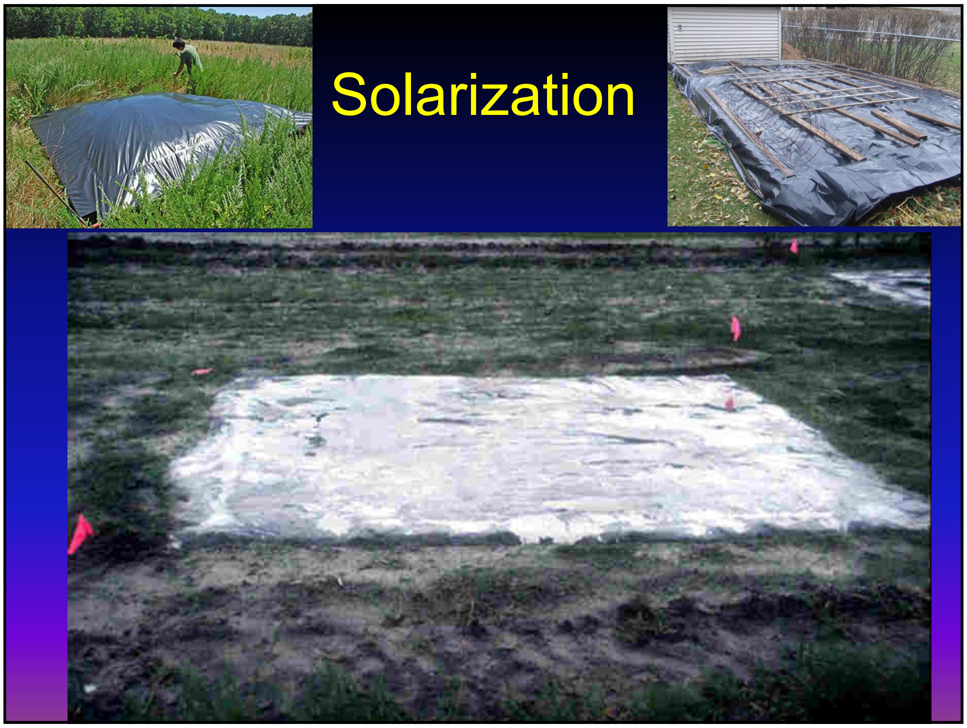
Herbicides



- Concerns have been risen about Glyphosate and bees


Weed Burners

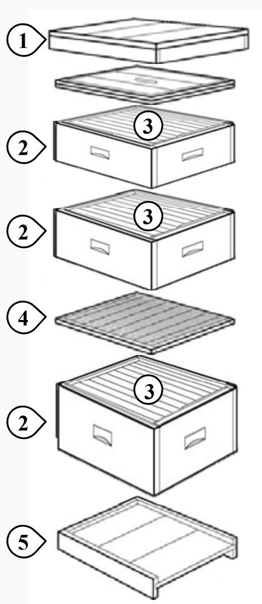

Cutting Weeds


Solarization

Beekeeping Equipment

University of Florida
Institute of Food and Agricultural Sciences
Beginner Beekeeper Workshop Series

Basic Parts of a Langstroth Hive



Modern Langstroth hives have standardized dimensions to allow equipment to be interchanged.

Hives are usually constructed from wood, though they also may be constructed of Styrofoam or plastic.

The basic hive parts are:

1. a lid(s) or cover(s),
2. a box or boxes,
3. frames,
4. a queen excluder, and
5. a bottom board.

The lids, boxes, excluders, and bottom boards are stacked to form a hive. The frames hang inside the boxes. There are no interlocking parts.

Hive Lids

All hives are covered by lids (sometimes called covers).

Lids are used to protect hives from the elements.

When used properly, lids can be removed easily to allow beekeeper access to the frames contained within the boxes.

There are two main types of lids (with variations of both):
1. telescoping outer lid or cover with inner cover, and
2. migratory lid or cover

Hive Lids – Telescoping Lid and Inner Cover

Traditionally, telescoping lids are made of wood and covered by a thin piece of sheet metal.

These lids must be used with an inner cover. Otherwise, bees will glue the telescoping lid to the frames of the uppermost box using propolis, making it difficult to get into the hive.

An inner cover fits flush with the edges of the uppermost box.

These lids are sturdy and resistant to the elements. However, they are bulky and expensive compared to migratory lids.

Hive Lids – Migratory Cover

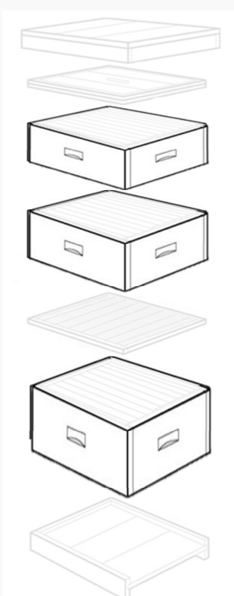
Migratory covers are used on hives that beekeepers move frequently.

Hives with these types of lids can be stacked closely together.

They may be single pieces of wood that fit flush with all sides of the uppermost box (top left image), or the two sides of the uppermost box (bottom left image).

These covers often have a hole in the middle, with the hole accommodating a feeder jar (arrowed).

Hive Boxes



Langstroth hives are composed of one or more of a series of stackable boxes. These boxes can be added to or removed from the hive as the colony contained within grows or shrinks, respectively.

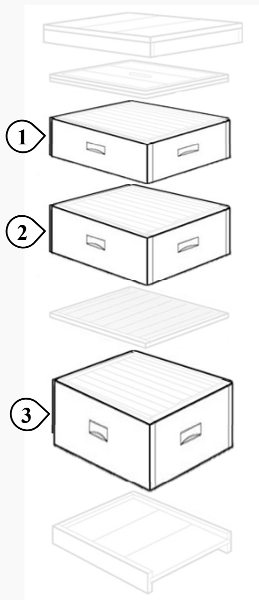
Hive boxes go by a few names, including supers, bodies, and chambers.

They typically are named by what they contain.

A brood chamber (sometimes called a hive body) is a box in which the queen lays eggs and where immature bees (eggs, larvae, and pupae – the brood) are reared. They usually are positioned at the bottom of the hive.

A honey super (a prefix meaning “above”) is a box in which the bees make and store honey. These typically are added to the top of the hive, i.e. above the brood chamber.

Hive Boxes



The boxes come in three standard heights (referred to as "depths" by beekeepers):

1. shallow: $5\,{}^{3}/_{4}$ inches (146 mm)
2. medium (sometimes called Illinois): $6\,{}^{5}/_{8}$ inches (168 mm)
3. deep: $9\,{}^{5}/_{8}$ inches (244 mm)

All three boxes are $16\,{}^{1}/_{4}$ inches (413 mm) wide and $19\,{}^{7}/_{8}$ inches (505 mm) long.

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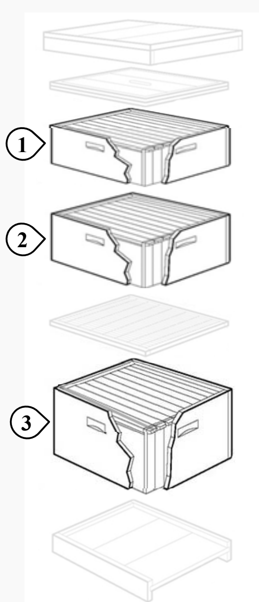
Frames



The boxes of a hive contain frames. The standard shallow, medium and deep hive boxes hold ten frames, though eight frame boxes are becoming increasingly popular.

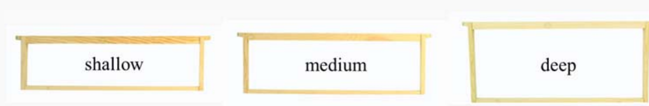
Frames are the structures that hold the comb and are usually are made of wood, though plastic frames are increasingly common.

Frames can be removed from the hive boxes, thus allowing beekeepers to manipulate a colony.

Frames come in three standard heights (referred to as "depths" by beekeepers). They are made to fit the corresponding hive box.

1. shallow: $5\,{}^{3}/_{8}$ inches (137 mm)
2. medium: $6\,{}^{1}/_{4}$ inches (159 mm)
3. deep: $9\,{}^{1}/_{8}$ inches (232 mm)

The standard frame is $17\,{}^{5}/_{8}$ inches (448 mm) long. Width varies slightly by manufacturer, but usually is about $1\,{}^{1}/_{8}$ inches (29 mm).



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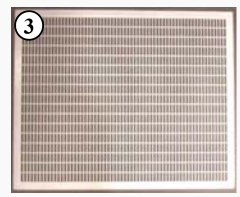
Queen Excluder

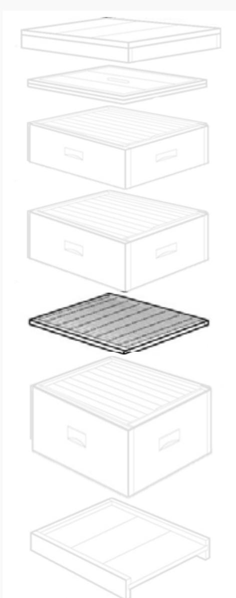
Queen excluders are grids through which queens cannot pass (they are too large) but through which worker bees can pass.

They can be metal bound (1), wood bound (2), or plastic (3).

Queen excluders typically are used to prevent the queen from moving from the brood chamber of the hive (typically the lower part of the hive) into the honey supers of the hive (typically the upper part of the hive) when placed between the two areas.

The excluder prevents brood from being reared in the honey supers.





Bottom Boards

A bottom board is the foundation on which the rest of the hive sits.

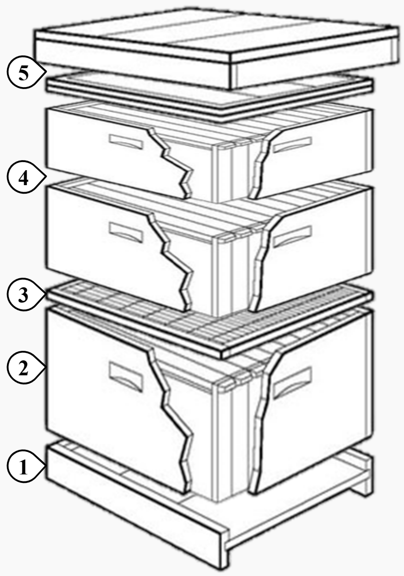
They are composed of pieces of wood that have a raised rim around the upper surface on which the brood chamber can sit. The raised rim is absent at the front of the bottom board (1) to create a gap between the board and lowermost box. This gap forms the hive entrance.

There are two types of bottom boards: solid and screened bottom boards.

The main surface of a solid bottom board is closed (or solid).

The center of a screened bottom board is made of 1/8th inch (3 mm) mesh hardware screen (2). Screened bottom boards are used as a pest management tool.

Configuring a Langstroth Hive



In review, the typical Langstroth hive is composed of:

1. a screened or solid bottom board,
2. one or two brood chamber boxes (these can be deep, medium or shallow boxes), each with ten frames,
3. a queen excluder,
4. one or more honey supers (depending on season), each with ten frames, and
5. a lid of some type (inner cover/telescoping cover or a migratory cover).

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The Essentials

There are many items that beekeepers find themselves using as they engage in the craft.

Some are necessary while others are matters of personal preference.

However, there are three items that are essential to beekeepers. They are the:

1. smoker,
2. hive tool, and
3. personal protective equipment.

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Smoker

People have used smoke to calm bees for thousands of years.

The smoke likely works by masking the alarm pheromones emitted by alarmed bees, not by causing the bees to think a fire is approaching.

Beekeepers create smoke with smokers.

Smokers are composed of a bellow (1), fuel chamber (2), and, at times, a guard (3).

Fuel commonly used in smokers includes pine straw, wood pellets, and dried grass, among other options.

Hive Tool

The hive tool is the most used piece of beekeeping equipment.

It is necessary due to bees' prolific use of propolis.

It is used like a pry bar to separate hive boxes, remove frames, scrape propolis, all among other things.

There are many different styles of hive tools.

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Personal Protective Equipment (PPE)

PPE allows you to work around honey bees while minimizing the threat of stings.

PPE can be made of cotton, polyester, or canvas-type material.

Beekeeping PPE includes suits, jackets, veils, and gloves.

The amount of PPE beekeepers wear depends on their comfort level around bees and the demeanor of the hive(s) they are working.

At a minimum, a beekeeper should always wear a veil to protect his/her face from stings.

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Beekeeping as a Business in Florida

2018 Fall Bee College, Gainesville

David Hall
University of Florida Master Beekeeper
Jefferson County

Why this discussion?

- Very little has been written on what you need to do to take beekeeping to the next level
- Few books discuss Business issues specific to Beekeeping
- Liability insurance is becoming necessary
- This presentation will try to provide an overview of the why liability insurance may be needed.

Disclaimer

- I am not an Insurance Salesman
- I am not a lawyer
- I do not get anything from this
- These are lessons learned
- These talks are the results of the answers to questions that I had to ask
- I just want to share what I have discovered for those who are asking the same questions

Commercial Beekeepers

- Insurance is part of doing business.
- Work with Insurance Broker
- Will have a variety of insurances in place
  - Worker's Compensation insurance
    - Employee work related injuries
  - Vehicle insurance
  - General Farm policy
    - The equipment,
    - The facilities
    - All things related to the business
  - Insurance against a loss of honey if there is a drought

This discussion on insurance

- Those with a few hives in the backyard
- Those who sell extra honey when we have it
- Those who sell lip balms and lotions at the local farmer's market
- Those who sell candles at the holiday craft fair
- Covers both Hobby and Sideliner

Liability

- Jerry Hayes once stated that litigation is one the major forms of entertainment in today's society
- We need to discuss how as Beekeepers you may be liable and how to be prepared
- Does your home owner's policy cover anything
  - Hobby or Business

Liability

- Areas of Liability
  - Which way are you making money in beekeeping that opens you to liability
  - How do you operate
- How to address these areas
  - Signed Best Practices
    - How does this help?
  - Liability Release statements
  - Legal structures
  - Liability Insurance

Ways to make money: beekeeping

- Sell Commodities (Farm products)
  - Wholesale
    - 5 Gallons or more (no Food Safety Permit required)
    - Bottled for resale (Food Safety Permit required)
  - Retail (Food Safety Permit may be required)
    - Cottage industry disclaimer?
  - Bees wax or wax by-products like candles, soap (taxable)
  - Pollen
  - Royal Jelly

How to make money in beekeeping

- Nucs and Package bees
- Pollination services
- Queen Breeding
- Equipment Sales and Manufacturing
- Education and training

The question to ask

- How much risk are you exposed in what you do as a bee keeper
- Are you doing anything that may expose you to a liability lawsuit
- If you do not take preventive measures, are you prepared for what may happen.

At risk examples

- You get a call from someone who purchased your honey at the church fundraiser. They claim it made them ill, and are sending you the medical bills
- That cute gap-toothed cousin of your neighbor kid, they're always roaming through your backyard, got stung. Turns out he's terribly allergic, and ended up in the Emergency Room.

Risk examples cont

- The lady who begged for comb honey, said there are worms in it. She wants her money back, and you to pay for the urgent care visits for all the kids who tasted it at the birthday party.
- A swarm of bees lands at the nearby soccer field, disrupting the all-day tournament. The organizers, food vendors and families from a three county area want their money back and approached you the only one in the area with bees.

Risk examples continued

- Great day at the craft fair—until someone fell into your booth and injured herself hitting your display table. She missed lots of work says her attorney, who contacted you.
- The farm market that sells your extra honey said a customer returned a bottle with rodent hair in it. They've pulled the rest of your honey, and want to know what to do about future customer complaints

Risk examples continued

- The teenager you hired to cut your grass while you were on vacation got stung badly and went to the ER. You'd told him to not even mow anywhere close to the hives, but he forgot
- A customer of your lip balm said it caused her to break out. She's been a customer for years and thinks that batch was tainted. You've got her medical bills to cover (or the hassle of challenging her about that), and you're tossing $400 worth of product just in case there is something to her claim

Additional questions

- Pollination contracts
  - Who is liable if your hives cause problems
  - Is the area fenced
- Epi Pen usage
  - May need to be certified to use on other
  - New Florida Law allows use of epi pens in public
- What if Queens you sell appear to be Africanized
- What if your Nucs have a disease
  - (AFB, EFB, varroa mites)

Risk Reality

- Everything on the list of possible examples is plausible.
- Things like those could happen to **any** beekeeper
- Whether someone has a case or not doesn't matter.
- They can always get a lawyer, and tie you up with legal hassles.

Risk reality: the bottom line

- The legal expenses **alone**,

  whether you ever go to court or not,

- may be enough to **justify** the cost of an insurance policy
- If insured, the insurance company is obligated to defend you

Waiver of Liability Statement

Northern Colorado Beekeepers Association
Liability Waiver

To cover the liability issues of possible injury while participating in Northern Colorado Beekeepers Association events, members are required to sign a Waiver of Liability.

Adult Waiver/Release

In consideration of participating in the Northern Colorado Beekeepers Association, the undersigned acknowledges and agrees that

- ☐ There is a potential risk of injury from activities involved in beekeeping, and while particular rules, equipment and personal care may reduce this risk, the risk of injury does exist; and
- ☐ I KNOWINGLY AND FREELY ASSUME ALL SUCH RISKS, both known and unknown, EVEN IF ARISING FROM THE NEGLIGENCE OF THE RELEASEES or others, and assume full responsibility for my participation; and,
- ☐ I willingly agree to comply with the stated and customary terms and conditions for participation. If, however, I observe any unusual significant hazard during my presence or participation, I will remove myself from participation and bring such to the attention of the nearest official immediately; and,
- ☐ For myself, and on behalf of my heirs, assigns, personal representatives and next of kin, HEREBY RELEASE AND HOLD HARMLESS the Northern Colorado Beekeepers Association, their officers, other participants, and if applicable, owners and lessors of the premises used to conduct the class ("RELEASEES"), WITH RESPECT TO ANY AND ALL INJURY, DISABILITY, DEATH, or loss or damage to person or property, TO THE FULLEST EXTENT OF THE LAW, WHETHER ARISING FROM THE NEGLIGENCE OF THE RELEASEES OR OTHERWISE.

I HAVE READ THIS RELEASE OF LIABILITY AND ASSUMPTION OF RISK AGREEMENT, FULLY UNDERSTAND ITS TERMS, UNDERSTAND THAT I HAVE GIVEN UP SUBSTANTIAL RIGHTS BY SIGNING IT, AND SIGN IT FREELY AND VOLUNTARILY WITHOUT ANY INDUCEMENT.

Release from Liability

- May need a separate signed form for minors by parents or guardians
- Most BeeKeeping groups have these forms for membership
  - Also used when going to look at hives
- Not sure if the release from Liability lowers the liability, but at least they knowingly choose
- Seek the advise of an attorney

The way you do business

- Are your hives far enough away from the property line
- Have you signed and are following the Florida Best Practices
  - If you follow these, you have the State of Florida stating you are doing the best we know how
- Do you have a sign warning people that there may be a danger if they get to close
- Do you have a signed liability release form
  - Even the Bee College and MB programs have these

Best Practices and liability

- Florida Best Management Practices
  - BMP for producing honey bee queens
  - BMP for maintaining European honey Bee colonies
  - New rules for hives in the cities
- Follow these practices
  - If sued, Apiary Dept can state:
    - You are doing everything possible
    - You are following state guidelines
    - Implies you are not at fault

Legal Stuctures

Legal Structures cont.

- May want to consider incorporating
  - Most common sideliner choice:
    - Sub chapter S Corporation
    - Limited Liability Corp (LLC)
- Incorporation is ***not*** really necessary
  - It depends upon your situation
- Why Incorporate?
  - Tax Reasons
  - Liability
- Get an opinion of a Financial Advisor
  - Someone with Small Business Experience

    Someone **You can trust**

Legal Structure Options

- Limited Liability Company
  - Must register with Fl Div of Corporations
- Corporation
  - Must register with Fl Div of Corporations
  - C-corporation
  - S-corporation
- If you are not a corporation you may be open to liability issues
  - Sole Proprietorship
  - Partnership (may be by default if married)

Legal structures and risk

- If you are a corporation or LLC are you still liable?
  - Purpose of incorporation and LLC is to limit liability
- Lawyers have been known to go against these and prove they are not real corporations
  - Need to file minutes,
  - Have board meetings
  - Issue Shares
- If you loose this protection, you are fully at risk personally

Beekeeper Definitions

- Hobbyist
  - Beekeeping is not a significant source of income
  - Generally a few hives on their own property
- Sideliner
  - Beekeeping is a ***secondary*** source of income
  - Attempts to make a profit,
  - Colonies on multiple locations
  - Relies on another income
- Commercial Beekeeper
  - Fulltime occupation
  - Beekeeping is the ***primary*** source of income
  - Generally will have assistance from other workers

Hobby or Business

- Which group you fall into is a matter of interpretation
- Many companies follow IRS guidelines
  - Business: When decision based on profit or expected profit.
  - Hobby: If you manage bees and occasionally sell excess honey to fiends
- If you file an IRS Schedule C or Schedule F you are probably a business.

Home owners insurance

- May apply to some instances for hobbyist
- Many companies will handle issue ***once***
  - They have the right to drop you when your risk becomes to high
- Your deductible will need to be met
- Most home owners policies will not cover because the issue was a business liability
- Some companies will add a “rider” for additional money
- *Product liability will not be covered*

Recommendation:
Get Insurance

Types of Insurance available

- Liability
  - Premises and operations
  - Products and completed operations
  - Commercial automobile
- Property
- Windstorm
- Flood
- Workers Compensation
- Business Interruption
- Key Man
- Health Insurance: Care Florida
  - Affordable Care Act: Obama Care

Liability Insurance

- Hobbyist
  - Generally at home and may be covered by Homeowners (one time)
  - Home owners ***will not cover*** a commercial venture
  - Home owners ***will not cover*** product liability
- Sideliner/Commercial
  - Will need some type of Liability Insurance
  - May not need if Incorporated (LLC)
  - You have to decide if this is a risk you are willing to take

Liability Insurance

- Ask the question
  - How exposed are you?
- How much risk do you want to put up?
- Insurance Cost is generally tied to annual Revenue
  - For example: If under $15,000 in annual revenue
  - Price may increase on volume of sales

It may be mandatory

- Liability insurance is becoming mandatory
  - Required for placement of colonies in
    - Federal Forests
    - State Forests
    - Water Management District controlled sites
  - Some farmer's markets are now making this a requirement
  - Schools are now making this a requirement
  - Plantations in the Florida Panhandle and Georgia are now adding this

Notes about Insurance agents

- They are in the business of making sure the *unexpected* doesn't wipe out:
  - Your lifestyle,
  - Your security or
  - Your future.
- They work all the time with people who have had the unexpected happen.
- They want you to have the appropriate protection, via insurance.
- They are quite happy to sell it to you.

Recommendations

- Get some liability insurance
  - For yourselves
  - For your association
- Get and use a ***Release from Liability*** form for people in the bee yard
- Get a good accountant/financial advisor

What will it cost

- Most policies run between $450 – $600 a year for base policy which include:
  - One million dollars
  - May cover all aspects of your work including product
- Example of my current policy
  - 2 million General and 2 million Products
  - 1 million Personal injury
  - Damage to Premises,
  - Medical Payments, Auto

Example

COMMERCIAL GENERAL LIABILITY COVERAGE

LIMITS OF INSURANCE

General Aggregate (Other Than Products-Completed Operations)	$2,000,000	
Products-Completed Operations Aggregate	2,000,000	
Personal Injury And Advertising Injury	1,000,000	
Each Occurrence	1,000,000	

Commercial General Liability Plus Endorsement

Damage to Premises Rented to You (Fire, Lightning, Explosion, Smoke or Water Damage)	300,000	Any One Premises
Medical Payments	10,000	Any One Person
Hired Auto & Non-Owned Auto	1,000,000	Each Occurrence

Companies that offer Liability Ins.

- Hartford
  - Used be the choice of a lot of beekeepers
  - Now will no longer issue any new policies
- Farm Bureau
  - Will provide as part of your whole Home/Farm owners policy
  - Will need to insure home, auto as well
- Texas Insurance & Financial Services Inc
  - www.abfinsurance.com
- Insurance Office of America
  - Longwood Florida: 407-998-4185

Companies that offer Liability Ins.

- Beekeeping Insurance Services
  - 21845 Powerline Road Suite 205
    Boca Raton, FL 33433
    - (888) 537-7088 Direct Dial
    - nepstein@beekeepingins.com
    - www.beekeepingins.com
- AutoOwners
  - Advanced Insurance Underwrites
  - 11440 Okeechobee Blvd Suite 201
    Royal Palm Beach, FL 33411
    (561) 784-5445

Find a good financial advisor

- You need someone you can trust
- Find someone that works with farmers
- Someone who deals with companies that work on cash basis
- Has experience with small business
- Look in the rural counties
- Ask about:
  - Legal structure
  - Software to use (or not use)
  - Affordable Care Act implications (Obama Care)
  - Avoid asking questions between Jan1 – April 15th

References

- MyFlorida.com
- Agriculture and consumer services
- Florida Trend website
  - www.floridatrend.com/small_biz.asp
- Florida Department of Ag and Consumer Services Division of Food Safety
  - www.freshfromflorida.com/fs
- Walter Kelly Blog, Beeyond Beehind the Hives
- American Bee Journal, Sept 2018

Contact information

- David Hall
  - 850-445-0141
  - cssdrh@gmail.com

Questions/Comments

Building Native Bee (and Wasp) Houses

Bees and Habitat Loss

- In a 2017 systematic review by the Center for Biological Diversity, more than half of the U.S. native bees assessed had populations that were shown to be in decline (Kopek and Burd 2017).
  - The review assessed 1,437/4,337 native U.S. bees, as most species had insufficient data on their populations. There's still much more to learn about wild bees!
- A main driver of the declines in native bee populations is habitat loss, mainly through agricultural intensification and urbanization
  - And so, by preserving, restoring, and creating healthy habitats that provide sufficient foraging resources and nesting sites, we could potentially reverse the decline of these native bee groups.

Who's Staying at the Bee (and Wasp) House? A Look at the Major Above-Ground Cavity Nesting Bee Groups

- Leafcutter Bees
  - Family: Megachilidae
    - Genus: *Megachile*
  - Leafcutters get their common name from the materials they use to line and separate the cells of their nests: leaves (and/or flower petals)!
    - This lining of leaves and/or petals is used to protect developing young from moisture, pests, and pathogens.
  - Leafcutter bees have large mandibles (jaws) used for manipulating materials.
  - Leafcutters are large-to-small in size, and they are typically black with white striping patterns.
    - They are also notably recognized by the bundles of hair, or scopae, that line their abdomens. These are used for pollen collection.
  - Degree of sociality: solitary, but gregarious
    - *Megachile* individuals produce secretions to mark the entrances of their respective nests for help with location.
- Mason Bees
  - Family: Megachilidae
    - Genus: *Osmia*
  - Mason bees get their common name from the materials they use to line and separate the cells of their nests: mud!
    - This lining of mud is used to protect developing young from moisture, pests, and pathogens.
  - Mason bees are medium-to-small in size, and they are notably recognized by their deep blue bodies, although they can also come in shades of black or metallic green.
    - They are also notably recognized by the bundles of hair, or scopae, that line their abdomens. These are used for pollen collection.
  - Degree of sociality: solitary, but gregarious

        - *Osmia* can be translated to “odor”, which refers to the unique scent mason bees produce and use to mark the entrances of their nest.
            - These somewhat lemony scents are unique to each individual and help them to locate their respective nests.

Housekeeping: Tips for Placement and Maintenance

- Placement
    - Mount and secure your bee (and wasp) house to a spot with partial shade.
        - Sun in the morning, shade in the afternoon!
            - Try to find a space where direct sunlight can shine on the house in the morning. This will encourage early morning foraging.
            - Shade in the afternoon will prevent overheating.
    - Face the house East, or Southeast, so that early morning sun will fall on the entrances.
    - Make sure the house is secure to whatever structure you are attaching it to.
        - A moving bee (and wasp) house can disturb developing bees and confuse adults trying to find their way back to their nest.
    - Place your house at a height that is above the ground and manageable for you.
- Maintenance
    - Exchange old and previously used tubes with new ones every couple of years to prevent the accumulation of pests and pathogens.

References

1. Kopek, K., & Burd, L. (2017). Pollinators in peril: a systematic status review of North American and Hawaiian native bees. *See https://biologicaldiversity. org/campaigns/native_pollinators/pdfs/Pollinators_in_Peril. pdf*.
2. Wilson, J. S., & Carril, O. J. M. (2015). *The bees in your backyard: a guide to North America's bees*. Princeton University Press.
3. Mader, E., Shepherd, M., Vaughan, M., Black, S. H., & LeBuhn, G. (2011). *Attracting native pollinators: protecting North America's bees and butterflies* (p. 371). Storey Publ..

Building Observation Hives

How to make an observation hive for under $25.00
2018 Fall Bee College
David Hall
Jefferson County

What Type of hive to build

- What is the purpose of the hive?
  - Demonstration: Class, trade show
  - Permanent hive
- Determines if hive is open or closed
  - Open Hive: Bees fly in and out
  - Closed Hive Bees are not out

Tips

- Have a standard hive as backup
- Try to have a marked queen so viewer can see
- Supplement the hive with additional display information
- Make sure the runway is clear

Suggestions

- Do not expose to direct sunlight
  - Create a privacy curtain
- Provide space for unobstructed viewing
- Make the base so it will not tip over
- Be cautious when transporting
- If outside access make runway as short as possible
- Locate outside entrance away from pedestrian traffic

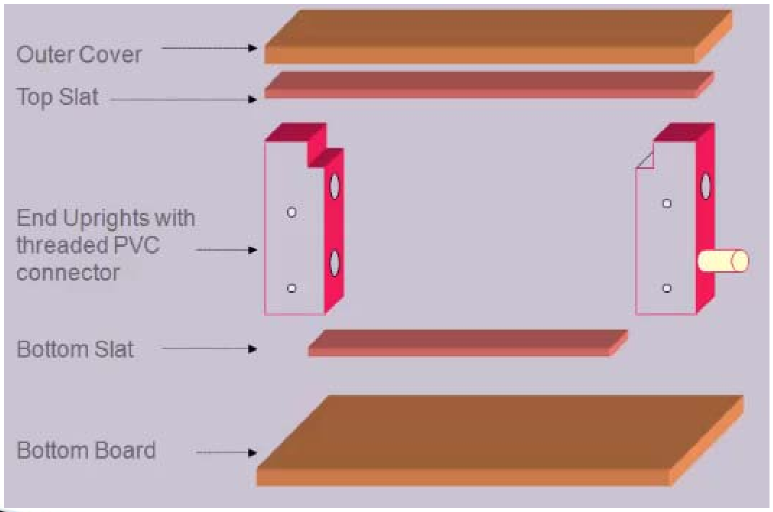
Building material

- Avoid pressure treated wood
- Glass is easier to clean for permanent hives
- Plexi-glass is safer if one has to move hives
- Plan to make it so it will not tip over
  - Assume that it will,
  - Make changes so it does not

Building Supplies

- Standard 2x4 Lumber
- Boards
  - ¾ x 8” x 8’
  - ½ x 2” x 6’
  - ½ x 3” x 6’
- ¼” Plexiglas
- Screws with washers
- Glue
- 8 Mesh Hardware cloth
- Industrial strength Velco strips

Exploded Hive components



Dimensions for one Deep frame

- Standard 2x4 Lumber
  - Cut two boards 10 ¼ inches (sides)
- Boards
  - ¾ x 8” x 8’ Cut one to 25 inches
  - ½ x 2” x 6’
    - Cut one to 25 inches (top)
    - Cut one to 18 inches (bottom)
  - ½ x 3” x 6’ Cut one to 25 (top)

Dimensions for two deep frame

- Standard 2x4 Lumber
  - Cut two boards 18 inches (sides)
- Boards
  - ¾ x 8” x 8’ Cut one to 25 inches
  - ½ x 2” x 6’
    - Cut one to 25 inches (top)
    - Cut one to 18 inches (bottom)
  - ½ x 3” x 6’ Cut one to 25 (top)

Notches for holding frame

- If possible cut a notch to hold frame(s)
  - Cut notch ½ by ½ on 2x4
  - Easy to do on a band saw
- Use of bookcase shelf holders
  - Expand width of boards by 1 to 1 ½ inches
    - 25 long becomes 26 long
    - Check that the holders are not to long
    - Cut them down or expand width accordingly
    - Easier to do if you do not have access to bandsaw

Notches/Hanger closeup

Hanger

Notch

Ventilation holes

- Drill ½ to 5/8 auger hole in for ventilation
  - Drill from each end to make it easier
- Space three for Deep frame
- Space two for Medium frame
- Use 8 mesh hardware cloth to cover holes
- Leave one open if you plan on using PVC runway to outside

Assembly instructions

- Make sure
  - that the frames fit correctly
  - That there is enough bee space on all sides
  - Top is attached permanently
    - Top should overhang both sides enough to cover glass
- Pre-drill holes for screws
- Glue everything down
- Paint/Stain

Plexi-glass

- Screw in permanently one side
- Make the other side removable
- Use nuts/washers to hold (and velcro)
- Bee frame is loaded from the side by removing nuts and Plexiglas panel
- Make sure it is secure and no bees escape
- Practice doing this without bees

Additional options

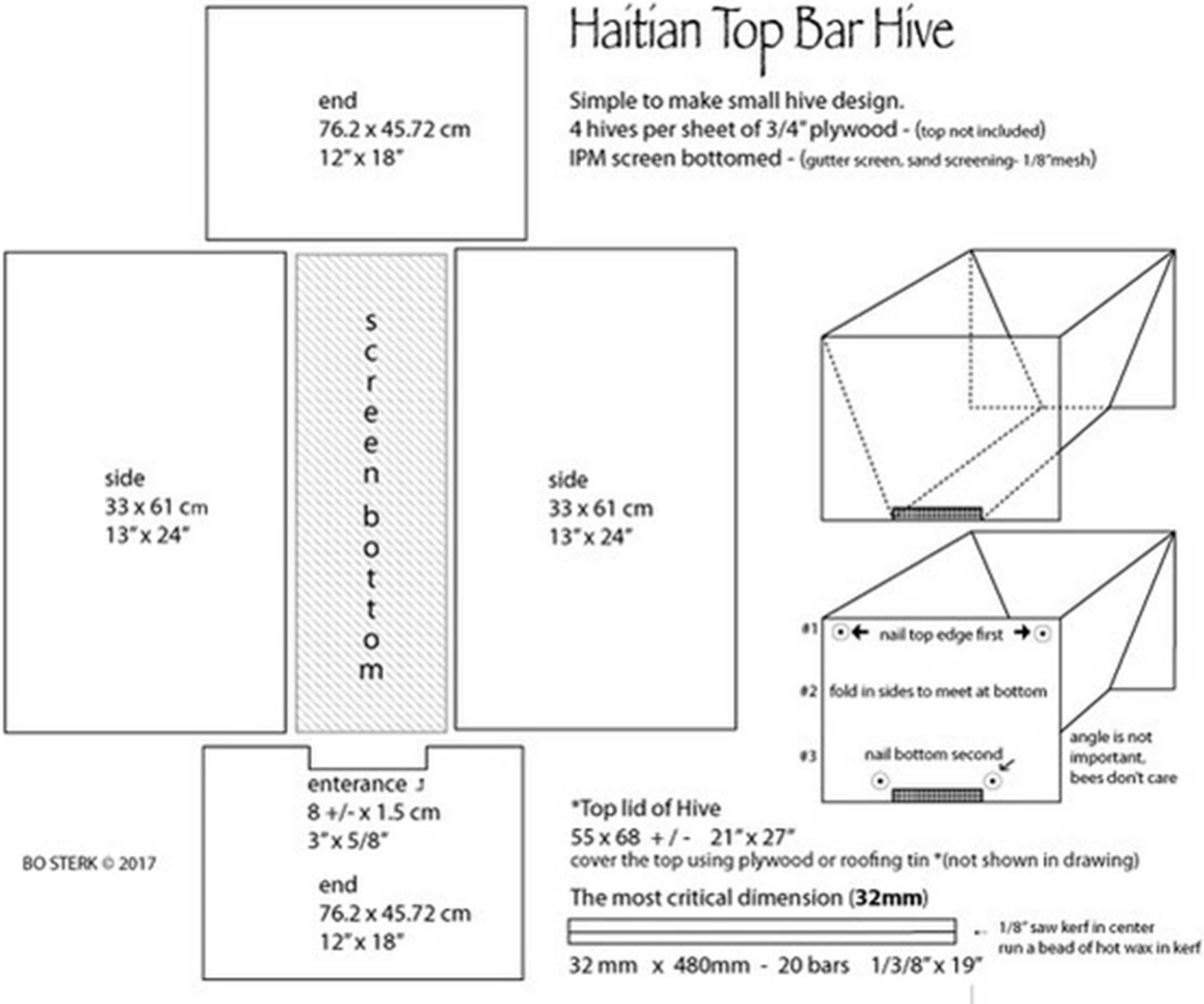
- Handle to carry
- Strap to carry
- Feeding Jar
- A small strip to make loading plexiglass easier
- Find a clear plastic or PVC tube and stick into one of the ventilation holes for entrance
  - (no hardware mesh)

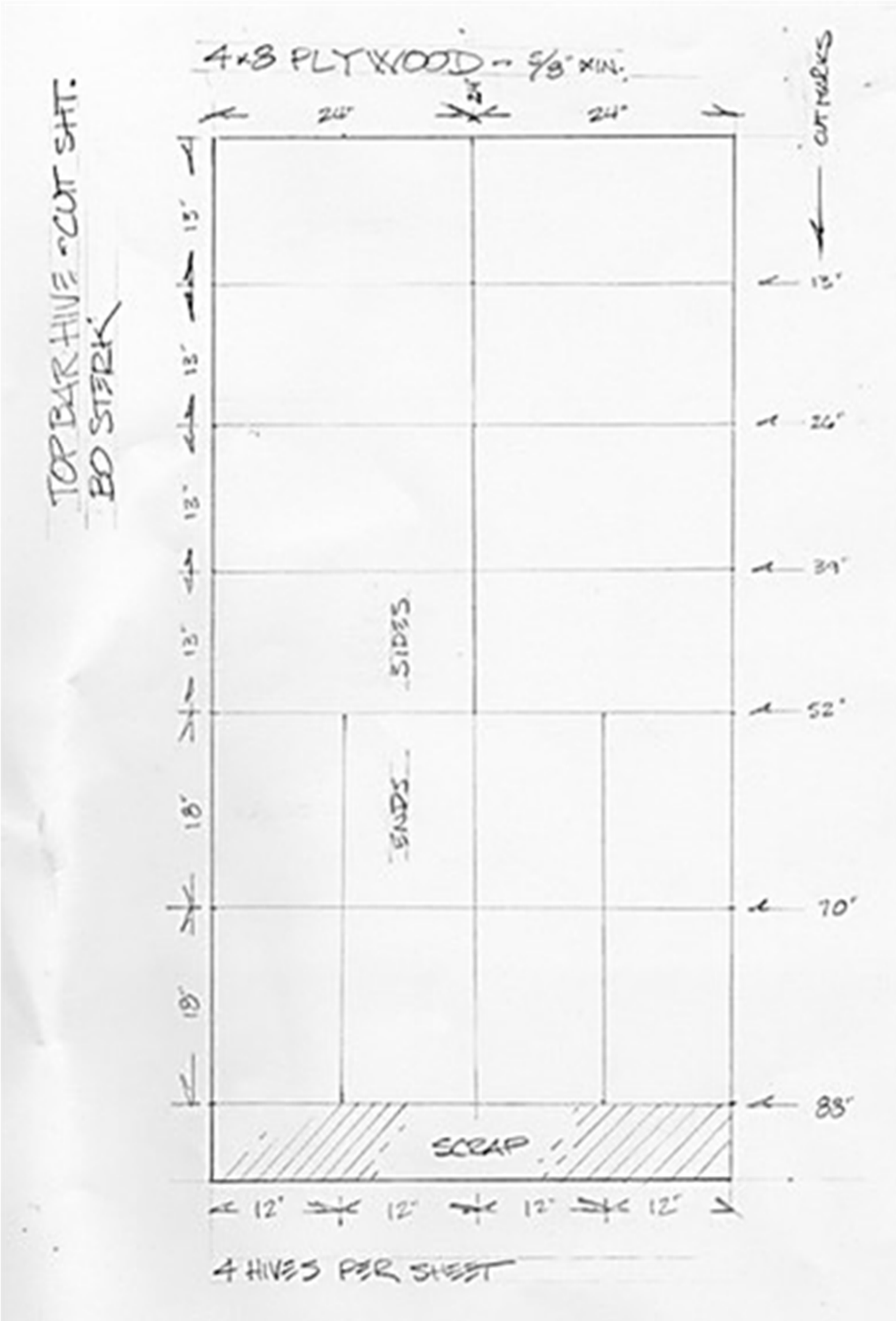
Other considerations

- Provide a cover when transporting
- Have a plan in place if bees escape
- Be careful when transporting
- Remember Bees are foragers

References

- ABC & XYZ of Bee Culture – A.I. Root, (2007) pgs 589-596
- EDIS document ENY131: Observation Hives
- The Hive and the Honey Bee – Dadant and Sons, Inc. (1992)
- Observation Hives Thomas Webster & Dewey Caron– A.I. Root, (2007)
- James Tew OSU Beelab presentation
- Bee Culture Magazine, Sept 2018


Haitian Top Bar Hive
Simple to make small hive design.
4 hives per sheet of 3/4" plywood - (top not included)
IPM screen bottomed - (gutter screen, sand screening- 1/8"mesh)
end
76.2 x 45.72 cm
12" x 18"
side
33 x 61 cm
13" x 24"
screen bottom
side
33 x 61 cm
13" x 24"
#1 nail top edge first
#2 fold in sides to meet at bottom
#3 nail bottom second
angle is not important, bees don't care
enterance
8 +/- x 1.5 cm
3" x 5/8"
end
76.2 x 45.72 cm
12" x 18"
BO STERK © 2017
*Top lid of Hive
55 x 68 + / - 21" x 27"
cover the top using plywood or roofing tin *(not shown in drawing)
The most critical dimension (32mm)
1/8" saw kerf in center
run a bead of hot wax in kerf
32 mm x 480mm - 20 bars 1/3/8" x 19"


4×8 PLYWOOD – 5/8" MIN.
TOP BAR HIVE "CUT SHT.
BO STERK
CUT MARKS
24"
24"
13"
26"
39"
52"
70"
88"
SIDES
ENDS
18"
SCRAP
12"
12"
12"
12"
4 HIVES PER SHEET

Catching and Hiving Swarms

William H. Kern, Jr.

UF UNIVERSITY of FLORIDA
IFAS Extension
Fort Lauderdale Research and Education Center

Course Objectives

After this course, you should be able to:

- describe the various methods used to catch a honey bee swarm,
- identify the types of lures that can be utilized in swarm trapping, and
- discuss the steps required to successfully hive a swarm.

Swarms are impressive and scary to the public because they are misunderstood.

How bees make decisions about new colony sites.

- Scouts go out and find possible sites.
- The better the site, the longer the scout will dance for that site.
- More scouts will check the site and take up the dance.
- The best site found will eventually win out.

Swarms are not defensive

Sugar syrup spray calms them and helps coalesce the swarm for capture.

Swarm lure

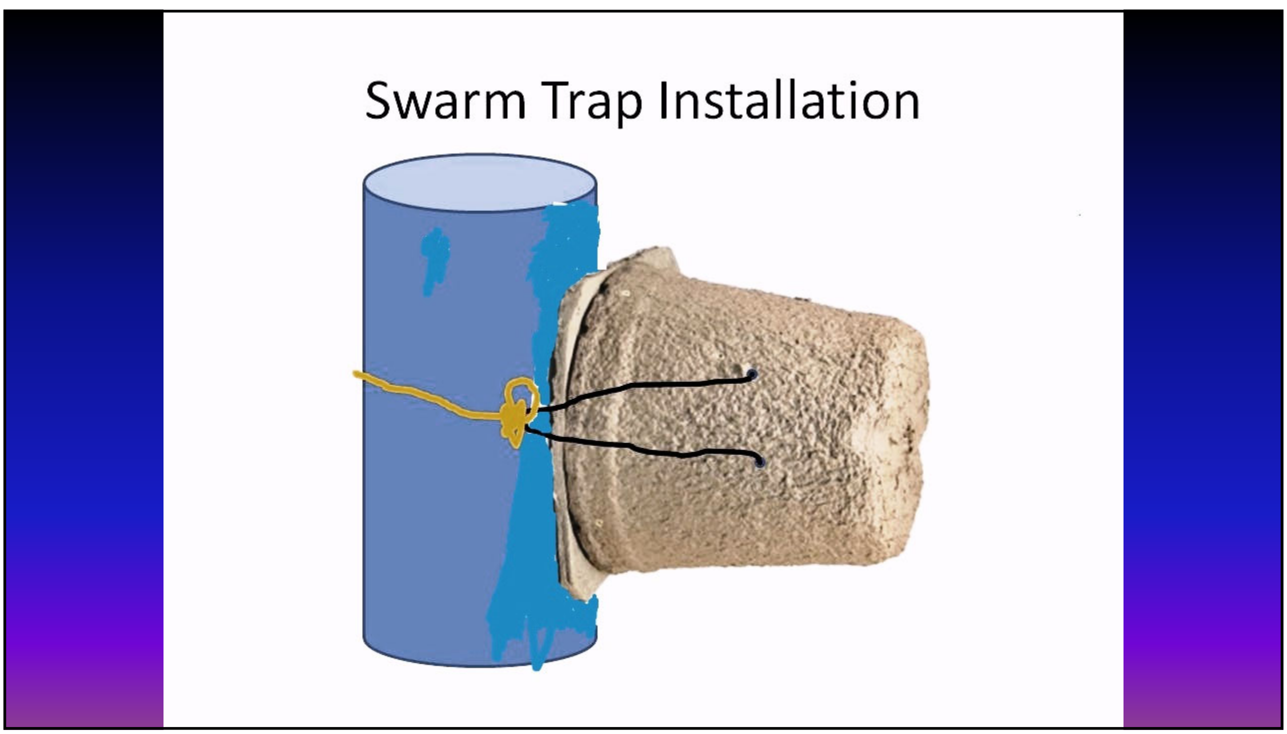
www.beeequipment.com

Swarm trap

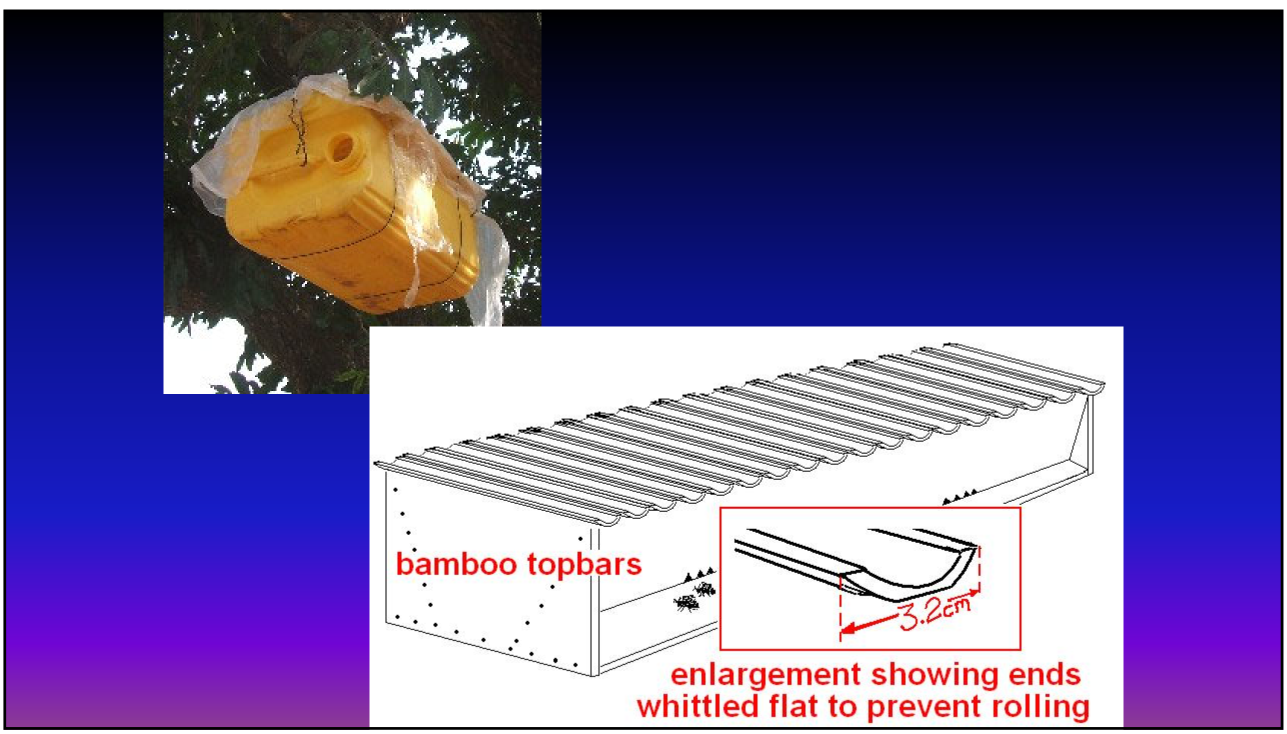
- Cone style trap is made from recycled wood pulp
- Nosonov Lure used to attract bees into swarm traps or hive


Swarm Traps


Successful swarm trap
7.10.2006


Swarm Trap Installation


Top Bar Trap


bamboo topbars
3.2cm
enlargement showing ends
whittled flat to prevent rolling

Swarm Traps.


Brood box swarm trap
54


FLREC
Nuc Box Swarm
Trap

Barn Owl Rodent IPM Project


42


Vinaceous Amazon Parrot


32

Nasonov Pheromone

- This pheromone is emitted by the worker bees and used for orientation.
- The **Nasonov** (alternatively, **Nasanov**) pheromone is released by worker bees to orient returning forager bees back to the colony. To broadcast this scent, bees raise their abdomens, which contain the Nasonov glands, and fan their wings vigorously.
- Nasonov includes a number of different terpenoids including geraniol, nerolic acid, citral and geranic acid. Bees use these to find the entrance to their colony or hive, and they release them on flowers so other bees know which flowers have nectar.

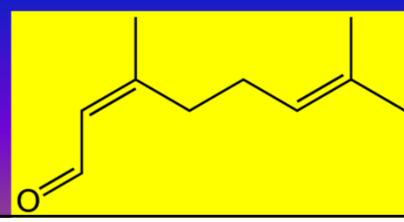
Nasonov Pheromone

- A synthetically produced Nasonov pheromone can be used to attract a honey bee swarm to an unoccupied hive or a swarm-catching box.
- Synthetically produced Nasonov consists of citral and geraniol in a 2:1 ratio.

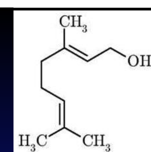
Citral
(geranial, neral, geranialdehyde)

$30 /100ml LG $41 / 4 oz. (118ml) FG

- Lemon myrtle (90-98**%),** *Backhousia citriodora*
- *Litsea citrata* (90%), Litsée Lemon
- *Litsea cubeba* (70-85%), May Chang
- lemongrass (65-85%), *Cymbopogon citratus*
- lemon tea-tree (70-80%), *Leptospermum liversidgei*,
- *Ocimum gratissimum* (66.5%), Clove Basil
- *Lindera citriodora* (about 65%), Lemon Myrtle
- *Calyptranthes parriculata* (about 62%),
- petitgrain (36%),
- lemon verbena (30-35%),
- lemon ironbark (26%),
- lemon balm (11%),
- lime (6-9%),
- lemon (2-5%)



Geraniol



- occurs naturally in essential oils, such as geranium, rose and lemon.
  $33 / 25 g (28 ml) LG $42 / 4 oz. FG
- Primary part of rose oil, extracted from rose flowers
- palmarosa oil, *Cymbopogon martinii* Other common names include Indian geranium, gingergrass and rosha or rosha grass.
- citronella oil, *Cymbopogon nardus*

Lemon Grass

- Rub the inside of the trap with Lemon grass or lemon grass oil.
- Add some palmarosa grass or citronella grass.

Smokers Calm Bees and Can Be Used to Move Them back into the Nest


Fuels: pine needles, wood chips, burlap, dried banana leaves, commercial smoker fuel, pet bedding products.


Bee suits with zippered veil and bee gloves are the best protection

Foot and ankle protection

Insect IQ, Inc.

Eye protection under the veil

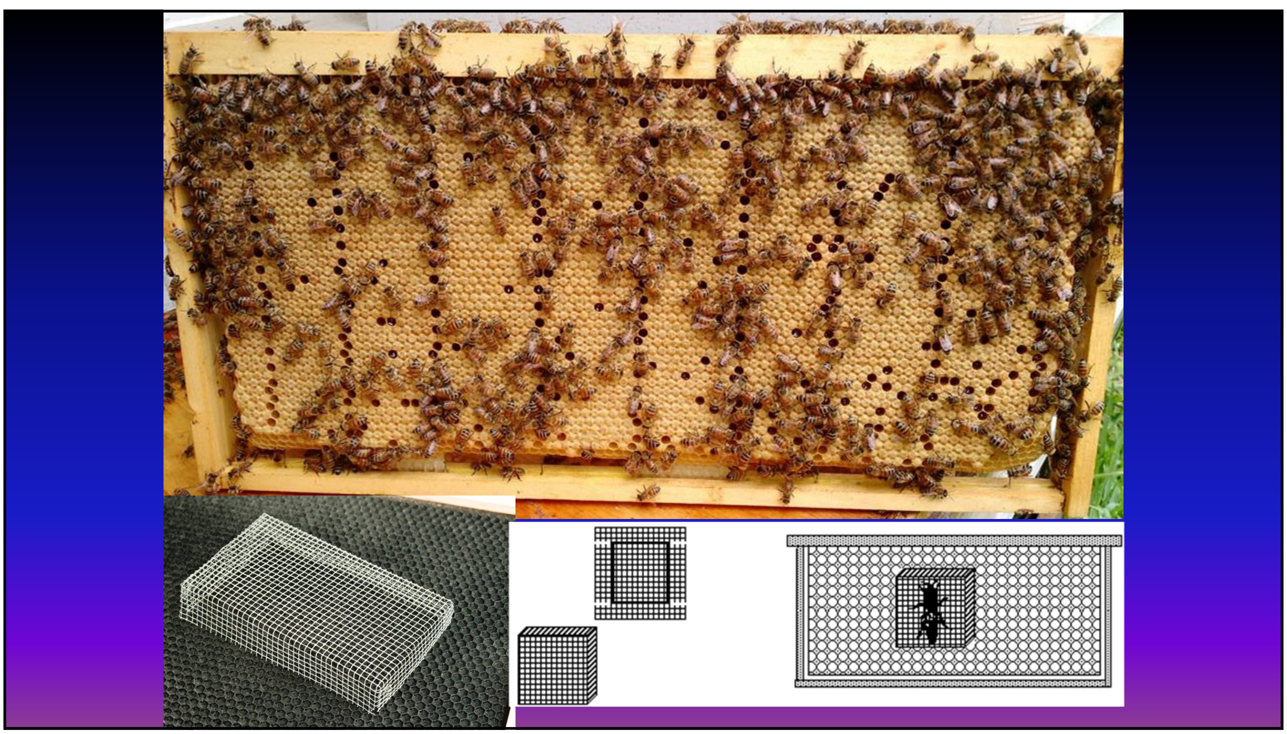
Agitated AHB will spray venom through the veil

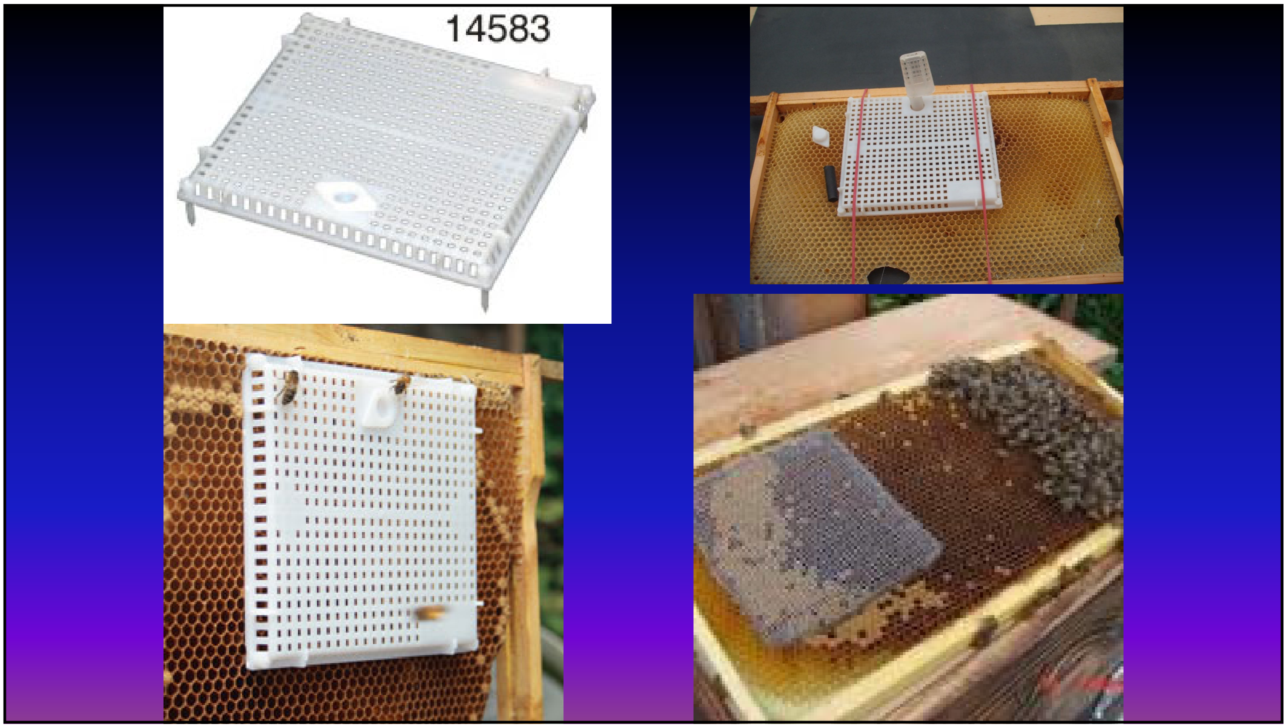
Transfer colony from trap to hive.

- 1. Move swarm trap to bee yard.
- 2. Leave swarm trap at the site of the new hive for 2 days to 1 week.
- 3. Place the new hive where the swarm trap had been in the bee yard.
- 4. Transfer the comb from the swarm trap to frames to go inside the hive.
- 5. Remove the swarm trap from the beeyard

Requeening

- 1. At least one week after transferring the colony to the new hive brood box – requeen!
- 2. Remove old queen and all queen cells. Return in one week and again remove all queen cells.
- 3. On a frame with mostly capped worker brood, secure the new, mated queen under a push-in cage. Leave cage in place until workers emerge and queen is laying eggs.

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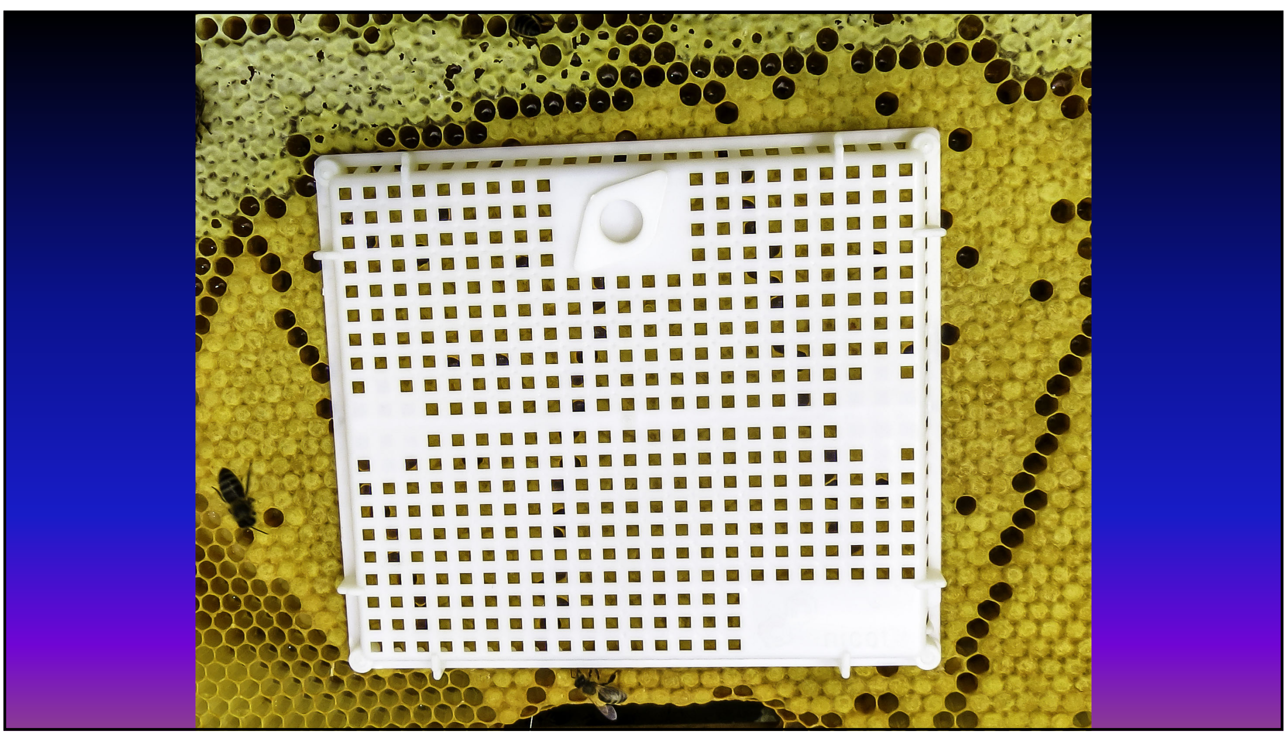



AFBEE
African Honey Bee
Extension & Education
PROGRAM
UF UNIVERSITY of FLORIDA
IFAS
Division of
PLANT INDUSTRY
Fresh From Florida
Protection through Detection
Florida Department of Agriculture & Consumer Services
Charles H. Bronson, Commissioner
IPM Integrated Pest Management
Florida
SOLUTIONS
for your LIFE

Collecting and Studying Pollen

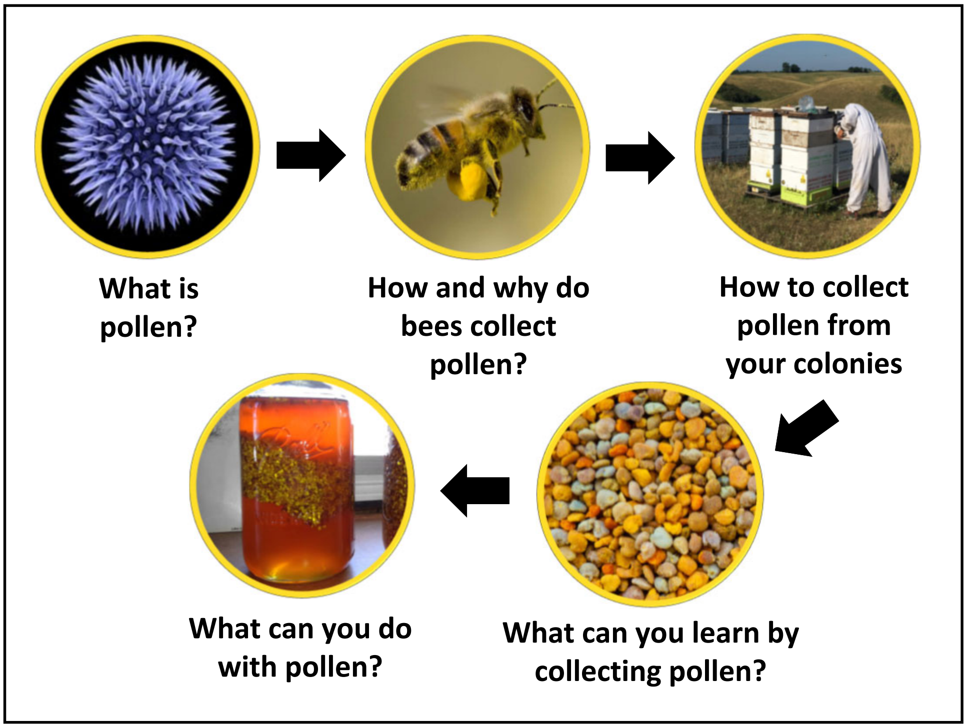
Emily Noordyke

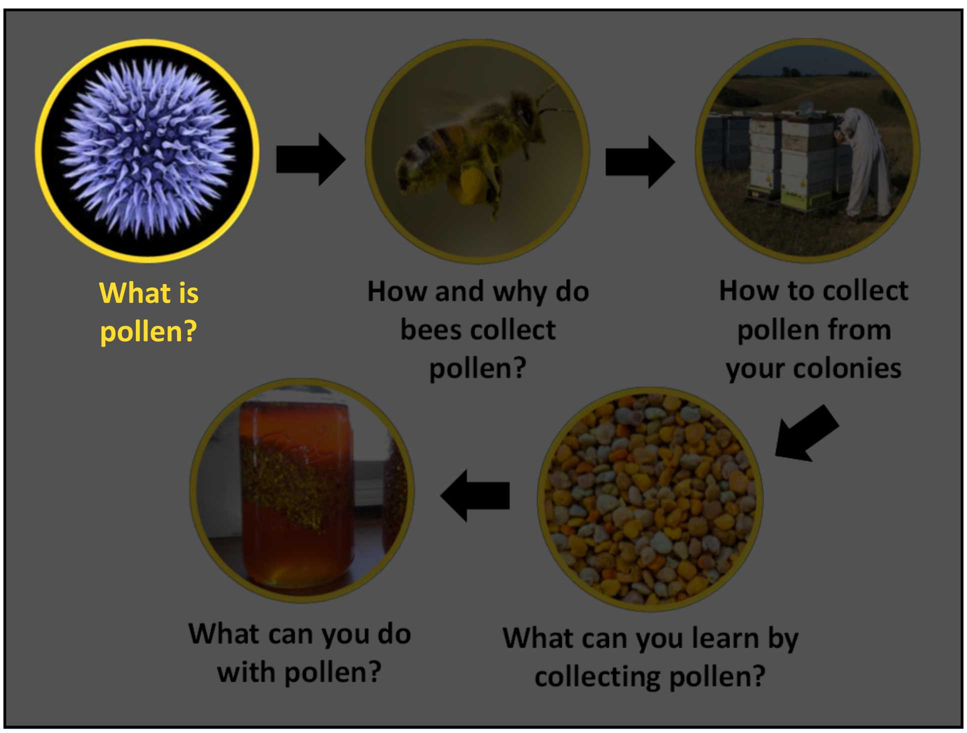
Why should I pay closer attention to the pollen coming into my hives?

You can learn a lot from bee collected pollen

- Learn about your bee yard
  - Floral resources
  - Timing of pollen flows
- Learn about your bees
  - Honey bee diet
  - Amount and diversity of pollen coming in

Collecting pollen is fun


What is pollen?
How and why do bees collect pollen?
How to collect pollen from your colonies
What can you learn by collecting pollen?
What can you do with pollen?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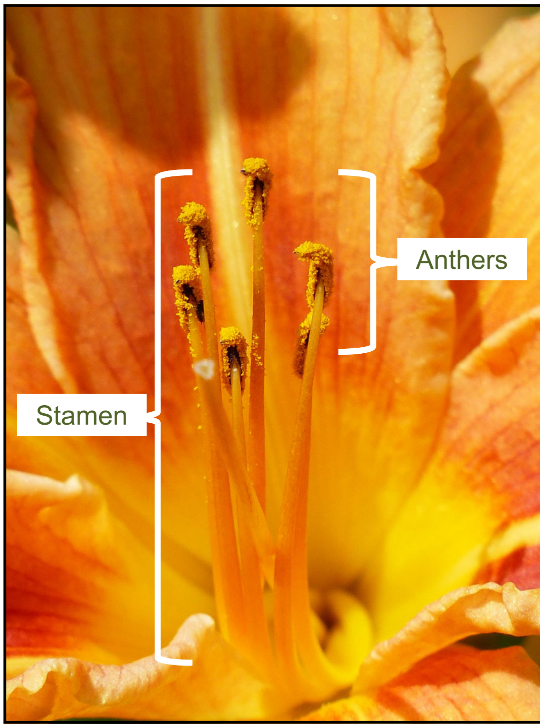
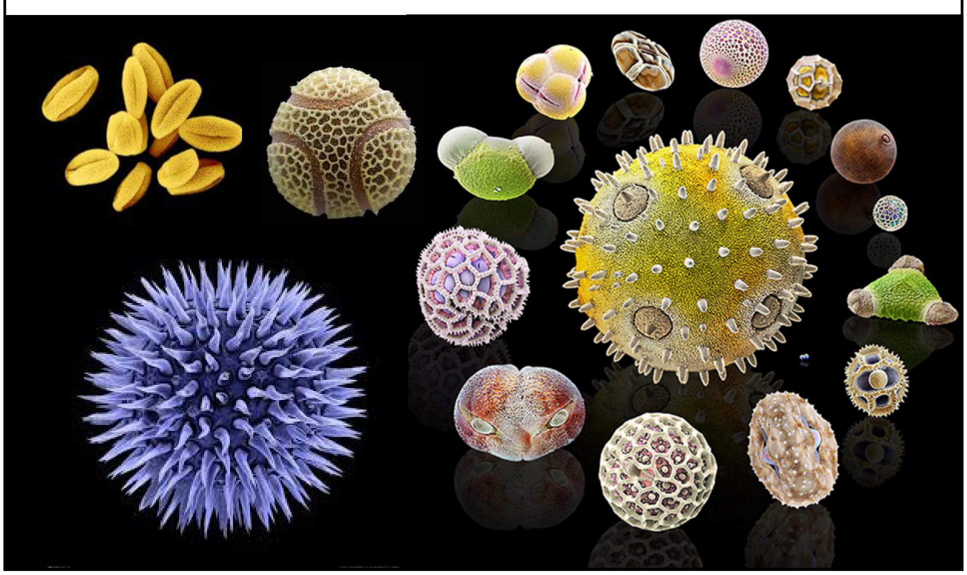


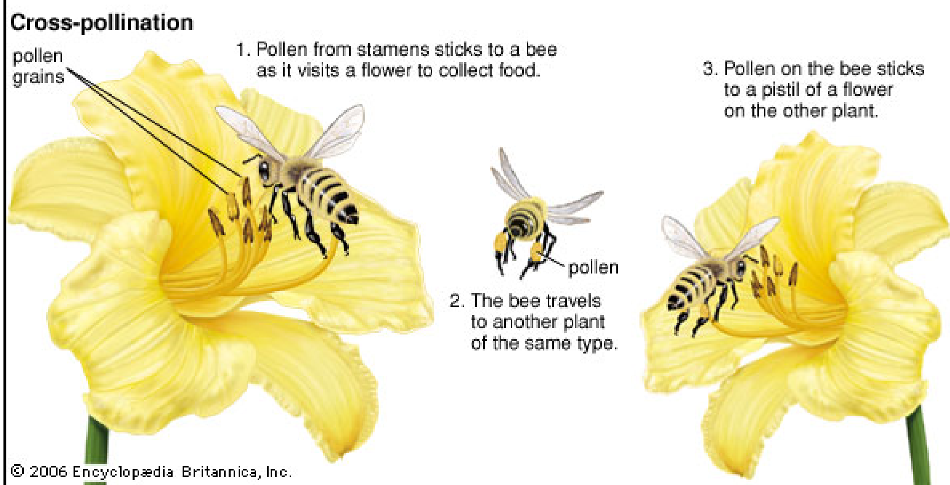
What is pollen?

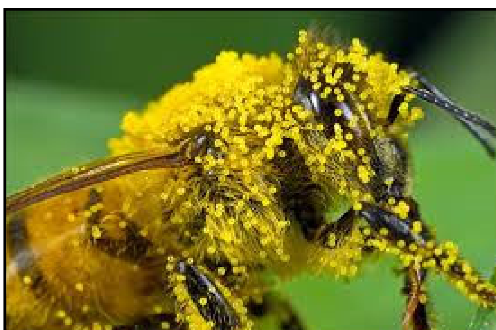
- Pollen = male plant reproductive mechanism
- Produced by the male reproductive parts of a flower

Let's take a closer look...



Pollination = Plant Reproduction

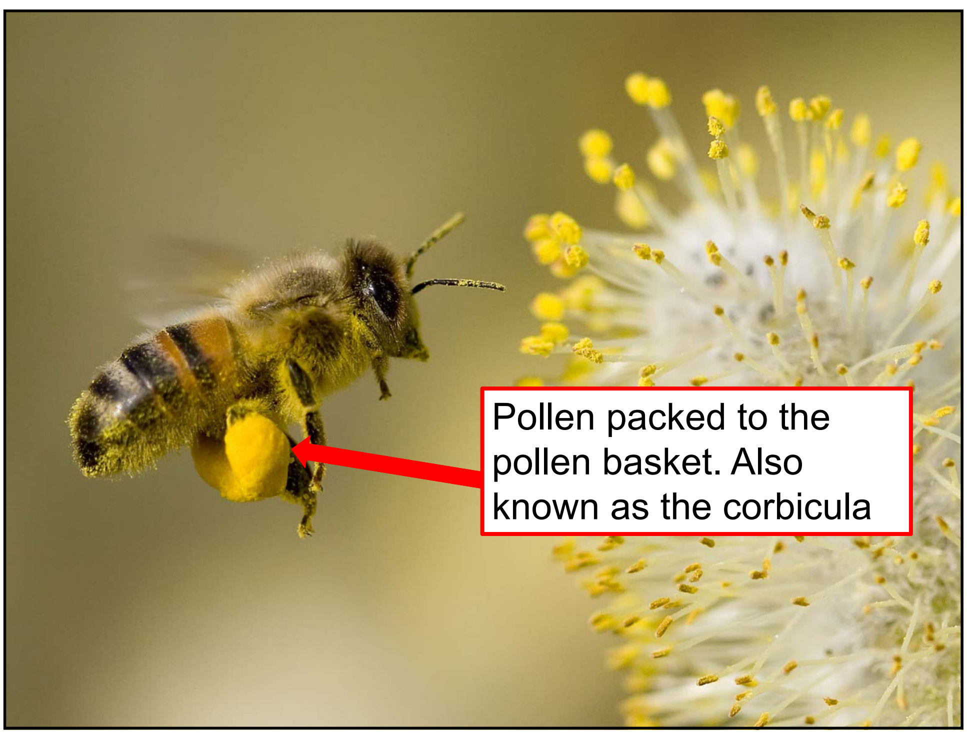




Fuzzy bees make good pollinators

“Spiky” pollen acts like Velcro


What is pollen?
How and why do bees collect pollen?
How to collect pollen from your colonies
What can you learn by collecting pollen?
What can you do with pollen?


Pollen packed to the pollen basket. Also known as the corbicula

How honey bees pack pollen

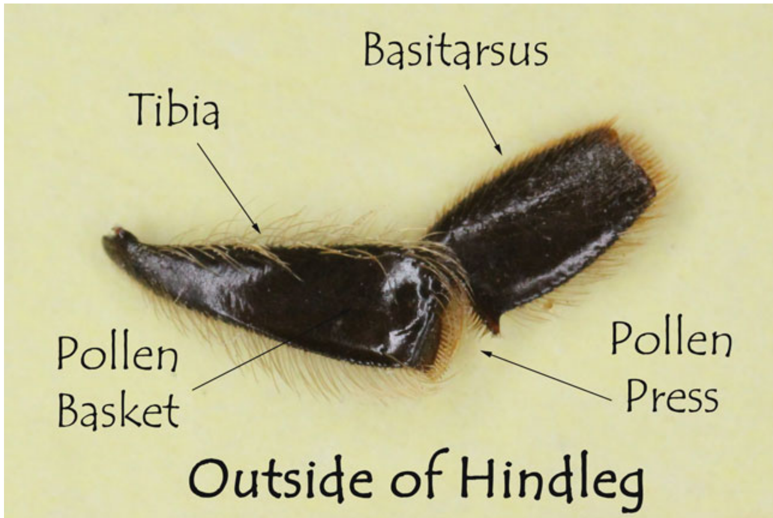


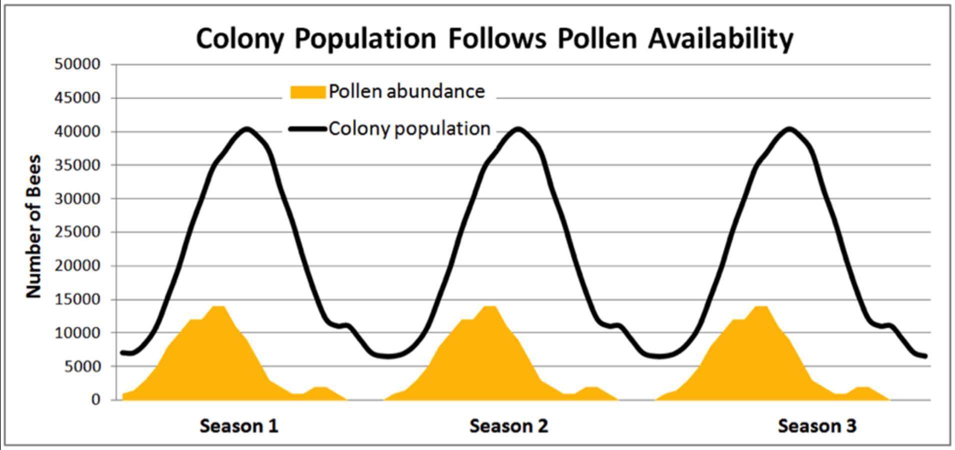
Photo by Rusty Burlew; https://honeybeesuite.com/how-the-honey-bee-makes-pollen-pellets/

- Nurse bees consume pollen to make royal jelly for queens and early worker brood
- Nurse bees feed mixture of jelly, bee bread and honey to worker brood later in development

Pollen is for baby bees

- Pollen provides protein for baby bees
- Lipids
- Vitamins
- Other trace minerals

Pollen = Colony Buildup



Pollen Diversity is Important!

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- C nd
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Good pollen diversity
relates to the landscape


What is pollen?
How and why do bees collect pollen?
How to collect pollen from your colonies
What can you learn by collecting pollen?
What can you do with pollen?

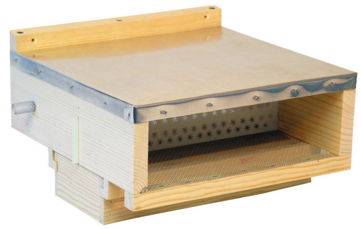
Choose a pollen trap

(not an exhaustive list)

Sundance Pollen Trap

Plastic Front Porch Pollen Trap

Superior Pollen Trap



Wooden Front Porch Pollen Trap

Sundance Pollen Trap

Superior Pollen Trap

Underneath or on top of the hive

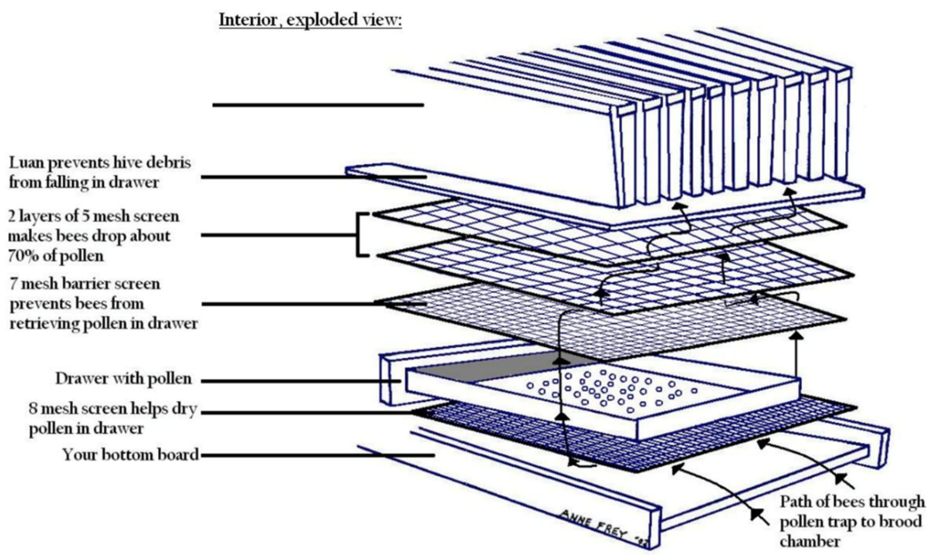
In front of hive entrance

Plastic Front Porch Pollen Trap

Wooden Front Porch Pollen Trap

Sundance pollen trap

Sundance pollen trap



Sundance pollen trap

Advantages:

- Big drawer makes it easy to get pollen out
- 8-frame or 10-frame
- Models for top and bottom
- Sturdy

Disadvantages:

- Hard to clean
- Bees take longer to adjust to changes at entrance

*New versions can now go on top of the hive. I haven't personally used them.

“Superior” Pollen Trap

“Superior” Pollen Trap

Advantages:

- Drawer is big and you can choose which side it goes on
- Very easy to open

Disadvantages:

- Must go under the hive
- Small parts to lose
- 10-frame only

Brushy Mountain Front Porch

Screw them to the front of the hive over the entrance

Brushy Mountain Front Porch

Advantages:

- Less expensive
- Adjustable for 10-frame or 8-frame
- Fits on the front
- Stripping sheet is easy to place

Disadvantages:

- Small drawer
- Restricts entrance

Plastic Front Porch Trap

Advantages:
- Cheap

Disadvantages:
- 10-frame only
- I’ve never used one...

If you’re feeling REALLY confident, you can make your own.

Beekeepers are always resourceful...

Pollen collection can have its challenges...

When should I collect pollen?

- Helps to open and close the pollen trap early in the morning or late at night. Otherwise it can confuse foragers!
- Try not to collect when there is a lot of rain in the forecast- gelatinous pollen

How often can I collect pollen?

- You don't want to take too much pollen
  - 24 hour period once a week during high pollen availability
  - 1-2 days every two weeks
- It helps to choose a strong colony
- When you do a hive inspection, make sure that they have enough stored pollen

You also don't want to leave pollen in the trap for too long

- It's not guarded by the bees
- Attracts pests (mice, ants, beetles, wax moths)
- Gets moldy quickly

Clean your pollen!

- Sort out foreign material if you plan to eat your pollen
- Pollen samples can contain:
  - Bee parts
  - Wax flakes
  - Other bugs
  - Many other mysterious things...


Cleaning Methods

- Different methods for cleaning:
  - Pick through by hand
  - Sift through different grades of mesh
  - Spread on trays in front of fan

Pollen storage

- Store in the freezer
  - Freezing kills pests
  - Surest way to keep pollen fresh
- Dry it in an oven or food dehydrator
  - Best if you want it to be shelf stable

Other Tips

- It helps to have a bee brush
- You'll want a plastic bag for storage
- It's nice to label it with the date and location

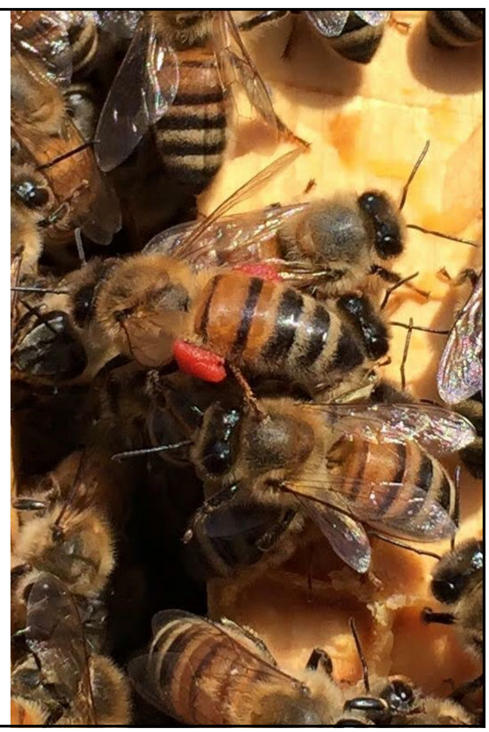

What is pollen?
How and why do bees collect pollen?
How to collect pollen from your colonies
What can you learn by collecting pollen?
What can you do with pollen?


What can you learn from pollen?
• Pollen diversity throughout blooming season based on color
• Pollen quantity in a given time
– Learn more about dearths

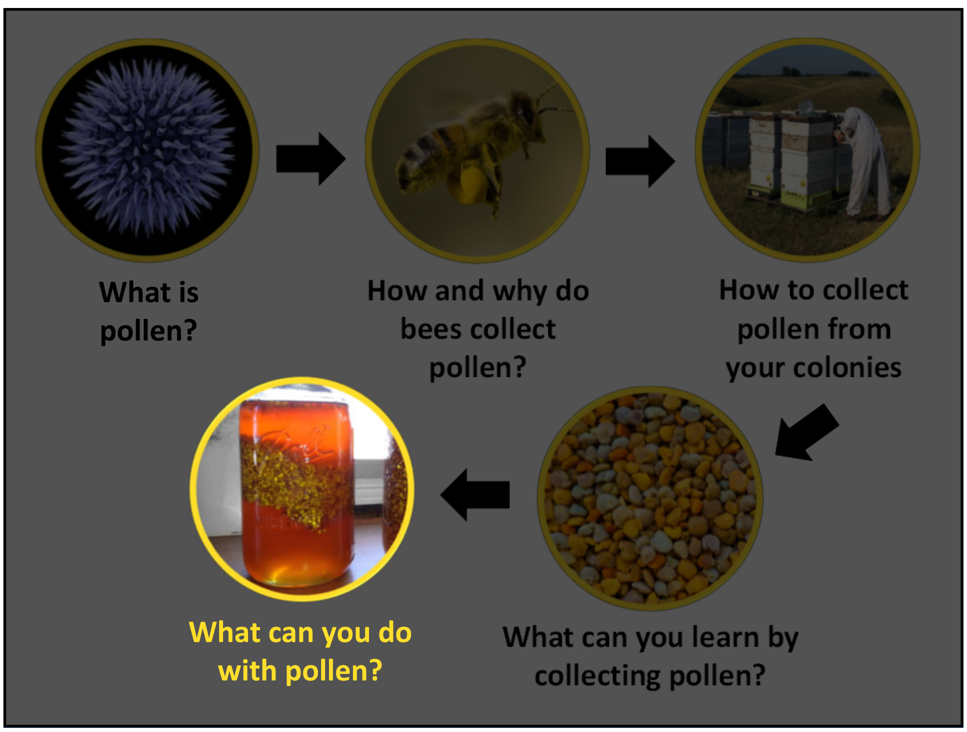

Phacelia pollen

Watch your foragers!

Even if you decide not to use a pollen trap, taking the time to watch incoming foragers can tell you a lot about your landscape.



Pollen Quantity



What to do with pollen

- Feed back to bees
- Eat your pollen
- Make your own bee bread
- Sell it

Making bee bread

- 1:3 pollen to honey ratio
- Turn jar once daily (at least) for at least 2 weeks


Selling pollen
• $11-$30 per kg
• Farmers' markets, health food stores, cosmetic industry
• Don't feed pollen from unknown sources back to your bees!


Questions?
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[1] Ellis, A., Ellis, J., O'Malley, M.K, Zettel Nalen, C.M. (n.d.) The benefit of pollen to honey bees. Retrieved from http://edis.ifas.ufl.edu/in868#FIGURE 1

[2] Alaux, C., Ducloz, F., Crauser, D., Le Conte, Y. (2010) Diet effects on honey bee immunocompetence. *Biology Letters*, 6(4).

Collecting, Processing, and Rendering Wax

Bee College Fall 2018

David Hall
University of Florida Master Beekeeper
Jefferson County

Agenda

- Overview of supplies
- Understand processes and options of collecting wax from hive frames.
- Recognize the various methods of processing harvested beeswax.
- Identify the numerous ways in which wax can be rendered into desired products.
- What to do with the rendered Wax

Supplies for working Wax

These *become dedicated* to working Wax

- Containers
  - 5 Gallon Pails
  - Small cooling containers that have a beveled side
    - Yogurt cups/Plastic Cocktail glasses
    - Silicone or tin muffin pans
- Wax/Soap thermometer (not a meat thermometer)
- Pouring pitcher (Stainless steel)
- Double Boiler, or wide pot for melting pot
- Hot plate or two
- Nylon curtain/cloth for straining wax
- Small cast iron skillet
- Hydrogen peroxide (2-3 bottles)

Getting Fresh cappings

- Take frame of capped honey (no bees)
- Cut fresh cappings over 5 gallon bucket
  - If you use a Wax knife,
    - Cut the Tops of Caps of honey
  - If you use Roller or Brush, not as much wax will come off
- Put Honey/Cappings into strainer
  - Let drain over night
- Honey that has been spun off should also be put through strainer

What is included in cappings

- Honey
- Pests:Wax moth silk, Hive beetles
- Bee body parts
- Pollen
- Wax bits
- Propolis
- Silk from brood cells

Warnings and disclaimers

- Wax is very flammable
  - Requires Constant observation when handling
  - Take care to not burn yourself and others
- Wax melts at 160 degrees
  - Use the thermometer to monitor constantly
- Avoid any open flame
  - Stove top or smoking
- Avoid microwave ovens
- Avoid direct contact of melting pot to direct heat

Need to sign a Liability Release

- *Never* use your spouse's kitchen to work wax
- Causes permanent damage to:
  - Stove top and counters, tables, floor
  - Pans and pots used
  - Utensils
- To maintain a happy marriage,
  - Get a signed liability release form from your spouse
  - Buy your own separate equipment
- Do not clean any pots, pans, (equipment) in kitchen sink.

Ways to process Wax (wet)

- Use a double boiler or crock pot
- Fill partially with water
- Get water to over 170 degrees
- Insert Cappings (honey, bug parts and all)
- Watch temperature carefully
- When wax is melted
- Take off heat, let it cool down
- When cool, wax block will be at top

Ways to process Wax (dry)

- Same as before, but use **no** water
- Put wax into Crock pot, presto pot, or pitcher in double boiler
- Let wax melt
- Watch temperature (do not over heat)
- Use nylon curtain as strainer/filter
- Pour into another pot
- Take strained wax and pour into smaller containers (muffin pans or cups)

Other things to consider

- Throw cappings into Solar melter
- Old frames recycled
  - Scrape off wax from foundation
- Caution on Wet Method
  - Hard water versus Soft water
  - Water method may change chemical make up of wax
  - May become spongy
  - Test with small amount
  - May need to use distilled, bottled water

Key to rendering wax

- Melt wax using dry or wet method
  - If wet, let it cool and then melt again (wax only)
  - If dry, you can proceed to next step
- Run through filter/strainer into a pouring pot
- Pour from pot into smaller size containers
  - Muffin Tins, Yogurt cups, dixie cocktail cups
- Filter will gum up as wax cools
  - Paper filters (paint filters) cannot reuse
  - Linen/Nylon filter can be reused

Keys to rendering wax continued

- Once Wax has cooled in cups
- Pop wax out of container
- Look at the bottom to see if there is sentiment
  - May need to be melted and re-filtered again
- Store was in a sealed container
- When melting for molds
  - Pick wax of the same shade (darker impacts lighter)
  - Have additional molds available for overflows
  - Do not let wax cool in pouring pot

Color of melted wax

- Wax is white by default
- Wax will be colored by
  - The type of nectar being collected
  - What time of the year nectar/ pollen was collected
  - Color of the pollen in the frame
  - The amount of Sub-gum (propolis, silk) in the frame

How to lighten wax

- Wax will darken the more times it is melted
- It is possible to lighten wax color
- Do the following and ***proceed with caution***
  - Take several bottles of hydrogen-peroxide
  - Empty into double boiler/crock pot and heat
  - When at 160 degrees add Wax
  - Let wax melt
  - Keep at 160 for several hours (cover pot)
    - Aluminum foil or pot cover
    - Do not want liquid vapors to “escape”
  - Pour off and cool when light enough


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One of the realities of beekeeping is that honey bees and their colonies are under constant attack from a number of biotic (living) stressors. These include bacteria, fungi, viruses, mites, other insects, spiders, birds, reptiles/amphibians, and mammals. As a result, beekeepers spend considerable time inspecting colonies for and remedying problems related to biotic stressors.

The truth is that all colonies have some sort of ailment at any given time. The majority of biotic colony stressors pose low to moderate threats to colonies. However, there are some biotic stressors that can kill bees or entire colonies if they are not addressed in a timely manner. Thus, beekeepers must adopt management practices that eliminate the presence, or mitigate the impact, of these stressors in honey bee colonies.

In this article, I will discuss the most common biotic stressors affecting honey bee colonies. This is *not* intended to be a thorough review of the biology and control of each stressor (I plan those articles for publication in future issues of the ABJ). Instead, consider this an introduction to the stressors that can kill bee colonies or severely limit their productivity. Every beekeeper, new or seasoned, must be aware of these stressors so that he/she can know how to manage their colonies appropriately. Additionally, every beekeeper must develop a control strategy that corresponds to his/her needs and those of the bees.

For each stressor, I briefly discuss its biology and control and include its scientific name, where appropriate, in parentheses. I also note the potential threat it poses to colonies (low, moderate, significant). It is important to realize that I ranked the stressors in Table 1 simply based on my views of how they impact colonies. In general, any stressor can have low, moderate, or significant impact on affected colonies and the level of the severity of the impact can vary widely by time of year or location. Consequently, my ranking of each stressor is only for reference purposes and not intended to be a static designation.

- Low threat – The stressor can kill bees or colonies, but usually does not. Thus, the beekeeper must be aware of its potential to cause harm and remedy the situation if necessary. Usually, stressors that present a low threat do not need to be managed actively and chemical control remedies usually are not necessary to bring the stressors under control. Stressors in this category usually only affect a small number of colonies in an apiary. In severe circumstances, low threat stressors can manifest as moderate threats and, correspondingly, would need to be controlled.
- Moderate threat – Stressors that present a moderate threat often are common (i.e. in/affect a high percentage of colonies) and can cause significant damage if not addressed appropriately. Often, moderate threat stressors can be managed via non-chemical control options, though intervention with chemical treatments can be necessary as a last resort. Moderate threat stressors can escalate into serious threats in some areas and in certain circumstances. Consequently, beekeepers must monitor for and actively manage moderate threat stressors to limit their overall impact on colonies.
- Significant threat – Significant threats are those threats that usually are widespread and typically kill colonies if the threat is not managed actively. In fact, these stressors must receive the full attention of beekeepers who may or may not have a viable list of control options available for the stressors (for the viruses, for example). This list includes a couple of stressors that are believed to harm colonies significantly, even if the level of threat they pose is not known with certainty.

Bacteria

1) American foulbrood, AFB (*Paenibacillus larvae*): American foulbrood is a ***significant*** bacterial disease that infects bee larvae that ingest the bacterial spores. It has a widespread distribution. American foulbrood kills capped stages of immature bee development, most notably the honey

Figure 1 - American foulbrood (AFB). A small metal wire was used to stir the contents (i.e. the dead bee) of the infected cell and perform the "rope test" for AFB. That the contents of the cell stuck to the metal wire when it was removed suggests that the dead bee was infected with AFB. *Photograph: University of Florida.*

bee prepupa and young pupae. The bees get infected as larvae and die as prepupae/young pupae (Figure 1). This is very important to know as it is one of the key differences between AFB and European foulbrood. One of the reasons that AFB is such a serious threat to honey bee colonies is that the bacterium that causes AFB forms a spore that is difficult to kill. In fact, it is so difficult to kill the spore that most bee inspection regulatory agencies require that infected colonies be burned. Once a colony has the disease, it cannot be saved. The best way to control AFB is to start with AFB-free equipment/bees, use AFB-resistant bee stock, and treat colonies prophylactically with an antibiotic to keep one's colonies from ever getting the disease.

2) European foulbrood (*Melissococcus plutonius*): European foulbrood (EFB) is bacterial disease affecting honey bee brood and caused by a non-spore forming bacterium. Like AFB, EFB has a widespread distribution. Unlike AFB, EFB poses a ***moderate*** threat to infected colonies. European foulbrood infects and kills honey bee larvae, or the uncapped stage of immature honey bees. Generally speaking, infected colonies recover from EFB during strong honey flows, by being requeened, or by being treated with an antibiotic. Because EFB is not caused by a spore-forming bacterium, it can be controlled after infection with an antibiotic.

Fungi

3) Chalkbrood disease (*Ascosphaera apis*): Chalkbrood disease is caused by a fungal pathogen that kills immature honey bees. It is a ***moderate*** threat to colonies. Chalkbrood-infected larvae (Figure 2) die and become overgrown with cotton-like mycelium. This mass dries, forms a hard corpse called a mummy, and usually is removed from colonies by adult bees. The fungus that causes chalkbrood is widespread. It usually can be controlled culturally, by using resistant stock, keeping colonies well ventilated, and locating colonies out of cool, damp areas. There are no chemical remedies for chalkbrood.

4) *Nosema apis*: *Nosema apis* (or *Nosema*) is a fungal disease caused by a group of single cell fungi called microsporidia. It is a ***moderate*** threat to honey bees. Adult honey bees ingest *N. apis*, thus passing the spore to its midgut where it infects the cells that line the midgut. *Nosema apis* causes, among other things, dysentery and reduced lifespans in infected bees. The true threat of *N. apis* to bees has been muddied somewhat by the discovery of another *Nosema* species believed to be a more serious threat than is *N. apis*. Regardless, *N. apis* tends to be a problem in late winter/early spring, is less common than it once was, and can be controlled reasonably well with a commercial product containing fumagillin.

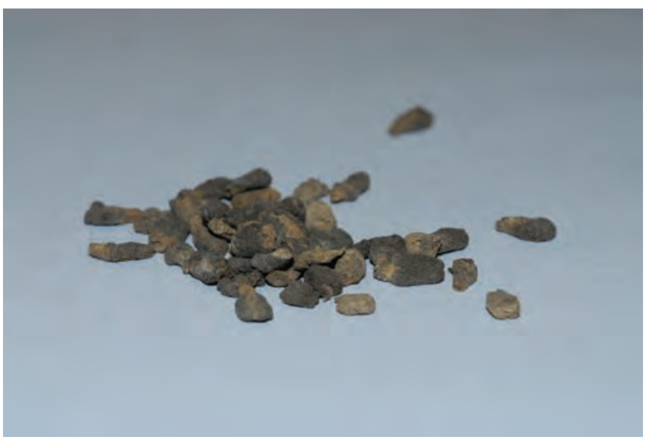
5) *Nosema ceranae*: *Nosema ceranae* (or *Nosema*) is similar to *N. apis* in many ways. It has a similar lifecycle in bees, is caused by a microspordian (Figure 3), and infects the cells that line the bee's midgut. *Nosema ceranae* is a newly recognized pathogen, having been discovered to be a separate species from *N. apis*, its less pathogenic relative. Though it is not known for sure, *N. ceranae* is believed to be a ***significant*** threat to infected bees. The growing mound of data suggest that this *Nosema* species is correlated with significant colony losses. It has a widespread distribution and in many situations can be controlled with fumagillin. That said, its control with the product is not guaranteed and there is little else that can be done to remedy it. Many colonies live with the disease and its true impact on those colonies remains unclear. This pathogen remains a subject of considerable investigation and speculation.

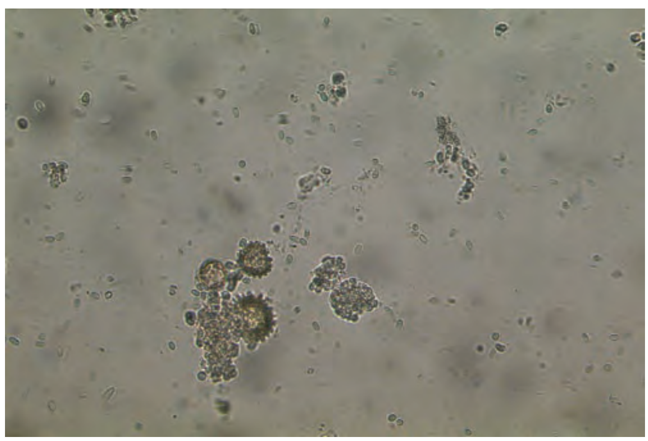
Viruses

Generally speaking, a number of viral pathogens affect honey bee colonies. The threat that most of these viruses pose to bees is unclear, but is believed to be moderate in many cases, and even severe in some. Some bee viruses have known associations with *Varroa destructor* (or *Varroa*), a parasitic mite that, itself, is a significant threat to bees. There are no true control remedies for any of the bee viruses at the moment. Most control recommendations concentrate on controlling the possible virus vector (*Varroa* in some instances) or requeening infected colonies in an effort to introduce more tolerant stock. Beyond that, colonies should be managed to remain strong and healthy, thus giving them the best chance to overcome virus infection on their own.

6) Acute bee paralysis virus or ABPV: The proposed threat ABPV poses to bees is believed to be ***moderate*** and comes mostly by way of reduced lifespan of infected bees. Infected bees also remain flightless, may lose their hair, and tremble. This virus may be associated with *Varroa*.

7) Black queen cell virus or BQCV: BQCV is believed to pose a ***moderate*** threat to colonies and is distributed globally. The virus affects developing queen pupae that die when infected and turn black





(l) Figure 2 – Chalkbrood mummies collected from an infected colony. (r) Figure 3 – Nosema spores as seen through a compound microscope. *Photographs: University of Florida.*

(l) Figure 4 – Adult worker honey bee infected with deformed wing virus. (r) Figure 5 - Tracheal mites. In this image, the bee's head has been removed from her thorax, and her thorax further dissected to reveal the two, upside-down, V-shaped trachea. The thoracic trachea on the left if infected with tracheal mites (notice the white matter in the trachea and the black scar tissue) while the one on the right is not. *Photographs: Tricia Toth, formerly of the University of Florida.*

in their cells. This virus may be associated with *Varroa*.

8) Chronic bee paralysis virus or CBPV: The proposed threat CBPV poses to bees is believed to be ***moderate***, principally by reducing the lifespan of infected bees. Infected bees also remain flightless, may lose their hair, and tremble, much like bees infected with ABPV do.

9) Deformed wing virus or DWV: DWV is a widespread virus with a documented association with *Varroa*. Increasingly, data suggest that DWV is a ***serious*** threat to honey bees, mostly when coupled with high colony *Varroa* infestations. As the name implies, DWV causes malformed wings in adult honey bees (Figure 4), a process that begins when they were infected with the virus as pupae. It also reduces infected bee lifespan and general body size. There are no known controls for DWV so controlling the vector, *Varroa*, helps limit the impact of this virus on bees.

10) Israeli acute paralysis virus or IAPV: IAPV is similar in presentation to ABPV, affecting bee longevity, causing bee trembling, infected bee hair loss, etc. It is believed to pose a ***moderate*** threat to honey bee colonies.

11) Kashmir bee virus of KBV: This virus is similar to ABPV in most ways, and can, in fact, be confused symptomatically for ABPV. It is vectored by *Varroa*, making vector control the best control method for KBV. Though extremely toxic to bees in the laboratory setting, KBV is believed to be a ***moderate*** threat to honey bee colonies.

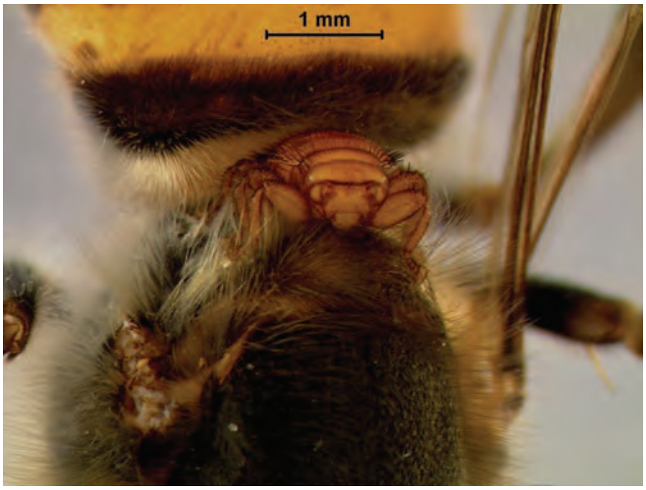
12) Sacbrood virus or SBV: SBV infects larval bees which ultimately fail to pupate when infected. Their bodies progressively darken and infected colonies express symptoms similar to those infected with American foulbrood. SBV is a ***moderate*** threat to honey bees and can infect adult bees who experience shorter lifespans when infected.

13) Other viruses: A number of other viral pathogens infect immature and adult honey bees. The true impacts of these viruses on bee and colony health are unclear, but may be moderate to significant in certain circumstances. Some of the known additional viruses include bee viruses X and Y, cloudy wing virus, iridescent virus, filamentous virus and slow paralysis virus.

Mites

14) Tracheal mites (*Acarapis woodi*): Tracheal mites are, as the name implies, mites that live in the thoracic tracheal system, or the breathing tubes in the thorax, of infected bees (Figure 5). Tracheal mites once were a major problem for bee colonies, but now are considered only a ***moderate*** threat to honey bees. These mites can reduce bee lifespan and kill colonies in severe circumstances. Tracheal mites probably are inadvertently controlled by beekeepers who use chemical treatments against *Varroa*. Regardless, the impacts of tracheal mites can be mitigated easily with resistant bee stock or sugar/vegetable oil patties.

15) *Tropilaelaps* (*Tropilaelaps clarea*): *Tropilaelaps clarea* is the only stressor I include in this article that has yet to threaten honey bee colonies outside its endemic range. Regardless, many scientists and regulatory officials consider this mite a potentially ***significant*** threat and maintain



(l) Figure 6 – An adult, female *Varroa destructor*. Photograph: Tricia Toth, formerly of the University of Florida. (r) Figure 7 - Bee louse on the bee's thorax. Photograph: Tomas Bustamante, University of Florida.

Figure 8 – A tachinid fly larva inside the abdomen of a worker honey bee. This larva feeds and develops in the abdomen of the living bee, ultimately killing it as it emerges from the bee's body. The two black circles on the right end of the fly larva are its spiracles, or breathing ports. ***Photograph: Joe Cicero, University of Florida.***

monitoring programs to search for and limit accidental importation of the mite.

16) *Varroa* (*Varroa destructor*): Many scientists and beekeepers suggest that *Varroa* (Figure 6) are the most ***significant*** threat to honey bee colonies globally. *Varroa* are ectoparasitic mites that are believed to feed on honey bee hemolymph and possibly fatty tissues. Adult female *Varroa* feed and reproduce on honey bee pupae developing in capped brood cells. Furthermore, they feed on adult bees while being transported through the colony in search of brood cells in which they can reproduce. *Varroa* are known vectors of several serious bee viruses. *Varroa* also enjoy a widespread distribution and infest many, likely most, colonies where they are present. Beekeepers managing colonies in areas where *Varroa* are present must manage colonies to minimize the impacts of *Varroa*. In fact, *Varroa* are said to have "domesticated" the honey bee in many places, given that most unmanaged/untreated colonies will succumb to *Varroa* infestations without proper management. Arguably, the spread of *Varroa* globally has had the most significant impact of any colony stressor on general honey bee management. Fortunately, there are a number of control strategies one can employ to limit the impact of *Varroa* on infested colonies. Unfortunately, many of the strategies are labor intensive and moderately efficacious at best. As a result, the commercial beekeeping industries in many areas where *Varroa* are present rely heavily on chemical remedies for *Varroa* control. In summary, if you keep bees, you almost certainly will have to address *Varroa*. They are unavoidable.

Insects

17) Ants: Numerous species of ants attack or live in honey bee colonies. Some species of ants in some areas and under certain circumstances can be significant problems for bees/bee colonies. However, generally speaking, ants typically pose a ***low*** threat to honey bee colonies. Almost all beekeepers will have to deal with an ant issue at some point during their beekeeping careers, but the issue usually is minor and can be controlled culturally or with chemical treatments.

18) Bee louse (*Braula coeca*): The bee louse (Figure 7) is a wingless fly that poses no or at most a ***low*** threat to honey bee colonies. The fly sits on the body of the infested bee and moves to the bee's mouthparts to feed on food passed between its bee host and another bee. The bee louse also can induce bees to regurgitate honey, on which the bee louse feeds. The only time the bee louse is perceived as a low threat is when many congregate on queen honey bees, presumably because the queens are fed so often, making it possible for the louse to obtain a reliable meal. I am not aware of any circumstances under which the bee louse should be controlled and they are not very common, likely owing to the widespread use of *Varroa* control products that probably kill the bee louse as well.

19) Flies: Flies, in general, pose a ***low*** threat to honey bee colonies. Flies can impact honey bee colonies in two main ways: as a parasite or as a predator. Some flies parasitize honey bees by laying eggs in or on them. The fly maggot will develop inside the living bee and ultimately kill its host (Figure 8). Other flies are predators of bees, capturing bees in mid-air and feasting on their internal organs (Figure 9). Though, conceivably, fly threats to honey bees can be severe, they usually are not and require no control efforts on behalf of the beekeeper.

Figure 9 - Robber fly feeding on an adult honey bee. ***Photograph: University of Florida.***

20) Greater wax moth (*Galleria mellonella*): Greater wax moths (Figure 10) are the larger of the two wax moth species known to infest honey bee colonies. The caterpillars (or "wax moth larvae") of the moths tunnel through wax combs, reducing the wax to a webby mass of frass and debris. Generally speaking, greater wax moths pose a ***moderate*** threat to honey bee colonies, though many beekeepers might argue this point. However, greater wax moths largely are considered a secondary pest, meaning that they do not affect healthy colonies significantly and only cause colony collapse in colonies that were otherwise already stressed. The only remedy for greater wax moths in living colonies is to keep strong, healthy colonies that can address the moths themselves. Greater wax moths can be a problem in stored combs. Thus, many beekeepers use temperature (refrigeration or freezing), cultural, and chemical methods to control greater wax moths in stored equipment.

21) Large hive beetles (Scarabidae): The term "large hive beetle" is a term used to describe any "large" beetle found

Figure 10 - Greater wax moth adult (a) male and (b) female. ***Photographs: Lyle Buss, University of Florida.***

Figure 11 - Lesser wax moth adult (a) male and (b) female. ***Photographs: Lyle Buss, University of Florida.***

in a honey bee colony. Usually, the term denotes beetles from the family Scarabidae, or scarab beetles. Scarab beetles can enter some colonies and consume pollen stores and possibly honey stores. That said, they pose only a ***low*** threat to strong colonies and require no control.

22) Lesser wax moth (*Achroia grisella*): Like their larger cousins (the greater wax moth), lesser wax moths (Figure 11) pose a ***moderate*** threat to honey bee colonies. They are smaller than greater wax moths and tend to tunnel under the cappings of the wax comb. They can cause problems in weak colonies and stored equipment. They are managed much the same way greater wax moths are managed, given that they have similar biologies and life cycles.

23) Small hive beetles (*Aethina tumida*): Like wax moths, small hive beetles (Figure 12) are largely considered a ***moderate***, secondary threat to honey bee colonies. Certainly, they can have high enough populations in some climates and in certain circumstances to kill colonies routinely, elevating their threat status in those areas to significant. Despite this, small hive beetles are only moderate threats to colonies in most locations. Small hive beetles damage colonies by virtue of the feeding habits of their larvae which eat honey bee brood, stored pollen, and stored nectar/honey. Many beekeepers find that they can control small hive beetles culturally through improved management techniques. In some instances, chemical intervention may be needed and is available to bring small hive beetle populations down to manageable levels.

24) Assassin bugs (insects from the Order Hemiptera, Family Reduviidae): Assassin bugs are a type of "true bug" (i.e. from the Order of insects actually called "bugs") that can be quite large and feed on other soft-bodied insects. Assassin bugs are considered only a ***low*** threat to honey bees. Sometimes, they can be seen sitting on the outside of a honey bee colony with a dead or dying bee positioned at the tip of their piercing/sucking mouthparts. Assassin bugs do not need to be controlled, unless you just cannot stand the sight of your bees being eaten alive, in which case you can simply squash the bug.

25) Wasps: Wasps are the most significant stressor in the ***low*** threat category. I placed them in the low threat category because, in most cases, honey bees and wasps live harmoniously with little to no negative interactions. However, wasps (hornets and yellow jackets specifically) can be moderate to significant problems for honey bee colonies during certain times of the year and under certain circumstances. Wasps, by nature, are carnivores. The adults hunt, sting, and catch prey (usually soft-bodied insects and other arthropods) to feed to their young. For most of the wasp-year, there is ample prey available for wasps to hunt. However, prey availability tends to decrease in late summer/early fall, when wasp populations remain high. Thus, honey bees become the favored prey during this season. Despite the fact that wasps can be a significant problem, even for entire apiaries, they usually are not and do not warrant control. The best control option is hunting down and destroying the problem wasp nest(s). Otherwise, bee colony problems with wasps can be controlled culturally or by moving the colonies away from the threat.

26) Spiders: There are many species of spiders that prey upon wasps. I am not aware of any spider species that eat honey bees exclusively. However, I have seen many types of spiders preying on honey bees that inadvertently got caught in their webs or were ambushed by the spiders. In general, spiders pose a ***low*** threat to honey bees and do not need to be controlled.

Figure 12 – Adult female small hive beetle. ***Photograph: Josephine Ratikan, formerly of the University of Florida.***

Figure 13 – An apiary destroyed by a bear. ***Photograph: University of Florida.***

Table 1: Ranking the biotic stressors of honey bee colonies by the threat they pose to the bees. Within the threat level (significant, moderate or low), the stressors are ranked from most significant (higher on the list) to least significant (lower on the list) based on their distribution and impact on colonies when present in an area. A given stressor's impact on a colony can vary according to many factors, meaning that most listed stressors are capable of being low, moderate, or significant threats at certain times or under certain circumstances. Thus, the ranking system that follows is general and somewhat fluid.

Significant threat - when present, you *must* address the issue and sometimes this is best done prophylactically	
Varroa	likely the most significant threat to honey bees, must be addressed in managed colonies
American foulbrood	very contagious brood disease, cannot be remedied once colony contracts the disease
Deformed wing virus	increasingly considered a significant threat to honey bees, intimately linked to *Varroa*
Nosema ceranae	true colony impacts unknown, believed to be a significant problem for colonies
Moderate threat - can be a stressor, sometimes even serious, in certain areas and under certain circumstances	
Small hive beetles	can decimate entire apiaries in certain circumstances, but usually manageable in most situations
Bears	when present in an area, will find and damage/destroy colonies in an apiary, must protect colonies when bears are in the area
Other viruses (BQCV, SBV, IAPV, KBV, ABPV, CBPV)*	virus synergisms possibly significantly damaging to already stressed colonies
European foulbrood	may have widespread distribution and affect colonies chronically
Greater wax moth	present in many colonies, waiting to overrun stressed colonies
Nosema apis	causes bee dysentery and may impact colonies in other ways
Tracheal mites	no longer considered a major problem, mainly an issue in late winter/early spring
Lesser wax moth	in many colonies, but rarely overrunning them
Chalkbrood	brood disease that manifests in certain colony conditions
Low threat - rarely a major problem, but can significantly stress a colony when conditions are right	
Wasps	can overrun colonies in late summer when natural prey is scarce
Ants	can destroy colonies and sometimes difficult to control
Flies	can parasitize bees
Skunks	eat bees at night, but rarely truly damage colonies
Birds	eat bees, but not usually at damaging levels
Assassin bugs	eat bees, but not usually enough to damage colonies
Mice	mainly a problem during winter months
Toads	only a minor problem in the U.S., but major elsewhere
Lizards	eat low numbers of bees
Large hive beetle	scarab beetles that cause minor colony damage
Bee louse	a wingless fly that can be present in colonies but is not known to stress colonies in any way
Emerging threat	
Tropilaelaps	the biggest potential threat on the beekeeper's horizon

*BQCV (Black queen cell virus), SBV (Sacbrood virus), IAPV (Israeli acute paralysis virus), KBV (Kashmir bee virus), ABPV (Acute bee paralysis virus), CBPV (Chronic bee paralysis virus.

27) Birds: Some birds will prey upon honey bees and can be significant threats to colonies in limited areas around the world. However, generally speaking, birds pose a ***low*** threat to honey bees and do not need to be controlled. That said, birds can damage some colonies if they happen to prey upon queen honey bees on the queens' mating flights. However, I suspect that this is not so common, meaning that most beekeepers have little to worry about when it comes to birds.

Reptiles/Amphibians

28) Lizards: Lizards pose a ***low*** threat to honey bee colonies. They may be seen sitting near the nest entrance, feeding on bees outside of the nest. However, I am not aware of any instances of lizards posing a significant threat to honey bee colonies. Consequently, no control for lizards is necessary.

29) Toads: In some parts of the world, toads, which can be predators of bees, can cause significant damage to honey bee colonies. In Australia, for example, cane toads can reduce a bee colony's population significantly in a single night's feeding. In most areas, however, toads pose only a ***low*** threat to colonies and control is not necessary.

Mammals

30) Bears: Where present, bears are a ***moderate*** threat to honey bee colonies. In fact, I tell people that the way to know if bears are in your area is to place a colony of bees nearby. If bears are present, they will find the bees! Contrary to popular myth, most bears do not destroy bee colonies to access the honey contained within it. Instead, the bears are interested in eating the protein/nutrient rich brood. Bears usually attack at night, sometimes carrying entire colonies away from the apiary so that they can snack at their leisure. The end result is a destroyed colony, and a decimated apiary if the problem is not noticed soon enough (Figure 14). People keeping bees in areas where bears are present should bear proof their apiary with an electric fence to reduce the threat that bears pose to their bees.

31) Mice: Mice pose only a ***low*** threat to bee colonies. They do not eat bees, but instead can build their nests in bee hives, especially in late fall/winter. I have worked many colonies in late winter, only to find that mice have moved into the bee nest and constructed a nest of their own. Mice, correspondingly, can cause significant comb damage. Despite this, they are an infrequent problem and can be controlled culturally through good husbandry practices.

32) Skunks: Skunks and other similar mammals pose a ***low*** threat to honey bee colonies. Skunks sometimes develop a palate for bees, attacking the colonies at night time and eating the bees that respond. Generally speaking, most beekeepers will never have a problem with skunks. When they do, the skunks usually can be controlled culturally.

Components of Commercial Crop Pollination

Pollination: the movement of pollen from anther to stigma

Relevant Plant Parts

- Flower (the part of the plant's anatomy primarily associated with sexual reproduction)
    - Anther: the part of the flowering plant which produces and contains pollen
        - Pollen: contains the flowering plant's male genetic material
    - Pistil: the part of the flowering plant which produces and contains the ovule(s)
        - Stigma: the sticky tip of the pistil which receives pollen
        - Style: a supporting structure to the stigma
        - Ovary: the part of the pistil which produces and contains the ovules.
            - Generally, upon successful fertilization, develops into fruit
        - Ovule: contains the flowering plant's female genetic material
            - Generally, upon successful fertilization, develops into seed
    - Petals
        - Multiple petals encircle the primary reproductive parts to form a corolla.
        - Petals attract bees and other pollinators directly to the reproductive parts of the plant, as they use a variety of colors to stand out from green vegetation.
            - With their ability to see in the ultraviolet spectrum, bees can see guiding patterns on some petals (invisible to our naked eye, but visible under UV light) that direct them towards the center of the corolla, where nectar rewards and pollen are usually more centralized.
- Nectaries: nectar (carbohydrate) secreting organs usually located within the flower

- Fertilization
    - After a flower is pollinated (when viable, compatible pollen contacts and adheres to the stigma), the pollen grain germinates and sends a pollen tube down the style of the plant.
        - The pollen tube will travel through the style to the ovary and, ultimately, the ovule(s).
            - This allows male genetic material (sperm nuclei) to travel from the pollen grain down the tube to reach the ovule (s).
    - Fertilization occurs when one of the two sperm nuclei and the egg nucleus of the ovule meet to form a fertilized egg, or zygote.
        - If all goes well, this zygote will develop into a seed.
    - In general, upon fertilization, the ovary and its associated parts will begin to develop into a fruit, with the ovules developing into seeds.

The Importance of Insect Pollination

- About 1/3 of the American diet (in terms of land use) is dependent upon insect-pollination.
    - About 15% comes from a variety of cultivated crop plants, such as fruits, vegetables, and nuts.

        - Roughly that same amount comes from animal products, which are produced with the help of insect-pollinated legumes in the form of feed.
            - Insect-pollinated legumes also aid agriculture by enriching soil through nitrogen-trapping.
- Without insect pollination, we could see a decrease in the abundance and diversity of wild flowering plants which have specifically adapted features to attract insects for reproduction.
    - Insect pollinated plants also provide other ecosystem services, such soil enrichment and soil erosion prevention.
- Cross-pollination: pollination between flowers
    - Often mediated by insect pollination, as they forage for a diverse and sufficient amount of resources
    - Increased genetic diversity from cross-pollination gives future populations more potential traits and adaptations to work with when challenged by changing environments.
- Pollination by managed bee species is necessary because of the mass production of agriculture in the modern food system.
    - Too many plants to pollinate, not enough wild pollinators to keep up!

Bees Are the Most Important Pollinators

- Relevant Bee Parts
    - Specialized Hairs: Bees are usually hairy, which helps pollen to attach to them.
        - Scopa in wild bees: an area (usually on the hind legs) with a high concentration of specialized hairs used to pack and store pollen during foraging flights
        - Corbicula in honey bees and bumble bees: an indented or concave section of the hind leg accompanied by specialized hairs which allow the bee to pack pollen for storage during foraging flights
            - Also referred to as “pollen baskets”
- Relevant “Bee-haviors”
    - Bees actively collect pollen to provision their young.
        - Unlike most other animal pollinators, which forage for nectar exclusively, bees seek out pollen as their primary source of proteins.
    - Bees exhibit flower constancy and fidelity (i.e., they tend to stick to the same floral resources)
        - Honey bees can share the location of especially good floral resources through forms of communication like the “waggle dance” with other honey bees in their hive.
    - Pollen transfer (either direct or indirect) among social bees in their hives allows for a more likely chance of cross pollination.
        - Pollen transferred from separate, but compatible flowers between bees in the hive can be still carried on bees as they leave the hive to forage.
        - This is the primary mechanism of cross-pollination which helps orchard crops to set fruit.
- Economically?
    - In the U.S., honey bees provide an estimated value of over $14 billion to agriculture every year (Morse and Calderone 2000).

  - In the U.S., native bees provide an estimated value of over $3 billion to agriculture every year (Losey and Vaughan 2006).

Notable Bee-Pollinated Crops (By Order of Bloom Period)

- Almonds (*Prunus dulcis*)
  - Self-Incompatible (i.e., requires cross-pollination)
  - More than 1.5 million honey bee colonies are used for almond pollination every year (more than any other bee-pollinated crop).
  - California produces approximately 80% of the world's almonds.
- Cherries: Tart (*Prunus cerasus*) and Sweet (*Prunus avium*)
  - All major commercially grown tart cherries are self-compatible, while most sweet cherries are self-incompatible.
  - In the U.S., the largest production of tart cherries, which bloom after sweet cherries and are grown mainly for cherry pie filling, occurs in Michigan.
  - The U.S. is the top exporter of sweet cherries, with about 40% of U.S. production taking place in Washington.
- Apples (*Malus domestica*)
  - All commercial varieties are self-incompatible.
  - The U.S. produces more than $2 billion worth of apples every year.
  - Most U.S. apples, about 60%, are grown in Washington, but you can find apples growing in every state in the continental U.S.!
- Plums: Japanese (*Prunus salacina*) and European (*Prunus domestica*)
  - Most Japanese varieties are self-incompatible, while most European varieties are self-compatible.
  - California is the main producer of plums, with a value of $57 million in 2008.
- Pears: European (*Pyrus communis*) and Asian (*Pyrus pyrifolia*)
  - Most European pear cultivars are self-incompatible, while most Asian pears are self-compatible.
  - More than 90% of pear production in the U.S. takes place in the Western coastal states.
    - Most of these are European pears.
- Blueberries (*Vaccinium* sect. *Cyanococcus*)
  - The morphology of the blueberry flower makes it almost necessary to be insect-pollinated.
    - Pollen is heavy and sticky.
    - Shape of corolla restricts pollen movement by abiotic forces (e.g., wind).
  - Many species of bees pollinate blueberry in N. America.
    - Bumblebees and Southeastern Blueberry Bees are notable pollinators of blueberry.
  - Blueberry pollination is heavily reliant on buzz pollination, or sonication, which occurs when bees vibrate their muscles to a specific frequency which shakes loose pollen from the anther.
    - Bumblebees and Southeastern Blueberry Bees are known to sonicate, whereas honey bees are not known to sonicate.
  - Most blueberry production in the U.S. is from Michigan.
- Cranberries (*Vaccinium macrocarpon*)

  - Cranberries can be self-compatible but benefit in increased fruit size and abundance with cross-pollination by insects.
  - Bumblebees are notable pollinators of cranberry.
  - The majority of U.S. commercial cranberry production occurs in the states of Wisconsin, Massachusetts, New Jersey, Oregon, and Washington.
- Strawberries (*Fragaria* x *ananassa*)
  - Commercially grown cultivars of strawberries are self-compatible, but benefit in terms of fruit size, shape, and abundance from cross-pollination.
  - U.S. strawberry production is valued near $2 billion every year, with most strawberries produced in California, Florida, and Oregon.
  - Strawberry flowers are not very attractive to honey bees.
- Watermelons (*Citrullus lanatus*)
  - Flowers only bloom for one day, so a reliable source of insect pollinators must be available throughout the bloom period.
  - Wild bees are arguably better, more efficient pollinators of watermelon than honey bees, as honey bees are not particularly attracted to watermelon flowers.
    - Honey bees can be made more attracted to watermelon by reducing non-watermelon forage in the surrounding area.
  - Florida is one of the top producers of watermelon in the U.S.
- Cantaloupes and Muskmelons (*Cucumis melo*)
  - While muskmelons are technically self-compatible, they are greatly benefited by insect-pollination.
  - The majority of U.S. muskmelon production occurs in the states of California, Arizona, Texas, Georgia, and Indiana
- Cucumbers (*Cucumis sativus*)
  - Multiple colonies per acre are needed for cucumber production
    - Their flowers are not very attractive to bees.
    - Pistillate flowers (i.e., flowers which have female reproductive parts, but not male reproductive parts) need to be pollinated many times to yield fruit of sufficient shape and size.
  - Florida is one of the major producers of both fresh and pickling cucumbers.
- Sunflowers (*Helianthus annus*)
  - Many species of bees pollinate sunflowers.
  - Sunflowers are mainly cultivated for direct seed consumption and oil.
  - Most sunflower seed production in the U.S. occurs in South Dakota, Kansas, and North Dakota.
- Alfalfa (*Medicago sativa*)
  - Alfalfa is mainly produced as a nutritious feed for grazing farm animals.
  - Alfalfa is a notable field-rotation crop, as it fixes nitrogen in its roots.
  - Bees tend to experience a smack in the face as they pollinate alfalfa! This is because, upon foraging, bees exert pressure on a set of fused petals, called the keel, which hides/seals the reproductive parts of the alfalfa flower. The bee “trips” the flower after exerting enough pressure to release the reproductive plant parts. This mechanism allows pollen to be dusted onto the bee, which increases the likelihood of pollination.

- While alfalfa pollination is mostly accomplished by honey bees in California, the alfalfa leafcutter bee (*Megachile rotundata*) is employed in parts of the Northwestern U.S. and Canada.
    - Notable producers are California, Idaho, and South Dakota
- Alfalfa is technically self-compatible, but most non-tripped florets do not produce seed.

Optimal Honey Bee Colony Traits for Commercial Crop Pollination

- Strong, laying queen
- Population of 30,000 individuals or more
    - The percentage of foragers increases with the size of the colony and amount of brood.
    - 10,000 can potentially suffice.
- 6 frames or more of brood
    - 4 can potentially suffice.
- 3 frames or more of honey
    - Adequate honey stores incentivize the bees to spend more time foraging for pollen.
- Space for egg-laying and resource storage.
    - Space will stimulate colony growth and foraging activity, as well as, help prevent swarming.

Things to Consider When Using Honey Bees for Crop Pollination

- Competing Priorities
    - Crop pollination will almost certainly come at the cost of honey production or colony growth, as commercial crop pollination occurs mainly from May to June in the U.S., when colonies are usually gaining strength.
- Consider the Costs
    - There are many cost-increasing factors to consider when crop pollinating with honey bees.
        - Transportation
        - Room and meals
        - Wages of workers
        - Supplemental feeding
        - Antibiotics and miticides
        - Re-queening
        - Beekeeping equipment/hardware (e.g., tools, protective gear, boxes/frames)
        - Time!
- Think Ahead!
    - Beekeepers and farmers usually prepare pollination contracts months in advance.
        - Written pollination agreements or contracts greatly benefit beekeepers and their clients, as they allow for clear, planned commitments.
    - Make sure you have enough strong colonies in preparation of crop pollination.
    - Know your crop.
        - Or crops (as in multiple)! Blooming periods tend to be short, so commercial crop pollinators will hop from crop to crop throughout the year.
        - Pay attention to the density and distribution of colonies required for specific crops.
    - Weather Effects
        - Honey bees forage when the sun is out.

            - Honey bees can fly, and therefore forage, at temperatures above 50 degrees F (10 degrees C).
            - Honey bees will not fly during rain.
                - Honey bees may not resume foraging for hours after a rain.
                - Rainwater can dilute or remove nectar and pollen from flowers.
        - Honey bees will not fly when wind speed is higher than 25 mph.
    - Work out an efficient method of transportation.

Getting the Timing Right with Honey Bee Colonies

- Honey bees should be placed into agricultural spaces when enough flowers have bloomed to be attractive to honey bees compared to nearby non-target flowers.
    - This is dependent upon your crops blooming period but can generally be considered at around 10% bloom.
- Self-incompatible fruits, which require cross pollination, can be left without honey bees until at least two cultivars have bloomed.
- In pomes (e.g., apples, pears), honey bee colonies should be removed before the end of the blooming period.
    - Fruit size and quality decreases with amount of fruit set.
- In almond or seed crops, honey bees should be left in the field until bloom has decreased enough that the crop is no longer attractive to honey bees.
- Move your bees before post-bloom pesticide spraying.
    - Movements of colonies should be done when the sun is away, as foragers should be inside the hive.

Beyond the Honey Bee: Other Notable Managed Bees

- Common Eastern Bumble Bee (*Bombus impatiens*)
    - Beneficial Bee Features
        - Long-tongued
            - Can be more efficient than honey bees in crops with lengthy corollas.
        - Better adapted to flight in cold weather and light rain compared to honey bees
        - Unlike honey bees, bumble bees can be used in greenhouses due to their foraging patterns, as well as, the ease of transport of bumble bee colonies.
        - Buzz pollination!
            - Bumble bees grab anthers with their mandibles and then vibrate their wing muscles to a specific frequency which shakes the anther and releases pollen from the anther's pores
            - Useful in tomatoes, peppers, blueberries, and cranberries
    - Bumble bees have annual colonies, and thus new colonies must be purchased every year.
    - Notable pollinator of watermelon and blueberries.
    - Should be kept about 90 meters away from honey bee colonies to reduce robbing by honey bees.
- Mason Bees (*Osmia* spp.)
    - Blue Orchard Bees (*Osmia lignaria*) are used as alternative pollinators of orchard crops, such as almonds or apples.

        - Their foraging pattern of moving between rows can assist with cross-pollination
    - Unlike honey bees, mason bees can be used in greenhouses.
    - Mass production techniques for mason bees are still underway. Most stock is currently obtained from wild bees.
- Alfalfa Leafcutter Bees (*Megachile rotundata*)
    - Although not native to the U.S., the Alfalfa Leafcutter Bee has historically been a notable pollinator of U.S. alfalfa.
        - Use of this bee in the U.S. declined dramatically in the 1980's due to management challenges from disease.
            - Management practices have been since improved and implemented in areas of Canada.
- Alkali Bees (*Nomia melanderi*)
    - Managed in the western U.S. in well-drained, alkaline soils.
    - The only managed soil-nesting bee in North America!
    - Historically, this bee was used in alfalfa production; however, its use has been spread to other crops, such as mint and sweet clover.

Beyond the Managed Bees: Wild Bees as Pollinators

- Some wild bees are specialists which are specially adapted to use one or a handful of flower species as their foraging resource.
- Individual wild bees can be more efficient than individual honey bees.
    - What honey bees lack in efficiency, they make up in population size.
- Buzz Pollination!
    - Unlike honey bees, there are species of wild bees that can buzz pollinate.
- Notable Evidence/Publications
    - Positive correlations have been shown between wild insect visitation rates and increased fruit set in over 40 crop systems worldwide (Garibaldi et al. 2013)
    - Wild bees were shown to be the dominant visitors to flowers in 3 of 4 bee-pollinated summer vegetable crops at farms across Pennsylvania and New Jersey (Winfree et al. 2008)
    - A study in apple orchards in New York State correlated an increase in apple seed set and a decrease in apple pollen limitation with wild bee species abundance, richness, and diversity (Blitzer et al. 2016).
        - The increase in seed set and decrease in pollen limitation was not shown to positively correlate with increasing honey bee abundance.
    - Behavioral interactions between honey bees and wild bees has been shown to increase the pollination services to hybrid sunflowers by honey bees up to 5-fold (Greenleaf and Kremen 2006).
    - Native bees have the potential to significantly buffer losses in watermelon production caused by lack of honey bees (Winfree et al. 2007).

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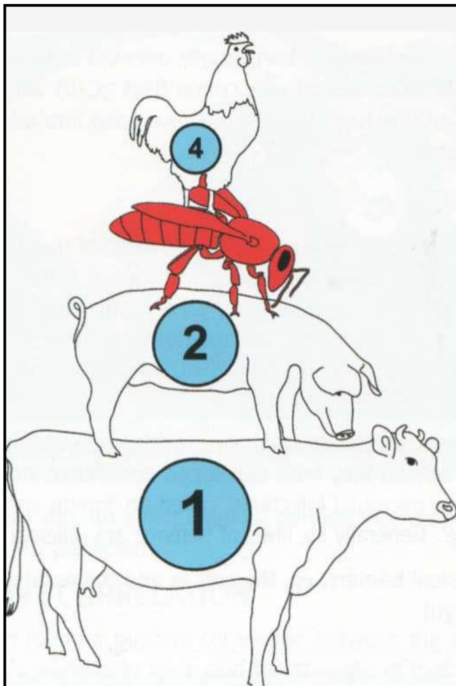


Value of Bees

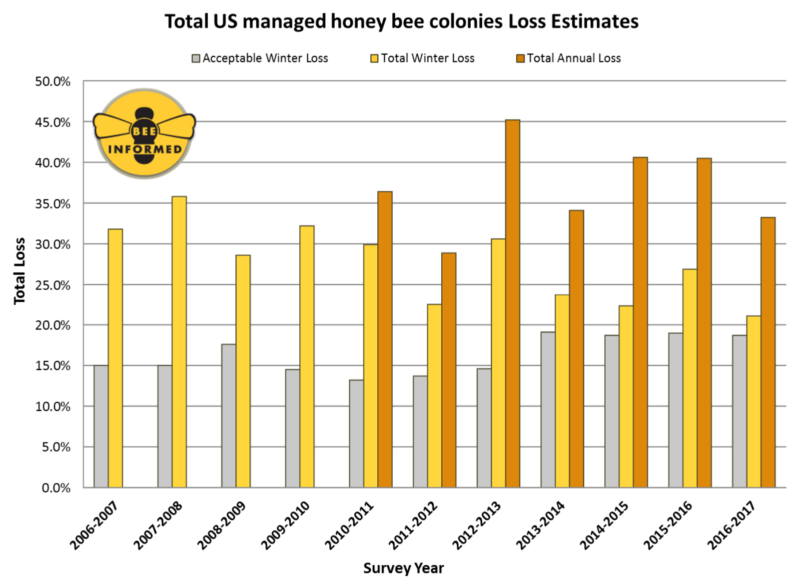
~$15-18 Billion Nationwide

~$216 Billion worldwide, or about 10% of the total value of the world agricultural food production (2008)

The economic ranking of cattle, pigs, honey bees and poultry

(from The Buzz about Bees, J Tautz and H Heilmann, Springer, Heidelberg 2008)

What's Killing the Bees?



Is It Colony Collapse Disorder?

Colony Collapse Disorder Symptoms

1. Dead or failing colonies with plenty of brood and honey but very very few adult bees
2. Slow invasion of hive pests (i.e. wax moths and hive beetles)
3. Lack of dead bodies in or around the colony

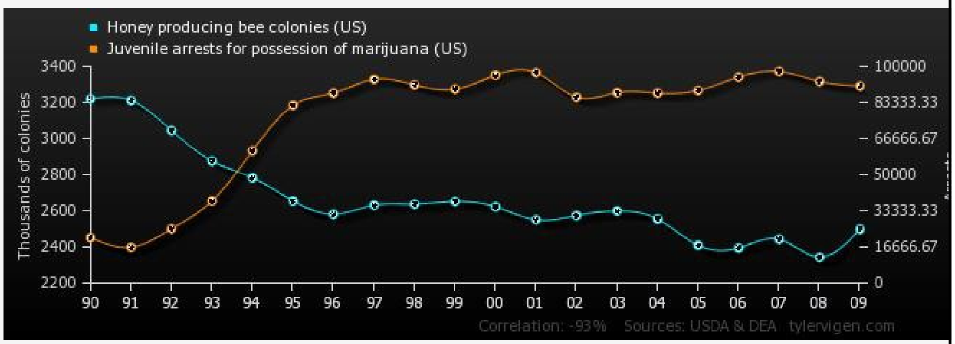
COLONY COLLAPSE DISORDER?

"For every complex **problem** there is an answer that is **clear, simple,** and **wrong**."

H. L. Mencken

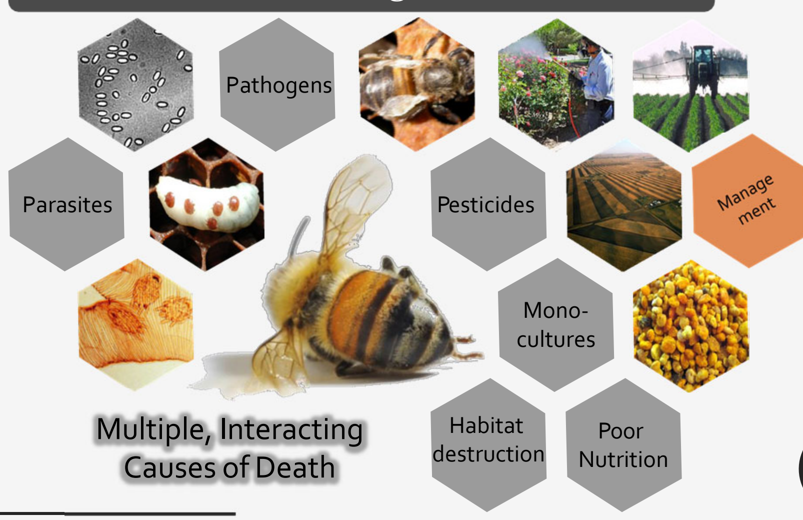
ANSWERS MUST BE DATA DRIVEN

Honey producing bee colonies (US)
inversely correlates with
Juvenile arrests for possession of marijuana (US)



R=-0.933389

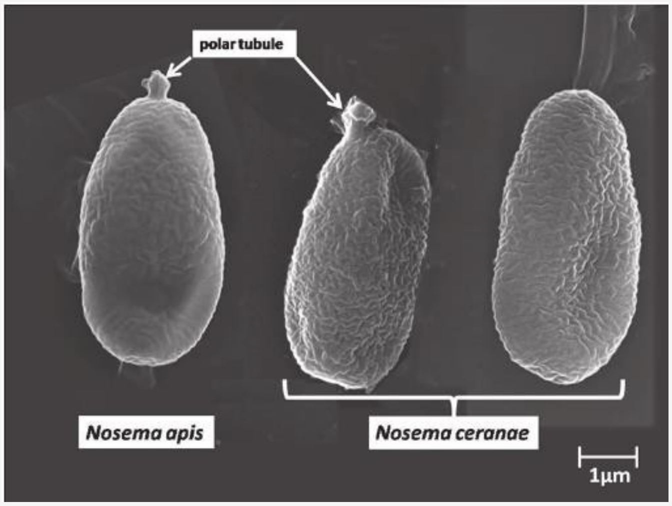
What is killing the bees?



Parasites

Bacteria

Fungi



Viruses

Pesticides

Poor Land Management

Poor Nutrition

Inbreeding

Climate Change

Socioeconomic Factors



THE BIG 3

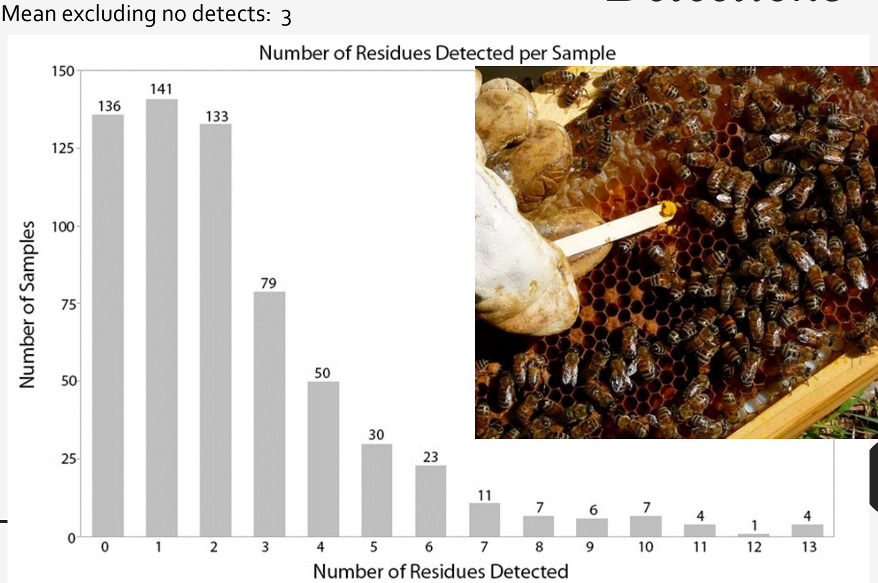
Self-reported causes of loss by MD Beekeepers

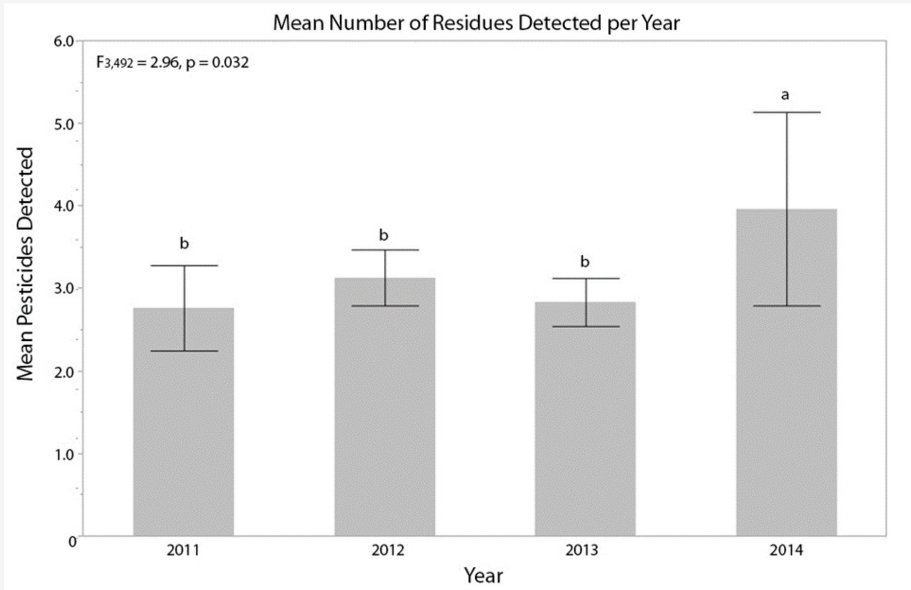
- Backyard beekeepers (n=120)
  - #1: Starvation
  - #2: Weak in the fall
  - #3: Poor wintering conditions
- Sideliners (n=3)
  - #1: Varroa mites
  - #2: Small Hive beetle
- Commercial (n=2)
  - #1: Varroa/Small hive beetle
  - #2: Queen failure/pesticides/weak in the fall/CCD

PESTICIDES

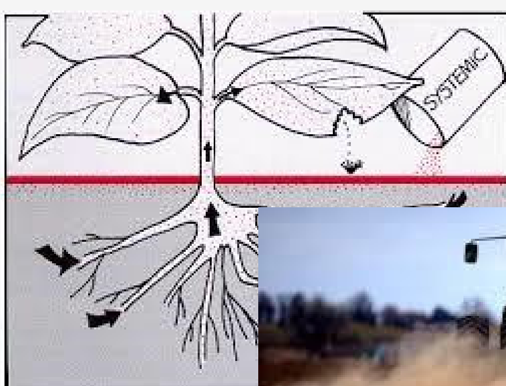
Pesticide Detections

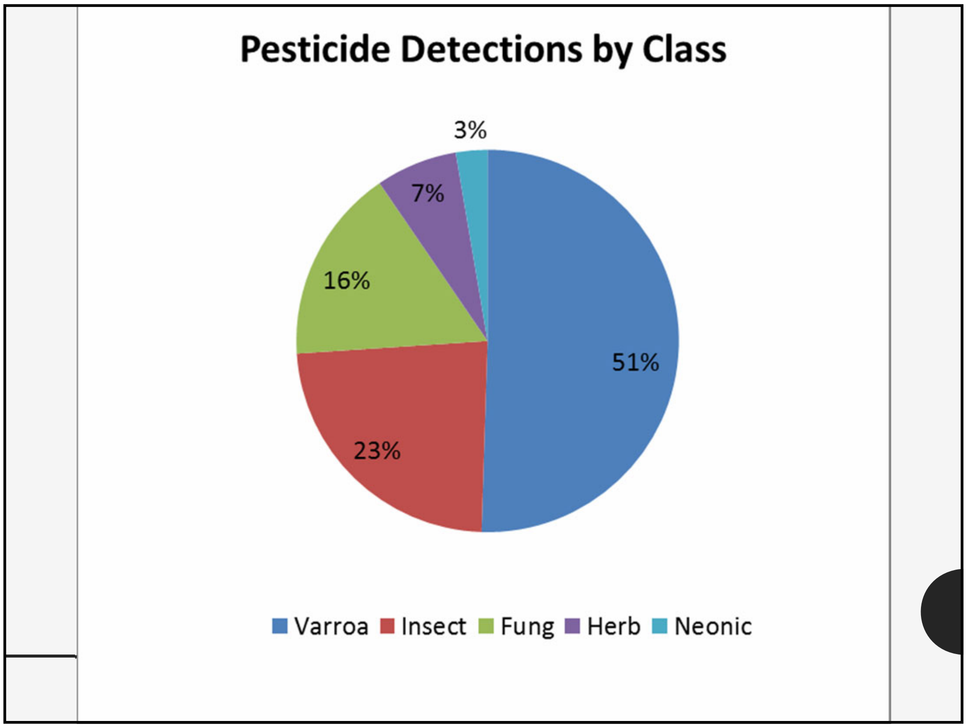
N=633
21 % had no detectable contamination
Mean 2.36 products
Mean excluding no detects: 3

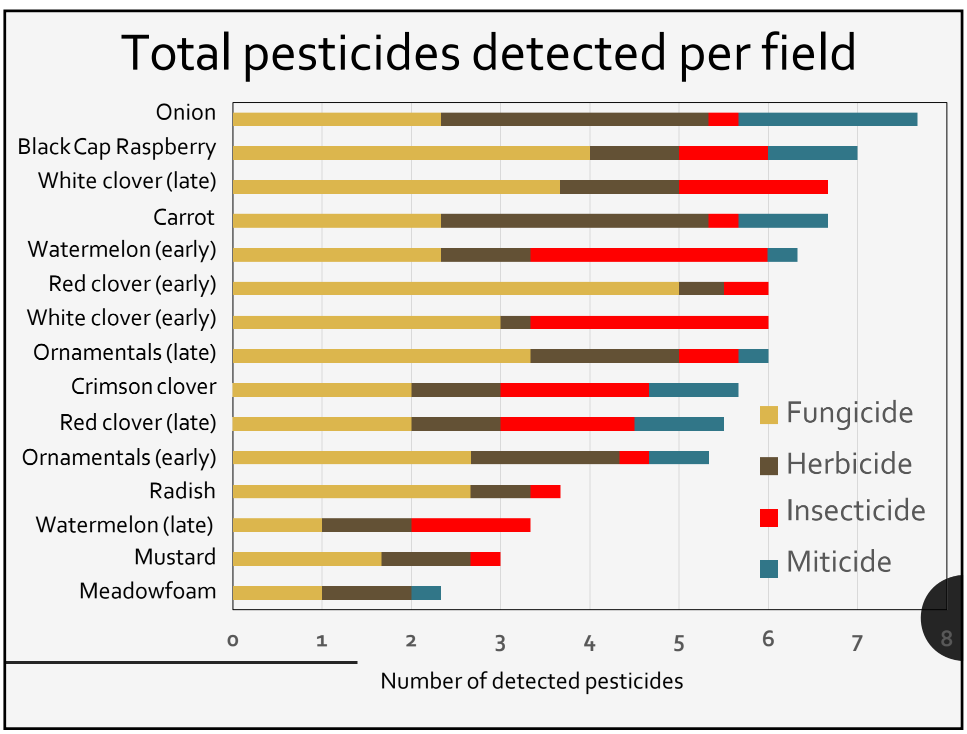



Mean Number of Residues Detected per Year
F3,492 = 2.96, p = 0.032
Mean Pesticides Detected
6.0
5.0
4.0
3.0
2.0
1.0
0
a
b
b
b
2011
2012
2013
2014
Year

Neonic's

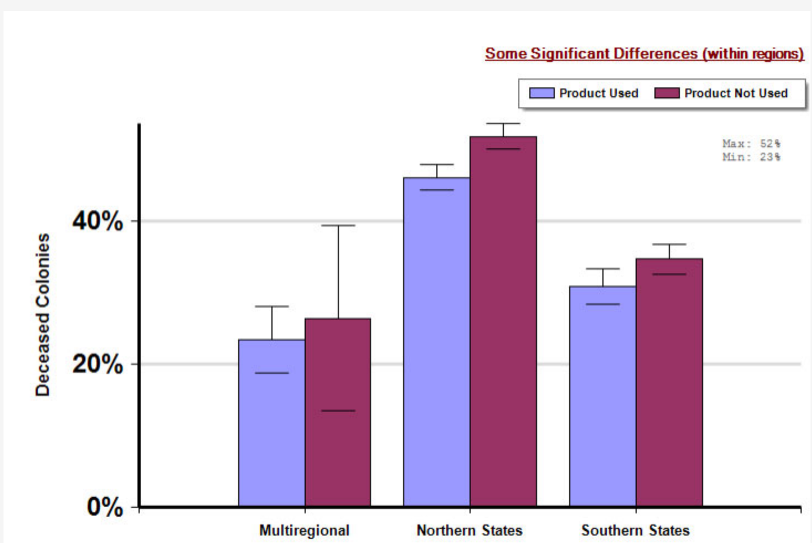

SYSTEMIC


Pesticide Detections by Class
3%
7%
16%
51%
23%
Varroa
Insect
Fung
Herb
Neonic


Total pesticides detected per field
Onion
Black Cap Raspberry
White clover (late)
Carrot
Watermelon (early)
Red clover (early)
White clover (early)
Ornamentals (late)
Crimson clover
Red clover (late)
Ornamentals (early)
Radish
Watermelon (late)
Mustard
Meadowfoam
0 1 2 3 4 5 6 7 8
Number of detected pesticides
Fungicide
Herbicide
Insecticide
Miticide

Nutrition

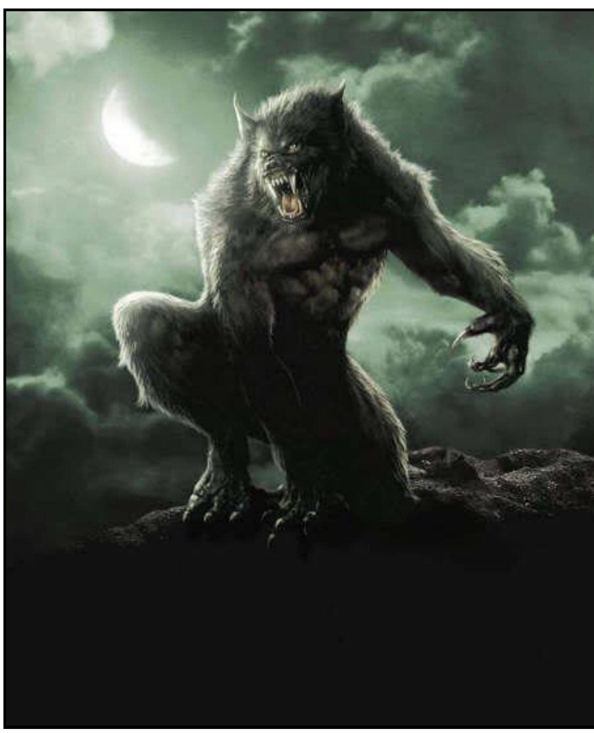
Protein Feed Use By Region





THE BIG 3

WE THOUGHT

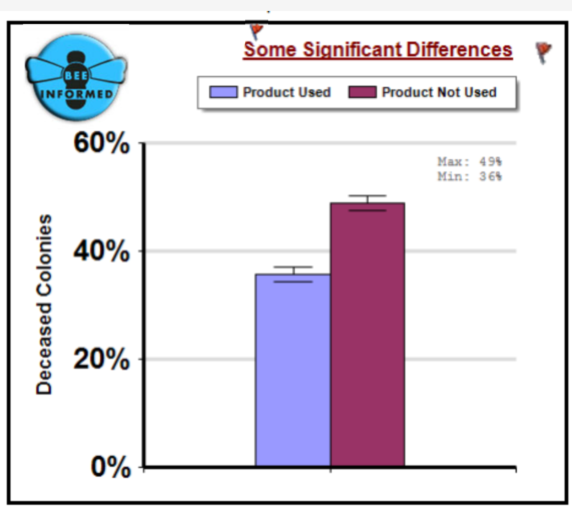


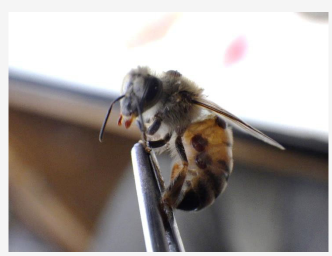
RE-THOUGHT

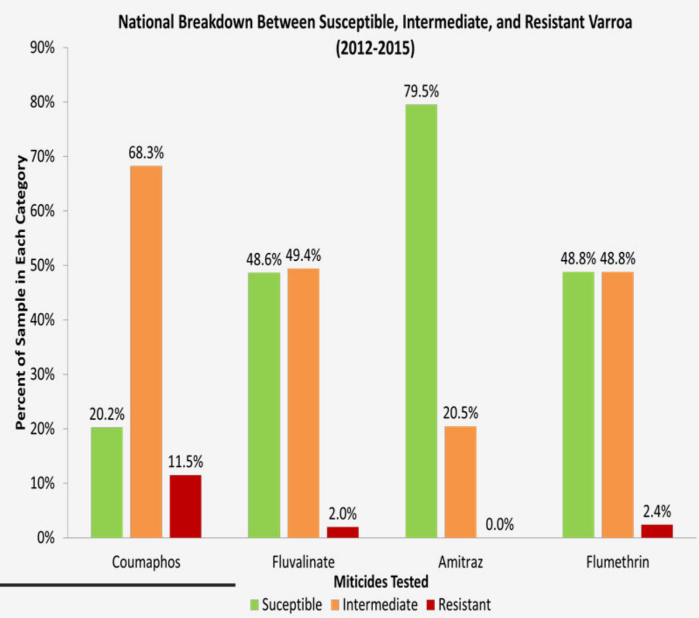


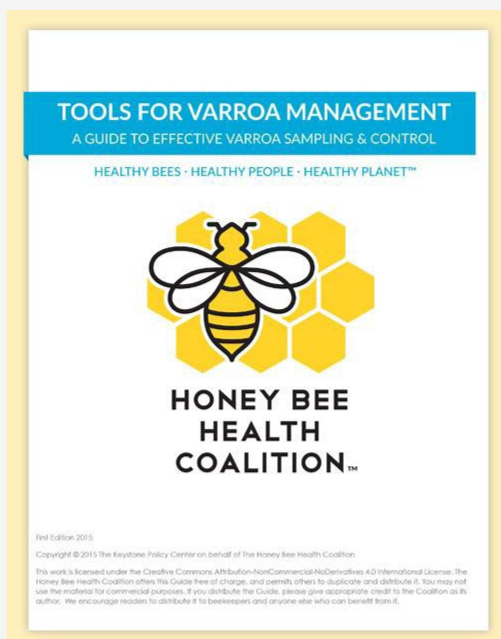
SO WHAT CAN YOU DO?

Known Varroa Control Product Used






National Breakdown Between Susceptible, Intermediate, and Resistant Varroa (2012-2015)
Percent of Sample in Each Category
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
20.2%
68.3%
11.5%
48.6%
49.4%
2.0%
79.5%
20.5%
0.0%
48.8%
48.8%
2.4%
Coumaphos
Fluvalinate
Amitraz
Flumethrin
Miticides Tested
Suceptible
Intermediate
Resistant


TOOLS FOR VARROA MANAGEMENT
A GUIDE TO EFFECTIVE VARROA SAMPLING & CONTROL
HEALTHY BEES · HEALTHY PEOPLE · HEALTHY PLANET™
HONEY BEE
HEALTH
COALITION™

Cornell Pollinator Network: 2016 New York Tech Team Report

https://pollinator.cals.cornell.edu/

Varroa mite control options and considerations

Essential oil | Organic acid | Synthetic chemical

Chemical	Active Ingredient	Method	Efficacy when used appropriately	Cost per colony ($)	Treatment duration	Can you treat with supers on?	Time to wait after treatment ends before you can super
Apiguard®	Thymol	Tray with gel sits on brood frames	74-95%	3.30 - 6.80	28 days (2 times for 14 days each)	No	Can super immediately after treatment ends
Api Life Var®	Thymol, eucalyptus oil, menthol	Tablets placed on the corners of the brood nest	70-90%	4.48 – 7.12	21-30 days (3 times at 7-10 day intervals)	No	1 month
MiteAway Quick Strips®	Formic acid	Pads placed on brood nest	61-98%	4.40 – 7.25	7 days	Yes	Supers can be left on during treatment
Oxalic Acid	Oxalic acid dehydrate	Dribble brood nest or vaporize entrance	82-99%	0.25 – 0.37	10 minutes	No	2 weeks
Hop Guard II®	Hops beta acids	Strips inserted in brood nest	75-99%	3.33 – 3.80	28 days	Yes	Supers can be left on during treatment
Apivar®	Amitraz	Insert strips into brood nest	95%	5.00 – 6.90	42-56 days	No	2 weeks
Apistan®	*Tau*-fluvalinate (pyrethroid)	Insert strips into brood nest	95-99%	4.19 – 6.79	42 days	No	Can super immediately after treatment ends

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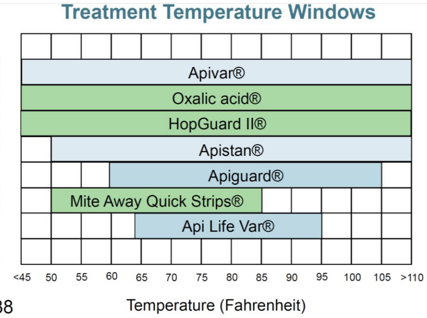
Notes:

- There have been cases of resistance in Apistan®. Varroa mites can develop resistance to any treatment, therefore is important to rotate treatments, remove treatment strips promptly, and practice Integrated Pest Management to reduce the likelihood of resistance developing. Make sure you monitor following treatment (or regularly every month) to determine efficacy.
- Efficacy levels are cited from **Honey Bee Health Coalition, 2017. Tools for *Varroa* management: a guide to *effective Varroa* sampling and control,** 5th edition.
- Treatment costs per colony vary depending on supply companies and order size.

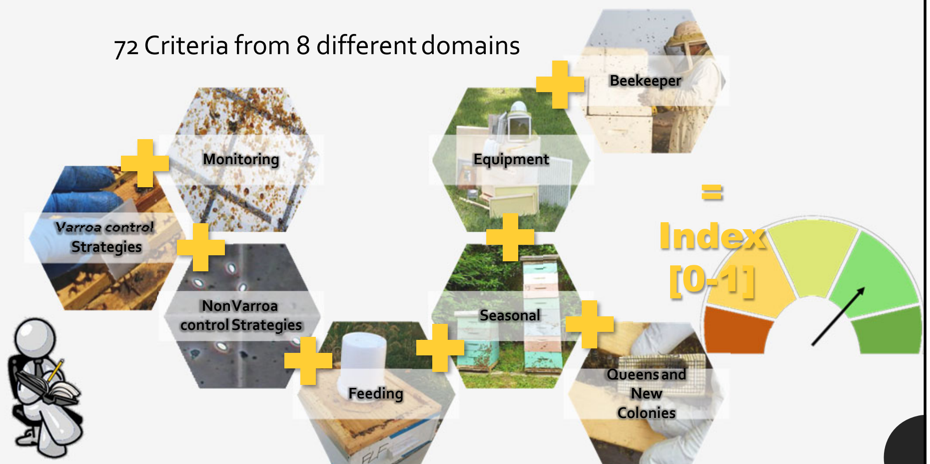
Treatment Temperature Windows



38

Summarized in a Management Index

72 Criteria from 8 different domains



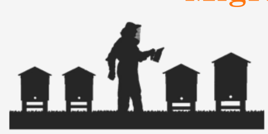
Ranking of Management Practices

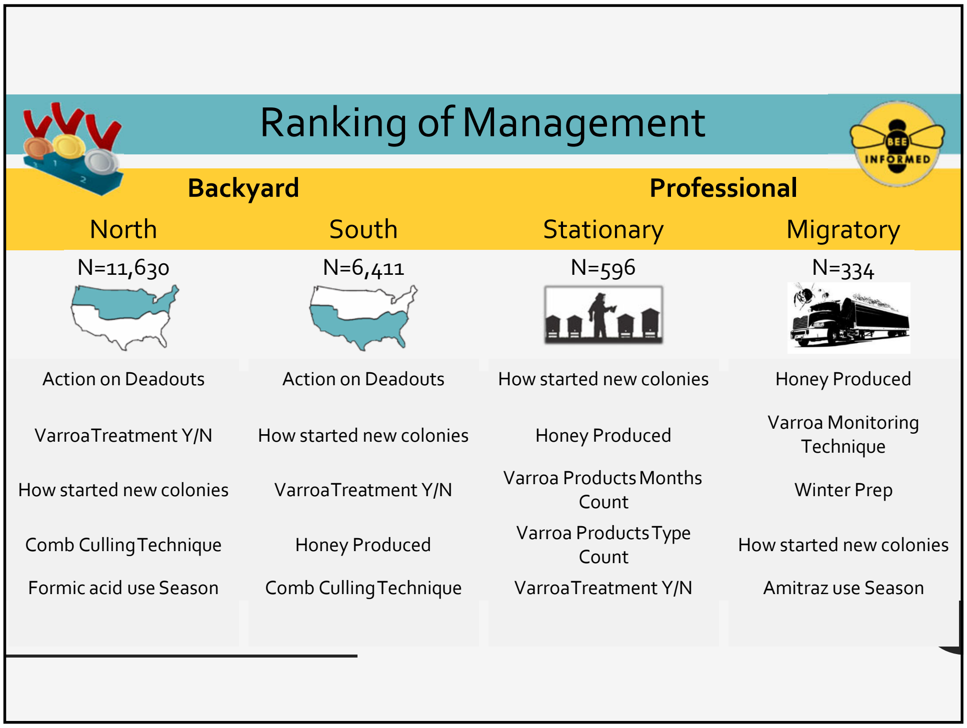
From most influential to least influential component of the index

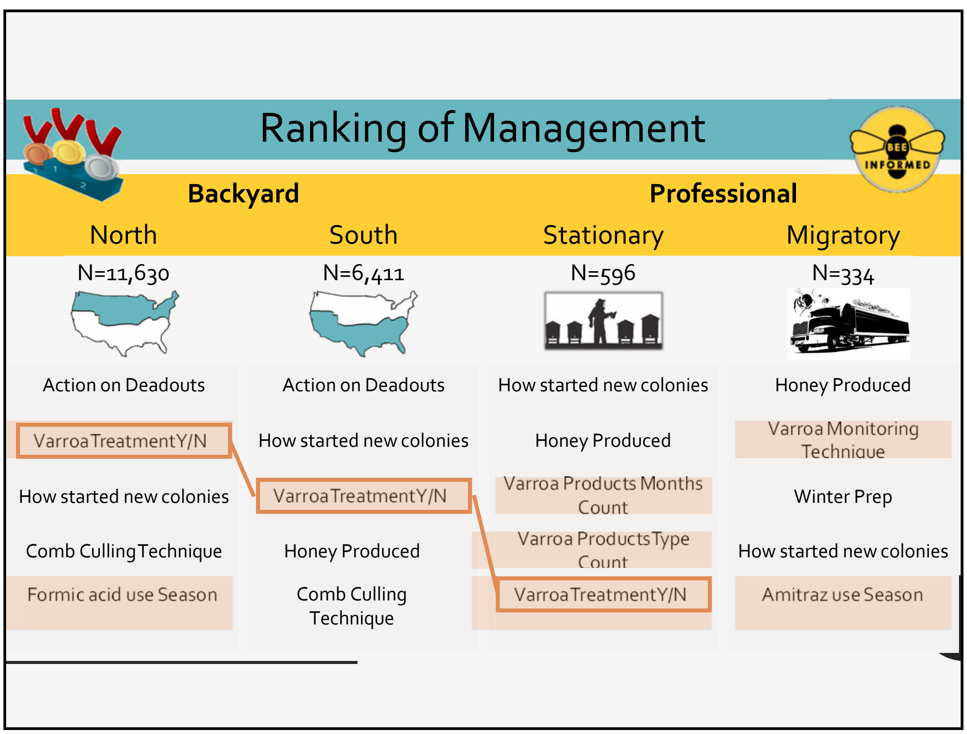
Backyard beekeepers

Professional beekeepers

Stationary
Migratory




Ranking of Management
BEE INFORMED
Backyard
Professional
North
South
Stationary
Migratory
N=11,630
N=6,411
N=596
N=334
Action on Deadouts
Action on Deadouts
How started new colonies
Honey Produced
Varroa Treatment Y/N
How started new colonies
Honey Produced
Varroa Monitoring Technique
How started new colonies
Varroa Treatment Y/N
Varroa Products Months Count
Winter Prep
Comb Culling Technique
Honey Produced
Varroa Products Type Count
How started new colonies
Formic acid use Season
Comb Culling Technique
Varroa Treatment Y/N
Amitraz use Season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BEE INFORMED
Backyard
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N=11,630
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Varroa Treatment Y/N
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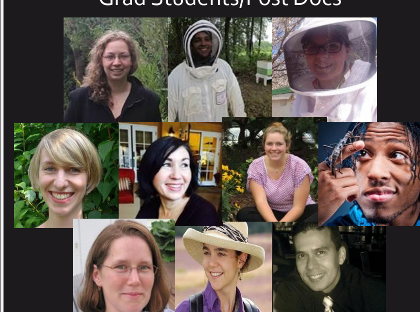
Varroa Products Months Count
Winter Prep
Comb Culling Technique
Honey Produced
Varroa Products Type Count
How started new colonies
Formic acid use Season
Comb Culling Technique
Varroa Treatment Y/N
Amitraz use Season

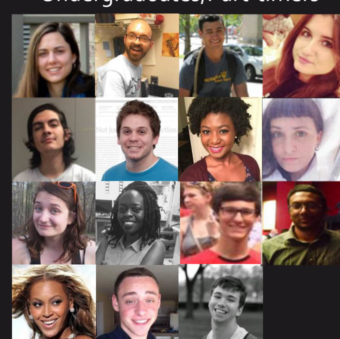
SO WHAT CAN YOU DO?

University of Maryland Honey Bee Lab

Grad Students/Post Docs



Undergraduates/Part-timers



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National Honey Board
EAS Eastern Apicultural Society
LAUNCH UMD
University of Maryland
Maryland Department of Agriculture
North Dakota Department of Agriculture
california almonds
AlmondBoard.com
IHPA
1912-2012
IPM
Project Apis m.


Heather Eversole/Nosema, Varroa Tech
Angela Spleen/Epidemiologist grad student
Rachel Bozarth/Nosema, Varroa Tech
Jessica Pasciak/Economist grad student
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Dan Wyns/PNW team
Alex Jones/HiveCheck
Megan Mahony/TX tech team
Liana Tiegen/FL tech team
The Bee Informed Partnership
www.beeinformed.org

Hot wax painting

Encaustic Painting

With Karen Brock Boger

Class Overview

What is Encaustic Painting?

- Also known as hot wax painting, the process involves using heated beeswax to which colored pigments are added. The word encaustic originated from the greek word “enkaustikos,” which means to burn in, and this element of heat is necessary for a painting to be called encaustic. Although regaining popularity again in the 1990’s, the oldest surviving encaustic panel paintings date back from the 1st century BC.

- In this class the instructor will demonstrate how to do an encaustic painting with a travel iron. Volunteers from the class can also participate creating their own encaustic painting .

What are Encaustic Paints and How to use them:

- General information about encaustic paints
- Setting up a safe and useful workspace
- Suggestions for tools and equipment
- Discussion and demo of basic methods and helpful hints for working with encaustics
- Setting up your toolbox

Review of Materials and where to purchase

Notes:

Honey Bee Basics

What Is A Honey Bee, Taxonomically? (The Honey Bee Family Tree)

- Kingdom: Animalia (multi-cellular, heterotrophic eukaryotes)
    1. Phylum: Arthropoda (animals with segmented bodies, exoskeletons, and jointed appendages)
        - Class: Insecta (arthropods with 3 pairs of legs and, typically, a head, thorax, and abdomen)
            - Order: Hymenoptera (insects with 2 pairs of membranous wings that exhibit complete metamorphosis)
                - Family: Apidae (generally fuzzy, long-tonged bees)
                    - Genus: *Apis* (honey bees)

What Is A Honey Bee, Anatomically? (Notable Honey Bee Features)

- Fuzzy! Honey bees have exoskeletons covered in specialized hairs to collect pollen with.
- Striped, black and yellow-orange abdomens
- 3 pairs of legs, and 3 body segments (head, thorax, abdomen)
- 2 pairs of membranous wings
    1. At rest, these wing pairs are connected by tiny, Velcro-like hooks called “hamuli”
- Medium length antennae compared to wasps (long antennae) and flies (short antennae)
- Corbiculae (i.e., pollen baskets): a concave section of the hind legs with long, curved hairs used to pack and store pollen during foraging flights
    1. Among honey bees, these are only found on workers (not in drones or queens).
- In female honey bees, a stinger
    1. The stinger is only found in females, because the stinger is a modified ovipositor (i.e., egg-laying body structure).
        - This rule can be extended to all bees: only the females can sting.

Honey Bee Sociality

- Honey bees, unlike most bee species, are eusocial and the honey bee colony functions as a superorganism.
    1. As a superorganism, the colony is able to accomplish tasks that an individual honeybee cannot accomplish well on their own (e.g., hive thermoregulation, swarming).
    2. The three characteristics of eusociality are:
        - Cooperative brood (i.e., young, developing bees) care
        - Overlapping generations of adults in the group
        - Division of labor into reproductive and non-reproductive groups
            - In honey bees, these groups are referred to as castes
- Haplodiploidy: the sex determination mechanism in honey bees
    1. A honey bee’s sex is determined by the number of sets of chromosomes it has.
        - Females in the colony (i.e., workers and the queen) are diploid.

            - This means they have 2 sets of chromosomes. One set comes from the queen and the other set comes from a drone with which she has mated.
        - Males in the colony (i.e., drones) are haploid.
            - This means they have 1 set of chromosomes. This set comes from the female alone, which would be the queen in a healthy colony.
                - In a queen-less colony, workers can sometimes lay eggs due to the lack of the regulating queen pheromone. This is abnormal and the sign of a failing colony. Because workers do not mate with males, their eggs only have 1 set of chromosomes and will become drones.

The Honey Bee Castes

- The Queen
    1. The only reproductive female in colony
        - Mates with drones from other colonies
            - Queens produce pheromones that prevent workers from laying eggs.
    2. Characterized by a very long abdomen
    3. Diploid
        - Even though workers and queens have the same number of chromosomes, female bees become queens, instead of workers, because of a difference in diet during development.
            - Brood food vs. royal jelly
                - Brood food: secretions from the worker bee's hypopharyngeal glands and mandibular glands
                - Royal jelly: secretions from the mandibular glands + sugars
            - Mass vs. progressive provisioning
                - Mass provisioning: continuous providing of food
                - Progressive provisioning: providing food as needed
            - Female larvae have the potential to become either a queen or worker during the first 3 days of development
                - Female larvae that are mass provisioned and given a higher ratio of royal jelly to brood food will become a queen.
                - Female larvae that are progressively provisioned and given a higher ratio of brood food to royal jelly will become a worker
- Workers
    1. Non-reproductive females which accomplish the non-reproductive functions of the colony
        - Temporal polyethism
            - Workers have different jobs in the hive based on their age. This is flexible dependent on the needs of the colony.
                - Hive maintenance

            - Brood care
            - Colony defense
            - Foraging
        - As a worker ages, the risk of their tasks increases. Workers start off maintaining the hive and caring for young. Older workers have riskier tasks associated with colony defense and resource foraging.
    2. Diploid
    3. The majority of bees in a colony
    4. Relatively small compared to the other castes
- Drones
    1. Reproductive males
    2. Haploid
    3. Notable physical characteristics:
        - Larger and rounder than workers
        - Large fly-like eyes used to visually identify queens during mating flights
        - Does not possess a stinger
    4. Present at low numbers in warmer seasons, but absent in Winter
        - Drones are kicked out of the hive by workers as Winter arrives, because they do not take part in non-reproductive tasks and are a drain on honey reserves.

Honey Bee Development

- Honey bees go through 4 primary life stages (in order):
    1. Egg
    2. Larva
    3. Pupa
    4. Adult
        - Stages 1-3 take place in the comb and are commonly referred to as “brood”.
- Eggs
    1. Eggs look like miniscule grains of rice.
        - They are deep in the cell and difficult to see without proper lighting.
    2. Usually 1 egg in each cell
        - Multiple eggs in a cell can be the sign of an egg-laying worker.
    3. The presence of eggs is evidence that your queen is also present in the hive.
- Larvae
    1. Larvae look like small, white worms.
        - They become larger as they age.
    2. Uncapped larvae lay on their side in the cell and form a c-shape.
- Pupae
    1. Pupae are not normally visible, because the comb is capped during this stage of development.
        - Also referred to as “capped brood”
- Adults
    1. Bees emerge from the comb when they are adults

2. Adults are the only life stage that are capable of free-movement and capable of leaving the hive.
3. Adults cannot sting or fly immediately after emergence.

- Recognizing Different Castes
    1. By cell shape and size
        - Workers: “standard” cell shape
        - Drones: slightly larger than worker cells and bullet-shaped
        - Queens: large, pulled-out, vertical “queen cup”
    2. By age at stages of development (by days):
        - Workers
            - Egg: 3
            - Larva: 6
            - Pupa: 12
            - Total: 21
        - Drones
            - Egg: 3
            - Larva: 6.5
            - Pupa: 14.5
            - Total: 24
        - Queens
            - Egg: 3
            - Larva: 5.5
            - Pupa: 7.5
            - Total: 16
    3. By life span
        - Workers: weeks-months dependent on season
            - Workers live longer during winter months due to the development of “fat bodies” (i.e., fat storing structures in the workers’ bodies).
        - Drones: 40-50 days
        - Queens: 2-5 years

Hive Resources

- Honey bee foragers collect 4 resources for use in the hive:
    1. Pollen
        - Derived from flower anthers
        - The primary source of protein in the colony
        - Important for brood production and development
        - Stored in comb and used to make “bee bread” consumed by adults.
    2. Nectar
        - Derived from floral nectaries
        - The primary carbohydrate (energy) source
        - Stored in comb and used to make honey
            - Important for keeping the colony alive in winter
    3. Water

- Used to dilute honey
- Can cool the hive through evaporation
- Keeps bees hydrated

4. Tree Resin
   - Used to make propolis
     - Seals openings in this hive to reduce danger from pests, pathogens, predators, and weather
     - Provides additional structural integrity to the hive
     - Anti-microbial
     - Why beekeepers use hive tools! Propolis seals together components of hive boxes.

References

1. Ayers et al. (2015). *The Hive and the Honey Bee*. Hamilton, Illinois: Dadant & Sons, Inc.
2. Sanford & Bonney (2010). *Storey's Guide to Keeping Honey Bees*. North Adams, Massachusetts: Storey Publishing.

Honey Bee decline?
A historical perspective

Bram Cornelissen

October 2018, Bee College, Gainesville

ARNHEMSE COURANT 23/2

13

Verdwijnen bijen ramp voor tuinders

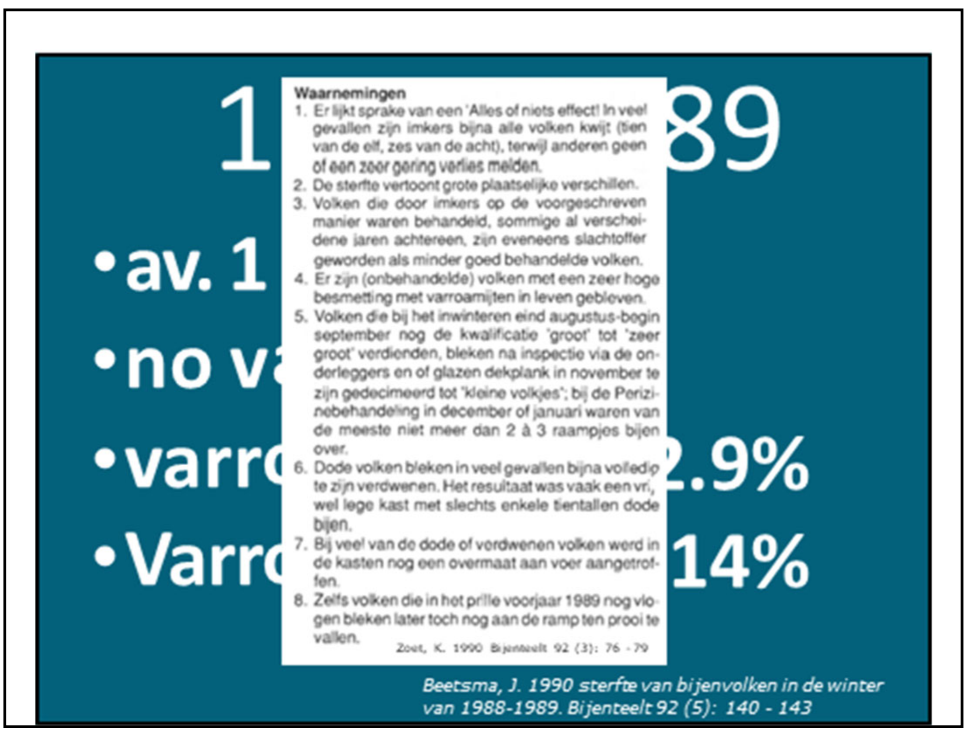

Winter mortality
(van Engelsdorp et al. 2010, Ratnieks and Carreck, 2010)

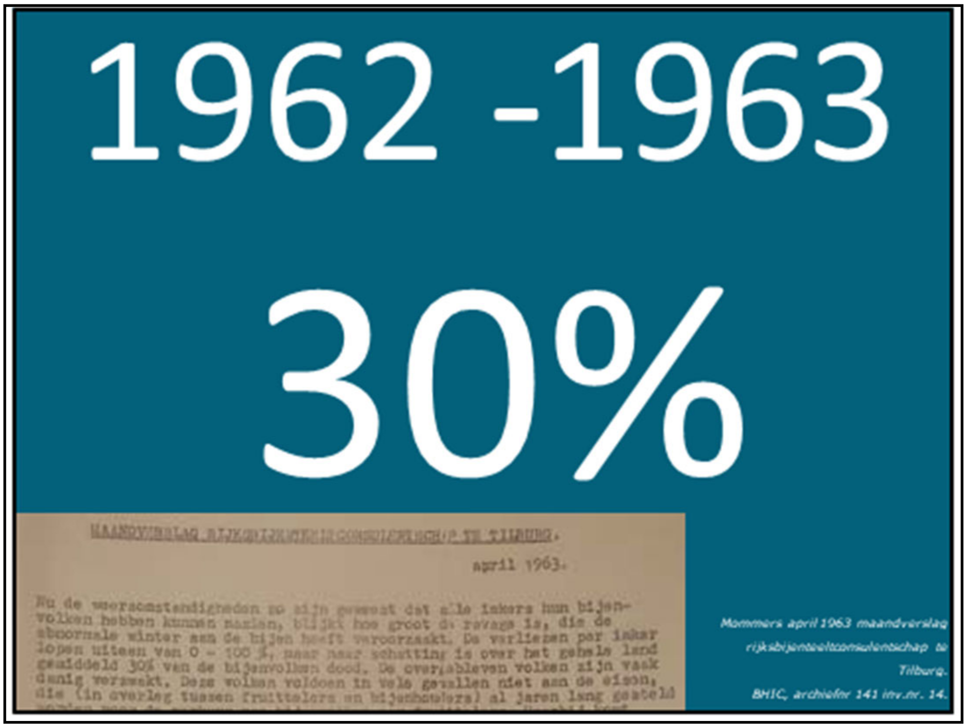

No single driver has emerged as a definitive cause
(Potts et al, 2010)

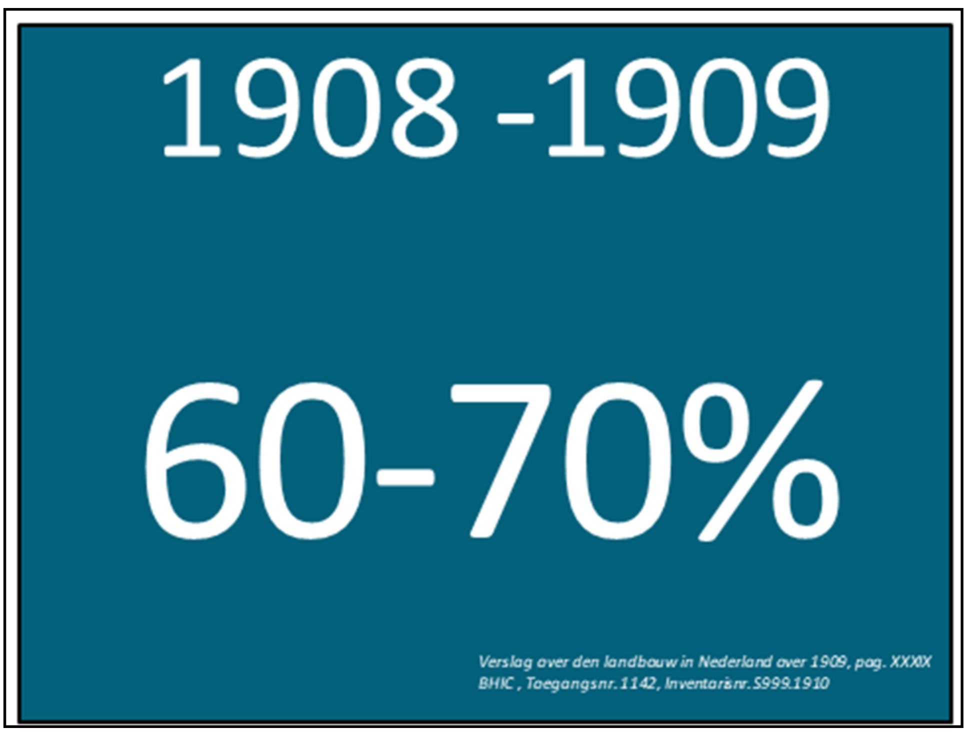

How bad is it?


Or, how good was it back in the old days?
SKYSCRAPER HIVES
which, in a good season, produced more than 200 pounds of surplus honey each


Winter mortality in the Netherlands 2001-2016
Yearly winter losses
2015-16
2014-15
2013-14
2012-13
2011-12
2010-11
2009-10
2008-09
2007-08
2006-07
2005-06
2004-05
2003-04
2002-03
2001-02
2000-01
6.5
10
9
14
22
22
23
21
23
15
26
15
18
15
12
0
5
10
15
20
25
30
% losses
Data are based on surveys by Bees@wur from Wageningen University and Research, by beekeepers associations NCB/ZLTO and by Beemonitoring.org. Most data are from voluntary responses to enquiries with many questions. The data from 2013-2016 are based on an active telephone poll by bees@wur and the NBV in April among a random sample of the members of the beekeeping associations.


1
89
•av. 1
•no v
•varr
.9%
•Varr
14%
Waarnemingen
1. Er lijkt sprake van een 'Alles of niets effect! In veel gevallen zijn imkers bijna alle volken kwijt (tien van de elf, zes van de acht), terwijl anderen geen of een zeer gering verlies melden.
2. De sterfte vertoont grote plaatselijke verschillen.
3. Volken die door imkers op de voorgeschreven manier waren behandeld, sommige al verschei-dene jaren achtereen, zijn eveneens slachtoffer geworden als minder goed behandelde volken.
4. Er zijn (onbehandelde) volken met een zeer hoge besmetting met varroamijten in leven gebleven.
5. Volken die bij het inwinteren eind augustus-begin september nog de kwalificatie 'groot' tot 'zeer groot' verdienden, bleken na inspectie via de on-derleggers en of glazen dekplank in november te zijn gedecimeerd tot "kleine volkjes"; bij de Perizi-nebehandeling in december of januari waren van de meeste niet meer dan 2 à 3 raampjes bijen over.
6. Dode volken bleken in veel gevallen bijna volledig te zijn verdwenen. Het resultaat was vaak een vrij wel lege kast met slechts enkele tientallen dode bijen.
7. Bij veel van de dode of verdwenen volken werd in de kasten nog een overmaat aan voer aangetrof-fen.
8. Zelfs volken die in het prille voorjaar 1989 nog vlo-gen bleken later toch nog aan de ramp ten prooi te vallen.
Zoet, K. 1990 Bijenteelt 92 (3): 76 - 79
Beetsma, J. 1990 sterfte van bijenvolken in de winter van 1988-1989. Bijenteelt 92 (5): 140 - 143


1962 -1963
30%
april 1963.
Nu de weersomstandigheden zo zijn geweest dat alle imkers hun bijen-
volken hebben kunnen nazien, blijkt hoe groot de ravage is, die de
abnormale winter aan de bijen heeft veroorzaakt. De verliezen per imker
lopen uiteen van 0 - 100 %, maar naar schatting is over het gehele land
gemiddeld 30% van de bijenvolken dood. De overgebleven volken zijn vaak
danig verzwakt. Deze volken voldoen in vele gevallen niet aan de eisen,
die (in overleg tussen fruittelers en bijenhouders) al jaren lang gesteld
Mommers april 1963 maandverslag rijksbijenteeltconsulentschap te Tilburg.
BHIC, archiefnr 141 inv.nr. 14.


1908 -1909
60-70%
Verslag over den landbouw in Nederland over 1909, pag. XXXIX
BHIC , Toegangsnr. 1142, Inventarisnr. S999.1910

timeline	winter mortality	Causes
1828 - 1829	90% in Liège + Brabant	bad honey harvest, no colony development
1908-1909	60-70% in sommige streken	hunger, bad harvest
1946 – 1947	35%	long harsh winter
1962 – 1963	30%	long harsh winter
1987 – 1988	13.8%	No varroa : 1% Varroa - ctrl: 32% Varroa + ctrl: 11%
1988 - 1989	14.8%	Geen varroa: 5.5% Varroa - ctrl: 42.9% Varroa + ctrl: ~14%
1993 - 1994	10.7%	top 3 according to beekeepers: diseases, queen failure, lack of food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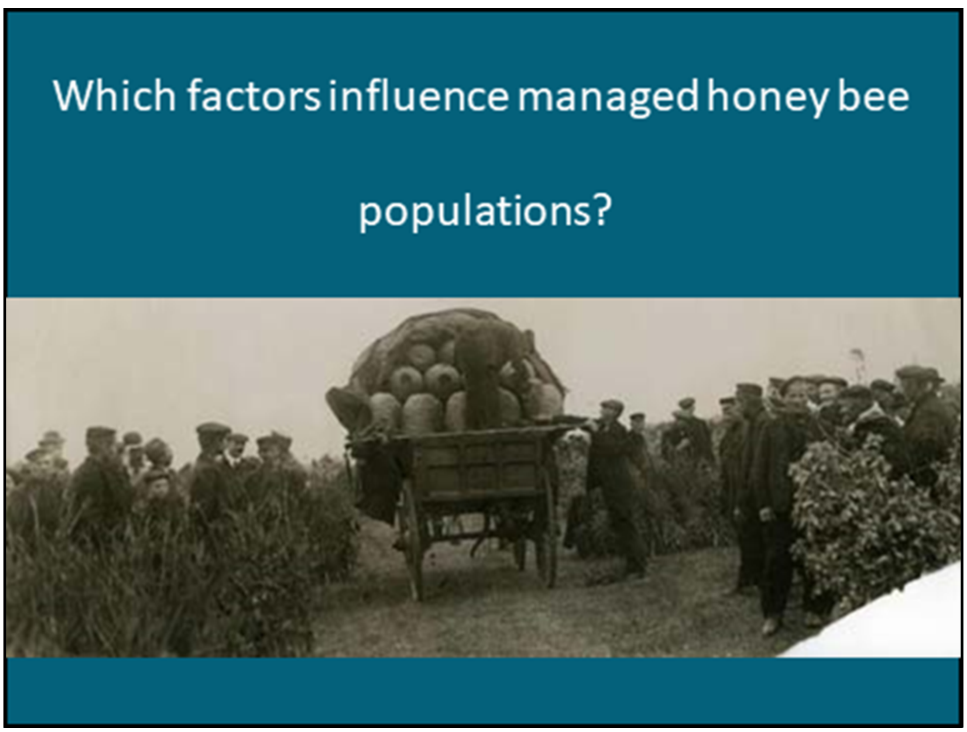
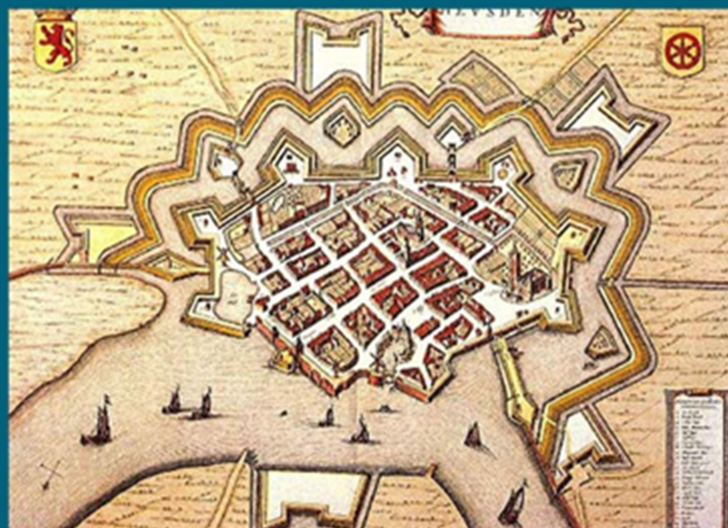
2012-13
2011-12
2010-11
2009-10
2008-09
2007-08
2006-07
2005-06
2004-05
2003-04
2002-03
2001-02
2000-01
6.5
10
9
14
22
22
23
21
23
15
26
15
18
15
12
0
5
10
15
20
25
30
% losses
Data are based on surveys by Bees@wur from Wageningen University and Research, by beekeepers associations NCB/ZLTO and by Beemonitoring.org. Most data are from voluntary responses to enquiries with many questions. The data from 2013 -2016 are based on an
active telephone poll by bees@wur and the NBV in April among a random sample of the members of the beekeeping associations.


Which factors influence managed honey bee populations?

Ghijsbrecht Jan from Venlo (1379)

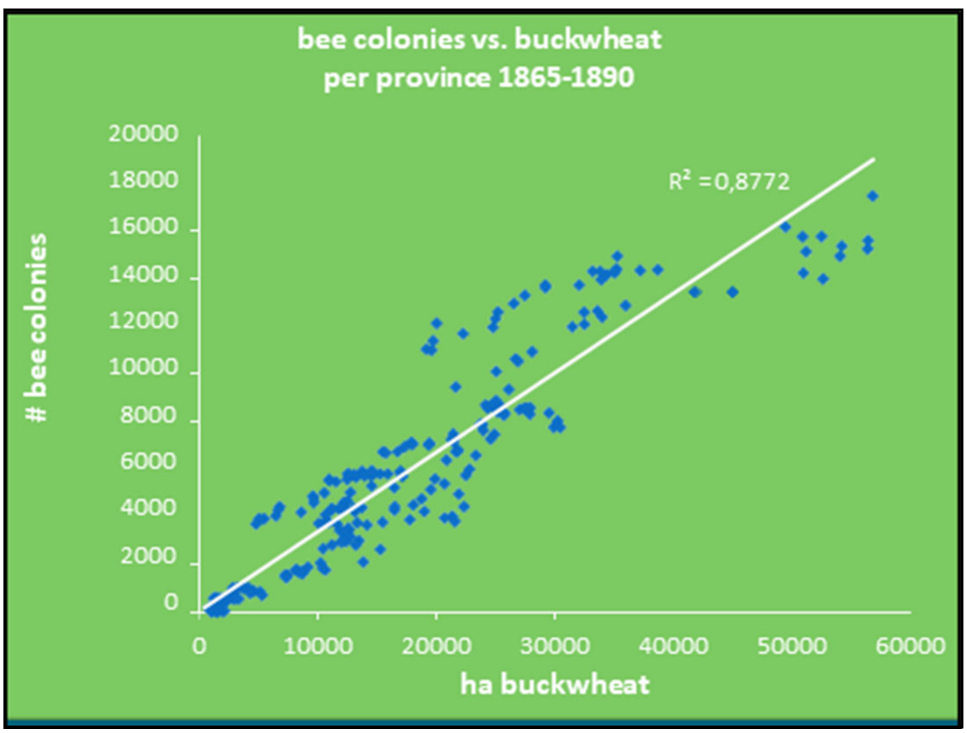


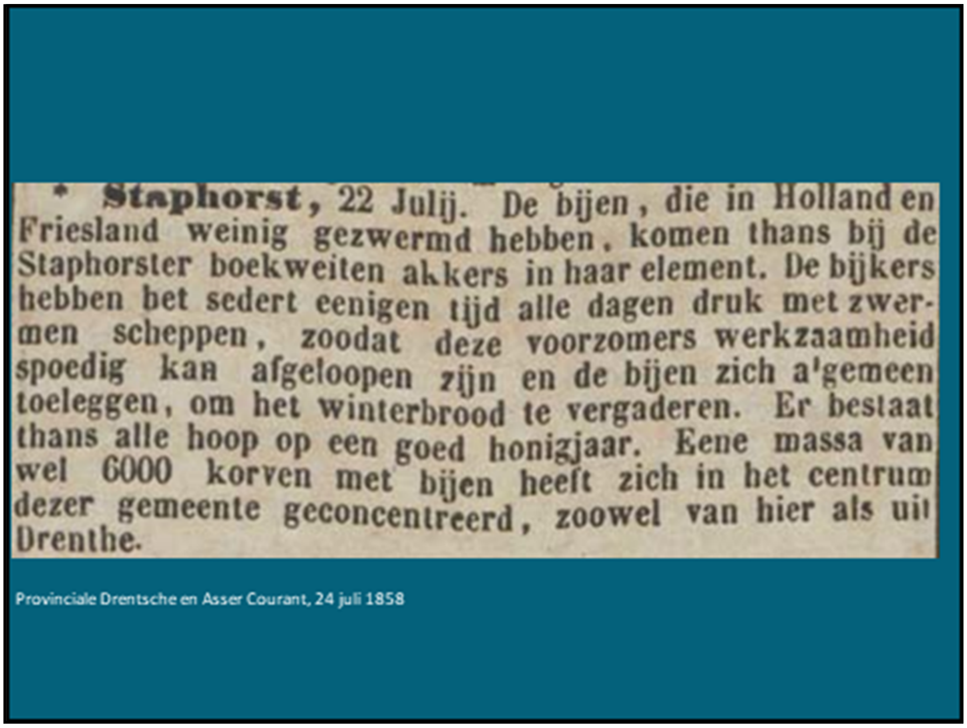
Toll of Gleede 1532-1534

YEAR	Beekeepers	#colonies
1532	20	34 (20 – 87)
1534	15	37 (9-72)

Anoniem 1996 geschiedenis van dordrecht tot 1572

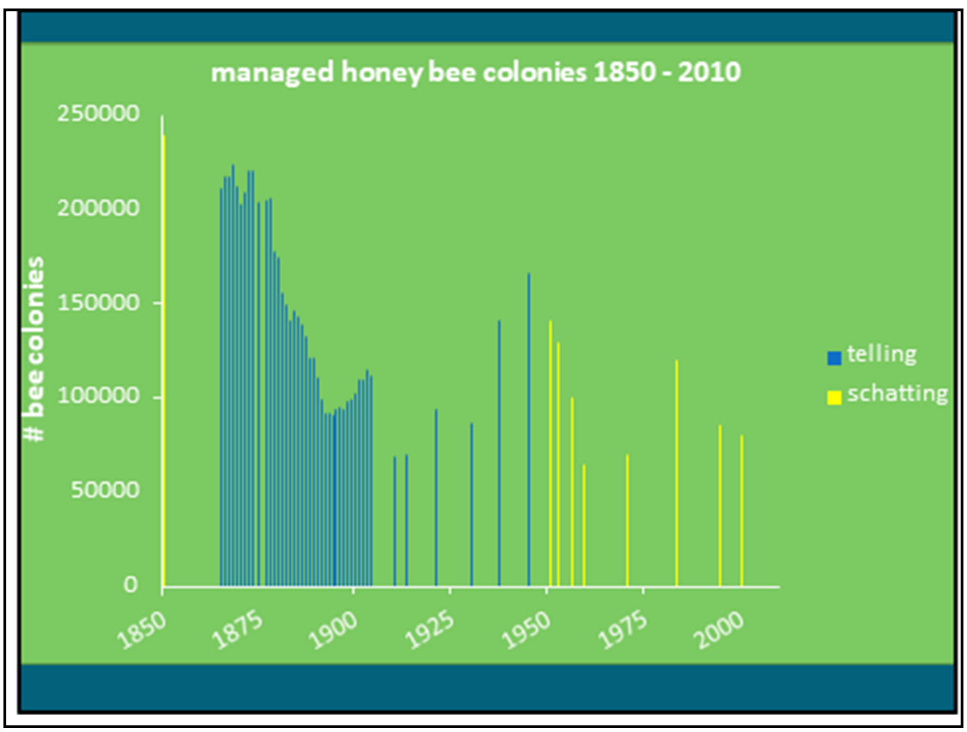
- Most travelling from the south
- In company of others
- From mid March
- Until the end of June


bee colonies vs. buckwheat
per province 1865-1890
bee colonies
ha buckwheat
R^2 = 0,8772
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
0
10000
20000
30000
40000
50000
60000



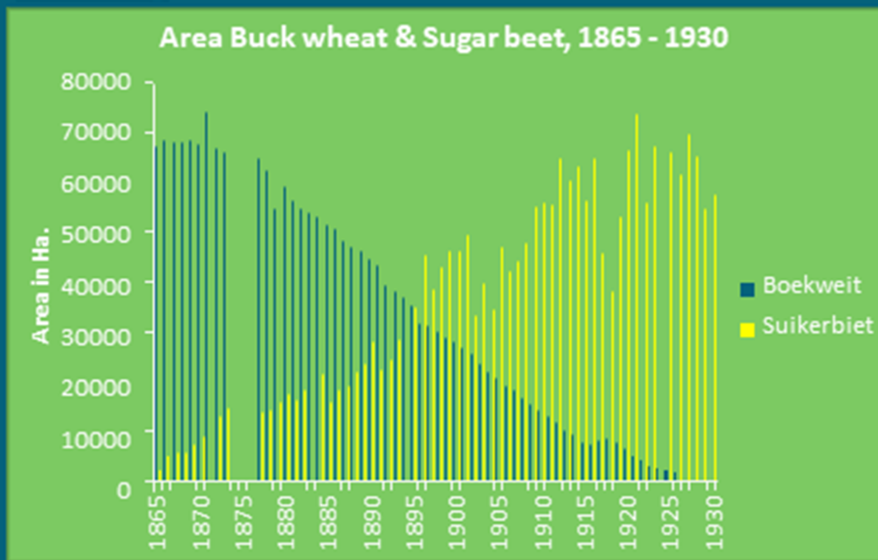
* **Staphorst,** 22 Julij. De bijen, die in Holland en Friesland weinig gezwermd hebben, komen thans bij de Staphorster boekweiten akkers in haar element. De bijkers hebben het sedert eenigen tijd alle dagen druk met zwermen scheppen, zoodat deze voorzomers werkzaamheid spoedig kan afgeloopen zijn en de bijen zich algemeen toeleggen, om het winterbrood te vergaderen. Er bestaat thans alle hoop op een goed honigjaar. Eene massa van wel 6000 korven met bijen heeft zich in het centrum dezer gemeente geconcentreerd, zoowel van hier als uit Drenthe.

Provinciale Drentsche en Asser Courant, 24 juli 1858



1850 – 1910

from ±240.000 to 69.406 bee colonies

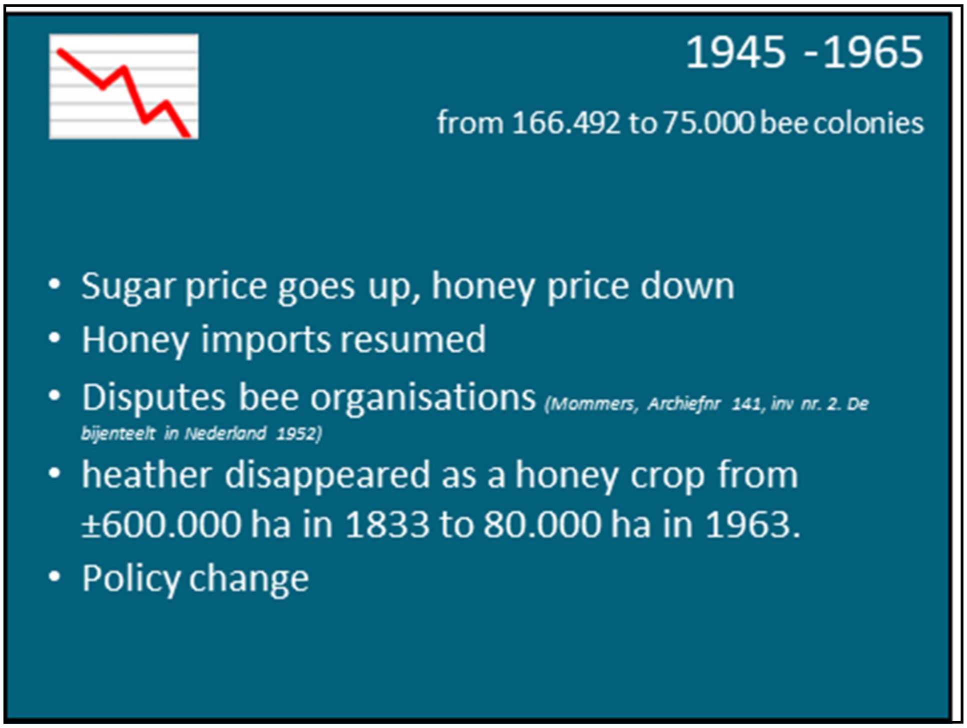


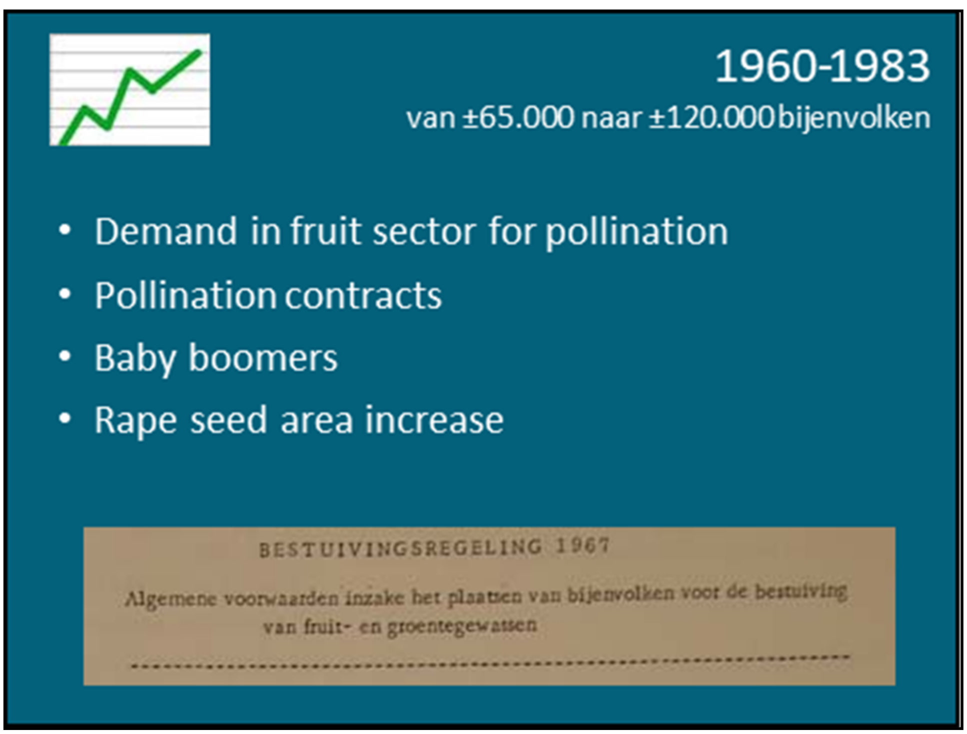
1910 – 1945

from 69.406 to 166.492colonies

- Beekeepers are organizing
- Science & Education
  - pollination
  - policy
  - method improvement
- >1909: Tax free sugar
- Good honey price
- WWII
  - No foreign honey imports
  - Scarcity
  - Tabaco beekeepers

Examencommissie 10-8-1940, Wageningen. Vlnr. Lauwers, Tilmans, Lammerink, Vroemen, Mommers, Lijkmans (?), Joustra

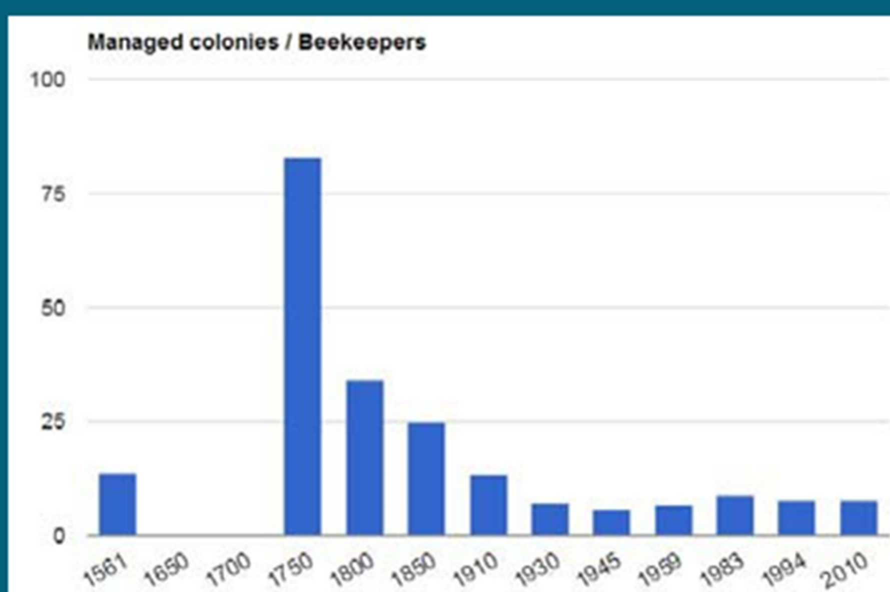

1945 -1965
from 166.492 to 75.000 bee colonies
• Sugar price goes up, honey price down
• Honey imports resumed
• Disputes bee organisations (Mommers, Archiefnr 141, inv nr. 2. De bijenteelt in Nederland 1952)
• heather disappeared as a honey crop from ±600.000 ha in 1833 to 80.000 ha in 1963.
• Policy change


1960-1983
van ±65.000 naar ±120.000 bijenvolken
• Demand in fruit sector for pollination
• Pollination contracts
• Baby boomers
• Rape seed area increase
BESTUIVINGSREGELING 1967
Algemene voorwaarden inzake het plaatsen van bijenvolken voor de bestuiving van fruit- en groentegewassen

1983 – 2010

van 120.000 naar 80.000 bijenvolken

- New pests and pathogens
- Sustained winter mortality
- Government support decreased
- Ageing beekeepers



'many factors influence beekeeping which in itself has the most dramatic effect on managed bee populations.'

(van Engelsdorp & Meixner, 2010 A historical review of managed honey bee populations. J. Inv. Path.)

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Lost colonies found in a data mine: Global honey trade but not pests or pesticides as a major cause of regional honeybee colony declines

Robin F.A. Moritz[a,b,c,*], Silvio Erler[a]

drivers are

- sociological
- economical
- political

Europe (empty circles), Southern Europe (filled circles) and whole world (grey circles).

2017 -.....
from 80.000 to .... colonies

- Awareness
- We have more beekeepers
  - younger
  - alternative motive

Questions?

Honey Bee Mating Biology

Reducing inbreeding and encouraging drone diversity

Mary Bammer
Honey Bee Research and Extension Lab
University of Florida

- **Let's start at the beginning...**

A colony rears a new queen

Swarming

- - OR - -

Supercedure

These *reproductives* are not of value to the colony until they mate.

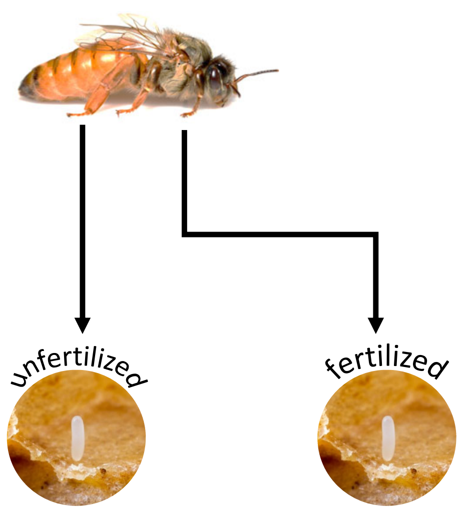
Where do honey bees mate?

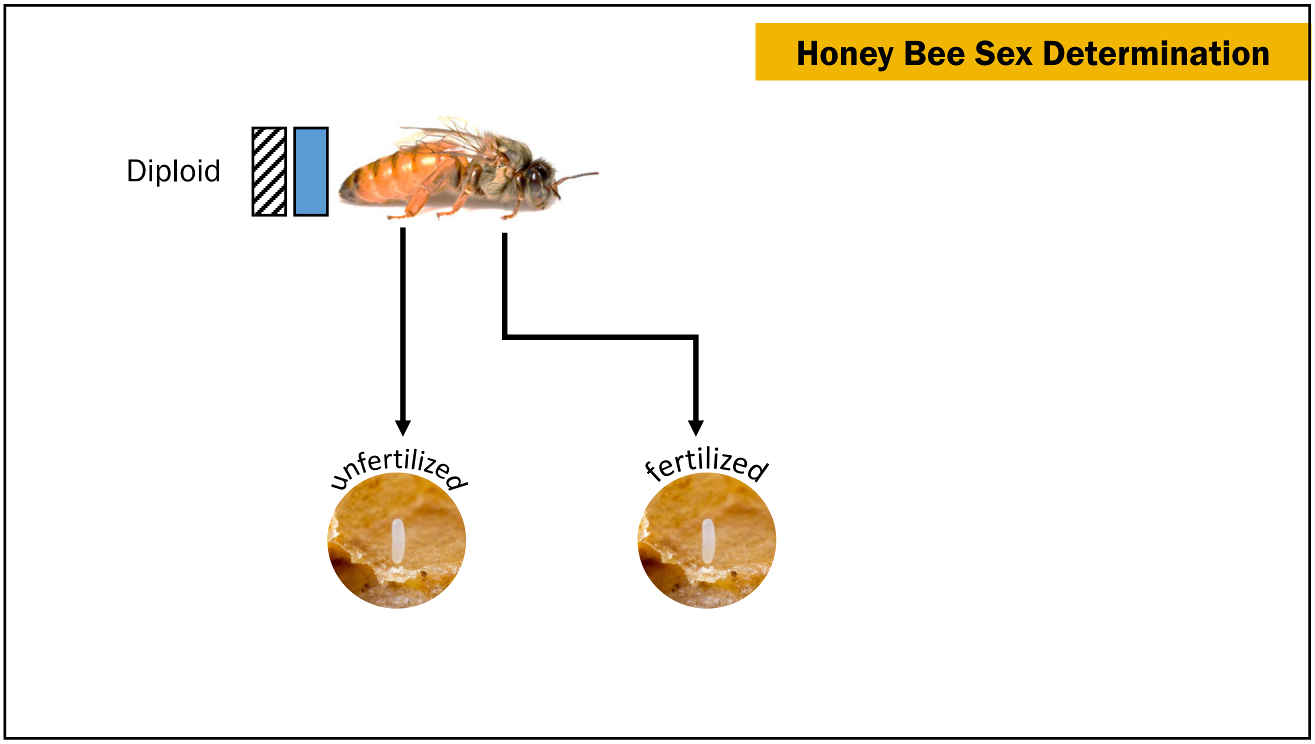
Where do honey bees mate?

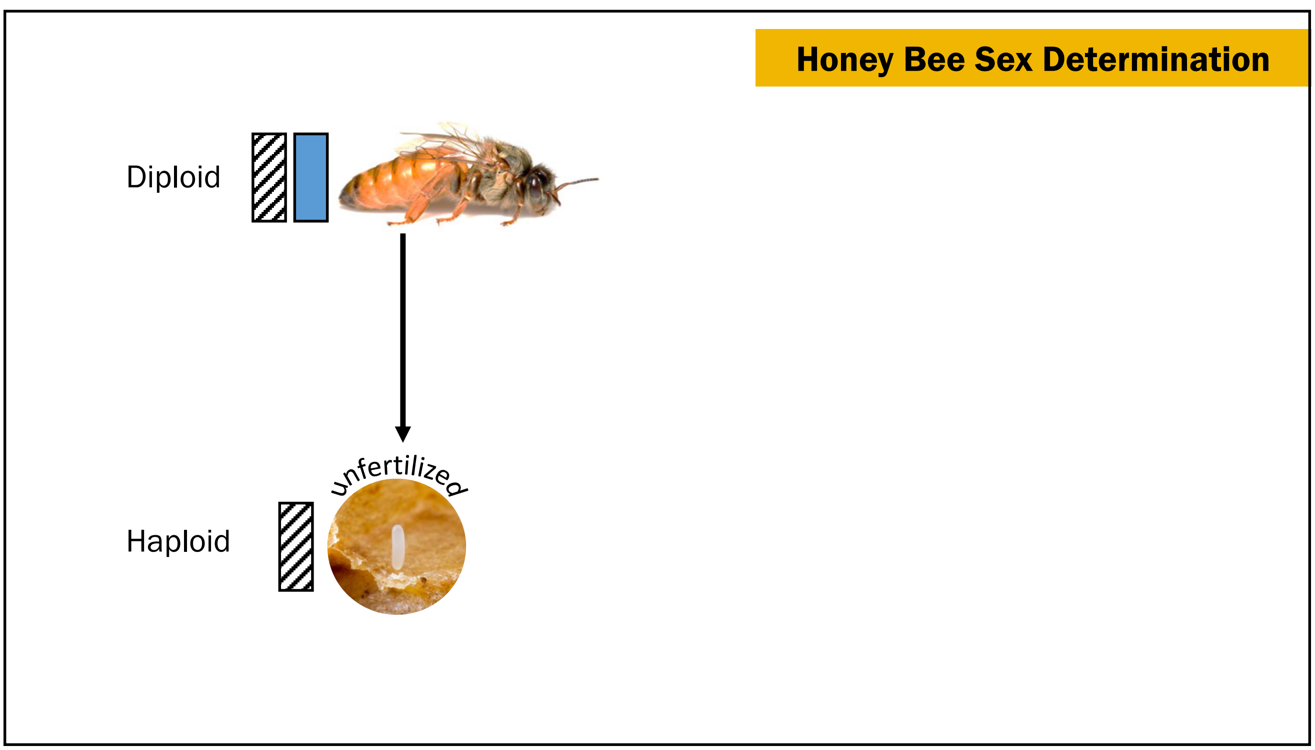
They mate <u>outside</u> of the hive

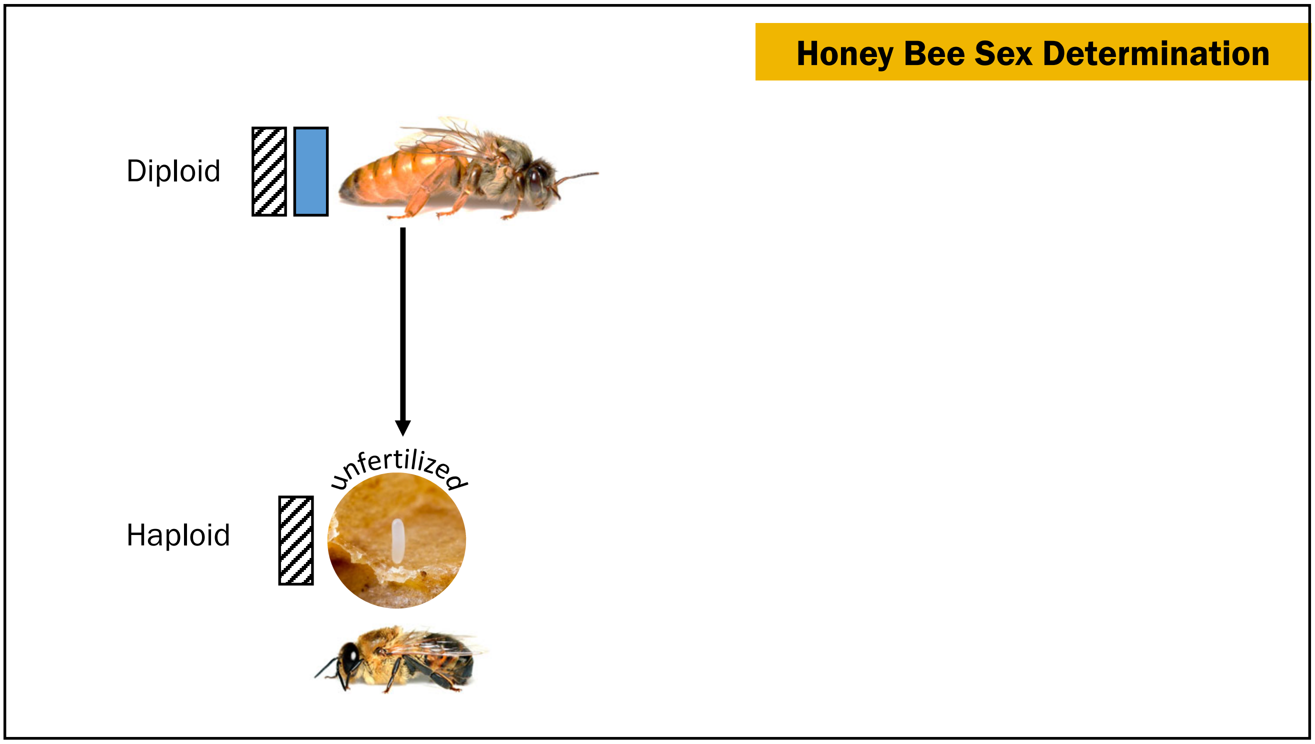
They mate outside of the hive

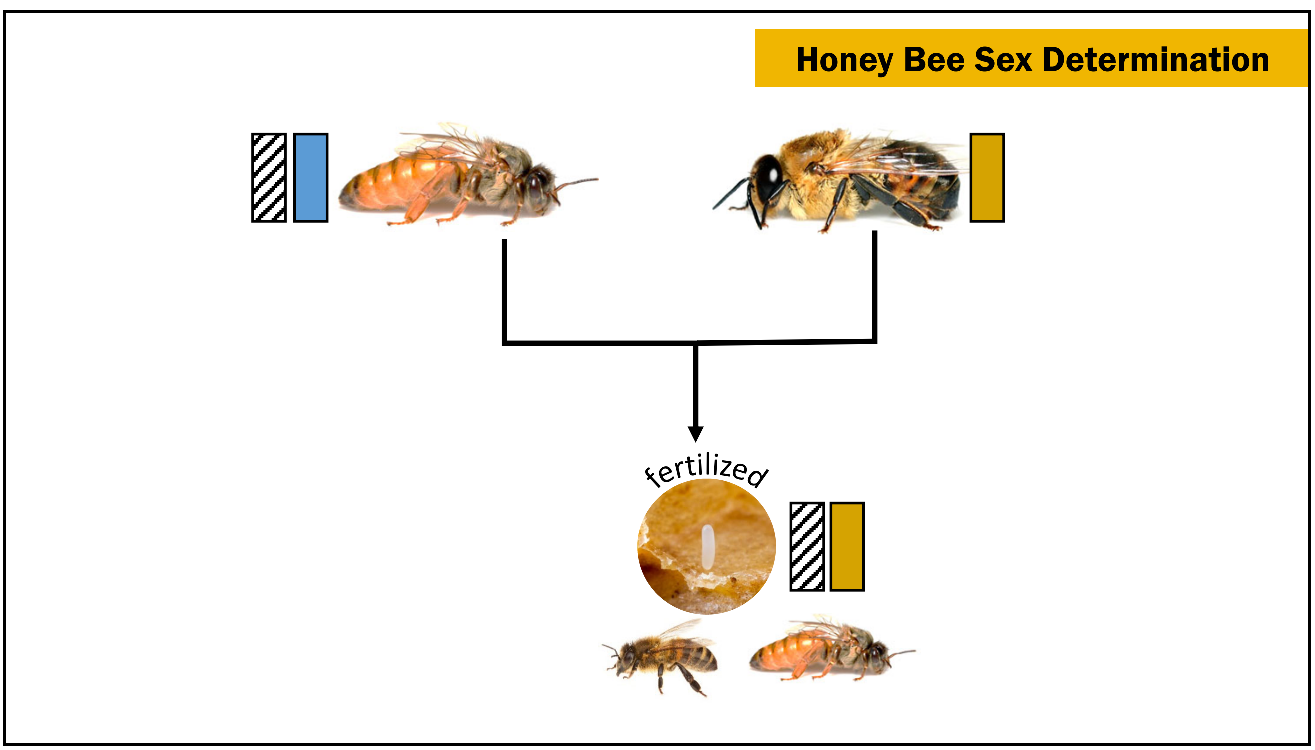
Honey Bee Sex Determination

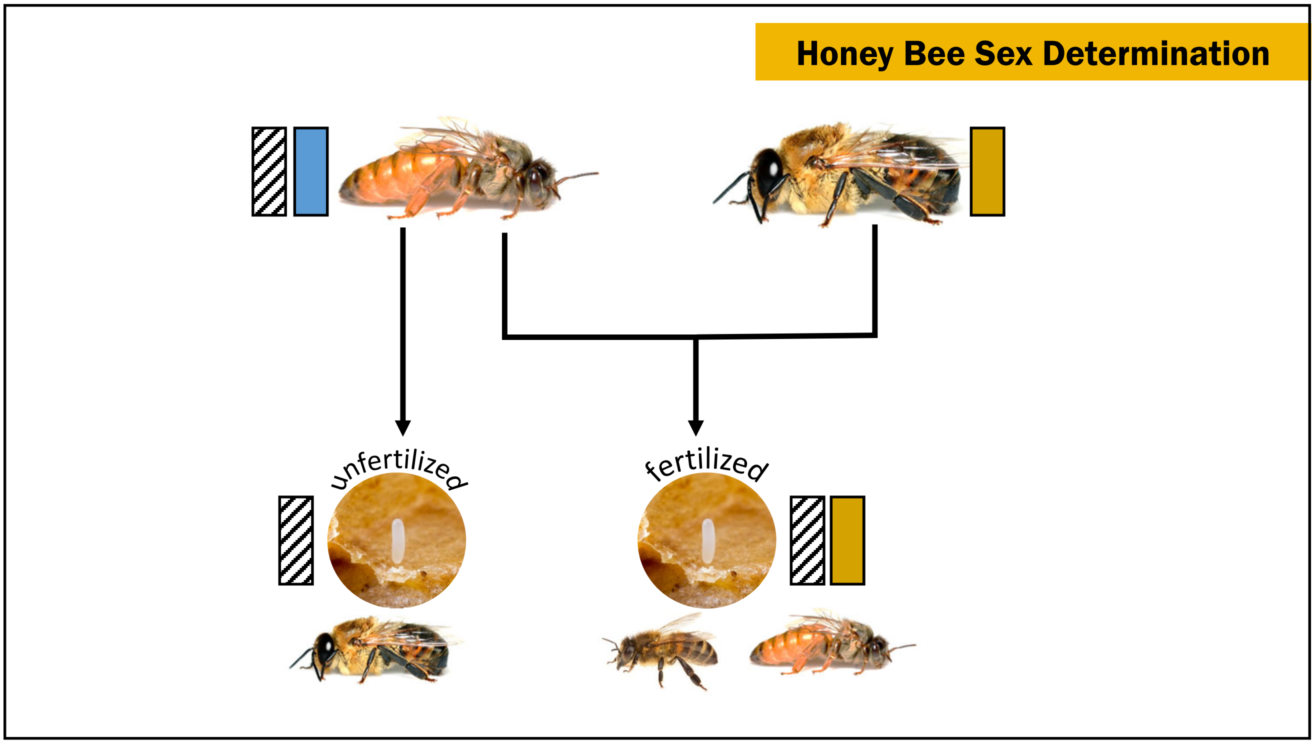


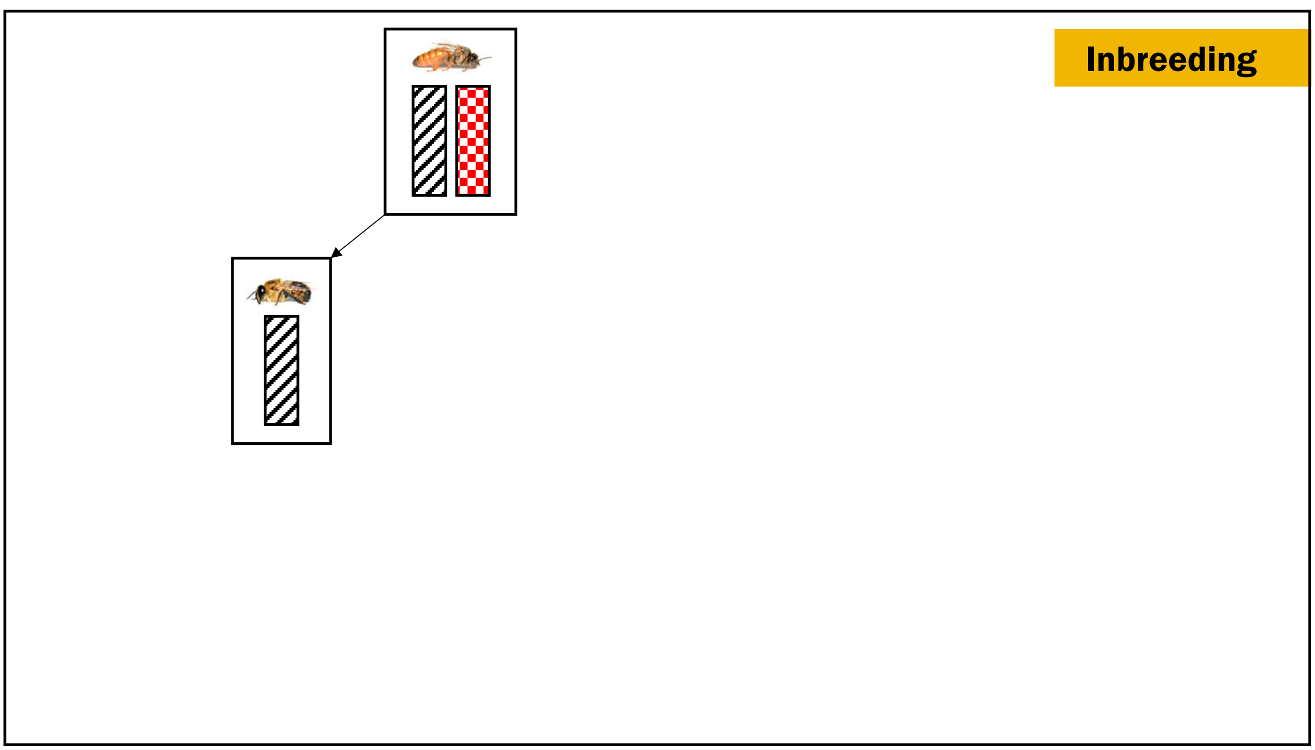

Honey Bee Sex Determination
Diploid
unfertilized
fertilized

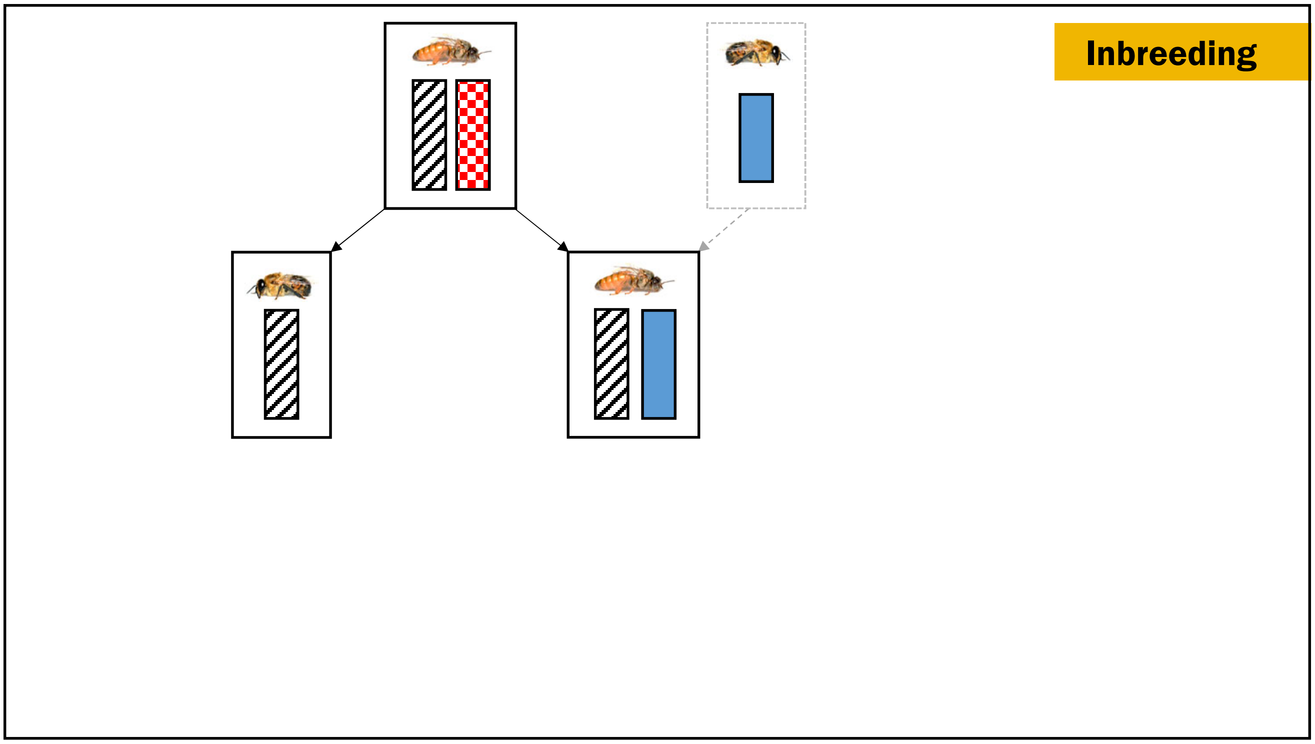

Honey Bee Sex Determination
Diploid
unfertilized
Haploid

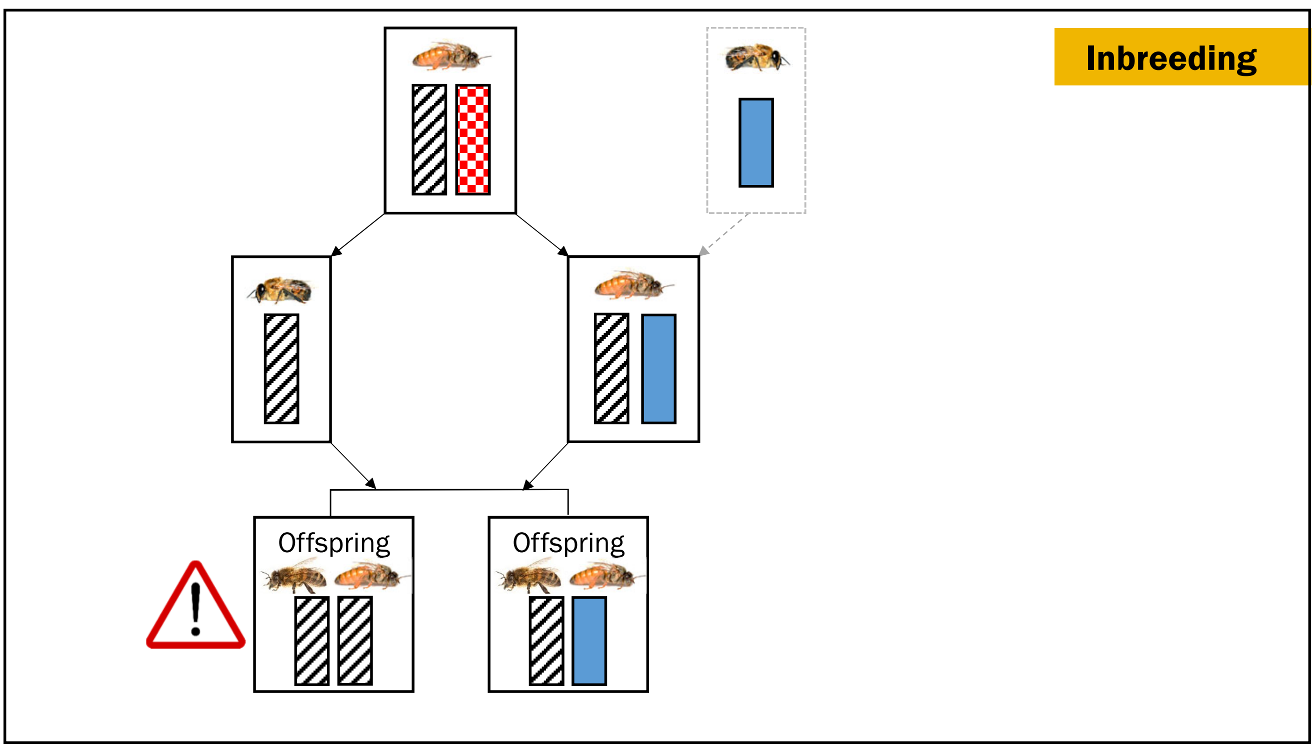

Honey Bee Sex Determination
Diploid
unfertilized
Haploid


Honey Bee Sex Determination
fertilized


Honey Bee Sex Determination
unfertilized
fertilized


Inbreeding


Inbreeding


Inbreeding
Offspring
Offspring

Inbreeding

Inbred workers leads to

- ❑ higher brood losses
- ❑ less honey produced
- ❑ less wax produced
- ❑ reduced vitality
- ❑ increased swarming tendency
- ❑ calmer colonies (alarm pheromone sensitivity)

(Bienefeld et al. 1989)

Inbreeding

Inbred workers leads to

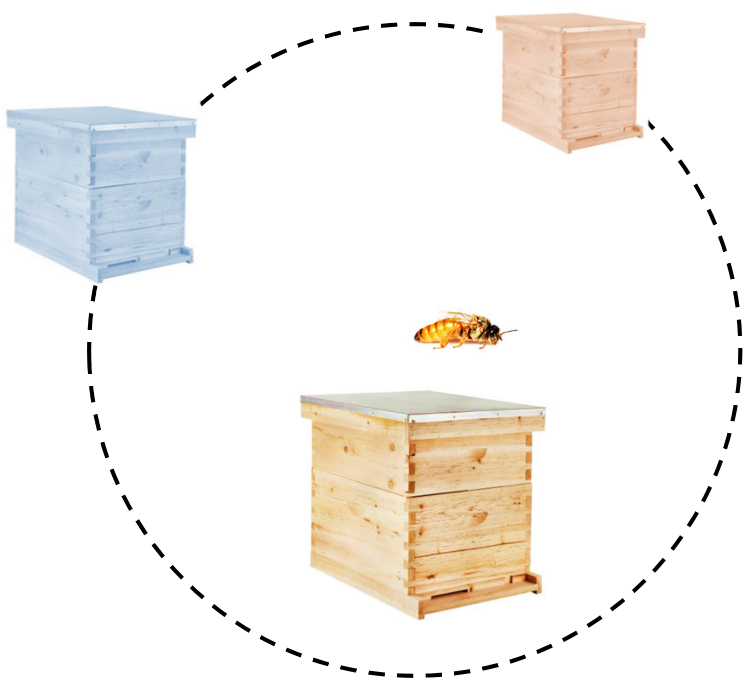
- ❑ higher brood losses
- ❑ less honey produced
- ❑ less wax produced
- ❑ reduced vitality
- ❑ increased swarming tendency
- ❑ calmer colonies (alarm pheromone sensitivity)

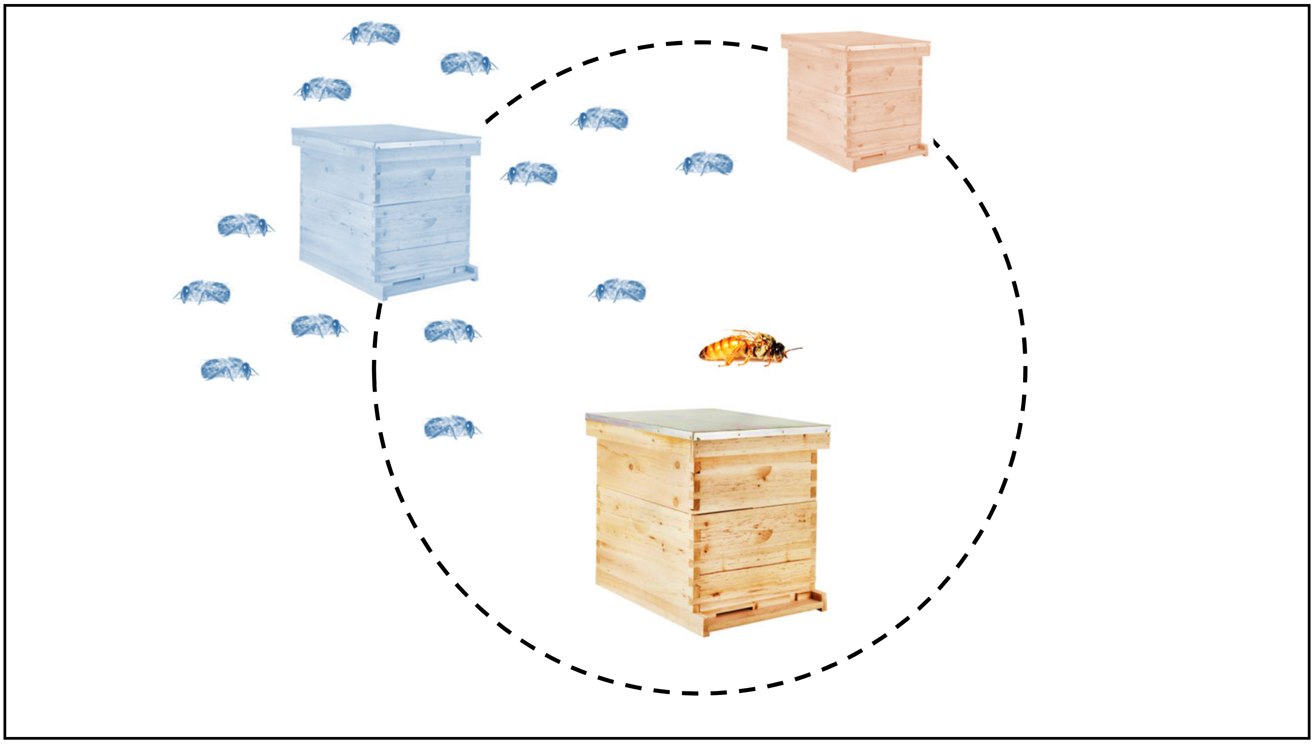
Inbred queens leads to

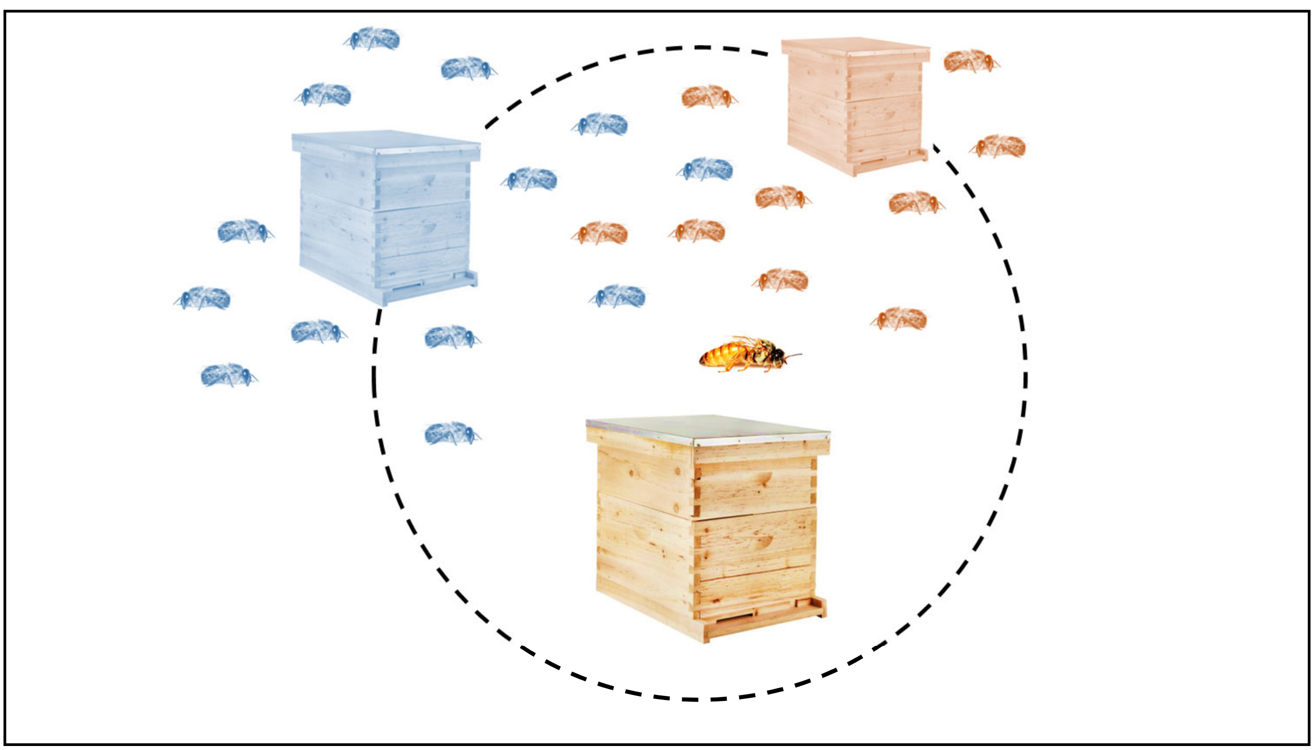
- ❑ more aggressive colonies (alarm pheromone sensitivity)
- ❑ morphological defects
  - reduced queen pheromone (supercedures, swarms)
  - fewer/lighter ovarioles (reduced egg laying)

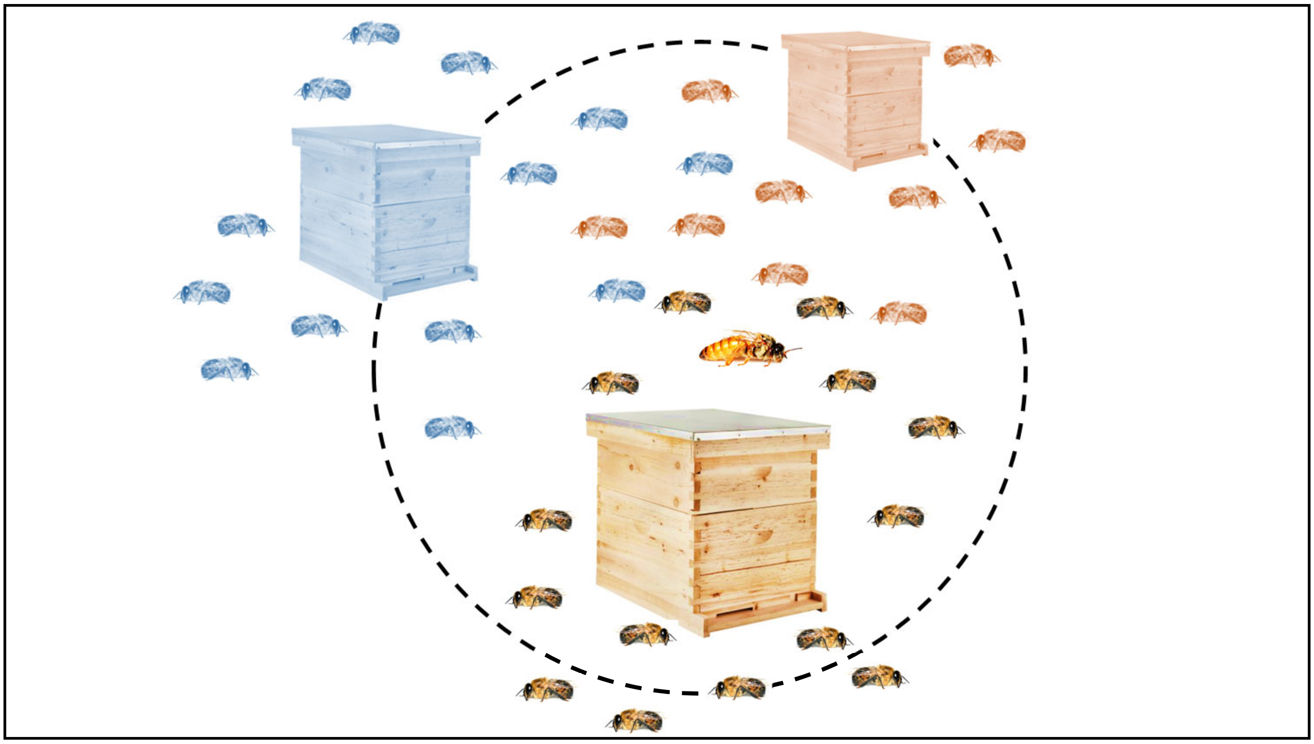
(Bienefeld et al. 1989)

Honey bees mate outside of the hive.







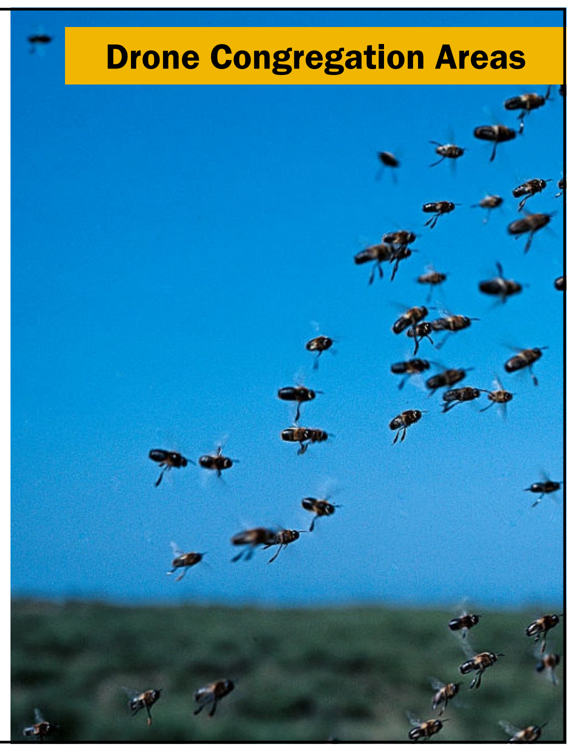


Large gathering places where drones congregate in the air, waiting for queens

Drones are only attracted to queens above 4m from the ground.

They can sense queen substance up to 200 ft away.

Drones travel back and forth between the hive (for food) and a DCA.

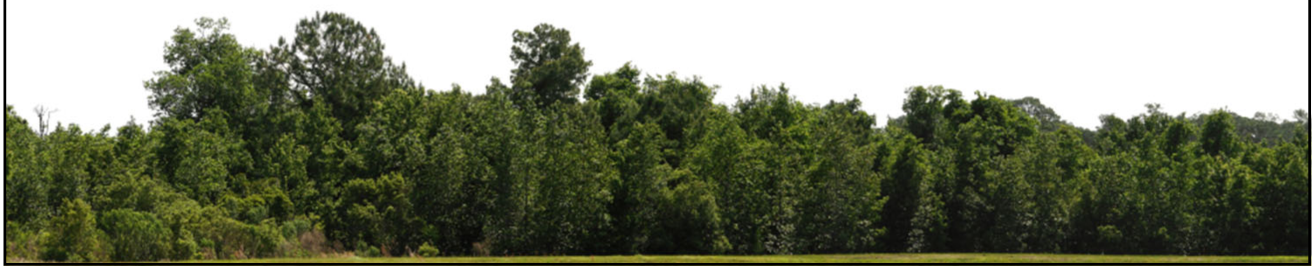


Drone Congregation Areas

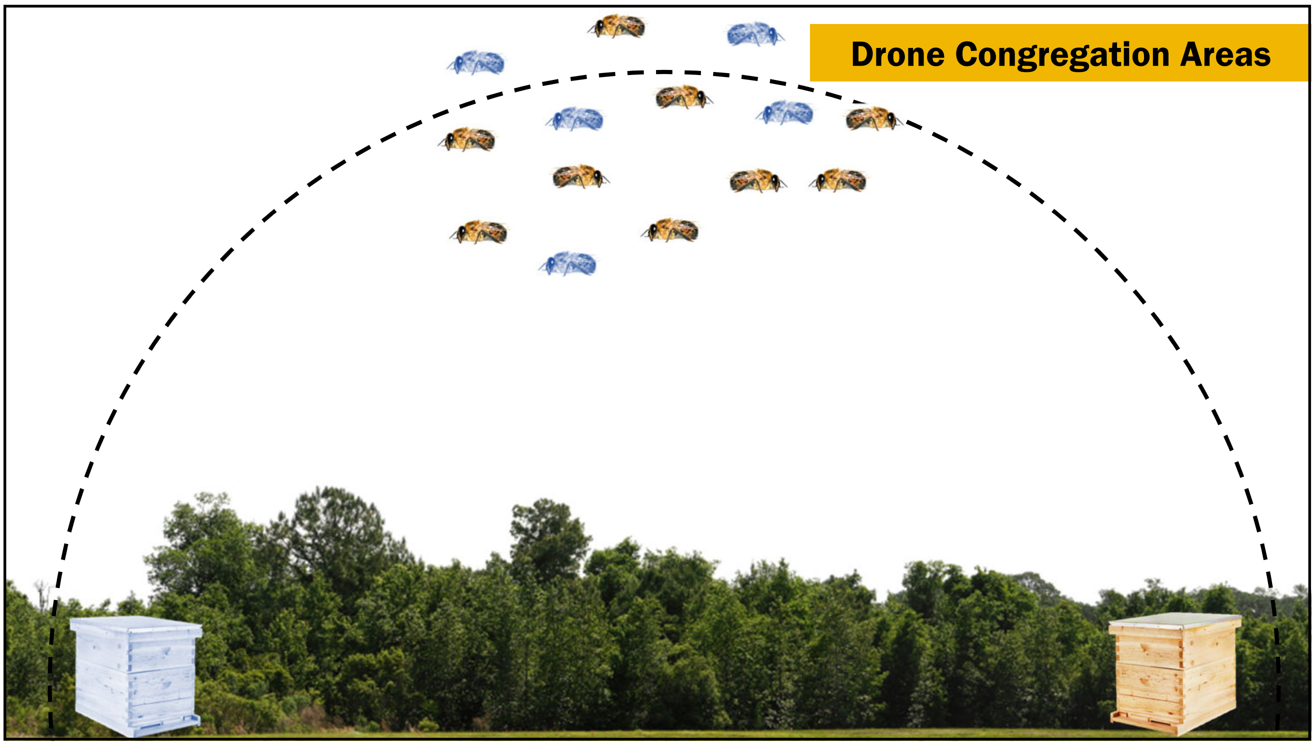
DCAs often occur in forest openings or along tree lines.

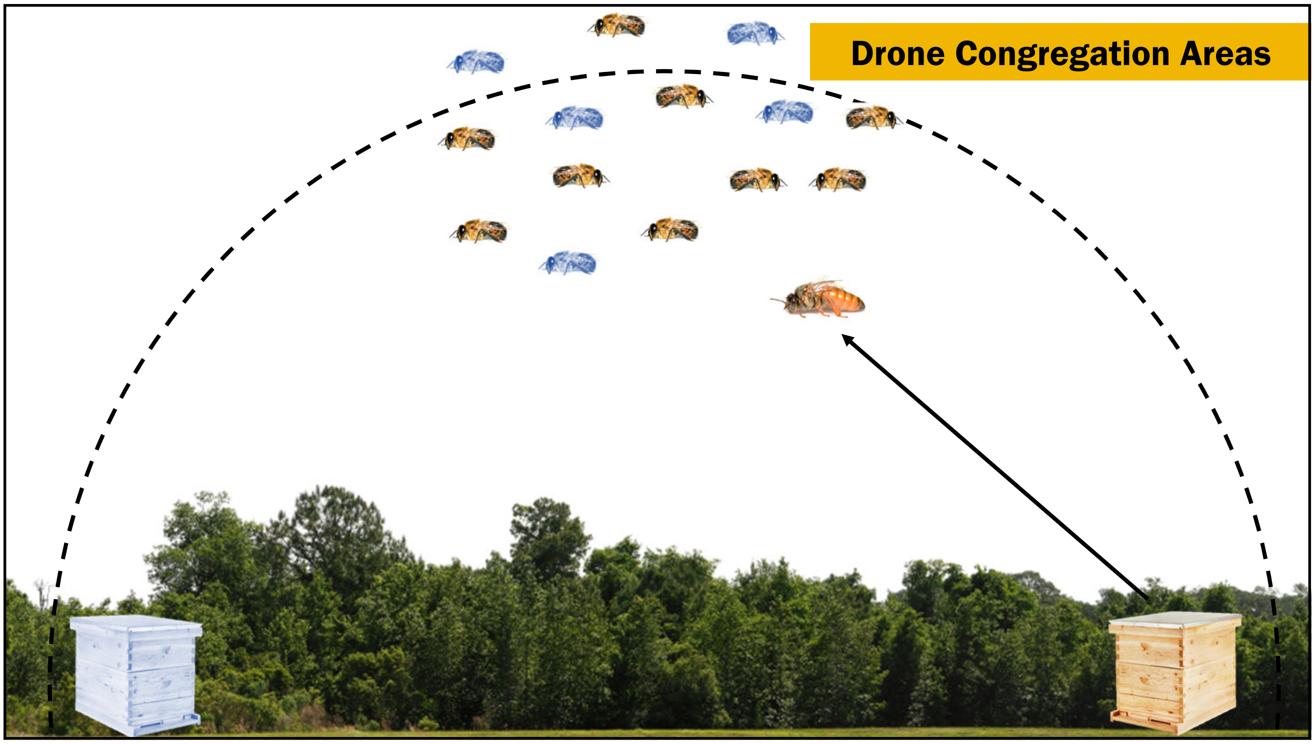
Constant locations year to year

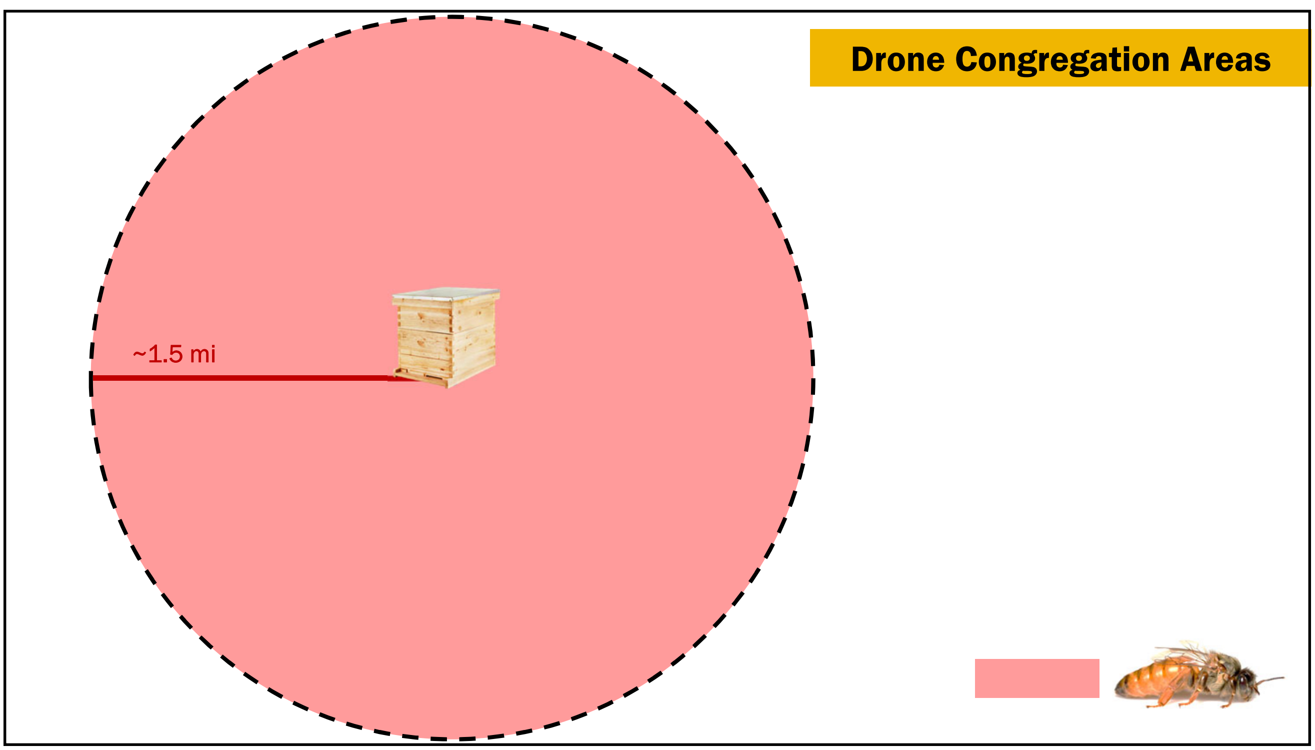
There can be many DCAs in an area, each with drones from multiple hives.
-Up to 230 colonies!



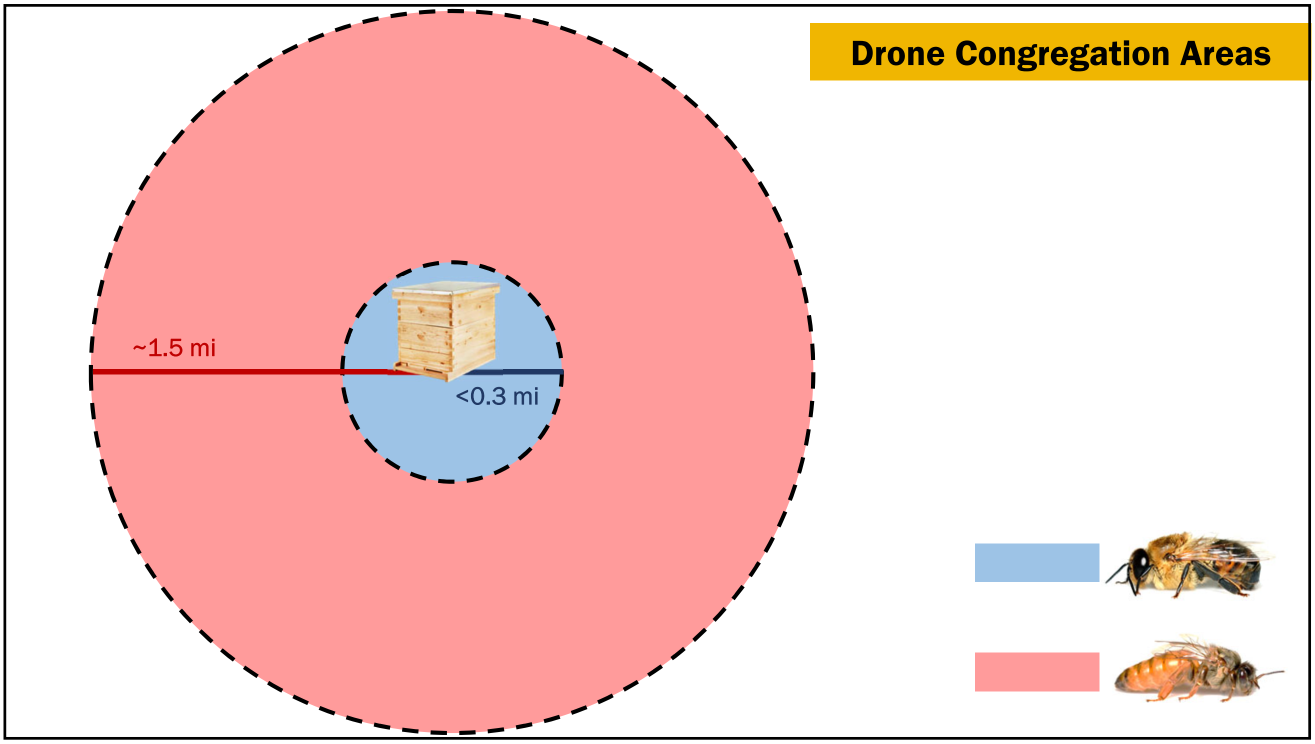
Drone Congregation Areas



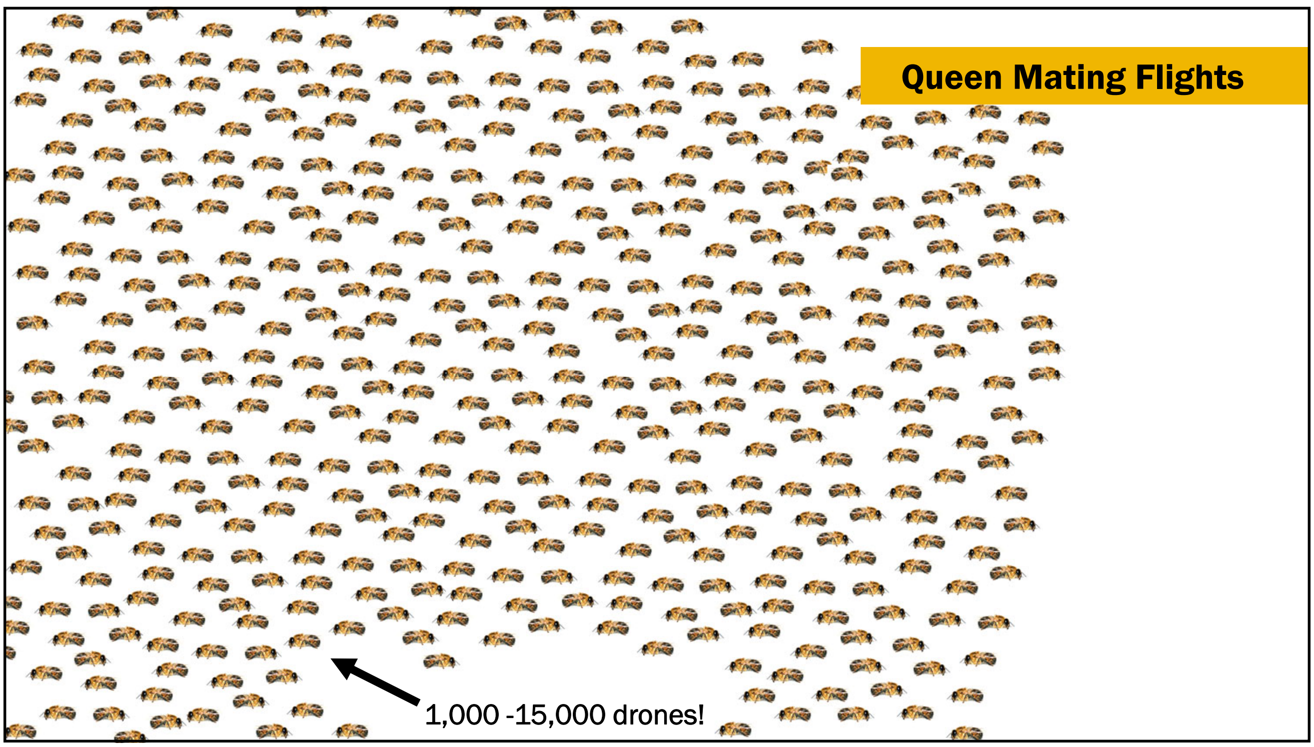

Drone Congregation Areas

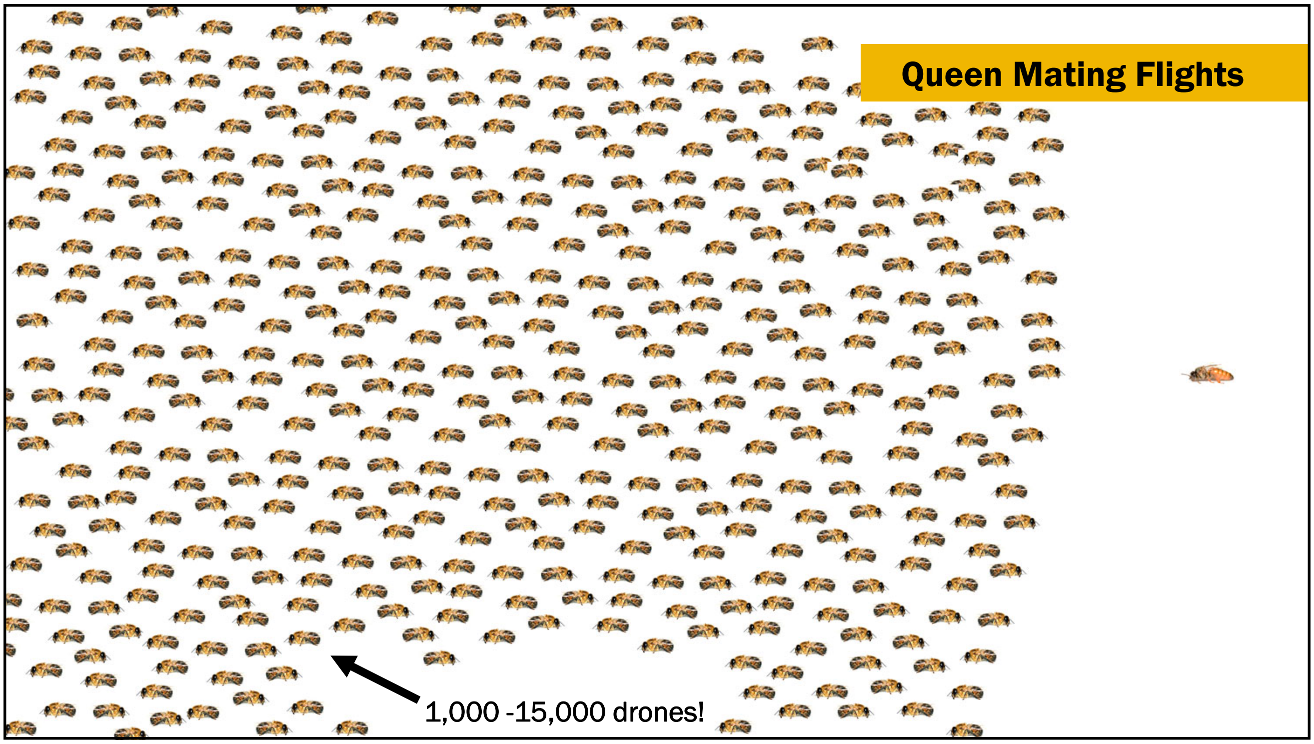

Drone Congregation Areas
~1.5 mi

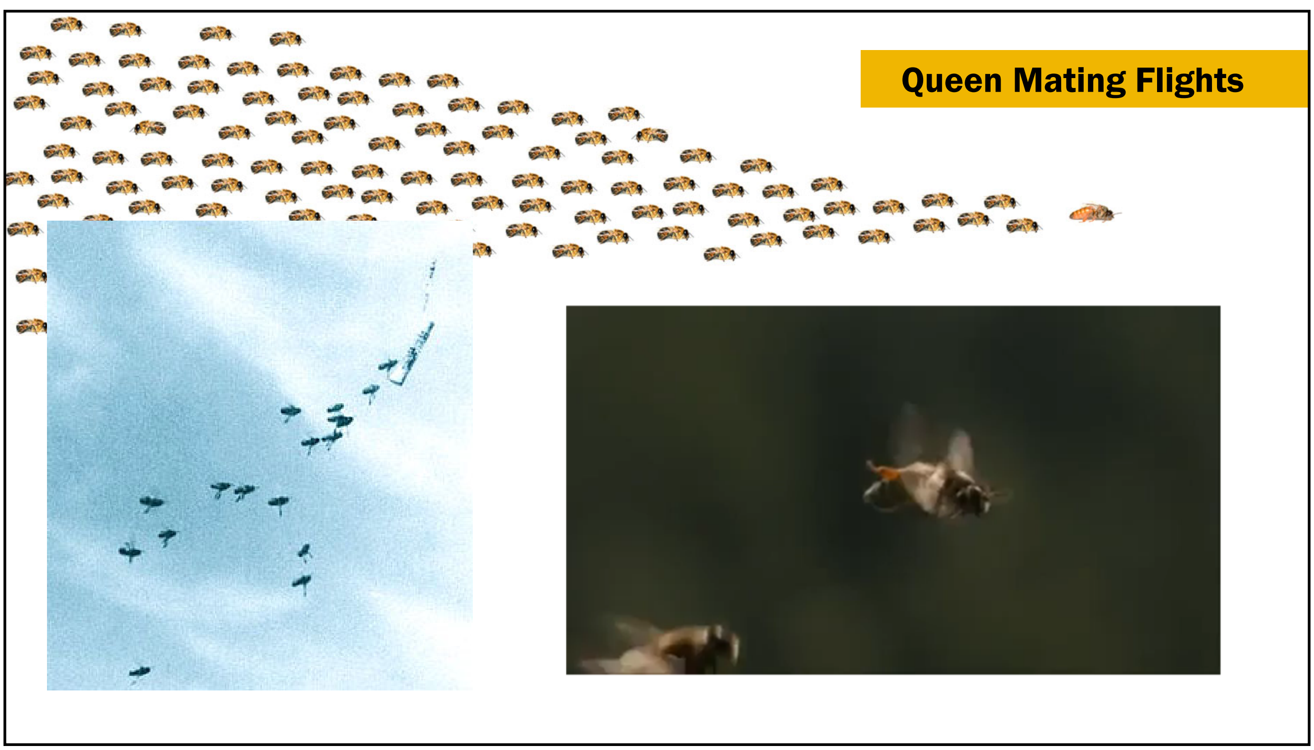
Drone Congregation Areas



Queen Mating Flights



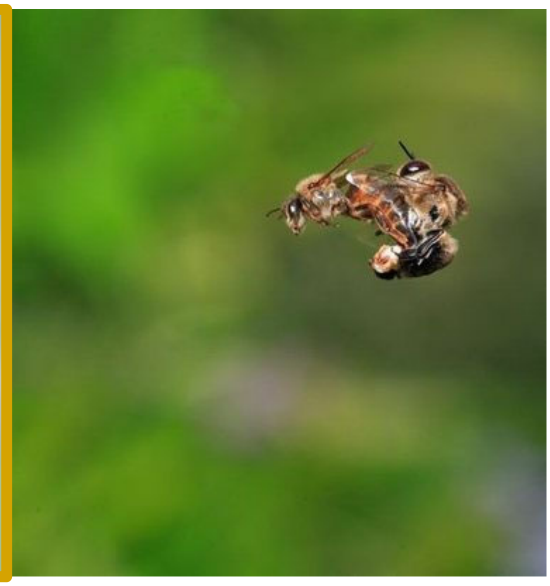

Queen Mating Flights
1,000 -15,000 drones!


Queen Mating Flights

Queen Mating Flights

Queens mate with up to 10 drones per flight.

They often go on multiple mating flights.



Multiple mating by queens can

- ❑ reduce poor brood patterns (Tarpy and Page 2002)
- ❑ increase sperm storage (more egg laying) (Schluns et al. 2005, Delaney et al. 2011)
- ❑ increase queen pheromones and longevity (Richard et al. 2007)
- ❑ delay the spread of infectious diseases (Tarpy 2003, Seeley and Tarpy 2007)

Queen Mating Flights

Once she begins laying eggs, the queen will go on no more mating flights.

During the mating flights is a crucial time in the life of a queen and a colony.

Bee Informed Partnership surveys

Nearly half of respondents attribute colony losses to queen failure.

Bee Informed Partnership surveys

Nearly half of respondents attribute colony losses to queen failure.

Why?

Bee Informed Partnership surveys

Nearly half of respondents attribute colony losses to queen failure.

Why?

Key factors in queen quality: Rearing success
Mating success

Reports of premature queen replacement, inconsistent brood patterns, early drone laying, and failed requeening

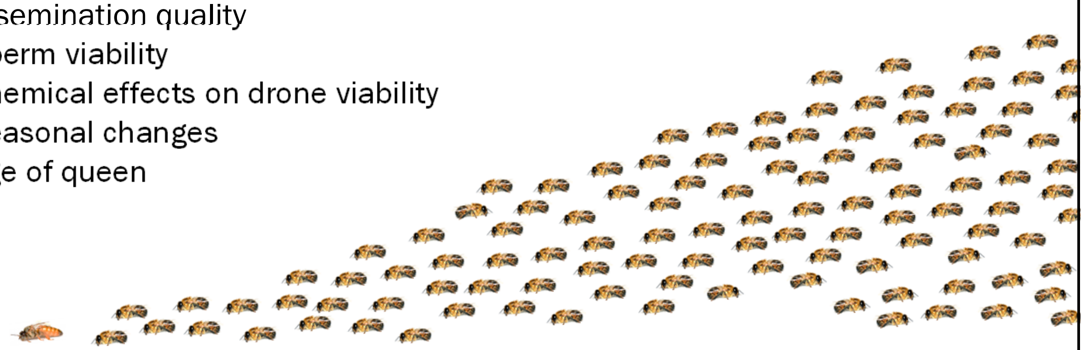
Reports of premature queen replacement, inconsistent brood patterns, early drone laying, and failed requeening

Why?

These signs are consistent with poor mating success

Researchers are looking at where mating issues are coming from:

- ❑ Mates/flight
- ❑ Insemination quality
- ❑ Sperm viability
- ❑ Chemical effects on drone viability
- ❑ Seasonal changes
- ❑ Age of queen



Commercially produced queens are mating with a high/adequate number of drones.

Insemination quality of queens can be variable depending on the operation.

There is big variation in sperm viability in mated queens.

There is variation in how chemicals affect sperm viability.

Sperm viability in mated queens gradually decreases over time.

Questions?

www.ufhoneybee.com

@ufhoneybeelab

The Melitto Files Blog

bammerma@ufl.edu

Honey Bee Nutrition

Carmen Fraccica

Florida Department of Agriculture and Consumer Services

Created by: Catherine Nalen, Jamie Ellis
University of Florida
Department of Entomology & Nematology

Objectives

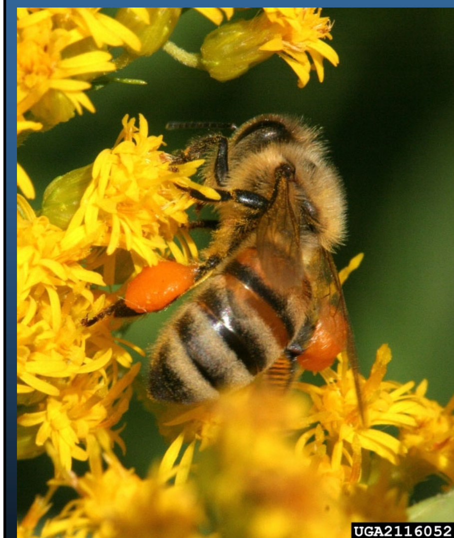
1) Indicate the nutritional needs of honey bees.

2) Interpret trends in nectar and pollen dearths in Florida.

3) Determine when a colony is low on food resources.

4) Recognize that most honey bee colonies need to be fed at certain times of the year.

Nutritional Requirements:



All honey bees need:

Proteins (amino acids)
Carbohydrates (sugars)
Minerals
Fats/lipids (fatty acids)
Vitamins
Water

Larval Nutrition

The female caste is determined by larval diet.

Brood food is produced by combining a secretion from the hypopharyngeal glands (clear liquid with high protein content) and mandibular glands (white liquid containing mostly lipids).

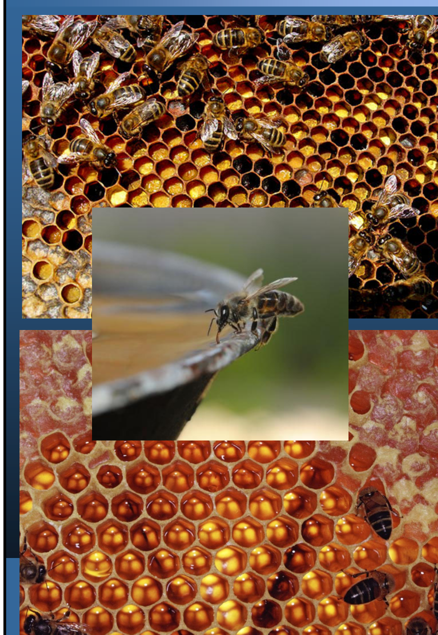
Worker Larvae:
- First 2 days – 20-40% white component.
- From 3rd day onward – the white component is no longer fed.
- On last 2 days, only the clear secretion + honey and pollen is provided.

Larval Nutrition

Drones feed on brood food, but with a different composition.
- higher protein and carbohydrate levels

Queens feed on brood food, but with equal milky mandibular secretions and clear hypopharyngeal secretions.
- called "Royal jelly"
- Queen larvae are provided more royal jelly than they need.

Adult Nutrition



Adults of all castes feed on pollen, honey and water.

Pollen contains proteins and vitamins. It is required for growth and development (primarily of larvae).

Nectar/honey contains sugars, carbohydrates and is required for energy.

Quality and quantity available in the field does not always match the requirements of the colony!

Adult Nutrition

Deficiencies may lead to:

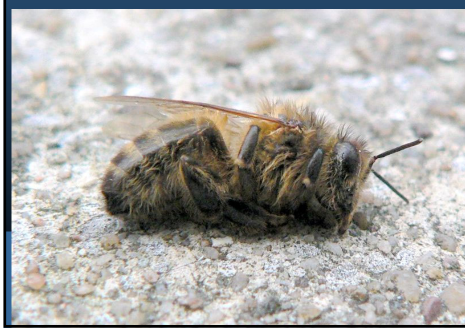
Population reduction

Reduced longevity

Reduction in drone populations

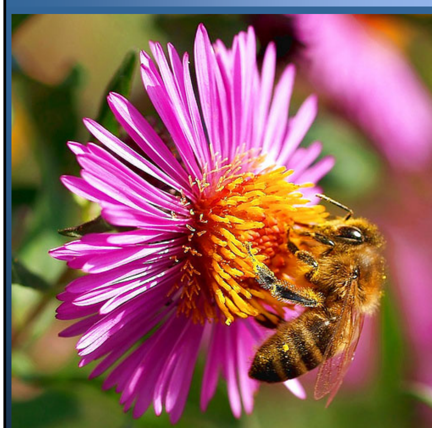
Increased disease susceptibility

Death of the colony



Scott Bauer, USDA Agricultural Research Service, www.insectimages.org

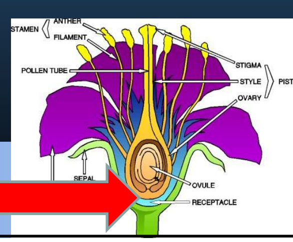
Adult Nutrition: Nectar



Primary energy source in the form of carbohydrates. Produce in nectary.

Composed of sucrose with various moisture levels including some enzymes and mineral content.

Sucrose is converted by enzymes (natural and from bees) to levulose (fructose) and dextrose (glucose).



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Adult Nutrition: Nectar

Worker honey bees carry nectar from the flower back to the hive in their crop.

Once at the hive, they pass the nectar to a “receiver bee”.

This bee deposits the nectar into the comb.

Other worker bees stand at the nest entrance and fan their wings to circulate air through the nest. This reduces the moisture content in the nectar to 12-21% water.

Adult Nutrition: Honey

Honey is defined by the National Honey Board as:

“the substance made when the nectar and sweet deposits from plants are gathered, modified and stored in the honey comb by honey bees.”

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Adult Nutrition: Honey

Fructose/glucose ratio varies.

Higher glucose crystallizes more rapidly (ex. Canola).

Fermented honey will cause death (of colonies).

Dark honey a richer mineral profile than light honeys.

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Adult Nutrition: Honey

Lack of nectar/honey

- Principal carbohydrate source – colony will perish within days.
- Colonies will become more defensive.
- Decline in field bees foraging for pollen.
- Reduced hygienic behavior.
- Reduction in brood area.

Adult Nutrition: Honey

Honey bees store honey to survive winter!!!

The amount of honey stores depends upon the:

- Size of the colony population: more bees need more honey
- Location (warm or cold)
- Brood rearing
- Flowering events

Adult Nutrition: Honey

Typically, winter losses are due to starvation, not cold.

Honey requirements 20-45 kg.

Ideal overwintering conditions:

- Warm location - supported by light nectar and pollen availability
- Cool location - no flowering events, colony broodless

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Adult Nutrition: Pollen

Protein (ratio of amino acids), fat, vitamins, and minerals.

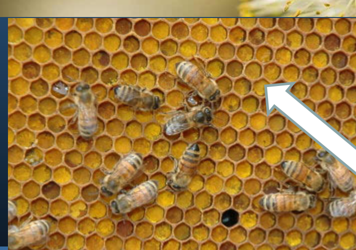
Worker bee longevity is enhanced with high protein pollen.

Brood rearing is reduced when colonies experience reduced protein diet.

Colonies rapidly decline in size if adequate pollen or supplement is not available.

Colonies normally consume pollen soon after collection or within one or two months. (colony growth is tied to pollen availability).

Adult Nutrition: Pollen



Forager bees collect pollen from different floral resources.

The pollen is mixed with nectar during the bee's foraging trip.

They return to the and deposit the pollen into cells in the nest.

Another bee visits the cell, adds enzymes and other substances, and packs the pollen into the cell.

The pollen undergoes lactic acid fermentation and is called "bee bread".

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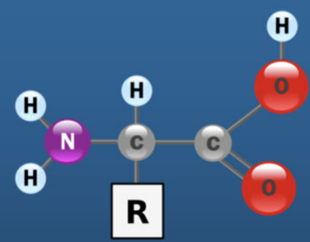
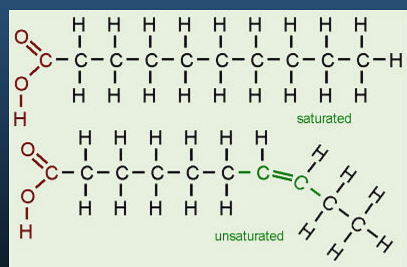
Pollen: Amino Acids and Fats





Protein requirements: 20-25% crude protein is minimum.

Amino Acids – 10 essential to honey bees:

Threonine, Valine, Methionine,Isoleucine, Leucine, Phenylalanine, Histidine, Lysine, Arginine, Tryptophan

Fats – lipid composed of fatty acids, sterols, and phospholipids.

Fats in pollen act as strong attractants to foraging bees.

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Pollen: Protein

Not all pollens are created equal!!!

Examples of Crude Protein Values:

Canola – 23%

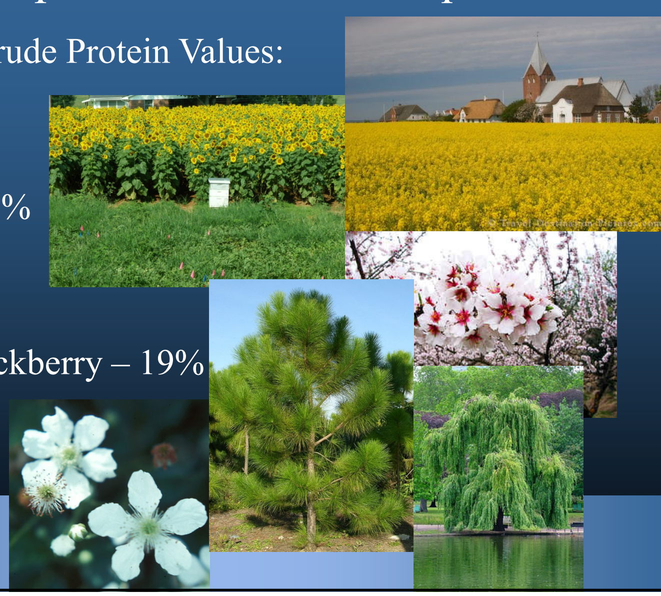
Sunflower – 16%

Almond – 26%

Pine – 7%

Raspberry, Blackberry – 19%

Willow – 17%



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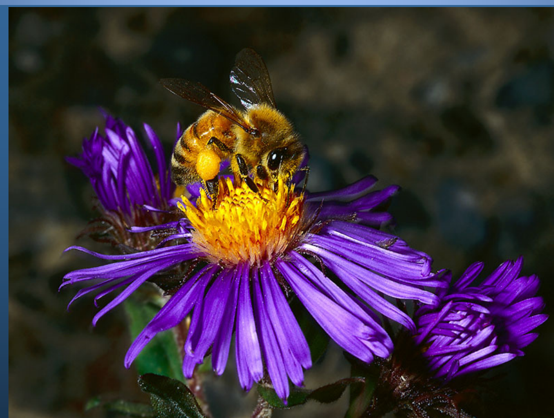
Pollen: Minerals



- Minerals – potassium, phosphate, and magnesium are required by all insects.
- Excessive levels of sodium, sodium chloride, and calcium are toxic to bees.
- Increased concentrations of minerals in pollens have been shown to limit brood rearing.

Pollen: Vitamins

Vitamins – not much known about honey bee requirements.

B complex vitamins essential for most insects.

Pantothenic acid, thiamine, riboflavin, and pyridoxine, plus vitamin A and K have been linked to development of the hypopharyngeal glands and brood rearing.

Many vitamins are not very stable and will deteriorate in stored pollen.

Supplemental Feeding – Sugar Syrup

Fed to hives to increase honey stores and encourage growth.

Usually a 1:1 mixture of sugar : water is fed in spring.

Can use other sugar sources such as high fructose corn syrup.

Supplements and pest control products can be added to the solution.

Should not be fed to bees once natural nectar flow begins if hives are used for honey production.

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Supplemental Feeding – Sugar Syrup

When to feed?
- Hoist the hive!
- Know your blooms!

What to feed?
- Dry sugar/thick syrup (2:1)/thin syrup (1:1)?
- Sugar syrup/corn syrup?

How to feed?
- Type of feeder (open or slow release)

Hive Feeders

Feeders are used to deliver sugar solutions to colonies to supplement the bees' diet.

They are used during low nectar flows or to stimulate colony growth in the spring.

Three main types:
1. Hive top feeders
2. Entrance feeders (boardman)
3. In-hive feeders (division board)

Supplemental Feeding - Pollen

An artificial pollen supplement used to help increase pollen stores and encourage hive growth.

Usually in sold in solid patties that are fed directly to the hives.

If used well, can lead to increased brood production.

Can be a magnet for small hive beetles so use only as needed.

Not typically necessary if bees are collecting pollen.

Supplemental Feeding - Pollen

When to feed?

- Whenever bee flight is restricted
- Weak colonies
- Pollen deficient honey flows
- When a pollen source is of doubtful quality

Pollen Supplement vs. Pollen Substitute

- *Supplement* – implies that pollen is available to the colony in the field but is of either poor quality or quantity is restricted.
- *Substitute* – suggests there is no pollen naturally available to a colony and a "complete" substitute is required by the colony to allow brood to be reared.

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Supplemental Feeding - Pollen

What to feed?

- Pollen
- Bee Bread
- Other Products
  - soy flour
  - Yeast
  - vitamin, mineral, and amino acid supplements

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Feeding Pollen Patties

Additional Reading:

1. Klowden, M.J. 2002. Physiological Systems in Insects. Academic Press, San Diego, CA. 402 pp.

2. Triplehorn, C.A. and N.F. Johnson. 2005. Borror and DeLong's Introduction to the Study of Insects. Thomson Brooks/Cole, Belmont, CA. 864 pp.

3. Winston, M.L. 1991. The Biology of the Honey Bee. Harvard University Press, Cambridge, MA. 281 pp.

UF UNIVERSITY of FLORIDA IFAS | UNIVERSITY of FLORIDA Honey Bee Research & Extension LABORATORY | SOLUTIONS for your LIFE

Where can I store ingredients and finished products for my cottage food business?

Ingredients and finished cottage food products must be stored in your single family domestic residence where the cottage food products are made. This includes your kitchen, a spare room or a basement that is free of dampness/water, pests or other unsanitary conditions. You may not use a garage, shed, barn or other outbuilding as a storage facility for your Cottage Food business.

Can I serve free samples of my cottage food products?

Yes. Approved cottage foods for sample must be pre-packaged in your home kitchen (e.g, if you sample bread, you can't cut it at the market, but can cut it in your home kitchen and individually wrap or package the bread samples into sample cups with lids). Although you do not need an individual label for each sample, you must have properly labeled packages of your product on display with the samples so your customer can review the ingredient list.

Links:

LABELING:
http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm2006828.htm

ALLERGENS
http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/Allergens/ucm106890.htm
http://www.fda.gov/food/guidanceregulation/guidancedocumentsregulatoryinformation/ucm059116.htm

2009 Food and Drug Administration Food Code
https://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm2019396.htm

Chapter 500, Florida Statutes
http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&URL=0500-0599/0500/0500ContentsIndex.html&StatuteYear=2015&Title=-%3E2015-%3EChapter%20500

Cottage Food Operations

Division of Food Safety
June 2017

Cottage food operations require no license or permit from the Florida Department of Agriculture and Consumer Services (FDACS) and are not inspected by any state government entity.

Gross sales for a cottage food operation must not exceed $50,000 annually. Cottage food operators may advertise for sale, offer for sale and accept payment for cottage food products on their website but the products are prohibited to be delivered by mail order. Cottage food products must be sold and delivered directly to the consumer or to the consumer's private event venue such as a wedding or birthday party. Sales of cottage food products are prohibited for wholesale.

Cottage food products must be labeled in accordance with the requirements as outlined in Section 500.80(5), Florida Statutes, and United States Code of Federal Regulations Title 21, Part 101.

All cottage food products offered for sale to the general public must be labeled: "Made in a cottage food operation that is not subject to Florida's food safety regulations."

Quick Reference Definitions

Cottage Food Operation means a person who produces or packages cottage food products at his or her residence and sells such products in accordance with Section 500.80, Florida Statutes.

Cottage Food Product means food that is not a potentially hazardous food, as defined by FDACS rule, which is sold by a cottage food operation in accordance with Section 500.80, Florida Statutes.

Residence is defined to mean a primary residence that is occupied by an individual who operates a cottage food operation and that contains a single kitchen with appliances designed for common residential usage. The residence may only contain one stove or oven, which may be a double oven designed for non-commercial use.

Potentially Hazardous Food means a food that requires time/temperature control for safety (TCS) to limit pathogenic microorganism growth or toxin formation; An animal food that is raw or heat-treated; a plant food that is heat-treated or consists of raw seed sprouts, cut melons, cut leafy greens, cut tomatoes or mixtures of cut tomatoes that are not modified in a way so that they are unable to support pathogenic microorganism growth or toxin formation; or garlic-in-oil mixtures that are not modified in a way so that they are unable to support pathogenic microorganism growth or toxin formation.

As a cottage food operator, you are allowed to produce food items that are considered not potentially hazardous.

Florida Labeling Requirements

The cottage food law requires specific labeling requirements for the sale of cottage food products.

A cottage food operation may only sell cottage food products which are prepackaged with a label affixed that contains the following information (printed in English):

- The name and address of the cottage food operation;
- The name of the cottage food product;
- The ingredients of the cottage food product, in descending order of predominance by weight;
- The net weight or net volume of the cottage food product;
- Allergen information as specified by federal labeling requirements;
- If any nutritional claim is made, appropriate nutritional information as specified by federal labeling requirements; and
- The following statement printed in at least 10-point type in a color that provides a clear contrast to the background label: “Made in a cottage food operation that is not subject to Florida’s food safety regulations.”

A sample is shown below and may assist with developing your cottage food product label.

MADE IN A COTTAGE FOOD OPERATION
THAT IS NOT SUBJECT
TO FLORIDA’S FOOD SAFETY REGULATIONS

Chocolate Chip Cookie

Ashley Christopher Bryant
1019 Food Safety Drive
Tallahassee, Florida 32399

Ingredients: Enriched flour (Wheat flour, niacin, reduced iron, thiamine, mononitrate, riboflavin and folic acid), butter (milk, salt), chocolate chips (sugar, chocolate liquor, cocoa butter, butterfat (milk), Soy lecithin as an emulsifier), walnuts, sugar, eggs, salt, artificial vanilla extract, baking soda.

Contains: wheat, eggs, milk, soy, walnuts

Net Wt. 3 oz

What Types of Cottage Foods Can I Produce?

- Loaf breads, rolls, biscuits
- Cakes, pastries and cookies
- Candies and confections
- Honey
- Jams, jellies and preserves
- Fruit pies and dried fruits
- Dry herbs, seasonings and mixtures
- Homemade pasta
- Cereals, trail mixes and granola
- Coated or uncoated nuts
- Vinegar and flavored vinegars
- Popcorn, popcorn balls

What Foods Are Not Allowed?

- Salsa, barbecue sauces, ketchups and/or mustards
- Canned fruits and vegetables, chutneys, vegetable butters and jellies, flavored oils, hummus, garlic dip and salsas
- Fish or shellfish products
- Canned pickled products such as corn relish, pickles, sauerkraut
- Raw seed sprouts
- Bakery goods which require any type of refrigeration such as cream, custard or meringue pies and cakes or pastries with cream cheese icings or fillings
- Eggs, milk and dairy products including hard, soft and cottage cheeses and yogurt
- Cut fresh fruits and/or vegetables. Juices made from fresh fruits or vegetables
- Ice and/or ice products
- Fresh or dried meat, or meat products including jerky
- Foccaccia-style breads with vegetables and/or cheeses

SALES

How do I sell my cottage food products?

You may sell your cottage food products from your residence directly to the consumer. Sales are also approved at farmers’ markets, flea markets and roadside stands, provided you have no other food items in your space that require a food permit.

If I have a roadside stand that is already inspected and permitted, can I also sell my cottage food?

No. A permitted food establishment cannot sell cottage foods since they are from an unapproved source.

Can I use the internet and my website to sell my cottage food products?

yes, the law allows orders and payments over the internet, however, the cottage food products must be delivered directly to the consumer or to the consumer’s private event venue such as a wedding or birthday party.

Can I sell my cottage foods to restaurants?

No. Cottage food is not allowed to be sold to local restaurants or grocery stores. These types of sales are considered “wholesale” and are not allowed under the law.

Can I place my cottage food products in a store or restaurant on consignment?

No. cottage food products cannot be sold on consignment. The sale must be person-to-person which means from the producer to the actual consumer.

Can I sell my cottage foods to a wholesaler, broker or distributor?

No. Under the cottage food guidance document, it is not legal for a producer to sell to a wholesaler, broker or distributor who would then resell the product.

Can nonprofit organizations produce and sell cottage foods?

No. Nonprofits do not have a single family domestic residence, and therefore do not qualify as a cottage food business.

Can I sell my cottage foods for special events such as wedding and birthday parties?

Yes, provided the cottage food products are produced and sold by the cottage food operator themselves and delivered by the cottage food operator to the specific event venue.

The farmers market where I want to sell my products says I need a food license, even though I am a cottage food business. Can the market require a license?

Yes. Even though an entity may meet the requirements of a cottage food operation, some farmers markets or other direct marketing venues may require vendors to have a food establishment license or to meet other requirements. Local policies enacted by farmers market boards and other local governing bodies are generally outside the scope of any Cottage Foods regulations.

Can cottage foods be picked up or distributed by a third party?

No, cottage food products must be delivered and distributed directly to the consumer or the consumer’s private event venue by the cottage food operator.

Can the County or City restrict me from having a cottage food operation?

Yes. County, city, and local governments can enact laws restricting a cottage food operation in your home. Check with the licensing agency in your area for details.

I lease space in a retail building where I operate a small antique shop. As a cottage food baker, can I sell my own baked goods from my shop under the current Cottage Food Guideline?

No. Since your small antiques store is not the cottage food operation, you would not be able to sell your cottage food products from this location.

PROCESSING LOCATION

Can I make cottage food products in an outbuilding on my property, like a shed or a barn?

No. Outbuildings such as sheds or barns are not allowed.

Can I make and sell products from my motor home kitchen, cottage or summer home under the cottage food guidelines?

No. Cottage foods may only be made in the kitchen of your primary residence. Second homes, vacation homes or motor homes do not qualify if they are not your primary residence.

Can I make products in a rented kitchen and sell them under the cottage food guidelines?

No. Cottage food can only be made in the kitchen of our home.

Are there any special requirements regarding my home on-site well?

Only potable water from a properly constructed on-site well or municipal water system can be used.

Are there any concerns related to my home septic system?

Depending on the nature and volume of the food products you will make for sale, there can be adverse effects to the existing system serving the home. The adequacy of the home system to handle additional wastewater loading can be evaluated by the local health department. The health department can advise you if modifications to the existing system may be needed.

LABELING

What does allergen labeling, as specified in federal labeling requirements, mean?

It means you must identify if any of your ingredients are made from one of the following food groups: milk, eggs, wheat, peanuts, soybeans, fish (including shellfish, crab, lobster or shrimp) and tree nuts (such as almonds, pecans or walnuts). If you have an ingredient made with a wheat based product, you can:

- Include the allergen in the ingredient list. For example, a white bread with the following ingredient listing: whole wheat flour, water, salt and yeast. In this example, the statement 'whole wheat flour', meets the requirements of federal law. OR
- Include an allergen statement ("Contains :") after the ingredient list. For example a white bread, with the following ingredients: whole wheat flour, water, sodium caseinate, salt and yeast. Contains wheat and milk. The "Contains" statement must reflect all the allergens found in the product. In this example, the sodium caseinate comes from milk.

Are there any special requirements for tree nuts labeling for allergens?

Yes. If your cottage food has tree nuts as an ingredient you must identify which tree nut you are using. For example, if you made nut bread, an acceptable ingredient list would be: Ingredients: wheat flour, water, almonds, salt, yeast. The following would not be acceptable: Ingredients: flour, water, nuts, salt, yeast.

Am I required to send my products to a laboratory to obtain an official ingredient list, or is it something I can put together on my own?

You are not required to have your product analyzed by a laboratory to obtain an official ingredient list. If you use a prepared item in your recipe, you must list sub-ingredients as well. For example, just listing soy sauce is not acceptable. You would need to list "soy sauce (wheat, soybeans, salt)" on your label. Allergen labeling, as specified in federal labeling requirements, must also be included.

I am concerned that some of my product ingredients that are not allergens are "trade secrets" and listing all my ingredients would lead to unfair competition. Do I have to list all of my ingredients or can I protect my trade secrets?

According to federal regulations (Food and Drug Administration (FDA), 21CFR 101.100g(1)(2)), exceptions to labeling can be made. In particular, if the Commissioner of Food and Drugs finds that alleged secret ingredients are harmless an exemption may be granted. You should contact the FDA to discuss and propose an exemption from labeling.

Do I have to include my home address on my product labeling or is a post office box sufficient?

Yes. You must use the physical address of your home kitchen on your product label, not a post office box. The purpose of including an address on product labels is in case of a recall or traceback associated with a foodborne illness complaint or outbreak.

If I make and sell wedding or other specialty cakes, how can I meet the labeling requirements, when I can't stick a label on the cake?

For cakes that are not easily packaged, you must include all labeling requirements on the invoice and deliver the invoice with the cake. If boxed, the label must be included on the box.

IS IT COTTAGE FOOD?

Are pet treats considered cottage food?

No. The cottage food guidance document applies to human food only.

Can I produce and sell cooked vegetable products, like salsas, tomato sauces, spaghetti sauces, or foccacia bread with roasted vegetables as a cottage food?

No. Food products made with cooked vegetable products do not qualify under the cottage food guidance document.

Can I produce salsa, barbeque sauce, mustard, and other "wet" products?

No. These food products must meet significant federal and state requirements.

Can I roast coffee beans in my home kitchen and sell them?

Yes. You can roast and sell whole bean coffee or ground coffee; however, you may not sell ready-made coffee and you may not wholesale the product.

Can I make liquid beverages/drinks?

No. Drinks and beverages are not allowed.

Can I bake bread in a wood fired oven?

Yes, as long as that oven is in your home kitchen.

Can I make and sell cake pops?

Yes - provided the cake pops do not have a filling that is not allowed and disco dust is not used as a decoration.

Can I make and sell caramel and candy apples?

Yes as long as the apples are raw and intact.

Can I make and sell apple butter or other fruit butters?

Yes. Butters made from fresh fruits are considered cottage food products. Fruit butters have significantly less sugar than a traditional jam or jelly. It is the combination of acid, sugar, pectin and heat that assures the safety of jams/jellies.

Can I make and sell vegetable butters such as pumpkin butter?

No. Butters using vegetable are not allowed.

Can I sell raw honey?

Yes, but ONLY if you harvest the honey from the hives, package and sell the product yourself.

Can I purchase bulk honey, repackage and sell the bottles of honey?

No. This is considered a manufacturing process and would require a food permit from FDACS.

Can I make and sell pumpkin and sweet potato pies?

No. Pies using these vegetables are not allowed.

Can I make vanilla?

Yes. Contact Department of Business and Professional Regulation, Division of Alcoholic Beverages and Tobacco for additional information about alcohol.

Can I make tinctures?

Yes. Contact Department of Business and Professional Regulation, Division of Alcoholic Beverages and Tobacco for additional information about alcohol.

Can I press and sell apple cider?

No. Apple cider is not a food allowed to be produced under cottage food, and beverages are not allowed.

Can I grind wheat and other grains and make them into flour?

Yes. You may grind any type of grain into flour, provided the packaging and labeling requirements are met.

Can I make and sell dehydrated meats under the cottage food Law?

No. Meats and jerky are not allowed.

Can I make and sell foods with meat fillings such as empanadas?

No. Meat products or foods with meat fillings are not allowed.

Can I make and sell hard candies or lollipops?

Yes. Hard candies, lollipops and peppermint candies are allowed.

Can I make and sell sweet breads, muffins or other baked goods made with fresh fruits and vegetables like zucchini, pumpkin and strawberries?

Yes, but only if the fruits or vegetables are incorporated into the batter and properly baked, labeled and packaged. The baked goods may not be decorated or garnished with fresh fruits or vegetables.

Can I use homegrown fruits and vegetables in baked goods?

Yes. You should take care to thoroughly wash the homegrown produce and the fruits or vegetables must be incorporated into the batter and properly baked, labeled and packaged. The baked goods may not be decorated or garnished with fresh fruits or vegetables.

Can homegrown produce be canned and used for making baked goods, like sweet breads, at a later date?

No. Home canned products cannot be used to make cottage food. Commercially canned fillings such as canned pumpkin, cherry pie filling, etc. can be used.

Can I freeze homegrown produce and use it for making baked goods, like sweet breads, at a later date?

Yes, as long as the frozen fruits or vegetables are incorporated into the batter and properly baked, labeled and packaged. The baked goods may not be decorated or garnished with fresh or frozen fruits or vegetables.

Can I make and sell dry bread mixes or instant bread mixes?

Yes. Dry bread mixes are an acceptable product to produce and sell.

Does my chocolate fountain business qualify as a Cottage Food business?

If your business is involved in any processing, preparation and storage of food items, including offsite, this food service business would not be eligible to operate under the cottage food guidance document and would required a food license from the Department of Business and Professional Regulation. If your service is hired to deliver the fountain equipment to the event, food product is purchased and delivered for each individual event, and assembled at the event, it would be considered a cottage food business.

PREPARING COTTAGE FOODS

Can I utilize commercial type equipment such as large rotary mixers in my cottage food operation?

No. A private home is not equipped with sinks large enough to effectively wash large commercial equipment.

Does my equipment, stove and/or refrigerator need to be NSF (a food equipment evaluation group) approved?

No. As a cottage food operator, you are not required to meet NSF standards for your equipment used to manufacture cottage food products.

How Bees Make Honey

University of Florida
Institute of Food and Agricultural Sciences
Beginner Beekeeper Workshop Series

Learning Objectives for this Lesson

After completing this lesson, you should be able to:

1. recognize the importance of honey to honey bee survival,
2. describe the process of how bees make honey, and
3. indicate ways in which beekeepers can increase colony honey production.

Why Bees Make Honey

Humans have collected honey for consumption for millennia.

Bees do not make honey for humans!

Honey provides honey bees with carbohydrates, the colony's energy source.

Bees rely on stores of honey to survive the winter.

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How Bees Make Honey

A forager (worker) bee collects nectar from plants using her proboscis (tongue).

The sugar content, aroma, and flavor of the nectar differs between flower species.

She stores the nectar in her honey stomach (crop) and carries it back to the hive.

While in the crop, the nectar is mixed with enzymes produced by the worker bee.

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How Bees Make Honey

The returning forager off loads her nectar supply to a worker bee waiting near the hive entrance.

Foragers can gauge if the colony needs more nectar by how long it takes for a receiver bee to take their forage.

This receiver bee finds an open cell in the hive in which to store the nectar.

At this point the nectar is about 80% water, 20% sugar.

University of Florida Honey Bee Research & Extension Laboratory

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How Bees Make Honey

Bees cannot store nectar in the hive without it fermenting.

The nectar must be dehydrated so that the carbohydrate source can be stored long term.

- Receiver bees blow bubbles
- Workers fan their wings over nectar cells

Bees work to get the moisture content between 17% and 18.5%.

At this point, the dehydrated substance is called honey.

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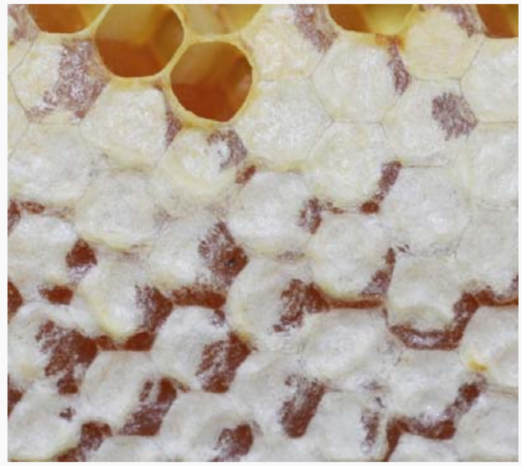
How Bees Make Honey

Worker bees cover 'ripe' honey cells with a thin sheet of pure beeswax.

Honey stored in this manner will remain edible forever, or until the bees need to eat their stored food.



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Increasing Honey Production

By maintaining strong honey bee colonies, beekeepers can increase honey production.

- Prevent swarming
- Healthy queen
- Control pests and diseases

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Increasing Honey Production

Not all plants are equal in terms of nectar production.

- Locate hives close to good nectar plants

Reuse drawn/pulled combs.

- It takes about 8lb. of honey to make 1lb. of wax.

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Supering

Supers (hive boxes) can be added on top of the hive to give bees more room to store honey.

Above the queen excluder and any other supers.

Only add an empty super to a hive when the one below it is about 75% full of honey.

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Questions?

Presentation created by Mary Bammer; UF/IFAS Honey Bee Research and Extension Laboratory

Varroa Management: How Mites Should Be Treated

Samuel Ramsey, Dennis van Engelsdorp, Ronald Ochoa, Gary Bauchan, Connor Gulbronson, Joe Mowery, Allen Cohen, Joseph Cicero, James Ellis

Varroa destructor

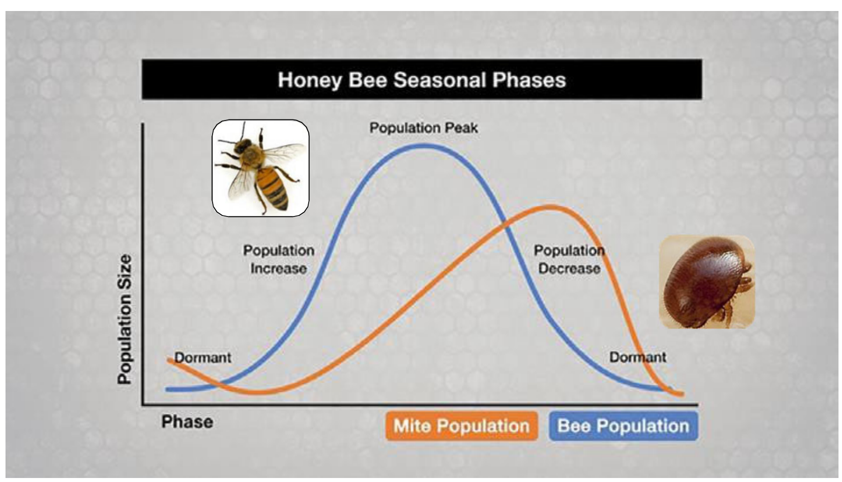
- Considered agent of primary concern in trend of colony losses (Annoscia 2012)
- First Found in the US in 1987
- Wiped out feral colonies by 1997

Month: 1

Varroa Management

- How to
- When to
- What to
- Why

4 Phases of Mite Population



Month: 2

Why Intervene?

- *Varroa* parasitism damages the entire colony
- Makes honey bees more susceptible to other maladies
- *Varroa* spread to other colonies via colonies with high mite load
- Unchecked populations double every month

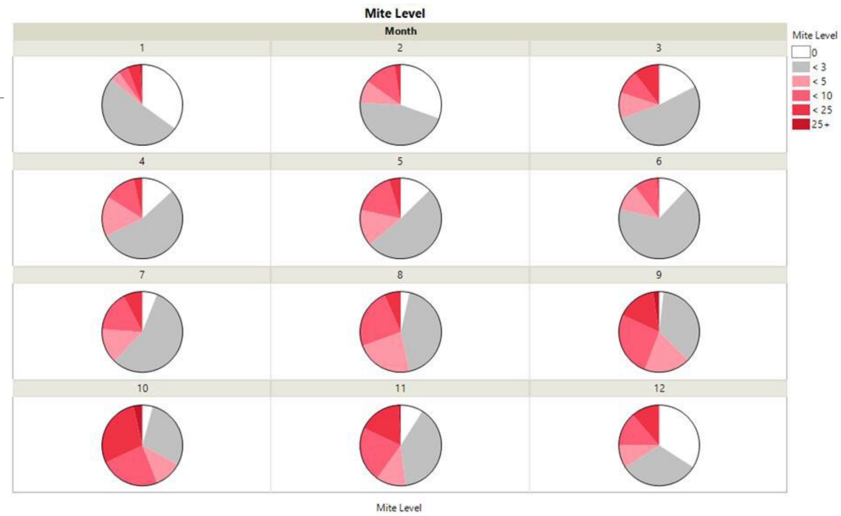
Am I My Brother's Beekeeper?

- Beekeeping is a "Team Sport"
- Herd Immunity

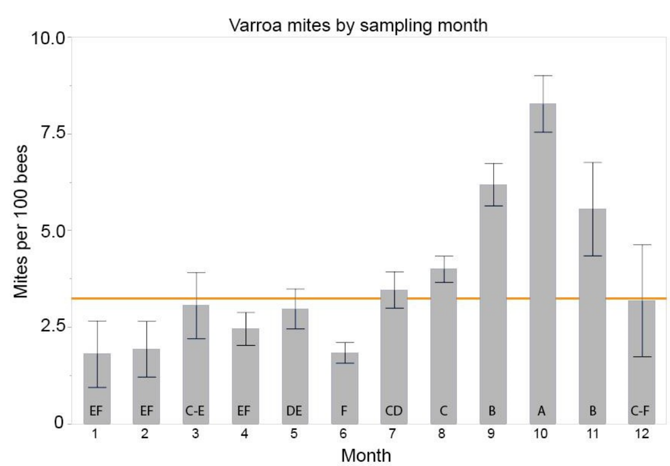
Fatbody

-Growth and Development
-Nutrient Storage & Energy Mobilization
-Metamorphosis
-Water Loss/Osmoregulation
- Pesticide Detoxification
- Immune Function
- Temperature Regulation
- Metabolic Activity
- Protein & Fat Synthesis
- Vitellogenesis

The Curious Case of the Bee Mite's Bite



Mean *Varroa* population by month

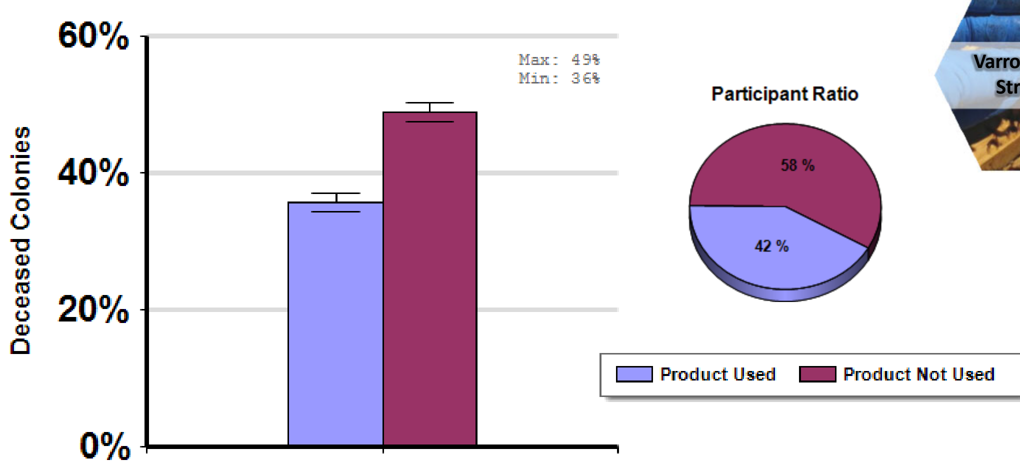


Month: 3

Am I My Brother's Beekeeper?

- Beekeepers exist as community
- Parasites spread more easily in communities
- No intervention selects for more virulent mites

Chemical *Varroa* Control



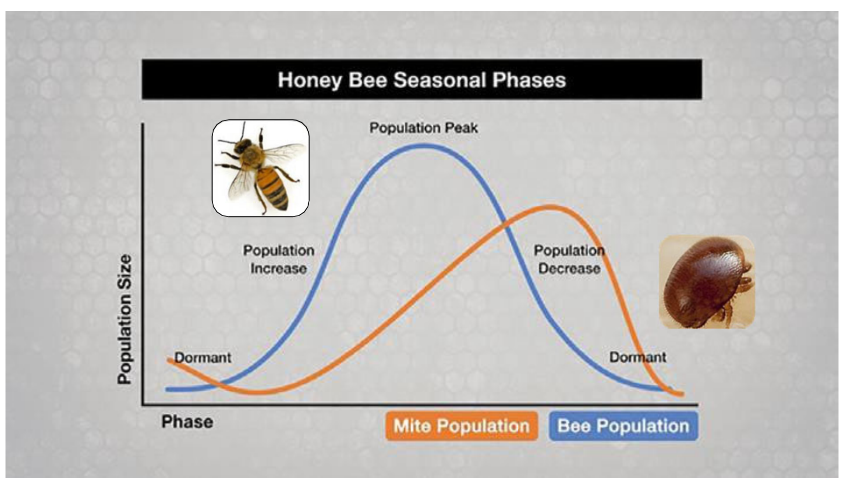
4 consecutive years illustrating that beekeepers who treat for Varroa lost significantly fewer colonies than those who did not use any product.

Month: 4

Monitoring

- Monitor before and after treatment
- Most important to monitor during increasing population and before dormancy
- For best results monitor at least four times annually
- Methods include
  - Sugar Shake
  - Alcohol Wash
  - Sticky Board Monitoring

4 Phases of Mite Population



Sugar Shake or Alcohol Wash?


Powdered Sugar Shake


Alcohol/Soap Wash

These sampling methods are accurate and easy to perform.
See the *Tools for Varroa Management Guide and/*or
the *Sampling Methods* video to learn how to use them.

Monitoring-Sugar Shake

Monitoring: Sugar Shake

- ½ a cup of bees = 300 bees
- Use multiple brood frames
- Counts are less accurate in high humidity

Monitoring: Sugar Shake

- Shake vigorously for a minute
- Set jar down for 3 to 5 min
- Shake out mites onto a light colored surface
- For best results add more sugar and roll again for 30 seconds

Month: 5

Cultural Controls

- Effective but require far more time than Chemical measures
- Measures include:
  - Screened bottom boards + Sticky Board
  - Drone Trapping
  - Brood Break

Drone Trapping

- Most effective Spring to mid-Summer
- Remove and destroy brood
- Must adhere to a strict schedule to avoid farming mites
- Remove brood frames within 27 days

Brood Break

- Most effective spring to late summer
- Need a new queen or an adoptive colony
- Best if paired with other controls
  - HopGuard
  - Oxalic

Month: 6

Chemical Controls

- Measures include:
  - Organic Acids
    - Mite-Away Quick Strips, Oxalic Acid, HopGuard II
  - Synthetic Acaricides
    - Checkmite+, Apistan, Apivar, Api Life Var
- Pay close attention to label instructions

Month: 1

Varroa Management

- How to
- When to
- What to
- Why

Month: 2

Why Intervene?

- *Varroa* parasitism damages the entire colony
- Makes honey bees more susceptible to other maladies
- *Varroa* spread to other colonies via colonies with high mite load
- Unchecked populations double every month

Month: 3

Am I My Brother's Beekeeper?

- Beekeepers exist as community
- Parasites spread more easily in comminities
- No intervention selects for more virulent mites

Month: 4

Monitoring

- Monitor before and after treatment
- Most important to monitor during increasing population and before dormancy
- For best results monitor at least four times annually
- Methods include
  - Sugar Shake
  - Alcohol Wash
  - Sticky Board Monitoring

Month: 5

Cultural Controls

- Effective but require far more time than Chemical measures
- Measures include:
  - Screened bottom boards + Sticky Board
  - Drone Trapping
  - Brood Break

Month: 6

Chemical Controls

- Measures include:
  - Organic Acids
    - Mite-Away Quick Strips, Oxalic Acid, HopGuard II
  - Synthetic Acaricides
    - Checkmite+, Apistan, Apivar, Api Life Var
- Pay close attention to label instructions

Amitraz (Apivar)

- Most effective after honey harvest
- Need 6 to 8 weeks
- Highly effective (estimated at 95%)

Amitraz (Apivar)

- 2 Strips per brood box
- Use no more 2x annually
- 35% to 47% fewer colonies lost in BIP survey

HopGuard

- 4 week treatment
- Strips impregnated with Potassium salts from hops
- Use when brood is not present
- Can be used with honey super present

Formic Acid (MAQS)

- 7 day fumigant
- Can be used with honey supers
- Should be less than 84˚F
- Can kill mites below the capping
- Best handled with respirator and gloves

Month: 6

Suspect Treatment Measures

- Ineffective Measures include:
  - Powdered Sugar Treatment
  - Comb replacement
  - Small cell size
  - Mineral Oil
- Shown via multiple studies to have no effect or negligible impact
  - Potentially Dangerous Measures
    - Organic Acid Fogger
- Unverified Measures
  - Heat Treatment

Cornell Pollinator Network: 2016 New York Tech Team Report

https://pollinator.cals.cornell.edu/

Varroa mite control options and considerations

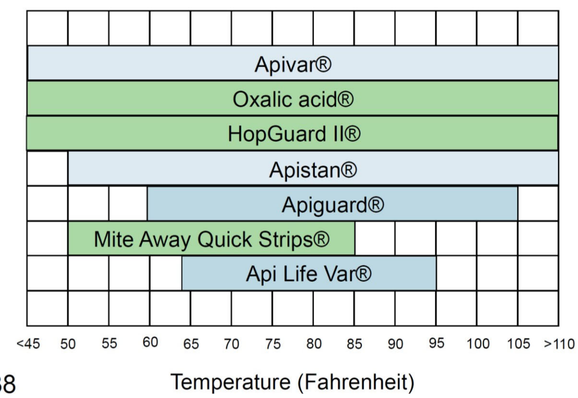
Essential oil | Organic acid | Synthetic chemical

Chemical	Active Ingredient	Method	Efficacy when used appropriately	Cost per colony ($)	Treatment duration	Can you treat with supers on?	Time to wait after treatment ends before you can super
Apiguard®	Thymol	Tray with gel sits on brood frames	74-95%	3.30 - 6.80	28 days (2 times for 14 days each)	No	Can super immediately after treatment ends
Api Life Var®	Thymol, eucalyptus oil, menthol	Tablets placed on the corners of the brood nest	70-90%	4.48 – 7.12	21-30 days (3 times at 7-10 day intervals)	No	1 month
MiteAway Quick Strips®	Formic acid	Pads placed on brood nest	61-98%	4.40 – 7.25	7 days	Yes	Supers can be left on during treatment
Oxalic Acid	Oxalic acid dehydrate	Dribble brood nest or vaporize entrance	82-99%	0.25 – 0.37	10 minutes	No	2 weeks
Hop Guard II®	Hops beta acids	Strips inserted in brood nest	75-99%	3.33 – 3.80	28 days	Yes	Supers can be left on during treatment
Apivar®	Amitraz	Insert strips into brood nest	95%	5.00 – 6.90	42-56 days	No	2 weeks
Apistan®	*Tau*-fluvalinate (pyrethroid)	Insert strips into brood nest	95-99%	4.19 – 6.79	42 days	No	Can super immediately after treatment ends

Notes:

- There have been cases of resistance in Apistan®. Varroa mites can develop resistance to any treatment, therefore is important to rotate treatments, remove treatment strips promptly, and practice Integrated Pest Management to reduce the likelihood of resistance developing. Make sure you monitor following treatment (or regularly every month) to determine efficacy.
- Efficacy levels are cited from **Honey Bee Health Coalition, 2017. Tools for *Varroa* management: a guide to *effective Varroa* sampling and control,** 5th edition.
- Treatment costs per colony vary depending on supply companies and order size.

Treatment Temperature Windows



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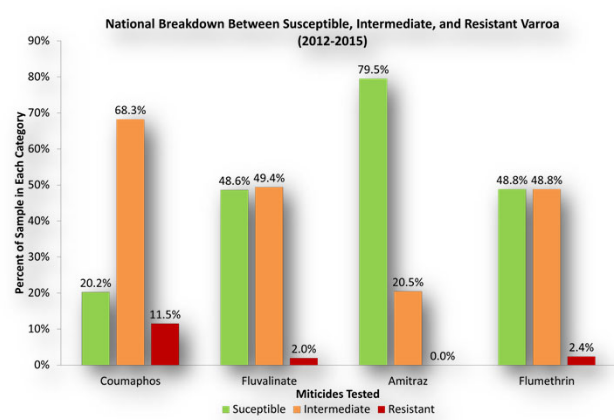
Results



"Resistant" mites were categorized by ≤20% mortality after treatment
"Susceptible" mites were categorized by ≥80% mortality after treatment
"Intermediate" mites had between 21-79% mortality after treatment

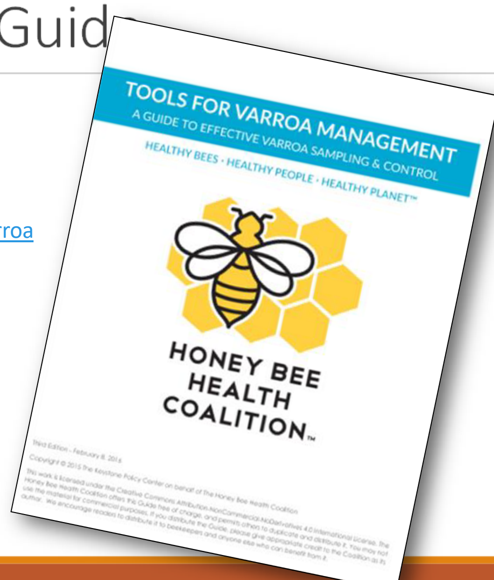
Results

Tested mites populations show resistance to 3 miticides tested

Coumaphos resistance most prevalent
Amitraz showed no resistance

Amitraz may be more effective in reducing mite loads than the other miticides

Resources: Tools Guide



Download the Guide:
www.honeybeehealthcoalition.org/varroa

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Am I My Brother's Beekeeper?

- Beekeepers exist as community
- Parasites spread more easily in communities
- No intervention selects for more virulent mites

Acknowledgements

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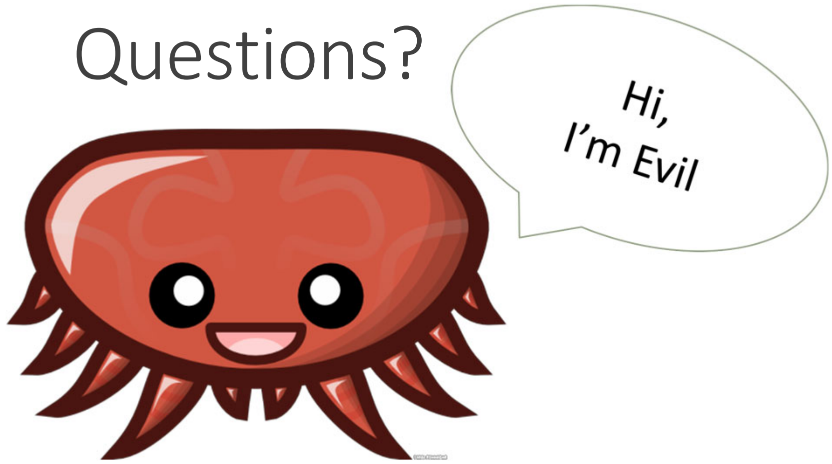
Kathleen Hackett

Many Thanks!

Questions?



Thank You For Your Time and Attention

I'd be Happy to Answer Any Questions?

Cornell Pollinator Network: 2016 New York Tech Team Report

https://pollinator.cals.cornell.edu/

Varroa mite control options and considerations

Essential oil | Organic acid | Synthetic chemical

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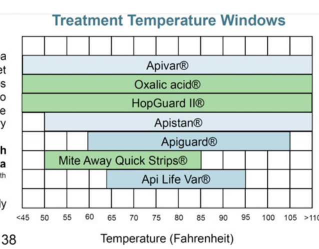


Identifying Common Bees of Florida

Rachel Mallinger

Bee College 2018

Gainesville, FL

Bees and their look-a-likes

Bees vs. flies: Flies have only two wings (one on each side of the body) and short stubby antennae while bees have 4 wings (two on each side of the body) and long slender antennae. Additionally, most flies have large bulging eyes that nearly touch one another at the top of the head while bees have smaller and more widely spaced eyes. Bees are typically hairier, especially on the legs. Some flies, including syrphid flies and bee flies, mimic bees and can thus be easily confused with them.

Bees vs. wasps: Wasps and bees share may common features including 4 wings and relatively long antennae. Wasps are generally less hairy and have longer thinner legs with spines while bees are more hairy with relatively robust and hairy legs. Some other distinguishing features include: wasps' antennae are closer together while bees' antennae are more widely spaced on the head, the integument ("skin") of wasps is generally rougher with more pits while bees have a smoother, less pitted integument, and wasps generally have a thinner body with a more narrow waist in comparison to bees.

Guide to different common bee groups

Size chart showing relative sizes of different native wild bees.

1. Honey Bees

Honey bees are ubiquitous, eusocial bees of the family Apidae, genus *Apis*, that are used intensively for agricultural pollination, honey production, and as a hobbyist pastime. There is only one honey bee species in Florida, the non-native European honey bee, *Apis mellifera*. Most honey bees in Florida are from managed hives, but feral colonies are also common.

SIZE: 6 – 7

IDENTIFYING FEATURES: Pale orange and black coloration on their abdomens, hairs on the compound eyes (can be difficult to observe without a microscope), females can be seen with neatly-packed pollen balls attached to corbiculae, or pollen baskets, on their hind legs, long proboscis (tongue)
NEST HABITAT: Aboveground
SOCIALITY: Social, perennial colonies

Honey bee photo courtesy Alex Wild. www.alexanderwild.com

2. Sweat Bees
Sweat bees of the family Halictidae are a diverse and common group of bees with over 40 species in Florida. They are called sweat bees because they are attracted to the salts and proteins in sweat and will often land on your skin for a drink.
SIZE: 0-5
IDENTIFYING FEATURES: Variable coloration and size: some species are bright green in color while others are dark gray/black, often with bands of white hair on the abdomen. Males of some species have a green head and thorax with a yellow-and-black-striped abdomen. All have short tongues and one subantennal suture, though these features can be difficult to see without a microscope. The metallic green species may be confused with the green orchid bee in southern Florida, but are generally smaller and more slender in size, while the black or gray species may be confused with a number of other groups of bees; a lack of the distinctive features can be used to differentiate sweat bees from other bee groups.
NEST HABITAT: Usually underground though some nest aboveground in wood.
SOCIALITY: Primarily solitary though there are some social species

Augochlora pura

Augochloropsis metallica

Agapostemon splendens


Lasioglossum versatum


Lasioglossum floridanum


Halictus confusus

3. Leafcutter Bees

Leafcutters are solitary bees of the family Megachilidae. Most are in the genus *Megachile,* which includes approximately 26 species in Florida. They are known for cutting round segments of leaves used to line their nest cells, which are made in elongated cavities in soil, rotting wood, or other pre-made holes.

SIZE: 4 - 6

IDENTIFYING FEATURES: Dark-colored, robust and round bodies, often with stripes of light colored hairs on their abdomens. Females have distinctive pollen-collecting hairs on the underside of the abdomen while males can sometimes be identified by long manes of hair on their front legs. The pollen- collecting hairs on the abdomen underside may be light or dark colored, but are quite visible when packed with pollen. Females also have a characteristic way of flying and foraging with their abdomens slightly flexed upward, exposing the hairs underneath.

NEST HABITAT: Primarily aboveground in pre-made cavities, though some species nest belowground

SOCIALITY: Solitary


Megachile pseudobrevis


Lithurgopsis gibbosus


Megachile integrella


Megachile campanulae


Megachile petulans


Megachile texana

4. Mason Bees

Mason bees, like leaf cutter bees, are solitary bees in the family Megachilidae but of a different tribe, Osmiini. Mason bees get their name from their nest construction materials; they use mud to line the walls of their brood chambers and nest entrances, usually built within abandoned holes in wood or hollowed reeds and twigs. Roughly 14 species of mason bees can be found within Florida and most of these are in the genus *Osmia*.

SIZE: 3 - 7

IDENTIFYING FEATURES: Like leafcutter bees, female mason bees can be identified from many other bees by their pollen-collecting hairs on the underside of the abdomen. Unlike leafcutter bees, many mason bees have a metallic sheen and dark blue coloration (*Osmia* spp.). The less common groups of mason bees in Florida, *Hoplitis* and *Heriades* spp., are small in size, black in coloration usually with white hair bands, and distinctive cigar-shaped bodies.

NEST HABITAT: Aboveground

SOCIALITY: Solitary

Osmia atriventris

Osmia chalybea

Osmia georgica

Heriades leavitti

Hoplitis pilosifrons

Hoplitis truncata

5. Bumble Bees

Social bumble bees are in the family Apidae, genus *Bombus*, and live in hives typically consisting of between 50 -200 individuals. They make their hives underground from abandoned burrows, on the ground surface in thick grass patches, or aboveground in hollowed-out trees. Roughly five species of social bumble bees can be found in Florida.

SIZE: 8 - 10

IDENTIFYING FEATURES: Bumble bees are most easily identified by their robust size, hairy abdomens, and pollen baskets on female hind legs, similar to honey bees. The hairs on the abdomen vary in color including black, yellow, white, red, and orange, with some species having mostly back hairs while others have mostly light-colored hairs. Bumble bees may be mistaken for carpenter bees, but they are much hairier, especially on the abdomen, while carpenter bees have relatively hairless abdomens.

NEST HABITAT: Typically at ground level or shallowly below-ground, some nest aboveground

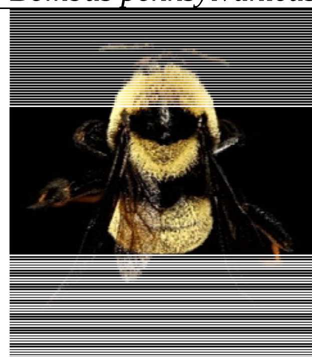
SOCIALITY: Social, annual colonies

Bombus impatiens

Bombus pennsylvanicus

Bombus griseocollis

Bombus bimaculatus



Bombus fraternus

6. Carpenter Bees

Carpenter bees are wood-boring bees of the family Apidae, subfamily Xylocopinae. In Florida there are only five carpenter bee species; two of which are very large in size (*Xylocopa* spp.) and three are very small (*Ceratina* spp.). The large carpenter bees are often observed using manmade wooden structures in which they create their nests. The smaller carpenter bees typically nest within excavated twigs or stems.

SIZE: 0-2 (*Ceratina* spp.) and 9-10 (*Xylocopa* spp.)

IDENTIFYING FEATURES: *Xylocopa* spp., or large carpenter bees, could be mistaken for bumble bees but are larger, have shiny and relatively hairless abdomens, faint metallic coloration, and dark wings. Males often exhibit a characteristic hovering behavior, and they can be found near man-made wooden structures. *Ceratina* spp., or small carpenter bees, are identified by the combination of their small, slender size, their metallic blue or black coloration, and yellow markings on the face.

NEST HABITAT: Aboveground in wood (large carpenter bees) or twigs and stems (small carpenter bees)

SOCIALITY: Mostly solitary, *Ceratina* spp. can be social

Xylocopa micans

Xylocopa virginica

Xylocopa micans

 *Ceratina dupla*	 *Ceratina cockerelli*	

7. Long-horned Bees
Long-horned bees are a tribe of bees in the family Apidae known as the Eucerine bees. Approximately 24 species in five genera are found throughout Florida. Long-horned bees of the genus *Xenoglossa*, known as squash bees, are important pollinators of pumpkin, squash, and other gourds. Long-horned bees also include species from the genus *Svastra*, known as sunflower bees. The most diverse group of long-horned bees are in the genus *Melissodes*, which frequently visit Asteraceae plants.
SIZE: 3 - 8
IDENTIFYING FEATURES: These bees are known for the relatively long antennae of the males; female antennae are normal length. Female long-horned bees can be generally recognized by a combination of their robust, medium- large body size, hairy legs, hairy wings, protruding clypeus (the area of the face in between the compound eyes) and wide stripes of white-yellow hairs on the abdomen. Some species additionally have white-yellow markings on their faces. None are metallic, and many are specialists, thus identified in part by the plant on which they are foraging
NEST HABITAT: Belowground
SOCIALITY: Solitary

 *Melissodes communis*	 *Eucera rosae*	 *Melissodes bimaculata*
 *Melissodes tepaneca*	 *Xenoglossa strenua*	 *Svastra aegis*

8. Mining Bees

Mining bees are a diverse group of ground-nesting bees in the family Andrenidae. The most common species of mining bees found throughout Florida are within two genera, *Andrena* (medium-sized bees) and *Perdita* (very small-sized bees), which account for over 50 total species statewide. They are known for boring underground nests in sandy soils, which create aboveground mounds of dirt.

SIZE: 1 - 7

IDENTIFYING FEATURES: Mining bees are generally dark in color, sometimes with light-colored hair bands on the abdomen, and all have short tongues. *Andrena* spp. can be identified by the thick hair patches on their face beside each eye (known as facial fovea) while *Perdita* spp. have distinctly small-sized bodies with bright yellow spots or stripes on the face and/or abdomen. Mining bees could be confused with many other groups so in addition to the above features, a lack of distinctive characteristics may set them apart.

NEST HABITAT: Belowground

SOCIALITY: Solitary

Andrena banksi

Andrena fulvipennis

Andrena confederata

Perdita bradleyi

Perdita octomaculata

Perdita bishoppi

10. Plasterer Bees

Plasterer bees, sometimes known as cellophane bees, get their name from the cellophane-like substance that they create to line their brood nests. Plasterer bees make up roughly 26 species statewide in two main groups: yellow-faced bees (genus *Hylaeus*) and *Colletes* spp.

SIZE: 1-2 (*Hylaeus* spp.), 3-6 (*Colletes* spp.)

IDENTIFYING FEATURES: Yellow-faced bees (*Hylaeus* spp.) are small with distinctly yellow faces and a lack of pollen-carrying hairs on their legs since they instead collect and carry pollen internally. *Colletes* spp. are medium-large sized bees that are generally dark in color with bands of light-colored hairs on their abdomens. Additionally, *Colletes* spp. have a uniquely heart-shaped face (with no facial fovea as in *Andrena* spp.) and tapered abdomens. All bees in this group are short-tongued.

NEST HABITAT: belowground (*Colletes* spp.) or aboveground in twigs or stems (*Hylaeus* spp.)

SOCIALITY: Solitary


Colletes distinctus


Colletes thysonellae


Colletes validus


Hylaeus georgicus


Hylaeus leptocephalus


Hylaeus modestus

11. Cuckoo Bees

Cuckoo bees are kleptoparasitic nest parasites of other bee species. This means females will enter another bee's nest chamber and lay her eggs on top of the pollen and nectar provision. Once the cuckoo bee offspring emerges, it consumes the pollen ball and may kill the other bee in the nest chamber. Over time, these cuckoo bees have lost much of their pollen-collecting hairs as they do not collect and transport pollen for their own nests. Kleptoparasitism is relatively common in the bee world and cuckoo bees can be found within different bee families.

SIZE: 2 - 6

IDENTIFYING FEATURES: Many species have dark orange/red or bright yellow coloration on the integument (skin) and a noticeable lack of pollen-collecting hairs. Some species (*Coelioxys* spp.) have uniquely pointed abdomens

NEST HABITAT: Above and belowground in other bee species' nests

SOCIALITY: Solitary, parasitic


Triepeolus lunatus


Triepeolus remigatus


Coelioxys germana

 *Nomada fervida*	 *Nomada australis*	 *Coelioxys octodentata*

Hive Inspection Checklist

You can use this checklist to evaluate your honey bee colonies during monthly hive inspections.

Apiary Location/Name: ________________ **Date of Inspection:** ________________ **Weather Conditions:** ________________

Hive Number/ID: ________________ **Time of Inspection:** ________________ ________________

Bees and Brood

Located queen? O Yes O No

Located eggs? O Yes O No

Brood Pattern

O Solid and uniform

O Intermittent

O Spotty

Excessive drones or drone cells? O Yes O No

Queen cells present? O Yes O No

Along frame bottom: # __________

Converted worker cells: # ________

Colony Population

O Full

O Moderate

O Low/Weak

Food Stores

Pollen/Bee Bread

O High O Medium O Low O None

Nectar/Unripe Honey: # frames ________

Honey (Ripe/Capped): # frames ________

Top super % full: ____________

Rate sugar water consumed: 1 jar/________ (time)

Pests/Diseases Present

O Varroa (#________ mites/100 bees)

Method used: Alcohol Wash / Sugar Shake

O Varroa-related viruses (deformed wing, k-wing)

O Small hive beetles

O American foulbrood

O European foulbrood

O Nosema

O Wax moths

O Chalkbrood

O Other: ________________

Management

Pest/Disease Control *Date Added:* ____________ *Date Removed:* ____________

O Apistan O Apiguard O HopGuard O Oxytetracycline O Tylosin O Fumagilin

O Drone comb O Other: ________________

Added honey super? O Yes O No

Removed honey? O Yes O No *Amount:* ____________

Other Colony/Management Comments: ________________________________

Installing Packages and Nucs

University of Florida
Department of Entomology & Nematology

Installing Packages

Equipment needed:

- Package of bees
- Caged queen
- New/empty hive with frames
- Personal protective equipment
- Spray bottle filled with water
- Hive tool
- Staple gun and/or duct tape
- String
- Sugar water
- Hive feeder
- Entrance reducer

Components of a Package of Bees

Packages are a wooden or plastic cages with mesh sides.

A removable lid on the top of the package is where bees will be released.

Under the lid is usually a feeder jar/can, filled with sugar water.

If your package comes with a queen, she will be inside a queen cage inside the package.

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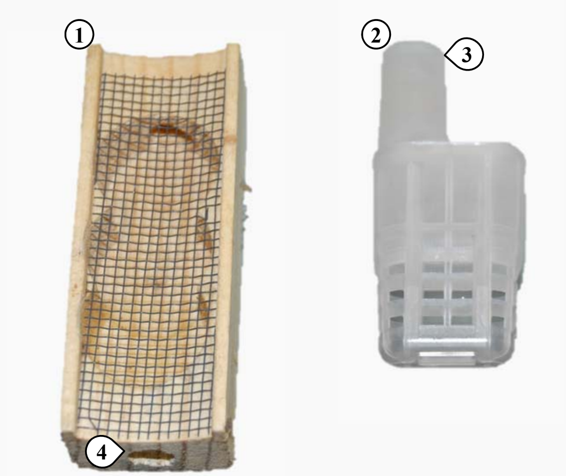
Components of a Queen Cage



The queen cage can also be plastic or wooden with mesh sides

The cage will have an opening on one end that will be sealed with a plastic cap or cork and/or will be filled with candy/sugar.

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Installing Packages

Before opening the package, spray the bees with water through the mesh, covering the bees with a fine mist.

Wet bees cannot fly away from the hive during installation and can be easier to pour from the package.

Installing Packages

To open the package, remove the lid using a hive tool.

Then remove the feeder jar and queen cage.

To prevent bees from leaving the package prematurely, replace the lid until the package is installed into the hive.

Installing Queens

Attach a piece of string to the queen cage using duct tape (for a plastic cage) or a staple (for a wooden cage).

Staple the other end of the string to the top bar of a frame at the outer edges of your empty hive box.

There are two ways to release the queen:

- Leave the hive alone for four days then release the queen yourself by removing the cap/cork.
- Before installing the queen cage, remove the cork, exposing the candy end. The worker bees will eventually eat through the candy, releasing the queen.

A new queen should never be immediately released into a colony as the worker bees will almost certainly kill her.

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Installing Packages

Before installation, remove five frames from the hive and insert an entrance reducer.

There are two methods for getting the bees into their new hive.

First, you can shake the bees from the package into the hive.

If you use this method, replace the five removed frames right away.

Replace these frames slowing to avoid squishing bees.

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Installing Packages

The second method of getting bees into the box is to place the entire opened package into the new hive.

The bees will eventually make their way out of the package into the hive body

B1

After your package is installed, put the lid on the hive and add a feeder with syrup. (2:1 mixture water:sugar by volume).

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Installing Packages

Package bees can also be installed into a nuc box, rather than a full hive body.

This method has the advantage of giving the bees a small space to defend, while they start to establish their colony.

If you use this method, you will want to shake the bees into the nuc box, rather than placing the package into the box.

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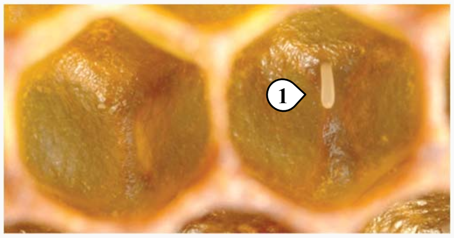
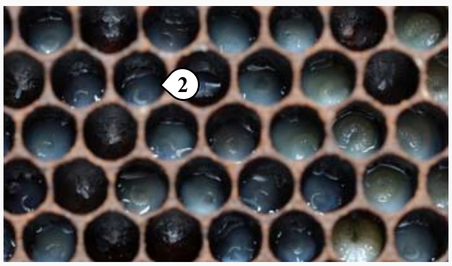
Package Installation Follow-up





After seven days, check the colony to verify that the queen has been released if you used a candied queen cage.

At that time, also check to see if the queen is laying eggs.

If you cannot find the queen and/or have a hard time seeing eggs, look for young brood.

If queen is missing and no brood is present, you will need to purchase and install a new queen.

Feed the growing colony sugar syrup as needed.

Installing Nucs

Equipment needed:

- 3-5 frame nucleus colony ("nuc")
- New/empty hive with frames
- Personal protective equipment
- Hive tool
- Sugar water
- Hive feeder
- Entrance reducer

Installing Nucs

Start with an empty hive body resting on a bottom board.

Make sure that the depth of your nuc matches the depth of your hive body (e.g. frames from a deep nuc can only be installed into a deep hive body).

Insert enough frames with foundation (and drawn comb, if available) into the box so that your hive body will be full once you have installed the nuc.

For example, if you are installing a five frame nuc into a 10 frame hive body, you will start with five frames in the box.

Place these frames along the outside of the hive, leaving space in the middle for your nuc frames.

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Installing Nucs

Using your hive tool, remove the nuc lid and transfer the frames in the nuc into the space in the hive body.

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Installing Nucs

Installing Nucs

Installing Nucs

Caring for New Colonies

Make sure colonies are fed regularly (as needed).

Check frames every 1-2 weeks to make sure they are not *honey bound* (i.e. there is still room for eggs and brood) and that pollen is present.

Continue to feed until all frames are drawn.

Watch and sample for small hive beetle larvae and other diseases/pests.

Monitor queen quality.

Florida Department of Agriculture and Consumer Services
Division of Plant Industry

ADAM H. PUTNAM
COMMISSIONER

BEEKEEPER COMPLIANCE AGREEMENT – BEST MANAGEMENT REQUIREMENTS FOR MAINTAINING EUROPEAN HONEY BEE COLONIES

Chapter 586.10 (1), F.S. / Rule 5B-54.0105, F.A. C.

1911 SW 34 Street/P.O. Box 147100, Gainesville, FL 32614-7100
Phone: (352) 395-4633 / Fax: (352) 395-4624

1. NAME & MAILING ADDRESS OF OWNER OR AGENT:	2. APIARY(IES) LOCATIONS BY COUNTY
3. REGULATED ARTICLE(S): **Honey bee colonies**	
4. APPLICABLE STATE QUARANTINE(S) OR REGULATIONS: **193.461, 570.32, 586.10 (1), Florida Statutes, and Chapter 5B-54, Florida Administrative Code.**	

Signature of this document indicates adherence to the following requirements and establishes compliance with Chapter 586, Florida Statutes. Beekeepers keeping bees in areas that are not classified as agricultural pursuant to Section 193.461, Florida Statutes, must adhere to these guidelines. The guidelines are recommended, but not required for beekeepers keeping bees in areas classified as agricultural pursuant to section 193.461, Florida Statutes.

BEST MANAGEMENT REQUIREMENTS FOR MAINTAINING EUROPEAN HONEY BEE COLONIES ON NON-AGRICULTURAL LANDS

The colony density limits in areas not classified as agricultural pursuant to Section 193.461, Florida Statutes, below, minimize potential conflict between people and honey bees and beekeepers following the BMRs outlined in this document. The honey bee colony requirements /densities may not be exceeded except under a special permit issued by the Director of the Division of Plant Industry in accordance with the requirements of Rule 5B-54.0105(3), F.A.C.

1. The placement of honey bee colonies on **non-agricultural private lands** must agree to and adhere to the following stipulations:
   A. When a colony is situated within 15 feet of a property line, the beekeeper must establish and maintain a flyway barrier at least 6 feet in height consisting of a solid wall, fence, dense vegetation or combination thereof that is parallel to the property line and extends beyond the colony in each direction.
   B. All properties, or portions thereof, where the honey bee colonies are located must be fenced, or have an equivalent barrier to prevent access, and have a gated controlled entrance to help prevent unintended disturbance of the colonies.
   C. No honey bee colonies may be placed on public lands including schools, parks, and other similar venues except by special permit letter issued by the Director of the Division of Plant Industry and written consent of the property owner.
2. Honey bee colony densities on **non-agricultural private land** are limited to the following property size to colony ratios:
   A. One quarter acre or less tract size - 3 colonies. Colony numbers may be increased up to six colonies as a swarm control measure for not more than a 60 day period of time.
   B. More than one-quarter acre, but less than one-half acre tract size - 6 colonies. Colony numbers may be increased up to 12 colonies as a swarm control measure for not more than a 60 day period of time.

C. More than one-half acre, but less than one acre tract size - 10 colonies. Colony numbers may be increased up to 20 colonies as a swarm control measure for not more than a 60 day period of time.

D. One acre up to two and a half acres - 15 colonies. Colony numbers may be increased up to 30 colonies as a swarm control measure for not more than a 60 day period of time.

E. Two and a half to five acres - 25 colonies. Colony numbers may be increased up to 50 colonies as a swarm control measure for not more than a 60 day period of time.

F. Five up to 10 acres – 50 colonies. Colony numbers may be increased up to 100 colonies as a swarm control measure for not more than a 60 day period of time.

G. Ten or more acres – 100 colonies. The number of colonies shall be unlimited provided all colonies are at least 150 feet from property lines.

3. Beekeepers must provide a convenient source of water on the property that is available to the bees at all times so that the bees do not congregate at unintended water sources.
4. Beekeepers must visually inspect all honey bee colonies a minimum of once a month to assure reasonable colony health including adequate food and colony strength. If upon inspection honey bees appear to be overly aggressive the beekeeper shall contact their assigned apiary inspector for an assessment.
5. Re-queen collected swarms, new colonies and maintain colonies with queens or queen cells from EHB queen producer(s).
6. Practice reasonable swarm prevention techniques as referenced in University of Florida's Institute of Food and Agricultural Sciences extension document "Swarm Control for Managed Beehives", ENY 160, published November 2012.
7. Do not place apiaries within 150 feet of tethered or confined animals or public places where people frequent. (Examples - day care centers, schools, parks, parking lots, etc.)
8. Do not place colonies in an area that will impede ingress or egress by emergency personnel to entrances to properties and buildings.
9. Deed restrictions and covenants that prohibit or restrict the allowance for managed honey bee colonies within their established jurisdictions take precedence and as a result supersede the authority and requirements set forth in Chapter 586 Florida Statutes and Rule Chapter 5B-54, Florida Administrative Code.

It shall be presumed for purposes of this article that the beekeeper is the person or persons who own or otherwise have the present right of possession and control of the tract upon which a colony or colonies are situated. The presumption may be rebutted by a written agreement authorizing another person to maintain the colony or colonies upon the tract setting forth the name, address, and telephone number of the other person who is acting as the beekeeper.

<table>
<tr><td>5. AUTHORIZED SIGNATURE</td><td colspan="2">6. PRINTED NAME & TITLE</td><td>7. DATE SIGNED</td></tr>
<tr><td colspan="2" rowspan="2">The affixing of the signatures below will validate this agreement, which shall remain in effect until canceled or renewed, but may be revised as necessary or revoked for noncompliance. All previous versions of this compliance agreement are superseded and rendered obsolete by this document.</td><td colspan="2">8. AGREEMENT NUMBER</td></tr>
<tr><td colspan="2">9. DATE OF AGREEMENT</td></tr>
<tr><td colspan="2">10. OFFICIAL NAME & TITLE
David A Westervelt, Chief Apiarist</td><td colspan="2" rowspan="2">11. OFFICIAL ADDRESS
Division of Plant Industry
Apiary Inspection Section
P.O. Box 147100
Gainesville, FL 32614-7100</td></tr>
<tr><td colspan="2">12. OFFICIAL SIGNATURE</td></tr>
</table>

Division of Plant Industry
(352) 395-4700

Post Office Box 147100
Gainesville, Florida 32614-7100

1911 S.W. 34th Street
Gainesville, Florida 32608

Florida Department of Agriculture and Consumer Services
Commissioner Adam H. Putnam

BRIEF SUMMARY OF THE APIARY INSPECTION LAW

Chapter 586, Florida Statutes, Rule Chapter 5B-54

The honey bee industry of Florida is of major importance in the pollination of various agricultural crops and in the production of high quality honey and honey bee products. Honey bee pests and unwanted races of honey bees that threaten this important industry must be regulated. To accomplish this, the Bureau of Plant and Apiary Inspection must register and inspect honey bee colonies in order to certify them as meeting the requirements of freedom or substantial freedom from honey bee pests of regulatory significance and freedom from unwanted races of honey bees. Therefore, the following is required by law, Chapter 586, Florida Statutes, and Rule Chapter 5B-54, Florida Administrative Code, to assist in the protection of the apiary industry.

Registration: Each beekeeper having honey bee colonies within the state must register with the Department using application form FDACS-08176 and pay the proper registration fee (see below for fee scale). Upon approval of the application, the Department will issue to the beekeeper a Certificate of Beekeeping Registration and the local apiary inspector will visit the apiary to conduct a routine apiary inspection. This certificate must be renewed annually on or prior to the anniversary date of the certificate.

Each application for registration or renewal of registration (FDACS-08176) must be accompanied by the proper registration fee based on the total number of colonies operated by the registrant as follows:

Number of Honey Bee Colonies	Fees
1 - 5	$ 10
6 - 40	$ 20
41 - 200	$ 40
201 - 500	$ 70
501 - over	$100

The penalty fee for late payments shall be $10.00. The law makes no provision for exemption from payment of this fee due to a person's disability or age. The certificate of registration must be renewed before the expiration date.

Fees for special inspection services may vary depending on the service requested. For further information contact: The Apiary Inspection Section at (352) 395-4633.

Inspection: Each apiary shall be inspected by the Department at such intervals as the Department deems best for the detection of honey bee pests and unwanted races of honey bees.

Inspection Conditions: Each apiary site shall be maintained in such a manner as to allow reasonable access for inspection. All hives must have movable frames.

Identification of Honey Bee Hives: All honey bee hives must be permanently imprinted on the upper left hand corner in letters at least ½ inch in height with the beekeeper's firm number issued by the Department. This number may be applied with paint, permanent ink marker or legible permanent marking method. Commercial beekeepers must post a 5" x 9" placard at each apiary location that is visible to the public with emergency contact information to include owner name and telephone number.

Certificate of Apiary Registration: A certificate is required:

A on each sale or movement of honey bees within the state;

B on all out-of-state movements; and

C on all shipments moving into Florida from outside the state.

Quarantine and Destruction or Treatment of Infested Hives:

A All hives found infested with American Foulbrood disease shall be destroyed by burning. Other hives in the bee yard shall be quarantined for a minimum of 30 days. Compensation shall be paid at ½ the estimated equipment value, not to exceed $25.00 **for the first 10 hives, after which payment will be discounted if the disease rate exceeds 50 percent of the total colony inventory, payment will be discounted 50 percent.**

B Hives infested with other related honey bee pests and any unwanted races of honey bees shall be quarantined and treated as prescribed by the Department. No compensation will be awarded for such action.

Abandoned Apiaries: Any apiary found without proper identification or registration information shall be considered abandoned. Following a reasonable effort to contact the owner, the Department shall dispose of such equipment following guidelines detailed in Rule 5B-54, Florida Administrative Code.

Penalties: Any person who violates the provisions of Chapter 586, Florida States, or rules adopted thereunder shall for the first offense be guilty of a misdemeanor of the first degree, and upon a second or subsequent conviction thereof shall be guilty of a felony of the third degree. The Department may, after notice and hearing, impose a fine not exceeding $5,000 for the violation of any of the provisions of this law or rules thereunder.

FOR ADDITIONAL INFORMATION, CONTACT THE ASSISTANT CHIEF, DAVID A. WESTERVELT, APIARY INSPECTION SECTION, DIVISION OF PLANT INDUSTRY, POST OFFICE BOX 147100, GAINESVILLE, FLORIDA 32614-7100, (352) 395-4636, OR EMAIL David.Westervelt@FreshFromFlorida.com.

Revised 10/01/2018

Maintaining European Honey Bee Colonies

Carmen Fraccica
Agriculture & Consumer Protection Specialist Supervisor
Bureau of Plant and Apiary Inspection
Division of Plant Industry

Florida Department of Agriculture and Consumer Services • Adam H. Putnam, Commissioner

Chapter 586
Honey Certification and Honeybees

- 586.02 Definitions- "Unwanted race of honeybees" means those natural, genetically isolated subspecies of honeybees which beyond a reasonable doubt can inflict damage to people or animal greater than feral honeybees commonly utilized in North America.

- 586.025 – Unlawful acts. – it shall be unlawful to:
  - Introduce into this state any honeybee pest or unwanted race of honeybees, except under special permit issued by the department, which shall be the sole issuing agency for such special permits.

https://www.flsenate.gov/Laws/Statutes/2012/Chapter586

Best Management Requirements

- Re-queen collected swarms, new colonies and maintain colonies with queen or queen cells from EHB queen producers.
- Practice reasonable swarm prevention techniques as refereed in University of Florida's Institute of Food and Agricultural Sciences extension document " Swarm Control for Managed Beehives".

http://www.freshfromflorida.com/content/download/71084/1640892/08492.pdf
http://edis.ifas.ufl.edu/in970

Best Management Requirements

http://www.freshfromflorida.com/content/download/71084/1640892/08492.pdf

European vs Africanized Swarming Behavior

EUROPEAN HONEY BEE

- 1-2 times per year
- Swarms are larger and need larger volume to nest
- Rarely abscond from nesting location

AFRICANIZED HONEY BEE

- Can swarm 10 or more times per year
- Swarms are much smaller, some not larger than a coffee cup or a softball-can nest in smaller area
- Abscond often and relocate to more suitable nesting location

Avoid possible nesting locations

- Lumber piles
- Water meters
- Vents
- Soffits
- Empty equipment
- Small holes in fencing and house columns/pillars
- Under sheds
- Mobile Homes
- Trees
- Grill
- Empty Pots
- Walls
- Inspect Trees for open air hives.
- Chimneys
- Swing set / playground
- Any open cavity that a Honey Bee can fit!


Keep Apiary Clean!
Florida Department of Agriculture and Consumer Services • Adam H. Putnam, Commissioner

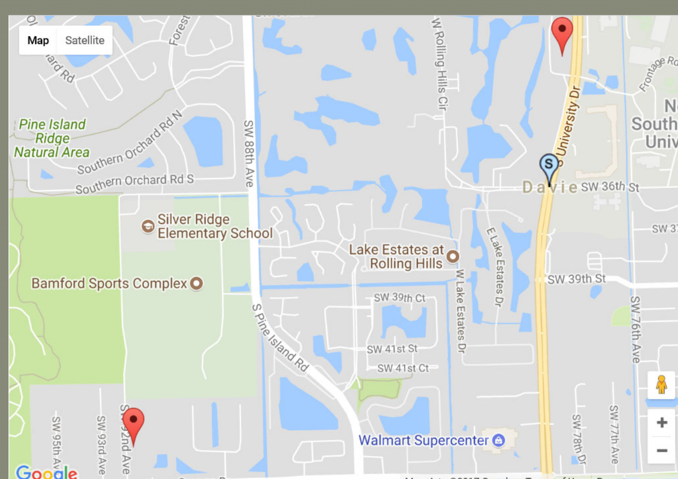

Keep Apiary Clean

Swarm Simulation

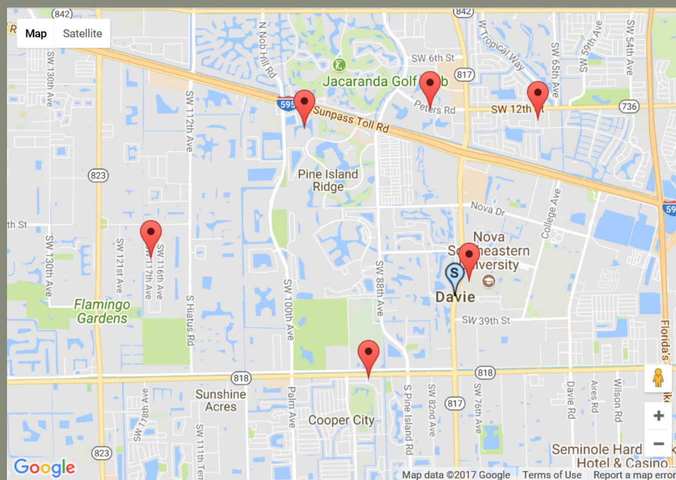
Disclaimer

- The next slides shows the effect of having European Honey Bees swarming twice a year vs Africanized Honey Bees Swarming at a rate of 10 times per year.
- This would only occur in absolute perfect conditions and no death occurring with any of the colonies.
- This is just a simulation.

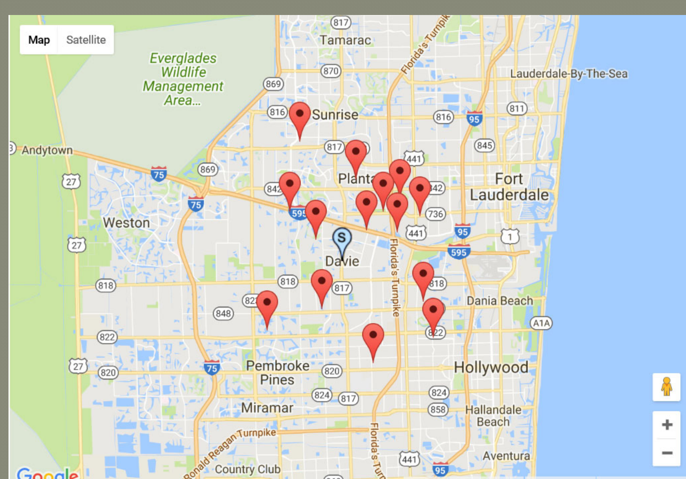
European Swarming Year 1



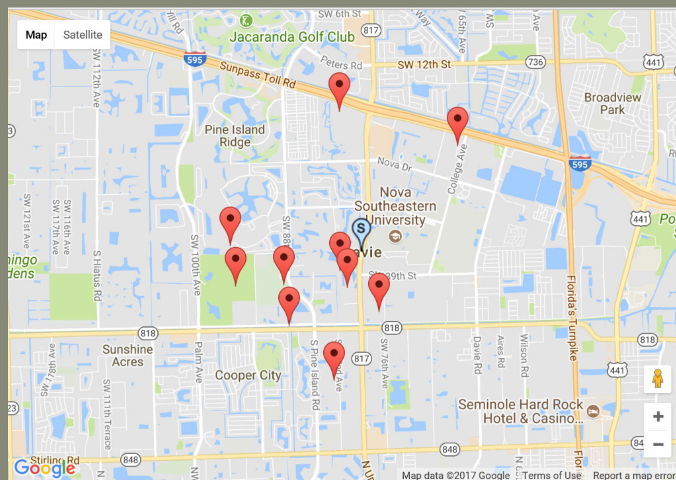
European Swarming Year 2



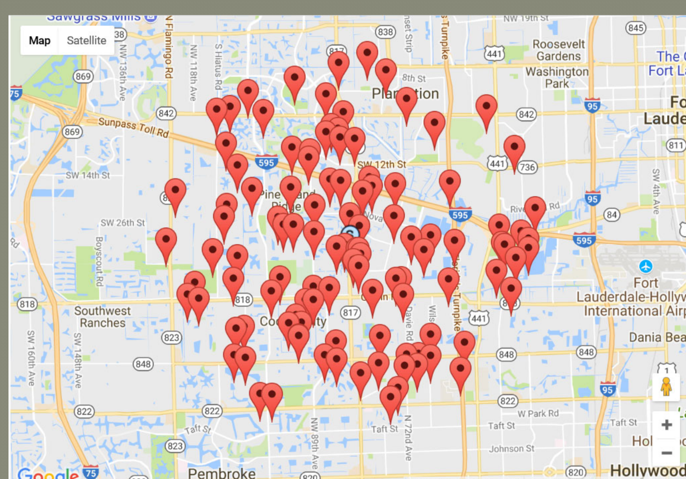
European Swarming Year 3



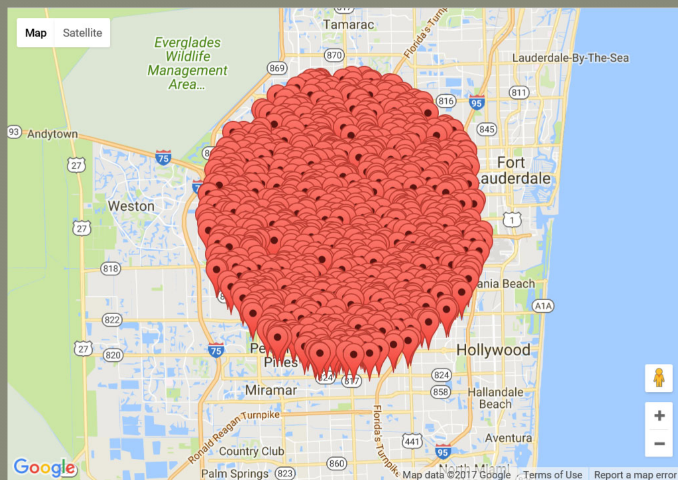
Africanzed Swarming Year 1



Africanized Swarming Year 2



Africanized Swarming Year 3



Requeening and Objectives

- Honey Production
- Increasing Number of Colonies
- Replacing Old Queens
- Disease
- Defensive Behavior

Requeening Colonies

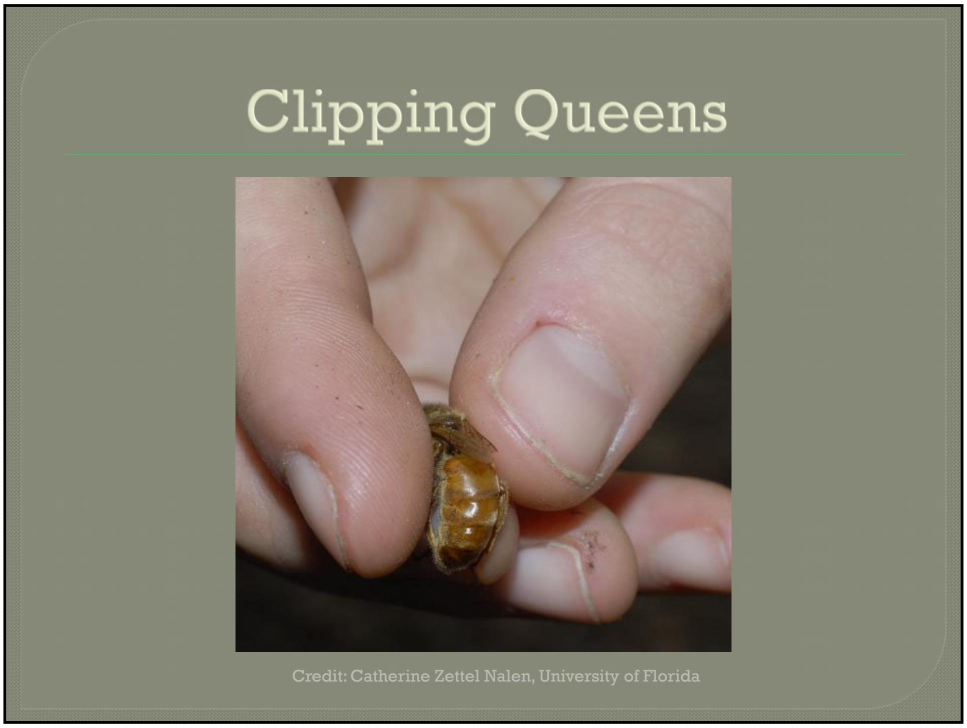
- Requeening a colony can help minimize swarming tendencies. Young queens produce more pheromones, thus inhibiting swarm preparation by the workers. It is best to enter the main nectar flow with a young, strong queen who will be laying at an optimal rate. This will ensure a robust population of bees for the production of honey or other managed hive products. Though requeening a colony 4–6 weeks before the principal nectar flow is advisable, it usually is difficult to acquire queens in early spring. A good alternative is to requeen colonies in late summer when queens often are more available. It is important to requeen colonies with European queens purchased from a reputable source to minimize the potential introduction of African bees into your apiary.

http://edis.ifas.ufl.edu/in970

Clipping Queens

- Clipping a queen's wing is a good way to minimize swarming tendencies in colonies. Since it usually is the old queen who leaves the colony with the swarm, clipping a queen's wing keeps her from being able to leave with the swarm. To clip a queen's wing, hold the queen between the thumb and pointer finger. Take a small pair of scissors and cut off ½ of the forewing (the large, front wing) on one side of the queen's body. A clipped queen will try to leave the colony with a swarm, but she will not be able to fly away with it, and the swarm will return to the nest. Frustrated swarms (those that cannot "coerce" their queen to swarm because she is clipped) often kill their queen in an attempt to rear one that can fly. So, clipping a queen's wing is more of a safety net than a method of reducing the swarming tendency. This technique is most effective in controlling swarms when other swarm control methods are practiced at the same time. Worth noting is that a clipped queen sometimes will be unable to reenter the colony after a failed swarm attempt. In this instance, she will climb up a nearby bush or under the colony where the swarming bees will cluster around her. These swarms are easy to capture and can then be housed in a new hive. One should not try to reintroduce the swarm back into the parent colony. Once a colony tries to swarm, it will continue to do so.

http://edis.ifas.ufl.edu/in970


Clipping Queens
Credit: Catherine Zettel Nalen, University of Florida


Clipping Queens
Credit: Amanda Ellis

Clipping Queens

Credit: Amanda Ellis

How I Requeen My Colonies

- 1. Determine which hives need to be split or requeened for specific reason.
- 2. Choose race and reputable queen breeder.
- 3. Split the hive or cull current queen 5 days before receiving new queen. This allows time for all eggs to hatch and queen cells to be drawn out.
- 4. Once queen has arrived go into the hive and remove all drawn queen cells. This forces the bees to accept the new queen since they can no longer make one from eggs or cells.
- 5. Place cap or tape over candy on queen cage prior to installation for two days. This allows more time for any missed cells to be noticed for removal and better acceptance of installed queen.
- 6. After the two days remove caps or tape over candy and gives the queen additional time to establish pheromones within the hive. By this time the bees should have accepted the queen.
- 7. DO NOT enter hive for a minimum of fourteen days. Allow time for the queen to be released and start laying. Once the brood pheromone has been established chances of balling are slim. Let nature takes its course. If she has not been accepted then add a frame of eggs from a stronger colony and Requeen next season.

I have had a 100% acceptance rate with this method.

Questions?

Florida Department of Agriculture and Consumer Services • Adam H. Putnam, Commissioner

Work Cited

- http://www.freshfromflorida.com/content/download/71084/1640892/08492.pdf
- http://edis.ifas.ufl.edu/in970

Florida Department of Agriculture and Consumer Services • Adam H. Putnam, Commissioner

Candle Making

Bee College Fall 2018

David Hall
University of Florida Master Beekeeper
Jefferson County

Agenda

- Steps to properly melt wax
- Preparing molds
- How to properly use molds when making beeswax candles.
- Wicks: things to consider
- Types of Candles
- Alternative wax options
- Candle alternatives
- How to price a candle
- Liability Insurance

Warnings and disclaimers

- Wax is very flammable
  - Requires Constant observation when handling
  - Take care to not burn yourself and others
- Wax melts at 160 degrees
  - Use the thermometer to monitor
- Avoid any open flame
  - Stove top or smoking
- Avoid microwave ovens
- Avoid direct contact of melting pot to direct heat

Melting wax

- Use clean rendered wax
- Use a double boiler or crock pot
- Melt only the amount of wax you need
  - Measure amount you need in advance,
  - Pour water in mold and then measure
  - Write amount on Mold
- Melt to 160 degrees F.
- Monitor the wax thermometer

Preparations Molds

- Spray your mold with mold cleaner if needed
- Thread in correct Wick in mold
- Apply rubber bands around mold to hold mold in place
- Duck Tape wick opening to plug hole
- Spray your mold with release spray
- Have ready on a flat surface
  - May want to have on a pan with sides for overflow
- Align wick so it is centered
  - Use straight pins, bobby pins

Other preparations

- In addition to prepared candle molds
  - Have overflow molds available for extra wax
- Watch the wax in the mold while cooling
  - May need to add more was as it cools,
  - May shrink

Wicks

- Wick can be pre-made with a base
- If you are making your own
  - Dip wick in wax prior to putting in mold
- Wicks need to be centered or anchored in the mold so they will stay in place when you pour
- Once wax has cooled and been removed from mold
  - Trim wick to ¼ inch from candle surface

Wicks: Things to consider

- Avoid any lead core based wick
  - Used to strengthen wick and keep it from bending
  - Can harm health by vaporizing Lead
- The diameter of the candle will determine the wick thickness to use
  - To big: melts wax so it drips
  - To little: will not melt the entire width of candle
- Most candle molds have a wick size the company recommends
  - Write size of wick on side of mold
- Very wide containers, may need multiple wicks

Other steps

- Cut bottom of wick close to surface
- Get iron skillet warm
- Rub candle bottom around on warm surface of skillet to flatten bottom
- Apply a decorative sticker with info on bottom over wick
- Bottom mold for taper candles are available

Hints

- Be patient while wax cools down
  - May need to wait overnight
- Put mold in freezer for a few minutes if difficult to remove
  - Works well for metal molds
- Store finished candles in closed sealed container
  - Wax moths will eat wax

Types of candles

- There are many types of candles
  - Tea lights
  - Votive
  - Pillars
  - Tapers
  - Decorative
  - Rolled
  - Container candles

Rolled Candles

- Rolled Candles are made using Beeswax foundation
  - Available in multiple colors
- Shape and size of candle are determined by the size and shape of the sheet you are rolling from
- Place wick from the side you are rolling from
- Extend wick above the top of the sheet about ½ inch
- Trim wick when done

Dripped candles

- Requires subsequent dipping of lengths of wick that can be hung when cooling
  - Must be timed precisely when dipping
- Requires a container deep enough to dip into.
- Special devices are available to hold wick
- These are considered the most difficult type of candle to produce
  - Takes practice and patience to produce one that look good
- Sold commonly as a pair

Container candle

- Melt rendered wax in double boiler
- Cut wick to extend past top of container
- Prime wick when wax is melted
  - Wait until bubble stop being released from wick
  - Allow to dry
  - Put into wick holder
  - Secure to bottom of container with spot of glue
- If Glass container
  - Preheat container in oven to 150 degrees F.
- Pour wax into container slowly
  - Do not want wax to pull away from glass

Decorative candle alternatives

- Making Wax sheets
  - Roll out candles instead of foundation
- Christmas Ornaments
  - Use holiday cookie molds
  - Specialized molds available
- Christmas Nativity Scene
- Wall plaques
- One ounce molds
  - Fly Fishing, Quilting, Carpentry, Blacksmith
- 3D models
  - Possible to make your own molds

Beeswax alternatives

- Beeswax
  - Provides sweet smell based on flower and pollen
- Earth Waxes
  - Ozocerite, Montan, ceresines
  - Refined from coal, shale, other fuels
- Petroleum Waxes
  - Paraffin most common
  - Come in variety of melting point ranges
  - Candles require melting point of 125 to 150 degrees

Beeswax alternatives contiued

- Spermaceti Wax
  - Waxy tissue found in head cavity of sperm whale
  - Prized for the brightness of their light
- Granulated Wax
  - Wax sold in small beads
- Tallow
  - Rendered animal fat
  - Can smoke and smell bad
- Vegetable Wax
  - Most common is soy-based wax
- Candle Gel

How to price candle

- Cost of wax (by ounce)
  - 1 lb is 7.99
  - I ounce is 7.99/16= .49
- Cost of Mold
  - Estimated how many times It will be used
- Cost of wick
- Cost of container

Liability Insurance

- Hobbyist
  - Generally at home and covered by Homeowners
  - Home owners will not cover a commercial venture
- Sideliner/Commercial
  - Will need some type of Liability Insurance
  - May not need if Incorporated (LLC)
- May be required
  - To sell in farmer's market or flea market

Resources

- Dadant www.dadant.com
- Brushy Mountain www.brushymountainbeefarm.com
- Mann Lake www.mannlakeltd.com
- Beeswax Crafting, Robert Berthold, Wicwas Press
- The Candlemaker's Companion, Betty Oppenheimer, Storey Publishing

Contact information

- David Hall
  - 850-445-0141
  - cssdrh@gmail.com

Making Splits

University of Florida
Institute of Food and Agricultural Sciences
Beginner Beekeeper Workshop Series

Learning Objectives for this Lesson

After completing this lesson, you should be able to:

1. recognize the steps of splitting a colony for swarm control and colony increase.

What is a Split?

One colony divided into two separately functioning colonies.

Splits can be used to:

- Control colony swarming
- Replace lost colonies
- Increase your colony number
- Sell to other beekeepers

Time to Split?

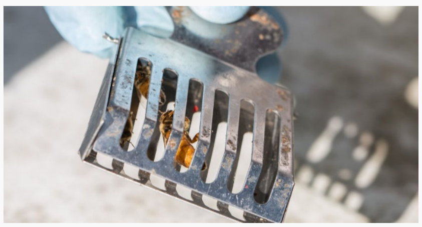
Before making a split, it is important to determine if your colony is ready.

The colony to be split should have:

- 4-6 frames of brood
- 4-6 frames of stored honey and pollen
- A healthy queen

How to Split a Colony

Place an empty nuc next to the parent colony.



Locate the queen.

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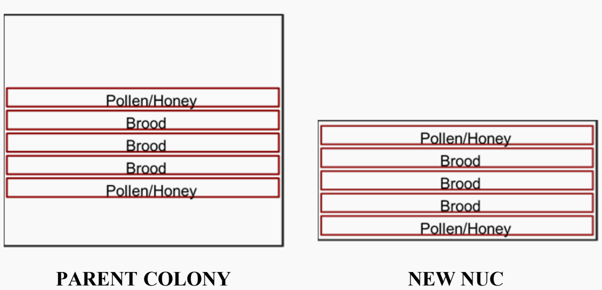
How to Split a Colony

Move half of the food and brood frames from the parent colony into the empty nuc.



Arrange the frames so that the brood frames are placed in between food frames.

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How to Split a Colony

PARENT COLONY

Foundation
Foundation
Foundation
Pollen/Honey
Brood
Brood
Brood
Pollen/Honey
Foundation
Foundation

NEW NUC

Pollen/Honey
Brood
Brood
Brood
Pollen/Honey

Make sure that the queen ends up in the new colony.

Replace the frames taken from the parent colony with empty frames.

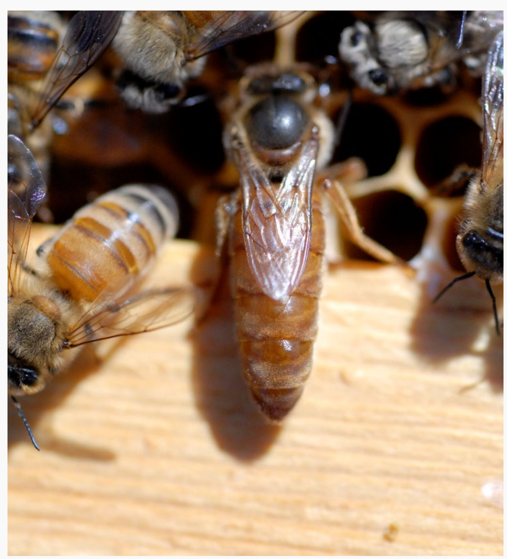
Remove any queen cells that are present on the frames in the new nuc.

Requeening the Parent Colony

Since the queen has been moved to the new nuc, the parent colony needs to be requeened.

This can be done in one of three ways:

1. From eggs
2. From queen cells
3. With a mated queen



Requeen from Eggs

Worker bees can rear a new queen from eggs or very young larvae.

This method leads to the longest gap during which no new eggs are being laid.

- 30-38 days

Queens raised in this manner will need to go on a mating flight, which can be risky.

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Requeen from Queen Cells

Capped swarm cells can be used to requeen the parent colony after a split.

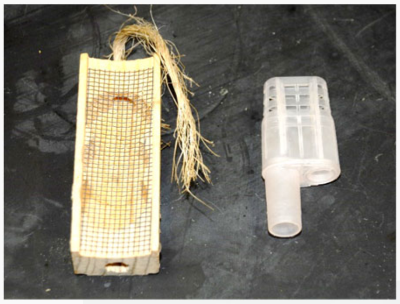
With this method there will be a 21-30 day time gap before the new queen will start laying new eggs.

Queens raised in this manner will need to go on a mating flight, which can be risky.

Queen cells can also be purchased from queen suppliers.

Honey Bee LABORATORY SOLUTIONS for your LIFE UF IFAS UNIVERSITY of FLORIDA

Requeen With a Mated Queen



Mated queens can be purchased from queen suppliers.

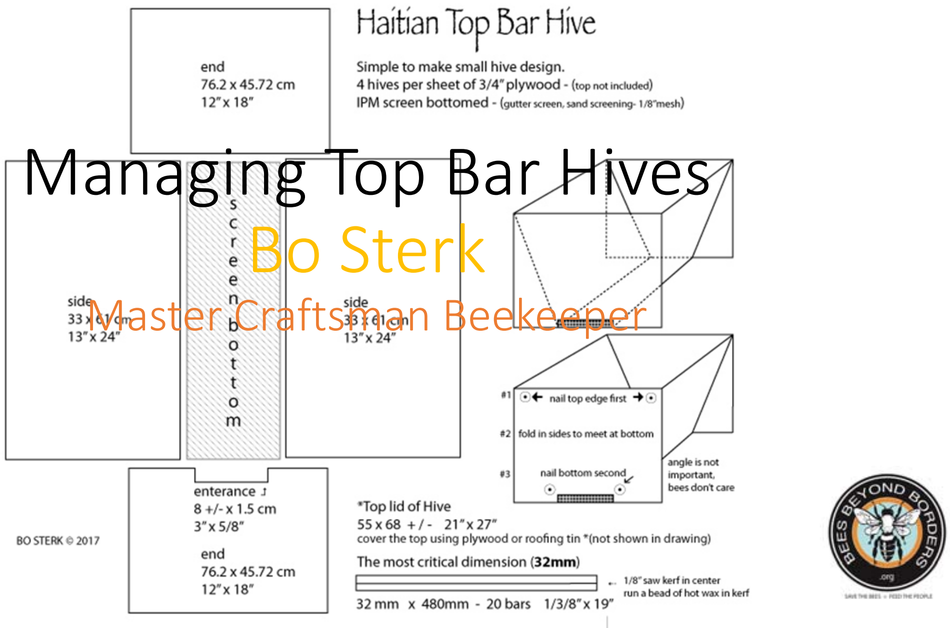
Have a new laying queen in the shortest amount of time.

- 4-5 days

Purchased queens arrive caged and can be released after 3 or 4 days.

Questions?

Presentation created by Mary Bammer, Ashley Mortensen, Jeanette Klopchin, Brandi Simmons; UF/IFAS Honey Bee Research and Extension Laboratory



Managing Top Bar Hives

Bo Sterk

Master Craftsman Beekeeper

Top Bar Hives

Why we choose Top Bar Hives

- Cheap to construct
- Simple to manage
- Easy on bad backs – no lifting honey supers
- Do not disturb brood area
- Simple honey extraction

TBH Management techniques

- Similar to Langstroth, but with a few modification to think about.

Keep hives as level as possible
This prevents comb crossover

Top Bar Hives horizontal hives

Pests

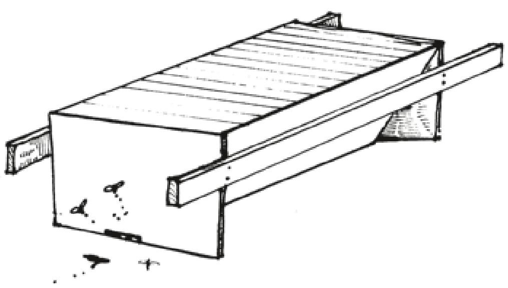
Problem
Ant Colony under mental top

Solution:
1 x 1" wood runners for
Air space

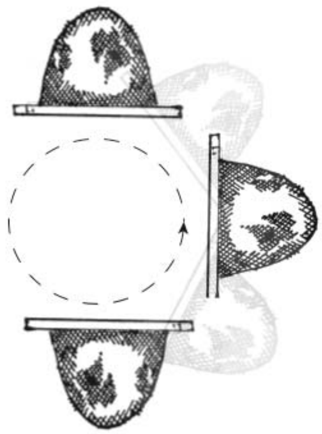
Varroa
Treat normally

Small Hive Beetle
Treat normally

Moving with simple handles



Rotation of top bars



Keeping Comb spline straight

Brood can be moved to strengthen another colony

Add frames as needed to colony
– division frame

Supering up with Langstroth

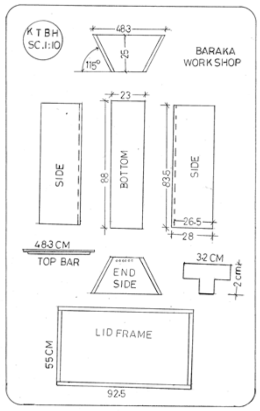
Swarm comb

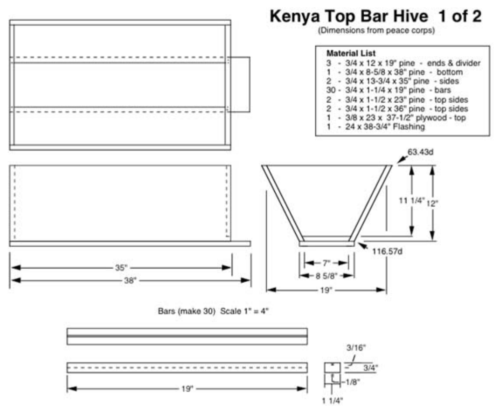
Top Bar designs – Bee Space; 1 3/8”

Waxing in a starter strip

Wax strips work best ; ½ - 1” wide
Alternatives to wax: cardboard, string or wood

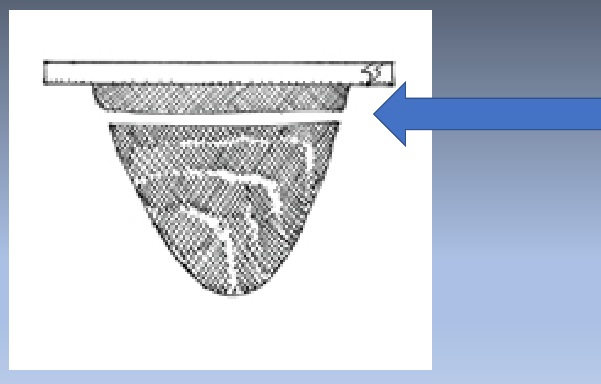
Design of top bar hive is not critical
*keep it simple





TBH frame in Tanzanian Horizonal hive -

Cutting comb for harvesting – leaving a starter strip of wax = 1”



Honey Extraction – Crush & Strain

- Drill holes in bucket bottom and cut ring out of bucket lid.

Honey Harvesting

Crush and Strain
Or
Comb Honey

Cheese cloth or
5 gallon paint
strainer bag

HONEY PRESS IN TOBAGO

Feeding in a dearth

Leave some Honey for the bees after honey harvest

Feeding Dry Sugar

1. Pour out about a 2 cups of white sugar
2. Crack honey frames

Brush in

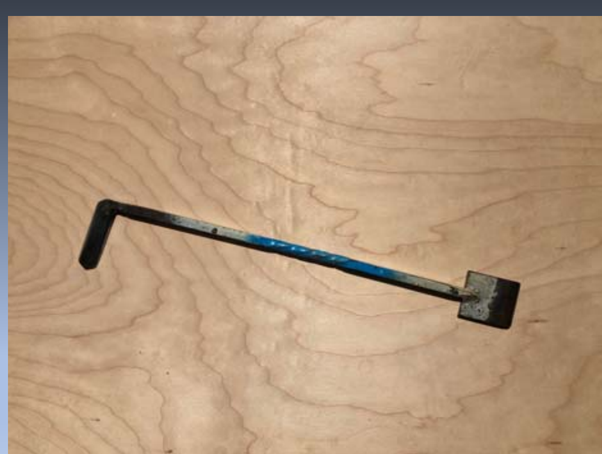
3. Do not leave any on top of frames - ants

* Only works with solid floor bottoms

Feeder inside colony

Float a wood raft for bees to stand on

Top Bar Hive Tool



Read and Experiment

Try a Top Bar Hive

Thanks

The End

Bo Sterk
honeybeeboy@ymail.com

Plants for Native Bees of Florida

Rachel Mallinger
Bee College 2018
Gainesville, FL

Types of plants for native, wild bees

Gardeners and land managers can aid in bee conservation efforts by planting flowers for bees. When selecting plants for native wild bees, use the following criteria:

- Avoid male-sterile or pollen-less plant varieties
- Avoid plants with long flower tubes such as honeysuckle. Flowers with long tubes may be beneficial for butterflies or hummingbirds, but bees will have a harder time accessing nectar and pollen from these plants.
- Design your garden to have three or more different plants blooming at any given time during the growing season, year-round in southern Florida and March through November in northern areas of the state.
- Trees and shrubs can provide excellent floral resources for bees, especially in the spring, while herbaceous wildflowers can provide good resources later in the summer and fall.
- Choose flowers that are white, yellow, or blue-purple to attract bees. Flowers that are orange, pink, or red are not as attractive to bees (but may be attractive to other pollinators including butterflies and birds)
- Provide a diversity of plants in the garden, including a range of flower colors, bloom times, and plant families, to attract a greater diversity of bees.
- Native plants are generally best for native bees, though some non-native plants may provide abundant nectar during times, or in places, with minimal other floral resources.
- Select seeds and/or starts that have not been treated with systemic insecticides

Tips for managing pollinator gardens

- Plant in full sun to achieve the most flowers and be most attractive to bees
- Keep in mind the soil and other requirements for plants (see https://ffl.ifas.ufl.edu/pdf/FYN_Plant_Selection_Guide_2015.pdf).
- Remove weeds in the year or season before planting with a combination of mowing, herbicides, and/or solarization (see: http://edis.ifas.ufl.edu/in1180)
- Avoid tilling when planting as this can increase future weed pressure
- Native wildflowers generally do not need fertilization
- Limit using pesticides on the plants after establishment, including herbicides, fungicides, and insecticides. In particular, avoid spraying the plants when they are flowering.
- If using pesticides when the plants are flowering, spray in the evening and in low drift conditions, and select products with a short residual activity.
- Avoid using systemic pesticides on the plants

List of plants for bees in Florida and the SE USA

North Florida and adjacent states (hardiness zones 8a – 8b)

Trees and shrubs

1. Red maple (*Acer rubrum*): pink – red early spring flowers, pollen source for many early-emerging bees. Native, plant in zones 8 – 10
2. Carolina silverbell (*Halesia carolina*): White flowers, springtime bloom. Attracts primarily bumble bees and other long-tongued bees. Native, plant in zone 8
3. Tulip tree (*Liriodendron tulipifera*): Yellow-orange spring flowers. Good nectar source for bees. Native, plant in zones 8 – 9a
4. Eastern redbud (*Cercis canadensis*): Pink – purple spring flowers. Native, plant in zones 8b – 9a
5. Crape myrtle (*Lagerstroemia indica*): Pink-purple flowers with a spring through summer bloom depending on variety. Non-native, plant in zones 8 – 10b
6. Fringetree (*Chionanthus virginicus*): White, showy flowers with a spring bloom. Native, zones 8-9
7. Swamp Dogwood (*Cornus foemina*): White spring flowers. Native, plant zones 8-10
8. Walter's viburnum (*Viburnum obovatum*): White early-spring flowers. Native, plant zones 8 – 10
9. Beautyberry (*Calicarpa americana*): Purple flowers, long bloom from spring through fall. Native, plant zones 8 – 10
10. Sweet pepperbush (*Clethra alnifolia*): White flowers with a summer bloom. Native, plant zones 8 -9
11. Saw palmetto (*Serenoa repens*): Yellow – white, spring bloom, good pollen source, native, plant zones 8 - 11
12. Sparkleberry (*Vaccinium arboretum*): White, spring bloom, native, plant zones 8 – 10b
13. Chaste tree (*Vitex agnus-castus*): Purple, summer flowers, non-native, plant zones 8 – 11
14. Bush daisy (*Gamolepis chrysanthemoides*): Yellow, long bloom from spring through fall, non-native, zones 8b – 11
15. Sabal palm (*Sabal palmetto*): White, summer flowers, native, plant zones 8b-11
16. Florida privet (*Forestiera segregate*): Yellow, early spring flowers, native, zones 8b – 11
17. Sweet almond (*Aloysia virgata*): White, summer through fall flowers, non-native, zones 8 – 11
18. Hibiscus (*Hibiscus spp*.): Spring through fall flowers of variable colors, some native bees are specialists on hibiscus, native, zones 8 – 11
19. Bottlebrush (*Callistemon spp*.): Red, spring through summer flowers, non-native, zones 8b-11.

Vines and groundcover

1. Climbing aster (*Aster carolinianus*): White-purple, late fall flowers, native, zones 8 – 10b
2. American wisteria (*Wisteria frutescens*): Purple, spring through summer flowers, native, plant zones 8 – 9
3. Powderpuff/sunshine mimosa (*Mimosa strigillosa*): Pink – purple, long bloom from spring – fall, native, plant zones 8 - 11

Annuals and perennials

1. Leavenworth's Tickseed (*Coreopsis leavenworthii*) : Yellow, spring – fall flowers, native, zones 8a - 11
2. Blanketflower (*Gaillardia pulchella*): Yellow, orange, and red flowers, summer bloom, native, plant in zones 8a - 11

3. Dune (beach) sunflower (*Helianthus debilis*): Yellow, spring – fall flowers, native, plant zones 8b – 11
4. Swamp (narrowleaf) sunflower (*Helianthus angustifolius*): Yellow, fall flowers, native, zones 8b - 10
5. Seaside goldenrod (*Solidago sempervirens*): Yellow, summer-fall bloom, native, zones 8a – 11a
6. Silver-leaved aster (*Pityopsis graminifolia*): Yellow, late fall bloom, native, zones 8a – 11
7. Elliot's aster (*Symphyotrichum elliottii*): Lavender flowers, late fall bloom, native, zones 8a – 11a
8. Blazing star (dense) (*Liatris spicata*): Purple, late summer – fall bloom, native, zones 8 – 10b
9. Spotted bee balm (*Monarda punctata*): Summer – fall purple flowers, very attractive to bumbles and other bees, native, zones 8b - 9
10. Lyreleaf sage (*Salvia lyrata*): Purple, spring bloom, native, zones 8a – 10b
11. False rosemary (*Conradina canescens*): Blue, spring – fall flowers, native, plant in zones 8 – 9
12. Blue-eyed grass (*Sisyrinchium angustifolium*): Small but attractive blue-colored spring flowers, native, zones 8 – 11
13. Sweet alyssum (*Lobularia maritima*): White, winter - spring flowers. Blooms at a time when there are few other resources, non-native, zone 8 – 11
14. Rosinweed (Starry or bigleaf) (*Silphium asteriscus*): Yellow mid-spring through fall flowers, native, zones 8a – 10b
15. Scorpion tail (*Heliotropium angiospermum*): White year-round flowers, native, zones 8 – 11
16. Patridge pea (*Chamaecrista fasciculata*): Yellow summer-fall flowers, native, zones 8 – 11
17. Giant ironweed (*Vernonia gigantea*): Purple summer-fall flowers, native, zones 8 -10

Central Florida (hardiness zones 9a - 9b)

Trees and shrubs

1. Red maple (*Acer rubrum*): pink – red early spring flowers, pollen source for many early-emerging bees. Native, plant in zones 8 – 10
2. Tulip tree (*Liriodendron tulipifera*): Yellow-orange spring flowers. Good nectar source for bees. Native, plant in zones 8 – 9a
3. Eastern redbud (*Cercis canadensis*): Pink – purple spring flowers. Native, plant in zones 8b – 9a
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5. Fringetree (*Chionanthus virginicus*): White, showy flowers with a spring bloom. Native, zones 8-9
6. Swamp Dogwood (*Cornus foemina*): White spring flowers. Native, plant zones 8-10
7. Walter's viburnum (*Viburnum obovatum*): White early-spring flowers. Native, plant zones 8 – 10
8. Beautyberry (*Calicarpa americana*): Purple flowers, long bloom from spring through fall. Native, plant zones 8 – 10
9. Sweet pepperbush (*Clethra alnifolia*): White flowers with a summer bloom. Native, plant zones 8 -9
10. Saw palmetto (*Serenoa repens*): Yellow – white, spring bloom, good pollen source, native, plant zones 8 - 11
11. Sparkleberry (*Vaccinium arboretum*): White, spring bloom, native, plant zones 8 – 10b
12. Chaste tree (*Vitex agnus-castus*): Purple, summer flowers, non-native, plant zones 8 – 11
13. Bush daisy (*Gamolepis chrysanthemoides*): Yellow, long bloom from spring through fall, non-native, zones 8b – 11
14. Sabal palm (*Sabal palmetto*): White, summer flowers, native, plant zones 8b-11

15. Florida privet (*Forestiera segregate*): Yellow, early spring flowers, native, zones 8b – 11
16. Sweet almond (*Aloysia virgata*): White, summer through fall flowers, non-native, zones 8 – 11
17. Hibiscus (*Hibiscus spp*.): Spring through fall flowers of variable colors, some native bees are specialists on hibiscus, native, zones 8 – 11
18. Bottlebrush (*Callistemon spp*.): Red, spring through summer flowers, non-native, zones 8b-11.
19. Jacaranda (*Jacaranda mimosifolia*): Purple flowers from spring – summer, non-native, zones 9b – 11
20. Sweet acacia (*Acacia farnesiana*): Yellow, year-round flowers, native, zones 9 – 11
21. Marlberry (*Ardisia escallonioides*): White year-round flowers, native, zones 9 – 11
22. Seagrape (*Coccoloba uvifera*): White flowers in the spring, native, zones 9 – 11
23. Twinberry, Simpson's Stopper (*Myrcianthese fragrans*): White year-round flowers, native, zones 9b – 11
24. Golden dewdrop (*Duranta erecta*): Purple flowers from summer – fall, non-native, zones 9b – 11

Vines and groundcover

1. Climbing aster (*Aster carolinianus*): White-purple, late fall flowers, native, zones 8 – 10b
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14. Rosinweed (Starry or bigleaf) (*Silphium asteriscus*): Yellow, mid-spring through fall flowers, native, zones 8a – 10b
15. Scorpion tail (*Heliotropium angiospermum*): White, year-round flowers, native, zones 8 – 11

16. Patridge pea (*Chamaecrista fasciculata*): Yellow, summer-fall flowers, native, zones 8 – 11
17. Giant ironweed (*Vernonia gigantea*): Purple, summer-fall flowers, native, zones 8 -10
18. Blue Porterweed (*Stachytarpheta jamaicensis*): Purple flowers, spring – fall bloom, native, zones 9 – 11
19. Privet senna (*Senna ligustrina*): Yellow flowers, blooms from autumn – late spring. Native, zones 9a – 11.
20. Tampa/beach verbena (*Gladularia tampensis/maritima*): Pink – purple flowers that bloom most of the year, particularly in spring – summer. Both are native, beach verbena can be planted from zones 9a – 11 while Tampa verbena can be planted in 9a – 10b
21. Bulbine (*Bulbine frutescens*): Yellow-orange, spring – summer flowers, non-native, zones 9 – 11
22. Blue daze (*Evolvulus glomeratus*): Blue, spring – summer flowers, non-native, zones 9 – 11

South Florida (9b – 11a)

Trees and shrubs

1. Red maple (*Acer rubrum*): pink – red early spring flowers, pollen source for many early-emerging bees. Native, plant in zones 8 – 10
2. Crape myrtle (*Lagerstroemia indica*): Pink-purple flowers with a spring through summer bloom depending on variety. Non-native, plant in zones 8 – 10b
3. Swamp Dogwood (*Cornus foemina*): White spring flowers. Native, plant zones 8-10
4. Walter's viburnum (*Viburnum obovatum*): White early-spring flowers. Native, plant zones 8 – 10
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6. Saw palmetto (*Serenoa repens*): Yellow – white flowers, spring bloom, good pollen source, native, plant zones 8 - 11
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19. Twinberry, Simpson's Stopper (*Myrcianthese fragrans*): White, year-round flowers, native, zones 9b – 11
20. Golden dewdrop (*Duranta erecta*): Purple flowers from summer – fall, non-native, zones 9b – 11
21. Buttonwood (*Conocarpus erectus*): Spring white flowers, native, zones 10b – 11
22. Wild tamarind (*Lysiloma bahamensis*): Small, white-pink flowers that bloom from spring – summer. Native, zones 10b – 11

23. Jamaican dogwood (*Pisidia piscipula*): White flowers tinged red or pink that bloom from spring – early summer, native, zone 11
24. Paradise tree (*Simarouba glauca*): Yellow, summer flowers, native, zones 10b – 11
25. Gumbo limbo (*Bursera simaruba*): Yellow-green flowers, spring bloom, native, zones 10b – 11
26. Pigeon plum (*Coccoloba diversifolia*): Small white flowers that bloom from late spring – early summer. Native, zones 10a – 11
27. Fiddlewood (*Citharexylum fruticosum*): White, year-round flowers, native, zones 10 – 11
28. Necklace pod (*Sophora tomentosa*): Yellow, year-round flowers, native, zones 10 – 11
29. Cocoplum (*Chrysobalanus icaco*): White, year-round flowers, native, zones 10 – 11
30. Wild coffee (*Psychotria nervosa*): White spring – summer flowers, native, zones 10b- 11

Vines and groundcover

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19. Bulbine (*Bulbine frutescens*): Yellow-orange, spring – summer flowers, non-native, zones 9 – 11
20. Chapman’s senna (*Senna Mexicana var. chapmanii*): Yellow, spring and fall flowers, native, zones 10a – 11
21. Yellowtop (*Flaveria linearis*): Showy, yellow, year-round flowers, native, zones 10a – 11
22. Blue daze (*Evolvulus glomeratus*): Blue, spring – summer flowers, non-native, zones 9 – 11

Prescription Antibiotics for Honey Bees

Mary Bammer

Honey Bee Research and Extension Laboratory
University of Florida

Overview

- FDA Ruling
- How beekeepers are affected
- Foulbrood diseases
- Options for beekeepers and veterinarians

FDA Ruling

Effective January 1, 2017:

Antimicrobials that are medically important in human medicine require a prescription or a Veterinary Feed Directive (VFD) from a licensed veterinarian.

A VFD is a "written statement issued by a licensed veterinarian…that authorizes the use of a VFD drug… in or on animal feed."

https://www.fda.gov/animalveterinary/developmentapprovalprocess/ucm455416.htm

How Beekeepers are Affected

For honey bee antibiotics, this ruling applies to three drugs.
- Oxytetracylcine
- Tylosin
- Lincomycin

Used to control bacterial foulbrood diseases.
- American foulbrood (AFB) – Oxytetracyline, Tylosin and Lincomysin
- European foulbrood (EFB) – Oxytetracyline

All are fed to bees via powdered sugar dusting, grease patty, or sugar syrup.

Use of these products in honey bee colonies now requires a VFD or prescription from a licensed veterinarian.

Honey Bee Research & Extension Laboratory
SOLUTIONS for your LIFE
UF IFAS UNIVERSITY of FLORIDA

Foulbrood Diseases in Honey Bees

Both foulbrood diseases kill the brood (developing bees) causing a sour smell.

If a colony has EFB, it can be treated with an antibiotic and the bacteria die.

- The colony can be treated for EFB.

AFB is significantly more problematic, because it is caused by a spore-forming bacterium.

- These spores are not easily destroyed and can persist for decades.

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Foulbrood Diseases in Honey Bees

Treating a colony *after* it has AFB only kills the vegetative stage of the bacteria. The spores will persist after treatment.

The current use:

Many beekeepers preventatively treat their colonies for AFB two times each year with an antibiotic.

Honey Bee Research & Extension Laboratory — SOLUTIONS for your LIFE — UF IFAS University of Florida

Concerns

- Beekeepers do not know how to approach veterinarians about their bees.
- Few, if any, veterinarians in the state have been trained in honey bee health.
- Preventative treatment may not be allowed under current antibiotic labels.

One Solution

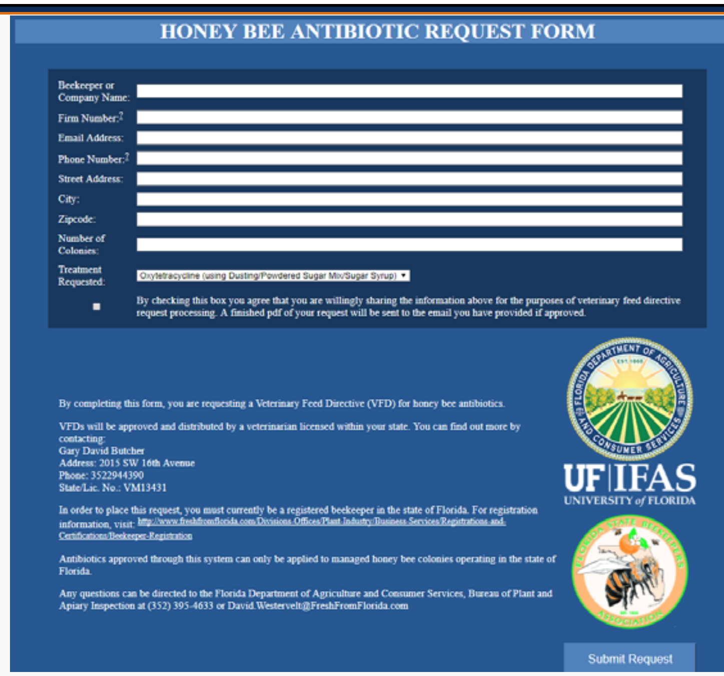
Collaboration between

- the UF College of Veterinary Medicine,
- the Florida Department of Agriculture and Consumer Services (FDACS) Bureau of Plant and Apiary Inspection, and
- the UF Honey Bee Research and Extension Laboratory.

One Solution

1. Beekeeper requests a VFD/prescription.

www.honeybeeVFD.com



HONEY BEE ANTIBIOTIC REQUEST FORM

Beekeeper or Company Name:

Firm Number:?

Email Address:

Phone Number:?

Street Address:

City:

Zipcode:

Number of Colonies:

Treatment Requested: Oxytetracycline (using Dusting/Powdered Sugar Mix/Sugar Syrup)

By checking this box you agree that you are willingly sharing the information above for the purposes of veterinary feed directive request processing. A finished pdf of your request will be sent to the email you have provided if approved.

By completing this form, you are requesting a Veterinary Feed Directive (VFD) for honey bee antibiotics.

VFDs will be approved and distributed by a veterinarian licensed within your state. You can find out more by contacting:
Gary David Butcher
Address: 2015 SW 16th Avenue
Phone: 3522944390
State/Lic. No.: VM13431

In order to place this request, you must currently be a registered beekeeper in the state of Florida. For registration information, visit: http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry/Business-Services/Registrations-and-Certifications/Beekeeper-Registration

Antibiotics approved through this system can only be applied to managed honey bee colonies operating in the state of Florida.

Any questions can be directed to the Florida Department of Agriculture and Consumer Services, Bureau of Plant and Apiary Inspection at (352) 395-4633 or David.Westervelt@FreshFromFlorida.com

Submit Request

One Solution

2. FDACS compares request to beekeeper registration records.

Does not see what drug you are requesting!

One Solution

3. Dr. Gary Butcher (UF) approves/denies request.

UF UNIVERSITY of FLORIDA College of Veterinary Medicine

One Solution

3. Dr. Gary Butcher approves/denies request.

Veterinary-Client-Patient Relationship

U.S. veterinary schools do not have honey bee curriculum.

The FDA recognizes that veterinarians are not trained to diagnose or treat honey bees.

- The FDA has recommended that veterinarians seek counsel and consultation with experts in the field.

One Solution

The beekeeper is emailed a digital copy of the signed order.

⬇

Beekeeper gives the signed order to their supplier (print or digital).

⬇

Beekeeper purchases and administers the medication.

ALL PARTIES MUST KEEP THESE ORDERS FOR TWO YEARS

Other Solutions

- Not all beekeepers will want to use this solution.
- Other veterinarians may want to be a part of the bee industry.
- This interpretation of the VCPR may not hold long term.

We also need:

- Guidelines for beekeepers and for veterinarians
- An online module for veterinarians who want to learn about honey bees and American foulbrood

Let's Discuss!

What are you concerns?

How might this work for you?

How might it not?

Do you/should you use antibiotics in your bee hives?

Honey Bee Research & Extension Laboratory — SOLUTIONS for your LIFE — UF IFAS UNIVERSITY of FLORIDA

Questions?

Mary Bammer
bammerma@ufl.edu

Dr. Gary Butcher -butcher@ufl.edu

David Westervelt -David.Westervelt@freshfromflorida.com

Dr. Jamie Ellis -jdellis@ufl.edu

Honey Bee Research & Extension Laboratory — SOLUTIONS for your LIFE — UF IFAS UNIVERSITY of FLORIDA

Protecting Bees from Pesticides - Practices to protect your hives

2018 UF Bee College

Dr. William Kern, Jr

- The prevailing theory among scientists in the EPA, USDA and global scientific and regulatory community is that the general declining health of honey bees is related to complex interactions among multiple stressors including:

- **pests** (*e.g.*, varroa mite), pathogens (*e.g.,* the bacterial disease American foulbrood) and viruses.
- **poor nutrition** (e.g., due to loss of foraging habitat and increased reliance on supplemental diets);
- **pesticide exposure**;
- **bee management practices** (e.g., long migratory routes to support pollination services); and
- **lack of genetic diversity**.

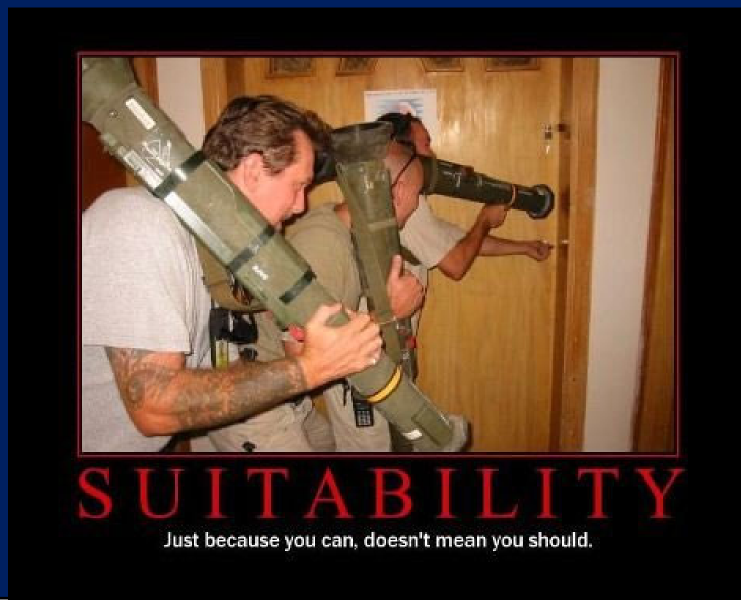
How can pesticides affect honey bees?

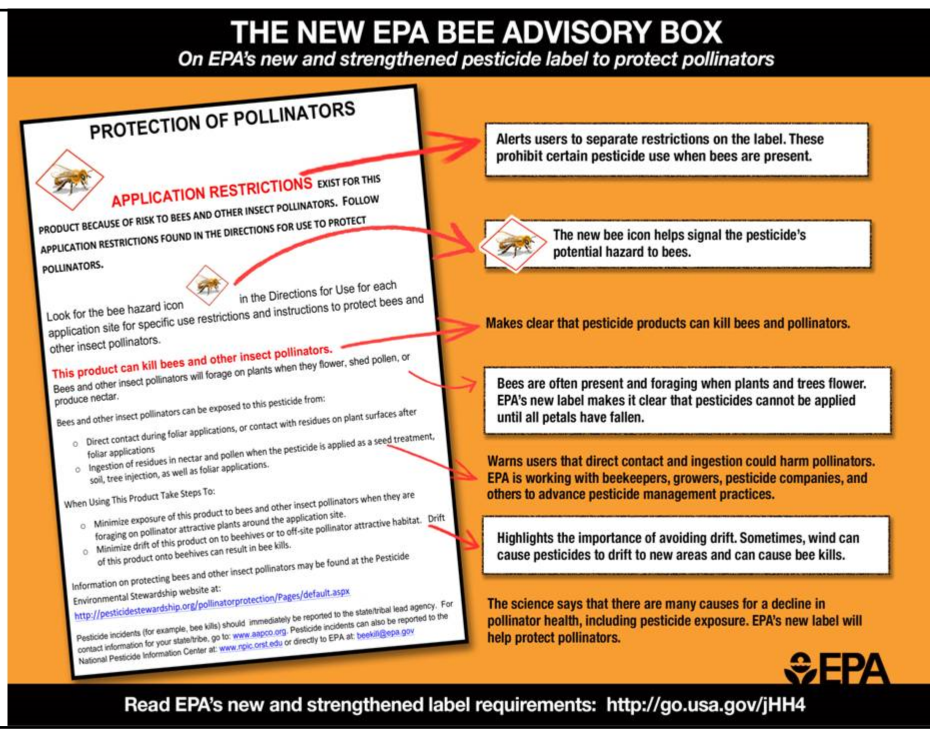
- Acute toxicity - drop and twitch
- Chronic toxicity – sub-lethal effects
  - Immune system compromised
  - Nervous system disrupted
  - Reproductive effects
- IGRs – Reproductive and developmental effects
- Fungicides – alter fermentation of bee bread, increase susceptibility to Nosema
- Herbicides – impact gut microbiome ?

How Can You Protect Your Bees ?

- Think about effects of the chemicals you apply.
- Follow the label directions.
- Use the most appropriate product for the pest situation.
  - Most targeted – like baits
  - Lowest environmental risk –
- Treat only the infested areas.

Use the most appropriate product





Choose the form of pesticide best suited to your target site and the pest you want to control:

- First, identify the problem correctly and then, choose the least-toxic pesticide that will achieve the results you want and be the least toxic to you and the environment.
- When the words “broad-spectrum” appear on the label, this means the product is effective against a broad range of pests.
- If the label says “selective,” the product is effective against one or a few pests.

Using the product safely and correctly:

- Never apply pesticides outdoors on a windy day (winds higher than 10 mph)
- Do not apply to plants when flowering (during the bloom) unless it specifically says you can on the label.

As part of the neonicotinoid Registration Review, six new pollinator studies are currently under way. EPA has also accelerated and coordinated the review of the neonicotinoid pesticides in their Registration Review program. The registration review schedule for each of the neonicotinoid compounds is listed below

	Initiation	Data Generation	Completion
Imidacloprid	Dec. 2008	2010-2015	2016-2017
Clothianidin	Dec. 2011	2013-2016	2017-2018
Thiamethoxam	Dec. 2011	2013-2016	2017-2018
Dinotefuran	Dec. 2011	2013-2016	2017-2018
Acetamiprid	Dec. 2012	2014-2017	2018-2019

Chemicals Applied to Bees

- Acaricides
  - CheckMite+, the formulated product containing coumaphos
  - Apilife Var and Apiguard, thymol
  - ApiVar, amitraz
  - Apistan, tau-fluvalinate
  - Formic acid / Oxalic acid
- Fungicides - Fumagilin B
- Antibiotics - Terramycin
- Pheromones - Nosonov
- Repellents/fumigants – paradichlorobenzene (***PDB***), Butyric anhydride (Bee-Go, Honey Robber)

Why can two products with the same active ingredient differ in their toxicity?

- Other ingredients play a key role in the effectiveness of a pesticidal product (Inert Ingredients aren’t)
- Solvents – usually nonpolar solvents -hexane
- Surfactants – Emulsifiers, soaps, detergents
- Diluents – usually water, but could be a solvent
- Carriers – inert (nonreactive material) clay, silica
- Catalysts -
- Synergists – can have a major impact on toxicity
- Preservatives – extend shelf life of concentrate

ACTIVE INGREDIENT:

Tau-fluvalinate (CAS #102851-06-9) . . . 22.3%
OTHER INGREDIENTS: 77.7%
Total 100.0%
MAVRIK® PERIMETER is a flowable formulation containing 2 pounds tau-fluvalinate per gallon (240 g/L).

≠

Mosquito Control and Chemical Trespass

Zika spraying kills millions of honeybees
CNN

Millions Of Bees Found Dead After South Carolina Sprays For Zika Mosquitos
By **Trap Chicago**

The plane, flew between 6.30am and 8.30am.

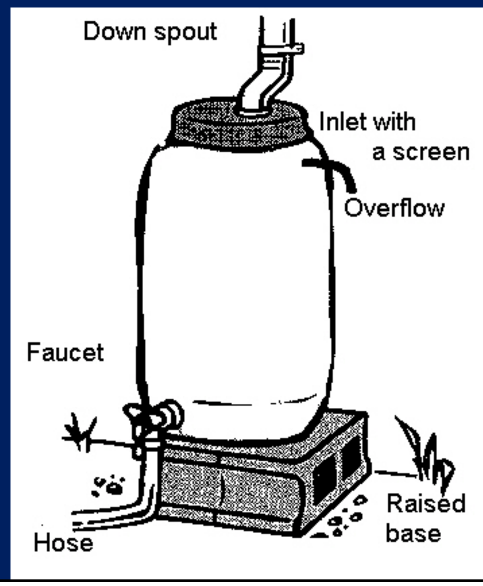
Why we conduct mosquito control.

- Dengue fever and Dengue hemorrhagic fever
- Chikungunya Fever (CHIKV)
- Yellow Fever (YF)
- Zika Virus
- West Nile Virus WNV)
- Eastern Equine Encephalitis Virus (EEEV) three humans, 51 horses, one mule, one donkey, one owl, five emu flocks 2018
- St. Louis encephalitis virus (SLEV) 14 humans, two blood donors, three horses, one crow
- Malaria
- Nuisance mosquito complaints

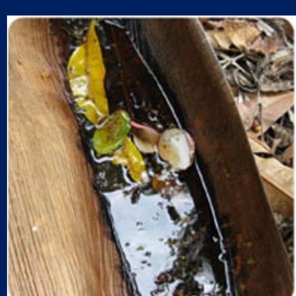
How We Control Mosquitos.

- Source reduction
- Larvaciding
  - IGR
  - Biological
- Adulticiding
  - Spraying

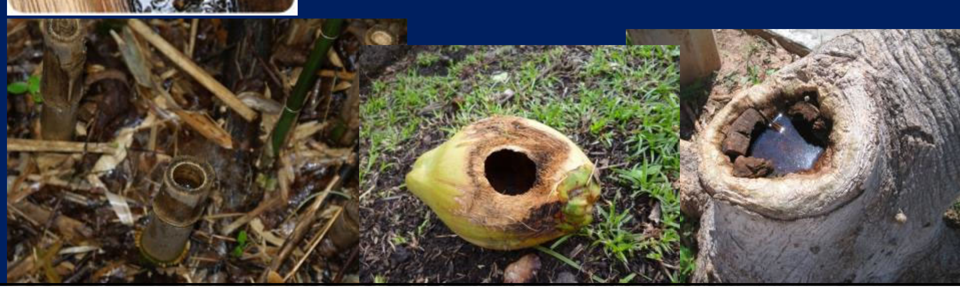
Rain Barrels



Botanical water sources



- Palm fronds, flower pods
- Coconut husks
- Bamboo stumps
- Tree holes




Exotic Bromeliads

Bird baths

Flush and wipe out bird baths regularly (once a week) to prevent mosquitoes from breeding.

Boats and Tarps

Store under cover or upside down to prevent water collecting and mosquitoes from breeding in boats.

Clean Out Gutters

Tires

- Remove, store under cover


Stagnant Swimming Pools

Containers

- Throw out plastic containers or store dry containers upside down or under cover.
- Empty buckets and wipe out interior, store upside down or under cover.

Larvacides

1. methoprene – (affects the development of insect egg / larva) moderately to highly toxic to fish and crustaceans; relatively non-toxic to birds; low toxicity to adult bees, but bee larvae may be more sensitive.

2. Bti (*Bacillus thuringiensis*) – not toxic to bees, has been used in hives for control of wax moth.

3. Bsp (*Bacillus sphaericus*) – not toxic to bees
~~4. temephos – highly toxic to bees, aquatic organisms, and is moderately to highly toxic to birds.~~

Insect Growth Regulators (IGR)

- Juvenoids (Juvenile Hormone Mimics and Analogs)
  - Pyriproxyfen is a pyridine; a juvenile hormone mimic IGR (Esteem, Archer, Distance, NyGuard, Nylar, Pivot)
  - Methoprene is a JH Analog (Altosid) Kinoprene (Enstar®II)
- Chitin Synthesis Inhibitors (CSI's)
  - Buprofezin is a thiadiazine IGR (Applaud, Atom, Blunt)
  - Diflubenzuron (Dimilin, Micromite) is a benzoylphenylurea
- Ecdysteroids
  - Tebufenozide (Confirm)
  - Methoxyfenozide

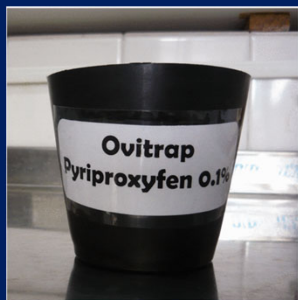
Bacillus thuringiensis var. israelensis (Bti)

Bacillus sphaericus 2362

- Valent Biosciences - VectoLex®.
- WDG- water-dispersible granule formulation
- FG (formerly CG) - granular formulation
- WSP - water-soluble pouch
- *Culex* and *Anopheles* larvae are most susceptible, while *Aedes* are less susceptible. Widely used for West Nile vectors

Methoprene IGR JHA

Pyriproxyfen



- IGR
- JHM

Ovitraps


Figure 1


(a) (b)

Figure 5. The left cup is a lethal ovitrap with the velour paper strip treated with the pyrethroid deltamethrin, which is toxic to adult mosquitoes. The right cup is a nonlethal ovitrap.

After an aerial Methoprene or Pyriproxyfen Application

- In the morning, supply fresh water close to the hive.
- These products will have little or no effect on adult bees, but may effect the brood.

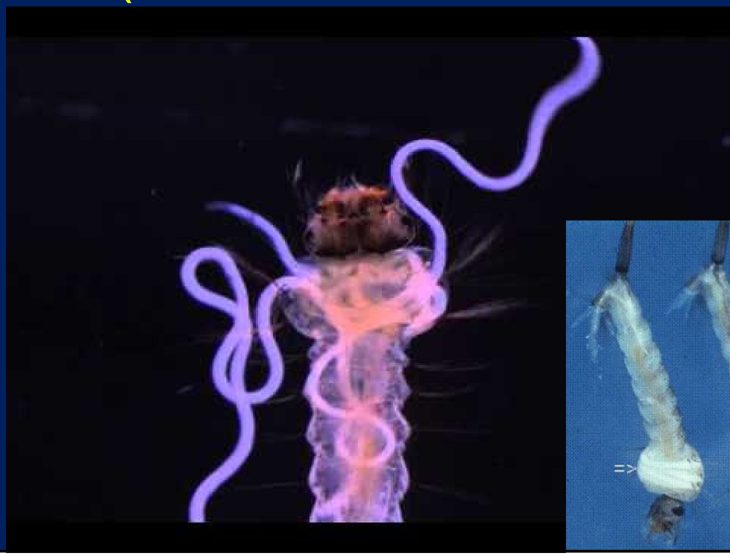
Eastern gambusia *Gambusia holbrookii*

Least Killifish
Heterandria formosa

Toxorhynchites rutilus

- The good mosquito

Memrihtid nematode (*Romanomermis culicivorax*)



Adulticiding

- Control of adult mosquitoes using pesticides
- Products available for use include:
  - Organophosphates
    - Naled
    - Malathion/Fyfanon
  - Synthetic pyrethroids

- Adulticides can be applied using:
  - ULV cold fogging
  - Thermal fogging
  - Barrier spray

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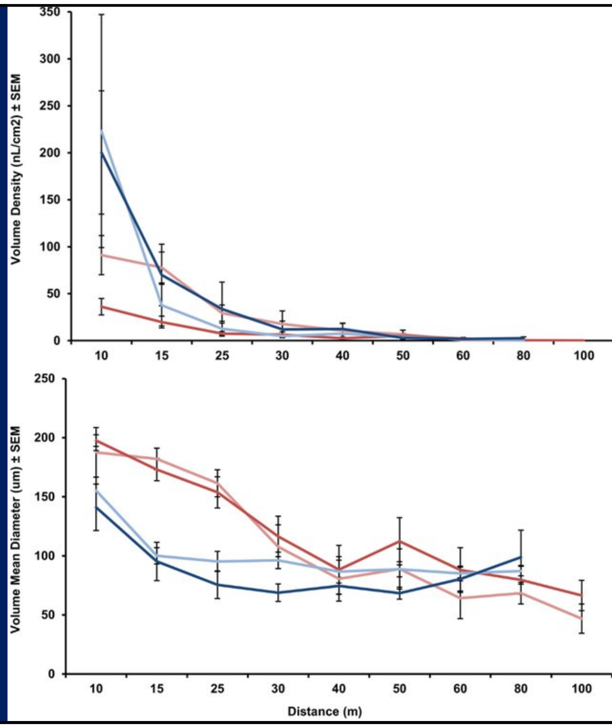
Organophosphate

- Naled / Dibrom
- Malathion

Pyrethroids

- Pyrethrum
- Resmethrin
- Sumithrin
- Permethrin

Ultra Low Volume Applications



AgCenter entomologist Kristen Healy

USDA Honey Bee Breeding, Genetics and Physiology Research Laboratory in Baton Rouge

- ULV truck sprayed six of the most common mosquito control insecticides toward pairs of cages containing bees and mosquitos.
- The cages were placed on poles at 50 feet intervals to 300 feet.
- 300 feet is the typical distance insecticides can drift from spray trucks.
- “This is the highest possible label rate that mosquito control would ever use out of a truck, and we didn’t see any bee mortality, even at 50 feet,”

Field Tests

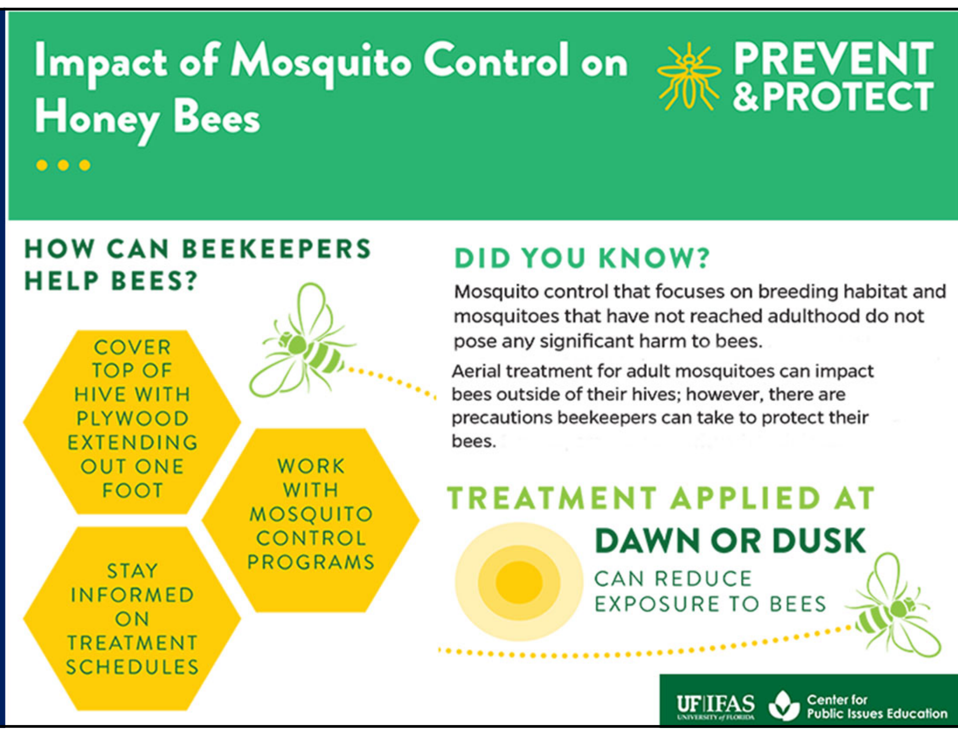
- Local beekeepers volunteered, half of them with hives in areas of frequent mosquito treatment, with the other half in areas without mosquito control (pesticide exposure control).
- They found no differences in the mortality rates of bees in either group.


DID YOU KNOW?
When airplanes are used to treat a large area with a very small amount of insecticide to kill either the mosquito larvae that hatch from eggs or adult mosquitoes, it's called an aerial treatment. Aerial treatment is a safe, quick, and efficient way to help control mosquitoes that can carry viruses and make people sick.
During treatment, about 1 ounce (2 tablespoons) of insecticide is used per acre (average football field size)
UF IFAS UNIVERSITY of FLORIDA
Center for Public Issues Education


Public Use of Pesticides

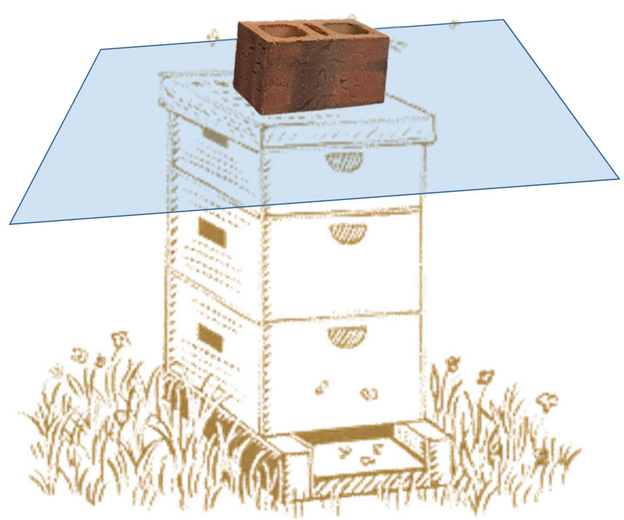
Pesticide Toxicity to Honey Bees

- highly toxic (acute LD50 < 2μg/bee)
- moderately toxic (acute LD50 2 - 10.99μg/bee)
- slightly toxic (acute LD50 11 - 100μg/bee)
- nontoxic (acute LD50 > 100μg/bee) to adult bees.



To Protect Your Hives

- Inform Mosquito Control District to be placed on the spray exclusion list for truck spraying.
- Place your hives at least 300 feet or as far as possible from the road.
- If possible place hives so vegetation is between them and the road. Vegetation intercepts more droplets than moving through uncluttered space.
- Cover hives to produce a droplet shadow over and around your hive.




Mosquito Free Yard
10 PLANTS that keep Mosquitos Away!
31 Plants That Repel Mosquitoes
11 Plants That Repel Mosquitoes

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UNIVERSITY of FLORIDA

Africanized Honey Bee Identification Using Machine Learning

Akira Sewnath

Ekaterina Vorobieva

Advisor Dr. Jamie Ellis

Bee College Design Presentation - Fall 2018

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Africanized Honey Bees

Origin

- African honey bees were originally introduced from Brazil in 1957, which later cross-bred with European breeds
- This hybrid spread to Central and South America by 1987, and reached the USA in 1991

Characteristics

- Similar in appearance to European breeds, but 10% smaller on average
- Aggression
- More frequent swarming behavior

Francoy T.M., Wittmann D., Drauschke M., Muller S., Steinhage V., Bezerra-Laure M.A.F., De Jong D., Goncalves L.S. (2008) Identification of Africanized honey bees through wing morphometrics: two fast and efficient procedures, Apidologie 39, 1–7

2

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Detection and Identification

FABIS (Fast Africanized Bee Identification System)

- Simplified morphometric and statistical analysis comparing body-part measurements of unknown samples to base populations
- Returns a probability estimate of *similarity* to base population
- **First level**: forewing length
  - Africanized honey bees have smaller forewings compared to European
- **Second level**: forewing and femur length, with "fresh weight" of bee
  - Fresh weight: weight of bee after the abdomen is removed
  - If fresh weight is not obtainable or accurate, "dry weight" is used
- Accuracy is dependent on how representative the *sampled baseline population* is of the *true population* of the local European breeds

FABIS manual: https://beesource.com/point-of-view/africanized-honey-bees/fabis-manual-fast-africanized-bee-identification-system/

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Detection and Identification

USDA ID

- 25 computer-assisted morphometric measurements of forewing, hindwing, femur-tibia, basitarsus of hind leg, and sternite
- Requires several hours of preparation and analysis per 10-bee sample

ABIS

- Automated morphometric identification based on forewing landmarks - 19 vein intersections.
- Created in 1999, it is a software for general purpose morphometric analysis
- After feature extraction, it performs statistical analysis on the data using tpsDig
- Not available to the public

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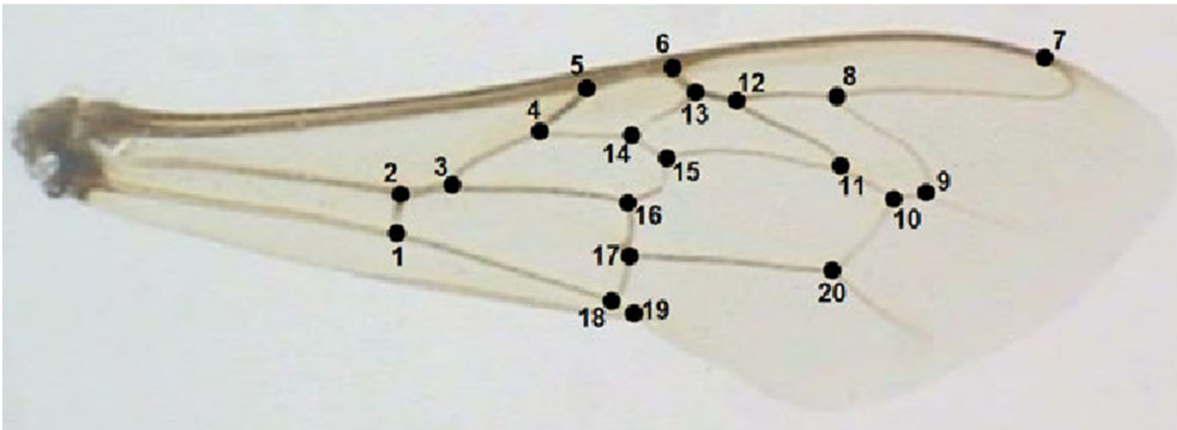
Focus: Identification using Wing Geometry



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ID using Machine Learning and Image Processing

Machine Learning

Image Processing

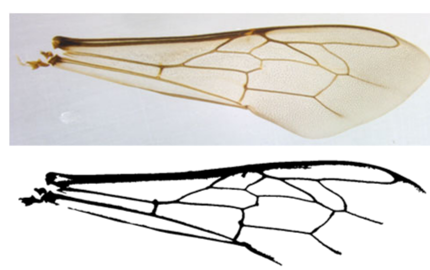
Training Images

Classification Model

Class

% Probability

Feature Extraction



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Benefits of using Machine Learning

- End product is similar to ABIS, but available to the general public online
- **Immediate identification** based on morphometric analysis of forewings
    - Forewing features are used in both FABIS and USDA-ID and carry a lot of weight in identification
- Wing images uploaded through the application can be re-used in future identification research (e.g. improving the classification model for Africanized honey bees based on region)

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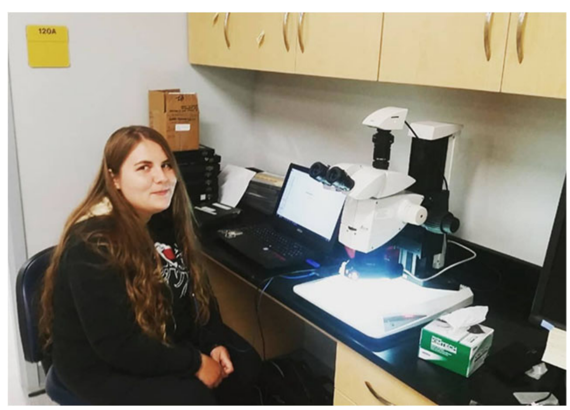
Our Project: Sample collection

FABIS and USDA-ID sample slides on loan from FDACS and bee lab in Tucson, AZ to Honey Bee Research and Extension Laboratory

- 1777 Samples of both AHB and European from all over the southern United States
- 87 European colonies
- 78 Africanized colonies
- Collection years span 2007 to 2018



Digitizing forewing samples. *Summer 2018*

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Our Project: Machine Learning Methods

Both of our considered approaches rely on **supervised learning** methods. Supervised learning means that the model classifying Africanized and European groups is built using a labeled **training set** of data. For it to distinguish the two groups, the algorithm must have enough examples of each group.

Neural networks

- Maps a set of specific features (coordinates of vein intersections, areas of cells, etc) to a classification result. The model self-adjusts (trains) to associate a range of features to a result.

Convolutional Neural Networks

- Commonly used in image analysis and image classification models
- Similar to neural networks in structure, but specific to using whole images as inputs

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Machine Learning Methods: Neural Networks

Full video: https://www.youtube.com/watch?v=aircAruvnKk

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Machine Learning Methods: CNN

Full video: https://www.youtube.com/watch?v=YRhxdVk_sls&t=1s

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Our Project: Work done so far

Feature Extraction

- We have scripts coded in MATLAB that extract information such as:
  - venation pattern
  - vein intersection coordinates
  - cell area measurements

Applying images to a CNN

- Our initial interest was in training a CNN to recognize AHB using whole images outlining venation
  - Large images (1024 x 758) created a large, difficult-to-train model with low accuracy.
  - In order to train a CNN more accurately, we would require thousands more images

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Our Project: Work done so far

Feature Extraction

- We have scripts coded in MATLAB that extract information such as:
  - venation pattern
  - vein intersection coordinates
  - cell area measurements

New Direction: Training a Neural Network with specific features

- The goal of a CNN is to create a very **general model** based off of a large number of examples of ideal AHB and ideal European images
- A neural network approach creates a **leaner model** that is easier to train
  - In order to generate inputs to the neural net, the **image processing** side needs to do more heavy lifting

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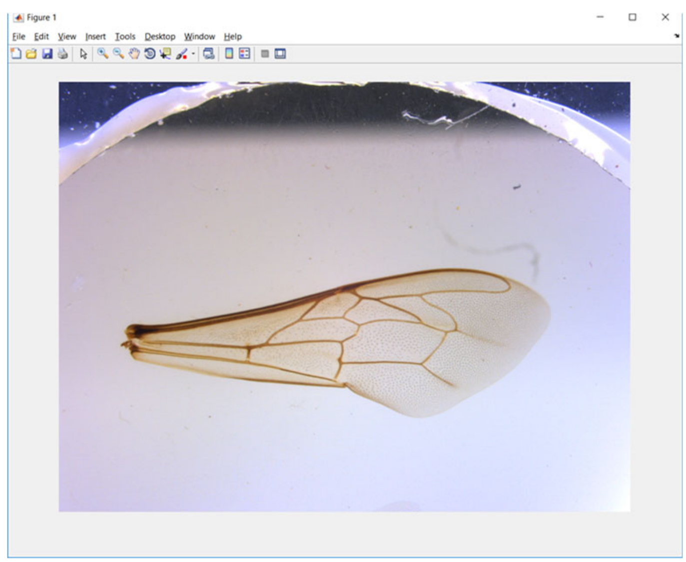
Our Project: Image Processing

Starting Image (1024 x 758)

Magnification: 1.6



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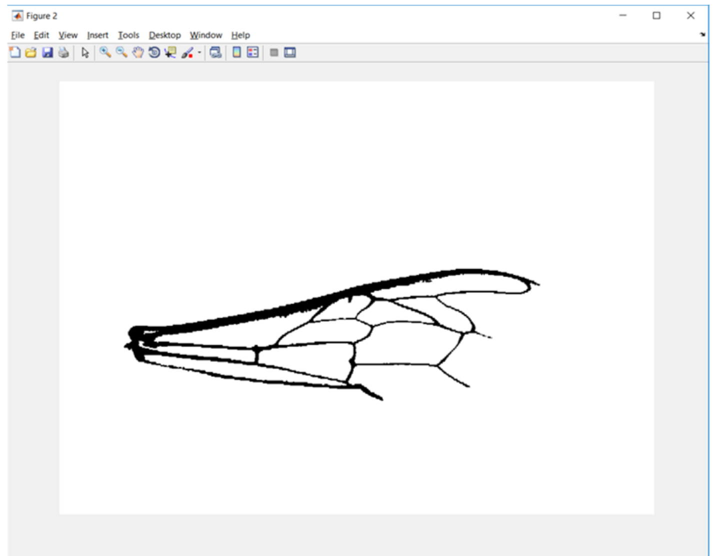
Our Project: Image Processing

First script:

Transforms raw image into a black and white (binary) image of wing venation



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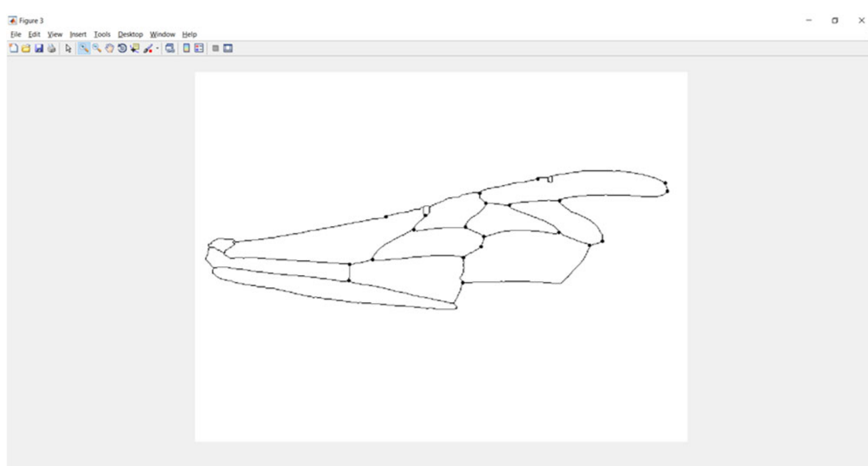
Our Project: Image Processing

Second script:

Transforms venation into a **skeleton**, and MATLAB's Image Processing Toolkit finds patterns of *line intersections*.

Bolded points are the 19 characteristic morphometric features of the forewing.



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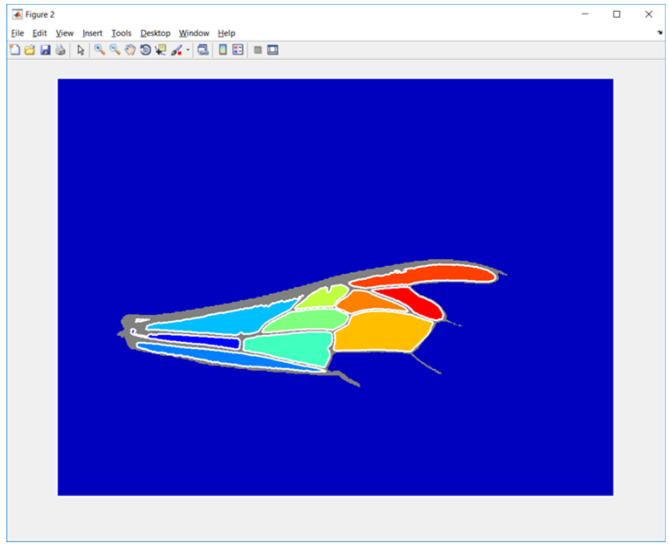
Our Project: Image Processing

Third script:

Detects boundary lines in venation image, and **highlights closed regions**.

Area within cells is calculated using:
regionprops(image, 'Area');



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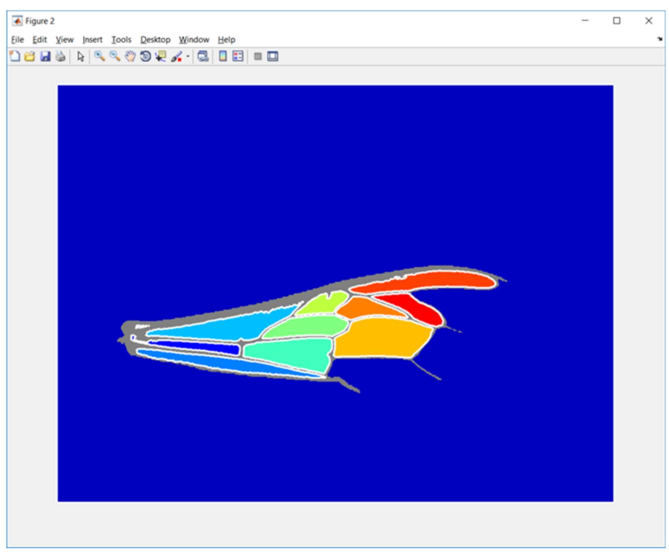
Our Project: Image Processing

Each Cell's Area is calculated:

Area	Centroid	
7.0812e+05	517.75	377.7
2782	255.81	480.88
76	154.49	444.97
5896	310.92	512.84
8141	317.7	445.42
4	169.5	443.5
7408	436.1	493.63
4771	462.65	445.74
2419	491.19	403.56
9	451.67	400
10709	598.01	466.59
3183	569.35	413.19
6530	681.12	363.74
3409	654.5	411.17
3	637	353



Demo

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Q/A

The Development Of A Rearing System For Varroa Mite Colonies For Use In Research

Noble Egekwu,

- Importance of rearing mites
- Recent paper
- Applications so far. Eg longevity, feeding sites, e behavior excretory
- Highlight differences between phoretic vs foundress
- Steve will comment on some aspect of artificial feeding devices and diet
- Noble concludes with what we have found and improvements on the VMS.
- -humidity
- Temp. etc…

Importance of Varroa rearing

- Opportunistic relationship
- Transmission of spectra of viruses
- Inflict injury
- Compromise immune response of host
- Possible culprits in mechanical damage
- **Economic Impact**
    - Implicated in Colony Losses
        - Cost of Control

Why Do We Need to Rear Varroa

- Provide mites for research
    - Known history
    - Known biology
- Have a closed clean colony/reference
    - Disease free mites
- Develop programs for integrated control

Problems Facing Varroa Research

- **Multiple non-standardized protocols**
- **Problems with rearing colonies**
  - Host specificity of Varroa
  - Thrives only inside hives (Specific condition)
  - Mites are not readily available (seasonal)
  - Lack of information on mite's status, age, etc..

Exp Appl Acarol (2018) 74:301–315
https://doi.org/10.1007/s10493-018-0236-0

CrossMark

Using an in vitro system for maintaining *Varroa destructor* mites on *Apis mellifera* pupae as hosts: studies of mite longevity and feeding behavior

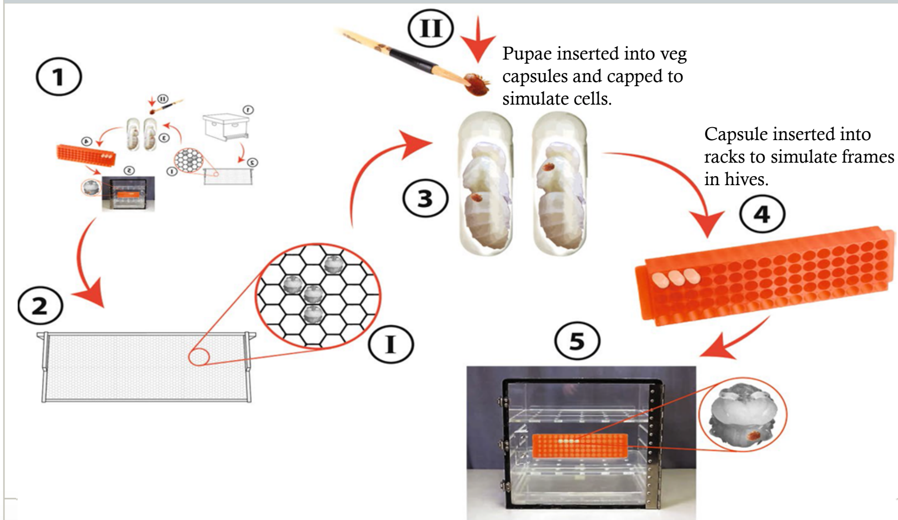
Noble I. Egekwu[1] · Francisco Posada[1] · Daniel E. Sonenshine[1,2] · Steven Cook[1]

Received: 16 September 2017 / Accepted: 22 February 2018 / Published online: 6 March 2018

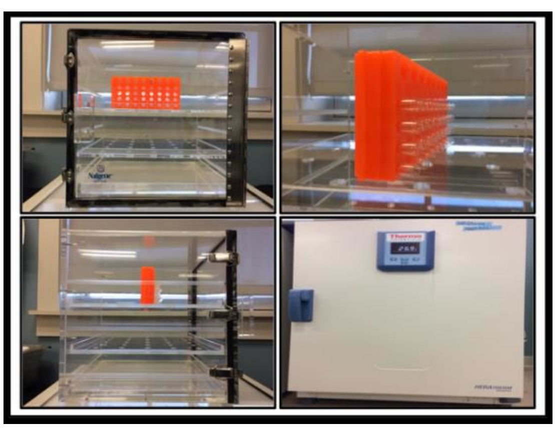
Abstract *Varroa destructor* mites (varroa) are ectoparasites of *Apis mellifera* honey bees, and the damage they inflict on hosts is likely a causative factor of recent poor honey bee colony performance. Research has produced an arsenal of control agents against varroa mites, which have become resistant to many chemical means of their control, and other means have uncertain efficacy. Novel means of control will result from a thorough understanding of varroa physiology and behavior. However, robust knowledge of varroa biology is lacking; mites have very low survivability and reproduction away from their natural environment and host, and few tested protocols of maintaining mites in vitro are available as standardized methods for varroa research. Here, we describe the 'varroa maintenance system' (VMS), a tool for maintaining in vitro populations of varroa on its natural host, and present best practices for its use in varroa and host research. Additionally, we present results using the VMS from research of varroa and host longevity and varroa feeding behavior. Under these conditions, from two trials, mites lived an average of 12 and 14 days, respectively. For studies of feeding behavior, female mites inflicted wounds located on a wide range of sites on the host's integument, but preferred to feed from the host's abdomen and thorax. Originally in the phoretic-phase, female mites in VMS had limited reproduction, but positive instances give insights into the cues necessary for initiating reproduction. The VMS is a useful tool for laboratory studies requiring long-term survival of mites, or host–parasite interactions.

Keywords Acari · Defecation · Gelatin capsule · Reproduction

Architecture of the VMS

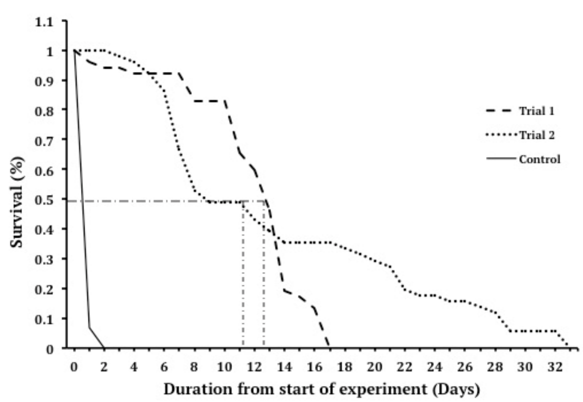


Mite Rearing System

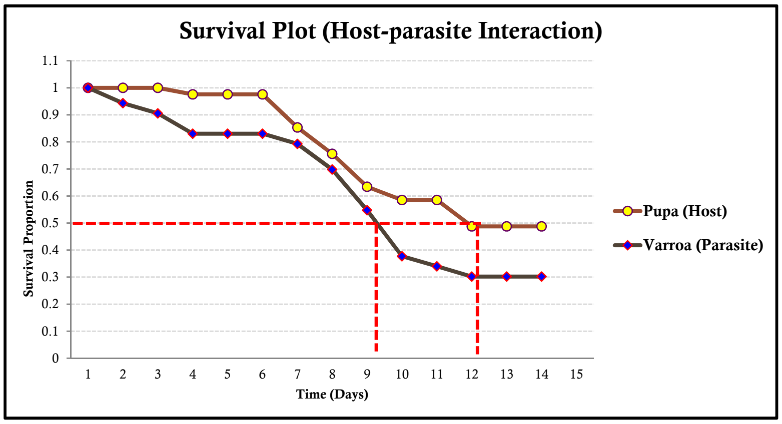


Biology of Varroa
Interplay with Bee Life Cycle

https://www.research.bayer.com/en/bee-protection-varroa-mite.aspx

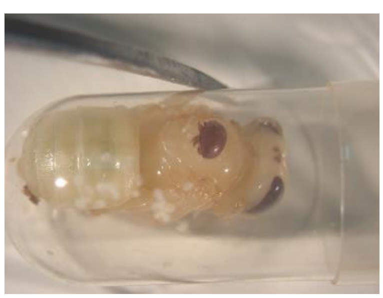


Varroa Dependence on Host



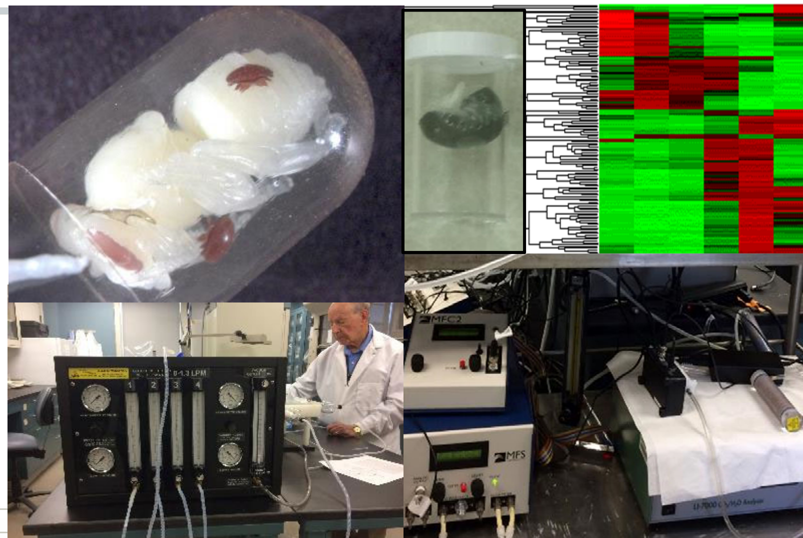
Reproductive Behavior

Oviposition?
Defecation?

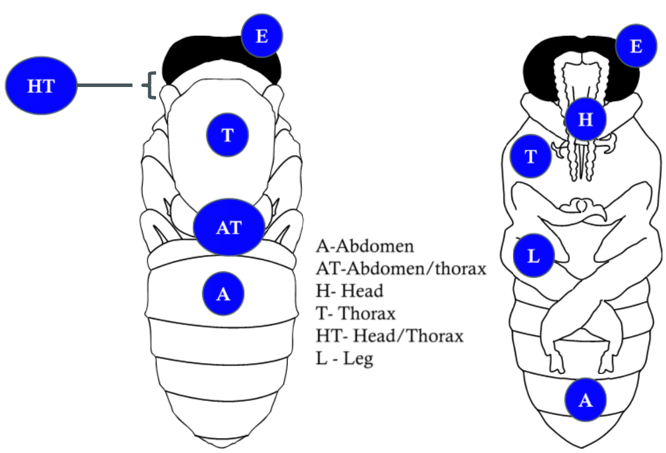


Reproductive Activity

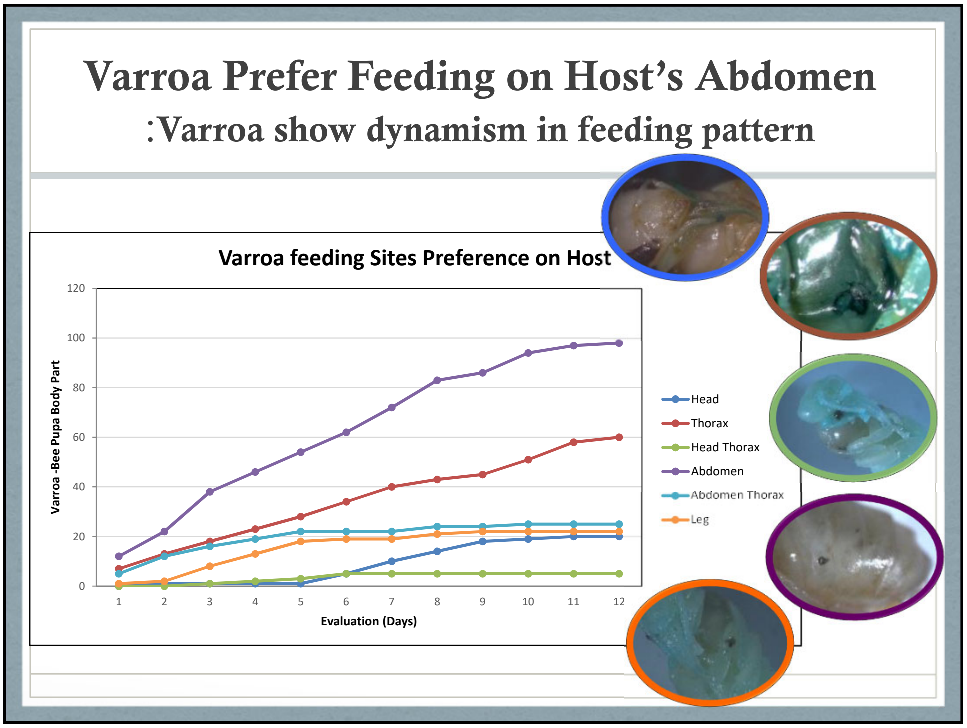
Our Research Interests With Varroa Adopts An Integrated Approach

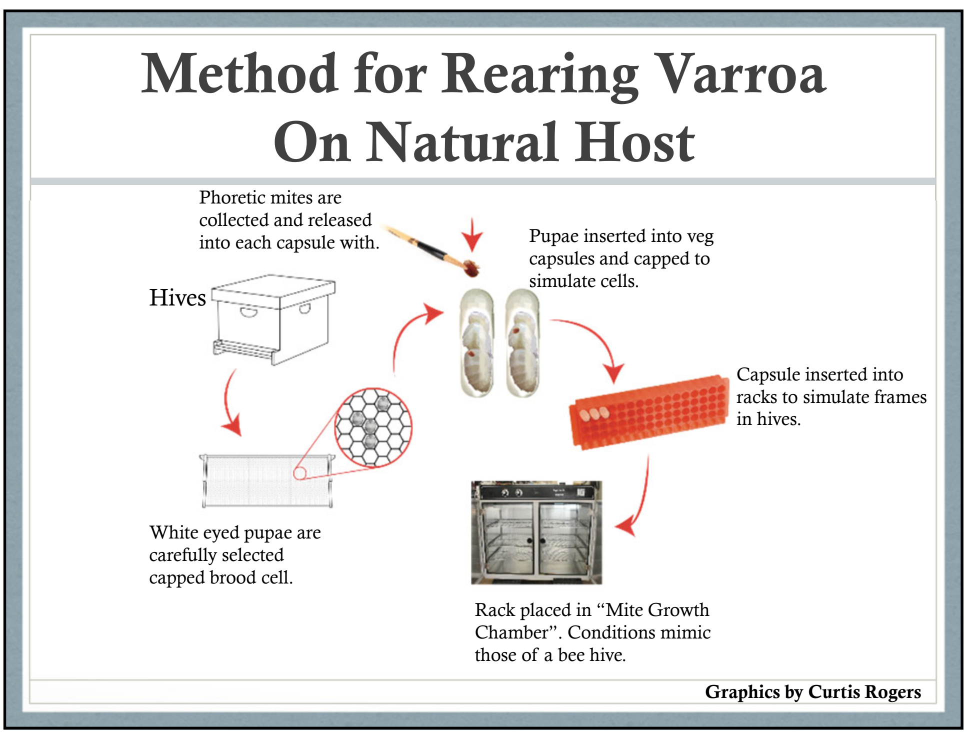


Coding Host Feeding Sites



Graphics by Curtis Rogers


Varroa Prefer Feeding on Host's Abdomen
:Varroa show dynamism in feeding pattern
Varroa feeding Sites Preference on Host
Varroa -Bee Pupa Body Part
0
20
40
60
80
100
120
1 2 3 4 5 6 7 8 9 10 11 12
Evaluation (Days)
Head
Thorax
Head Thorax
Abdomen
Abdomen Thorax
Leg


Method for Rearing Varroa On Natural Host
Phoretic mites are collected and released into each capsule with.
Hives
Pupae inserted into veg capsules and capped to simulate cells.
Capsule inserted into racks to simulate frames in hives.
White eyed pupae are carefully selected capped brood cell.
Rack placed in "Mite Growth Chamber". Conditions mimic those of a bee hive.
Graphics by Curtis Rogers

Varroa Rearing System

Recommendations Best Practices For Varroa Rearing

- Handling
- Growth conditions
  - Temp 32.5 C
  - RH 65 – 75%
- Orientation of Hive mimic
  - Angle 90°
- Capsules
  - Non-transparent

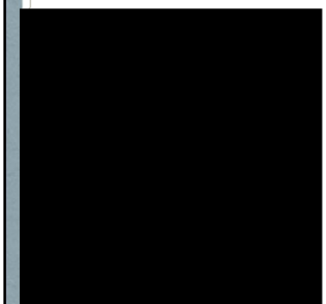
Artificial Diet-Odorant Studies

Answer: Translational Research

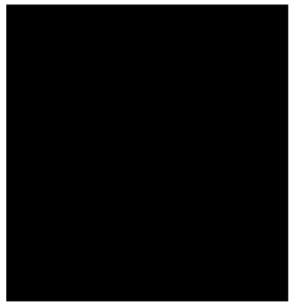
- Good foundation is needed for sustainable research towards control methods

- Combination of molecular tools, facility, and equipment available

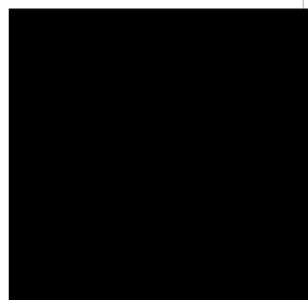
Feeding Behavior of Varroa



Mite Probing



Mite Lapping



Mite Twitching

Transcriptome of Feeding vs Starved Varroa Mites

Mites fed for 6-15 hrs on Natural Host

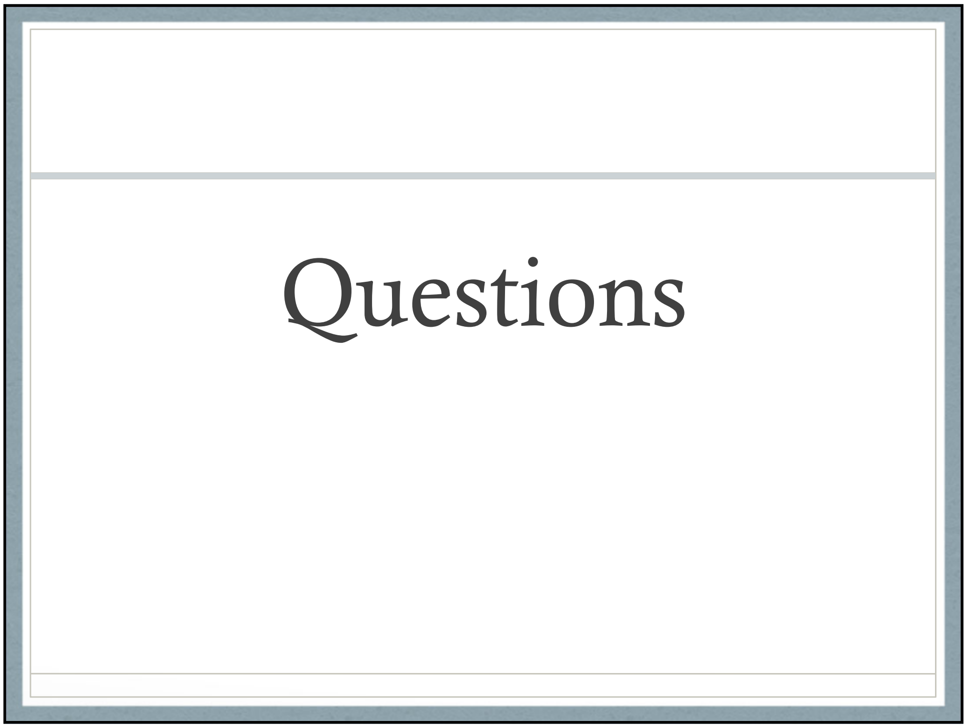
Differential Gene Expression

- Will Reveal Triggers/precursors to
  - Reproduction
    - Female Sexual maturation
    - Male factor stimulating female reproduction
  - Feeding
  - Host recognition
    - Odorant receptors
    - Signaling peptides etc.
  - Stress response

Goal

- We hope to provide Varroa year round without the natural host for research efforts towards an integrated control measures.

Thank You


Questions

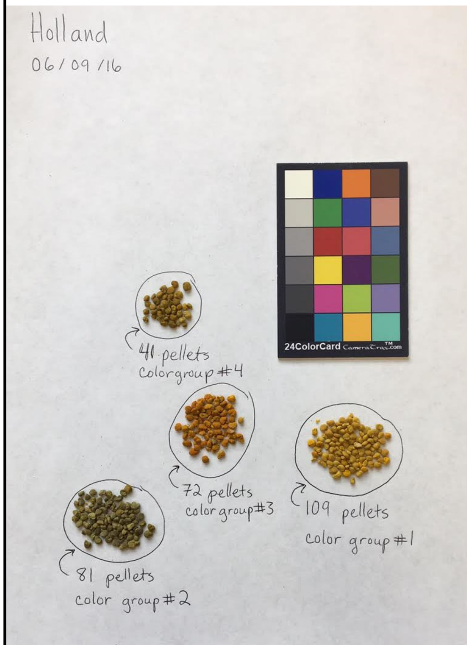
Future Honey Bee Nutrition Research at HBREL

Emily Noordyke

October 2018

Comparative Pollen Analysis of Honey Bee Colonies in Agriculture Versus Semi-Natural Prairie

Grand Valley State University

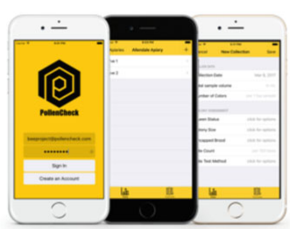


Results

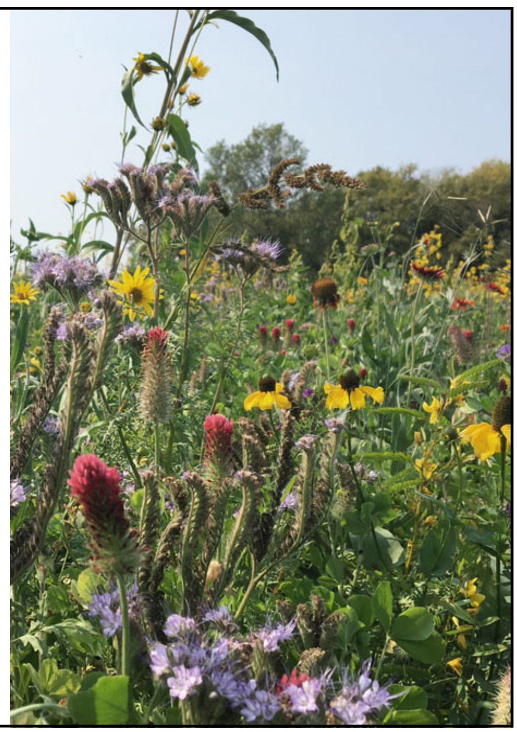
- No significant differences in pollen species diversity or crude protein content
- Neither location pollen limited
- Likely enough heterogeneity in landscapes surrounding both apiaries

PollenCheck Mobile Application

- Quantify the diversity and amount of incoming pollen
- https://beeinformed.org/programs/pollencheck/



Effects of land-use change on commercial honey bee health and ability to fulfill spring pollination contracts



- Quantifies impact of Federal conservation lands in the upper Midwest on pollinator forage and health
- Honey bee forage preferences to develop better seed mixes

AgBioResearch
MICHIGAN STATE UNIVERSITY

- Michigan Pollinator Initiative
- Issacs Lab- Pollination Ecology
  - Pollinator Champions Online Course
  - Honey bee colony health during blueberry pollination

Now: UF Honey Bee Research and Extension Lab

- Focus on honey bee nutrition
- More specifically, how nutritional supplements are used by honey bee colonies
  1. What is the fate of protein patties in the hive?
  2. Feed conversion ratio of various protein patties

Why focus on protein patties?

- Beekeepers spend significant time, money, and labor on supplemental feeding
- Little consensus in the literature about benefits of protein patties
- Previous studies at HBREL show neutral effect of protein patty on colony strength

Project 1: What is the fate of protein patties in the hive?

- Trace 3 major commercial pollen patties
  - Do the bees store them as bee bread?
  - Do the bees feed patties directly to larvae?
  - Do the bees consume and digest patties, and if so, in what proportion of the population?
  - Do the bees eject any patty in front of or below the hive?
- Compare between patty recipes

Project 1: What is the fate of protein patties in the hive?

- Trace bee-collected pollen patties through hives
- Bee-collected pollen patties are used as proxies for pollen collected by foragers in research
- Are the bees using bee-collected pollen patties like they do incoming pollen from foragers?

Hypotheses*

- The bees do not store protein patty as bee bread
- The bees do not feed protein patty directly to larvae
- The bees do consume and digest protein patties
- The bees eject some patty out of the hive

*Hypotheses based on a similar study done by Randy Oliver

Methods?

Current Progress

- Need to find the right fluorescent tracer
- Cage trial with various tracers to check:
  - If they appear in the bee gut
  - If they increase bee mortality
  - If they decrease consumption of the patty

Project 2: Feed conversion ratios of protein patties

- When we feed a protein patty, how much weight in adult bees and brood does a colony gain?
- FCRs are commonly used for livestock and farmed fish, but never used for honey bee colonies
- Beekeepers need increase in brood and bees even during pollen dearth

Calculating feed conversion ratio

Initial biomass + feed input = biomass output

+

=

- Challenge #1: bees forage freely at a far distance
- Challenge #2: weighing brood

Challenge #1: bees forage freely at a far distance

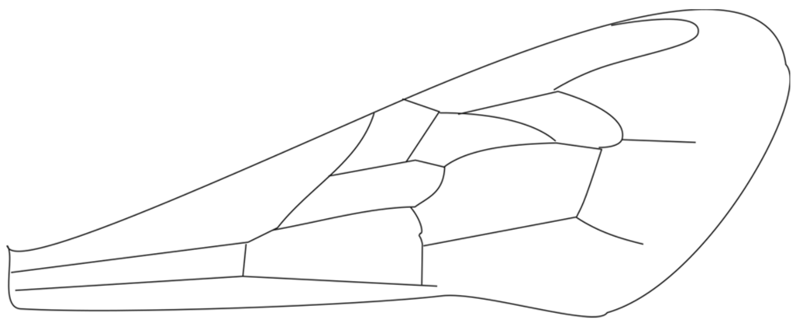
- Add pollen trap to simulate complete pollen dearth
- Account for weight gained ONLY from protein patty

Challenge #2: weighing brood

- Weigh each larva and pupa one by one?
- NOPE!
- Determine an average from a random sample of brood
- Extrapolate using total area of brood in the hive

Questions?

Identifying honey bees using forewings and other morphometric features.



Honey Bee Taxonomy

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Insecta
Order:	Hymenoptera
Family:	Apidae
Genus:	Apis
Species:	mellifera

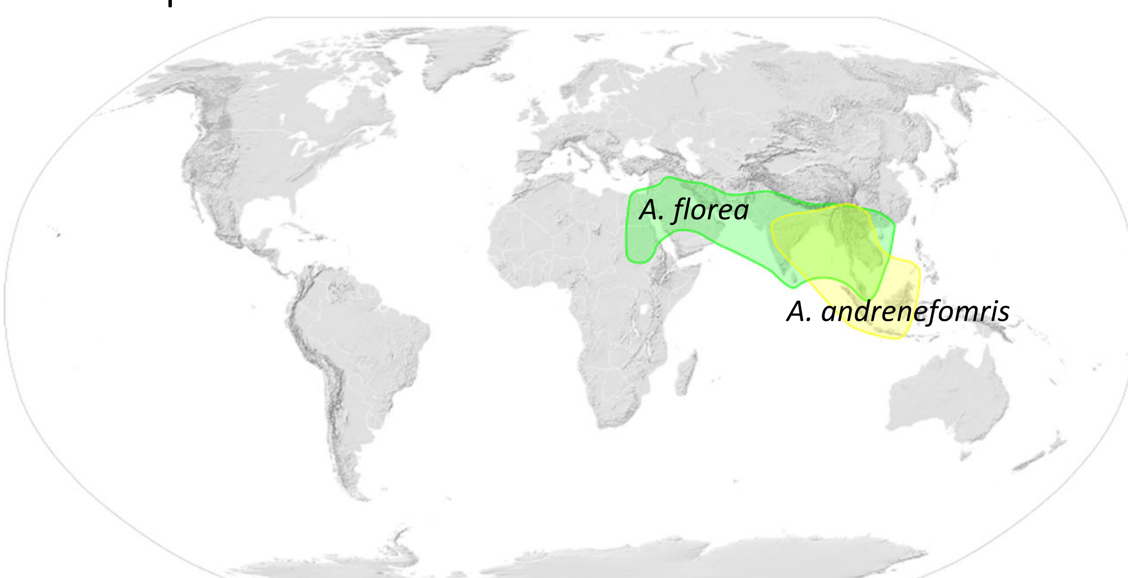
Honey Bee Species by Sub-genus

Micrapis
- Apis florea
- Apis andreneformis

Megapis
- Apis dorsata
- Apis laboriosa

Apis
- Apis mellifera
- Apis cerana
- Apis nuluensis
- Apis koschevnikovi
- Apis nigrocincta

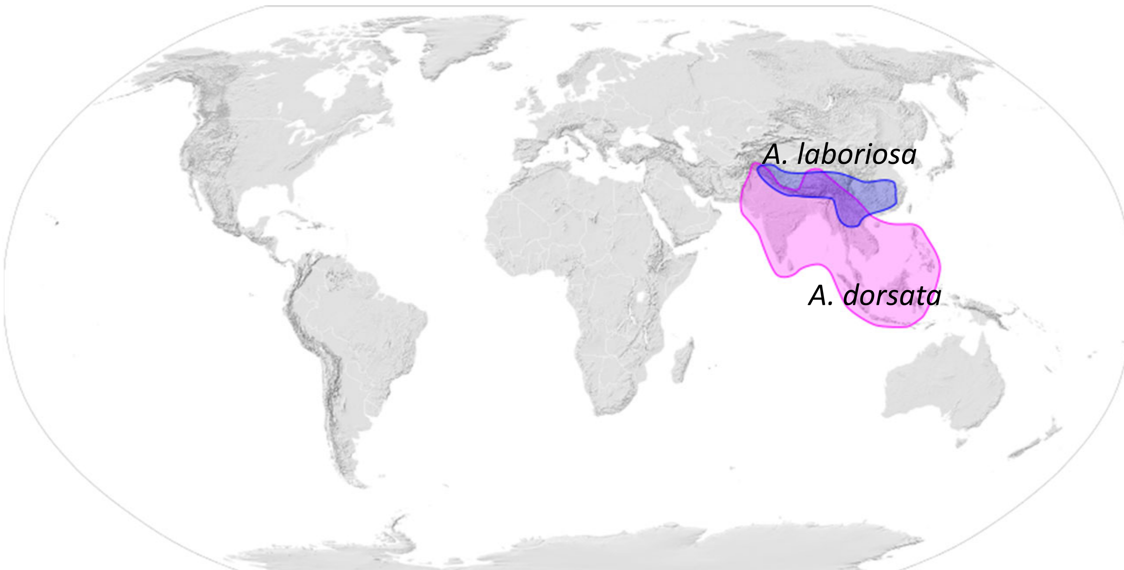
Micrapis



Example: *Apis florea*

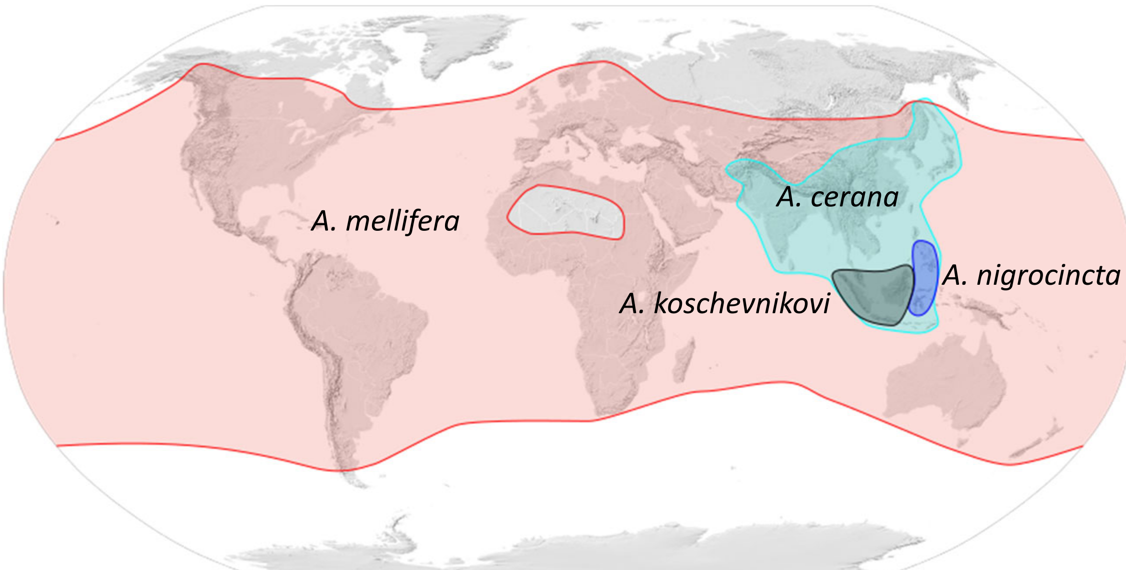
Example: *Apis florea*

Megapis



Example: *Apis dorsata*

Apis



Example: *Apis cerana*

Zac Huang

Example: *Apis cerana*

Zac Huang

What is a subspecies?

<u>Near East Subspecies</u>

– *Apis mellifera anatolica*
– *Apis mellifera adami*
– *Apis mellifera cypria*
– *Apis mellifera syriaca*
– *Apis mellifera medea*
– *Apis mellifera caucasica*
– *Apis mellifera armenica*
– *Apis mellifera taurica*

<u>Tropical African Subspecies</u>

– *Apis mellifera lamarckii*
– *Apis mellifera yemenitica*
– *Apis mellifera litorea*
– *Apis mellifera scutellata*
– *Apis mellifera adansonii*
– *Apis mellifera monticola*
– *Apis mellifera capensis*
– *Apis mellifera unicolor*

What is a subspecies?

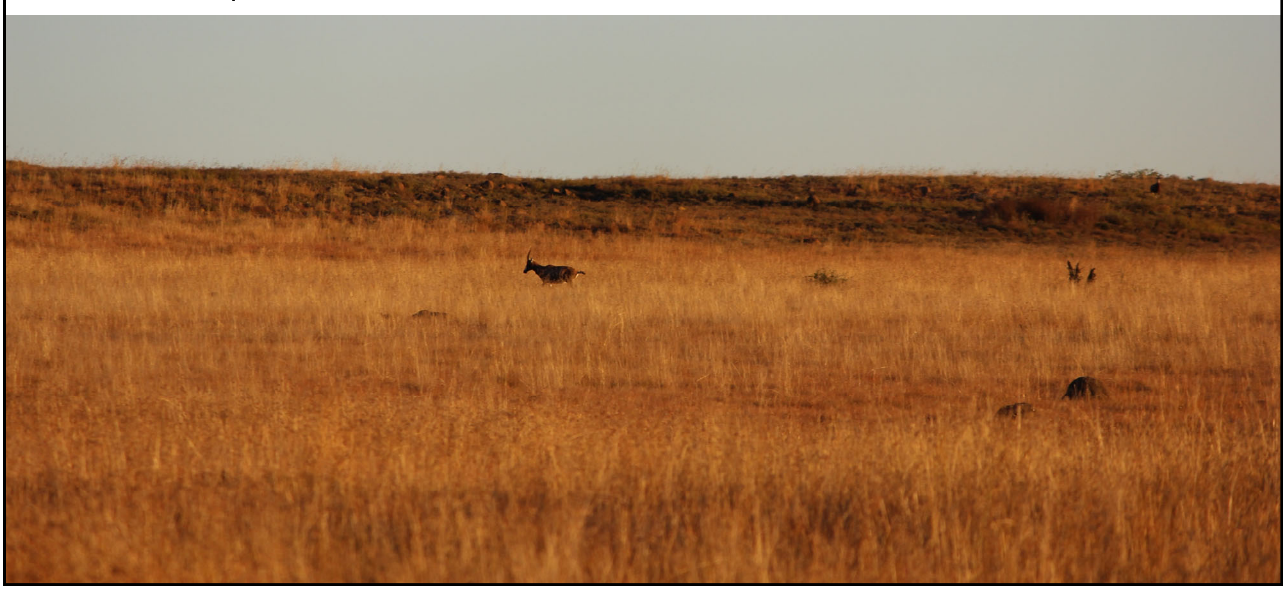
Western Mediterranean Subspecies
– *Apis mellifera saharensis*
– *Apis mellifera intermissa*
– *Apis mellifera iberica*
– *Apis mellifera mellifera*

Southeastern European Subspecies
– *Apis mellifera sicula*
– *Apis mellifera ligustica*
– *Apis mellifera cecropia*
– *Apis mellifera macedonica*
– *Apis mellifera carnica*

Example: A.m. lingustica

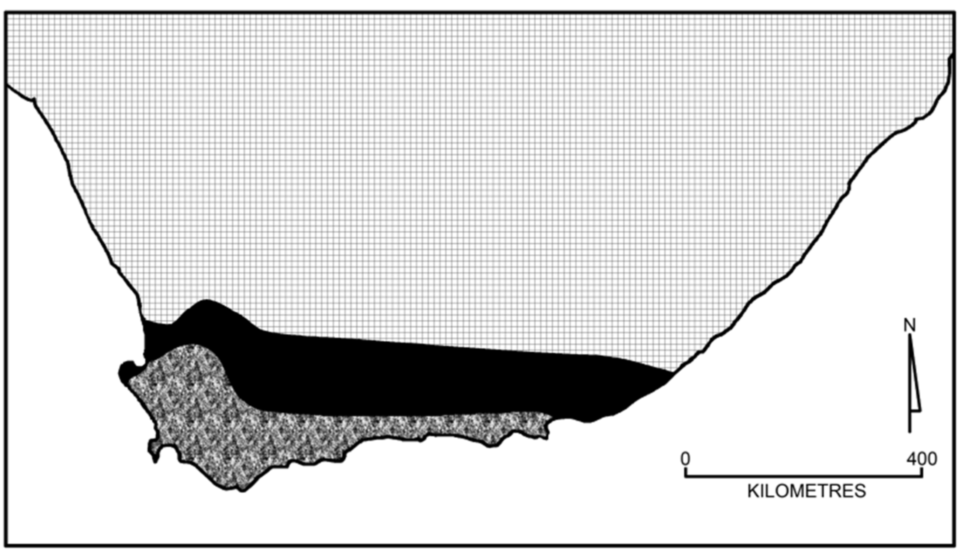
Example: A.m. caucasia

Example: A.m. scutellata

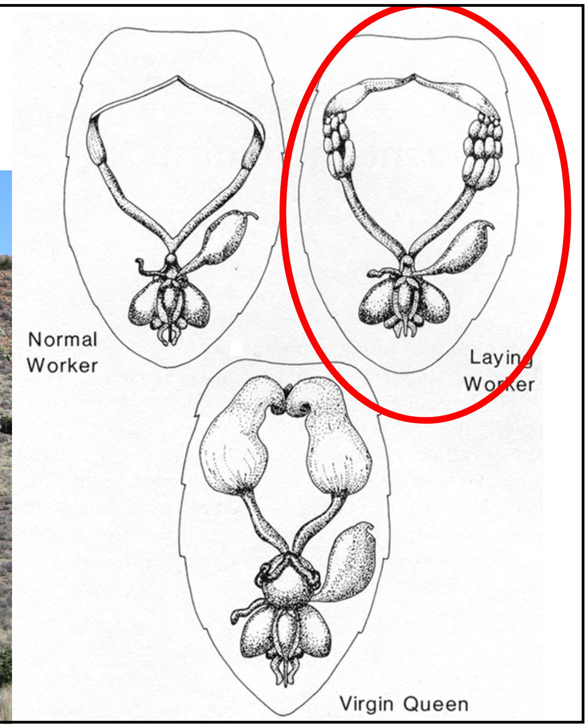


Example: A.m. scutellata

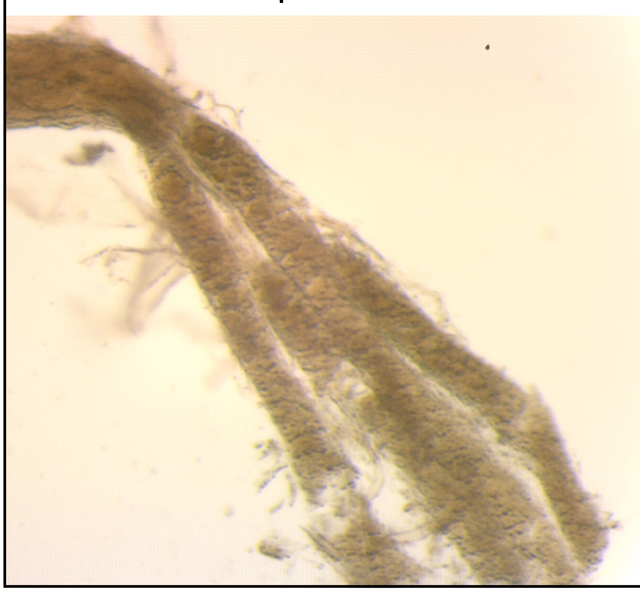
Example: A.m. capensis

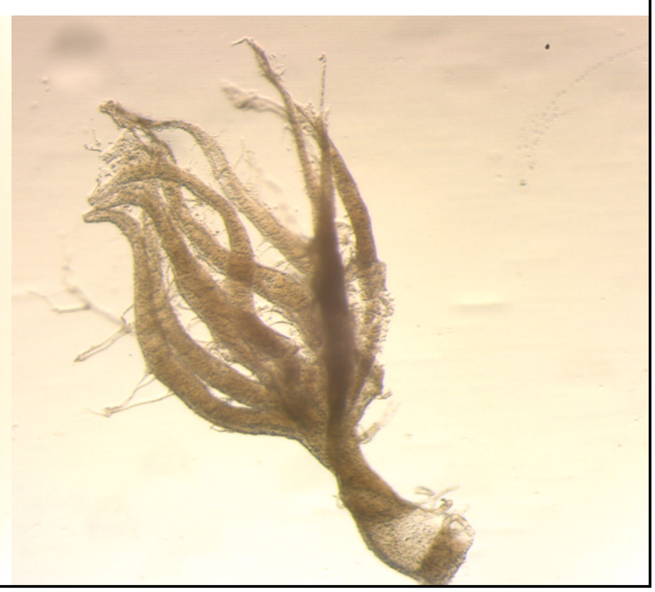


Example: A.m. capensis

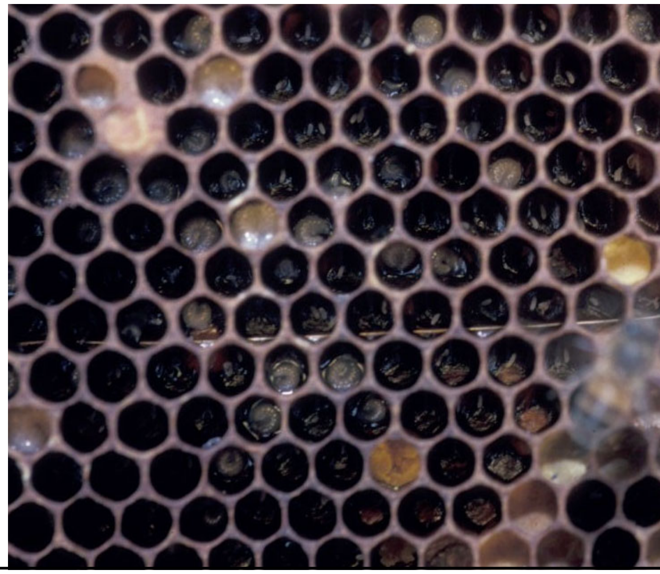


A.m. capensis





A.m. capensis



How are subspecies discovered?

Subspecies, breed or race?

Buckfast bee

African-derived (a.k.a. Africanized) honey bees

African-derived (a.k.a. Africanized) honey bees

How do you tell the difference?

Behavior

Behavior

Zac Huang

Visual Signs

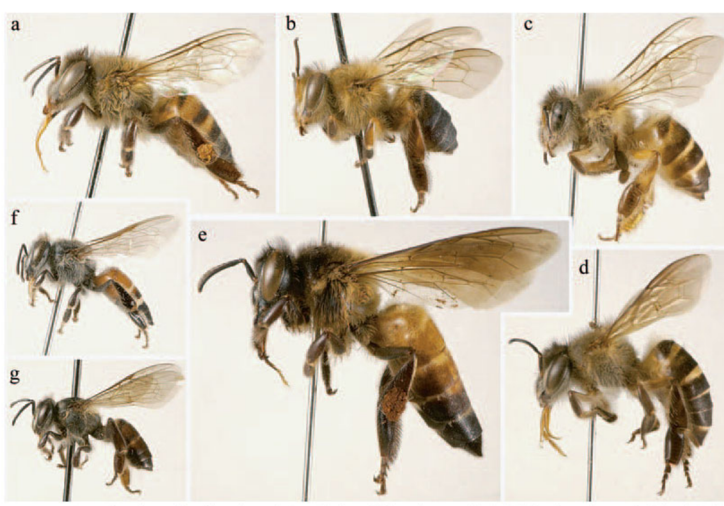
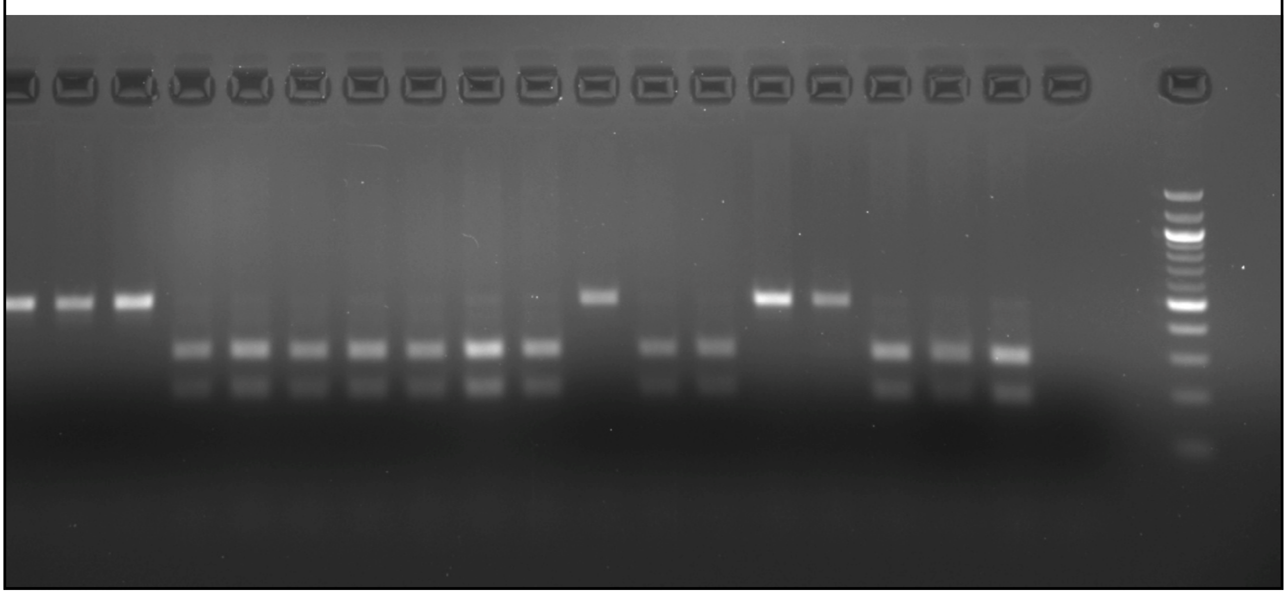


FIGURE 1. Modern honey bee diversity – a) *Apis* (*Apis*) *mellifera* Linnaeus; b) *A.* (*A.*) *koschevnikovi* Enderlein; c) *A.* (*A.*) *nigrocincta* Smith; d) *A.* (*A.*) *cerana* Fabricius; e) *A.* (*Megapis*) *dorsata* Fabricius; f) *A.* (*Micrapis*) *florea* Fabricius; g) *A.* (*M.*) *andreniformis* Smith. All specimens to same scale.

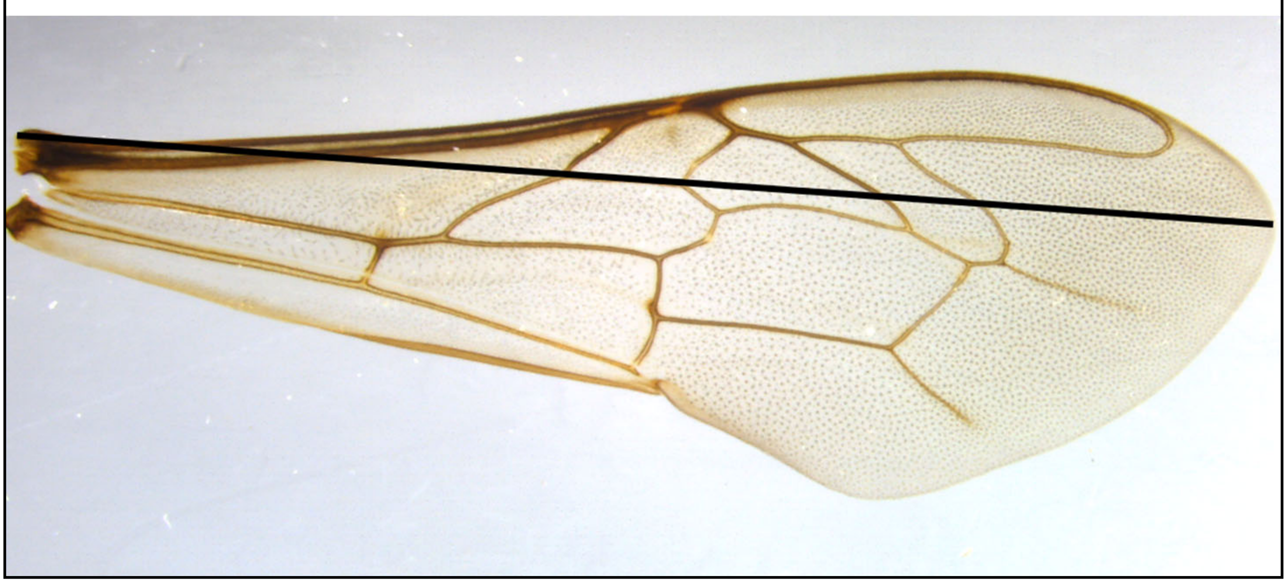
How do you tell the difference?

Molecular Evidence

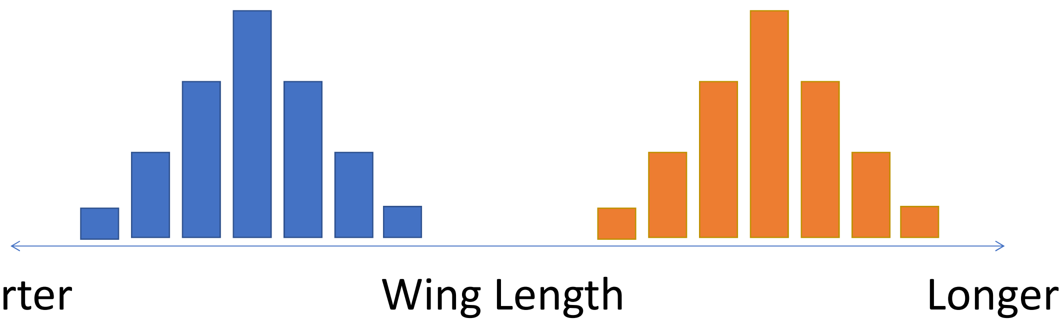


Morphometrics analysis.

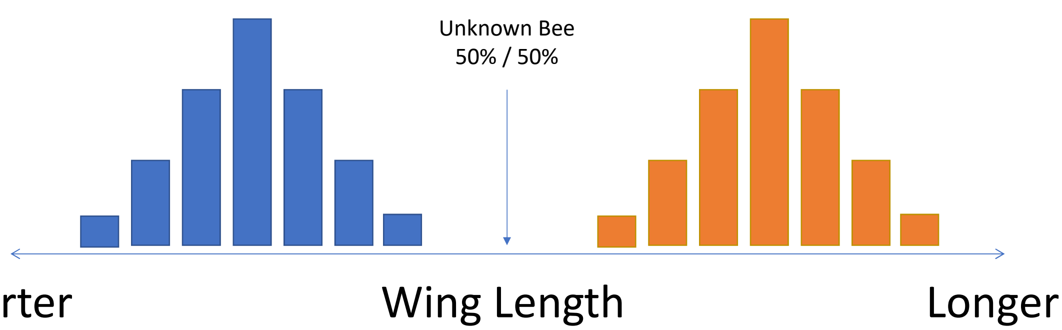
FABIS: A simple example



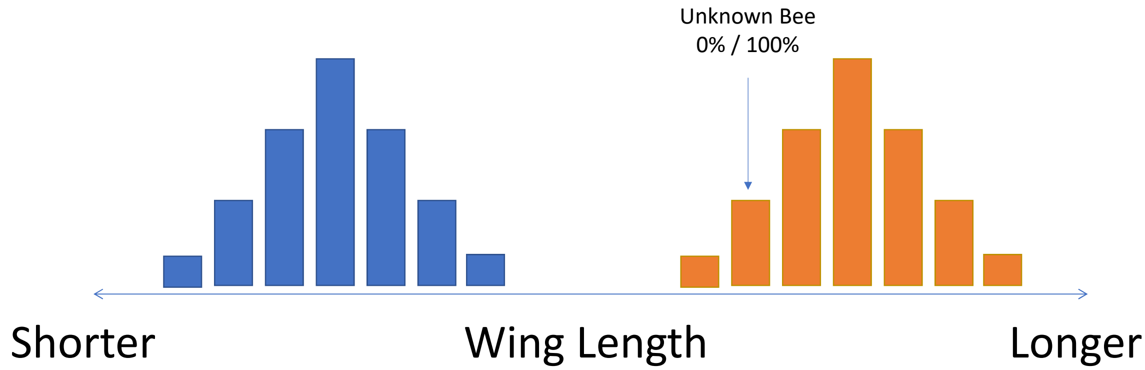
Looking for separation of known groups



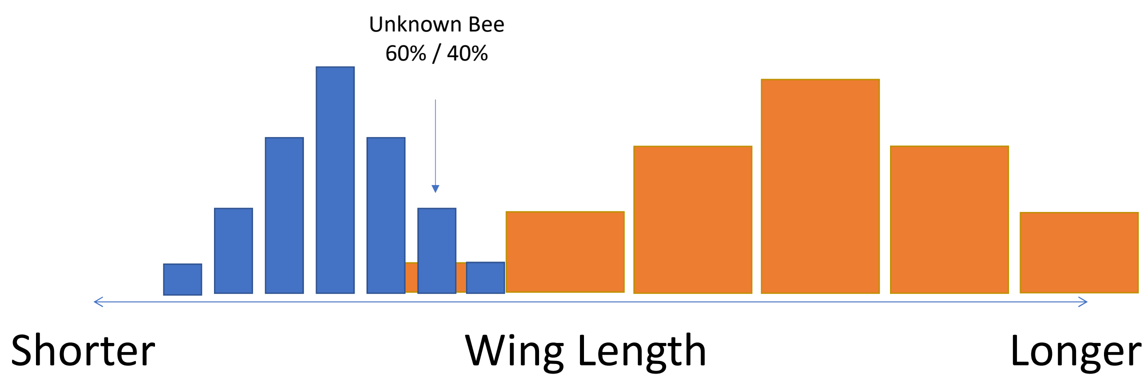
Halfway between is 50% if groups are spread evenly.



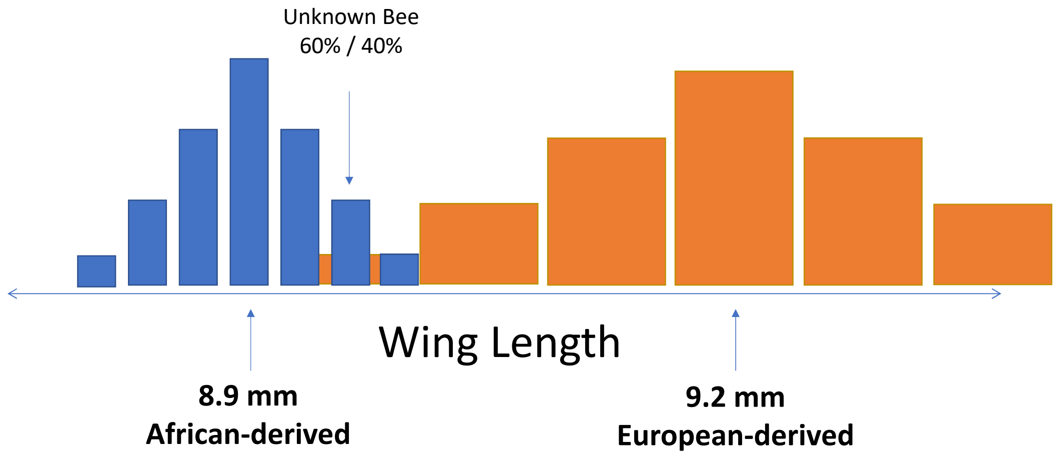
Probability increases to 100% when you cross into a group.



Group spread and overlap can adjust the score.

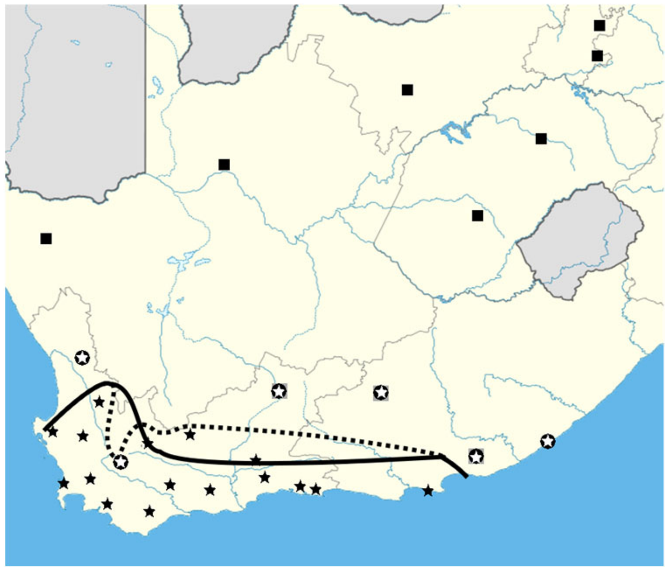


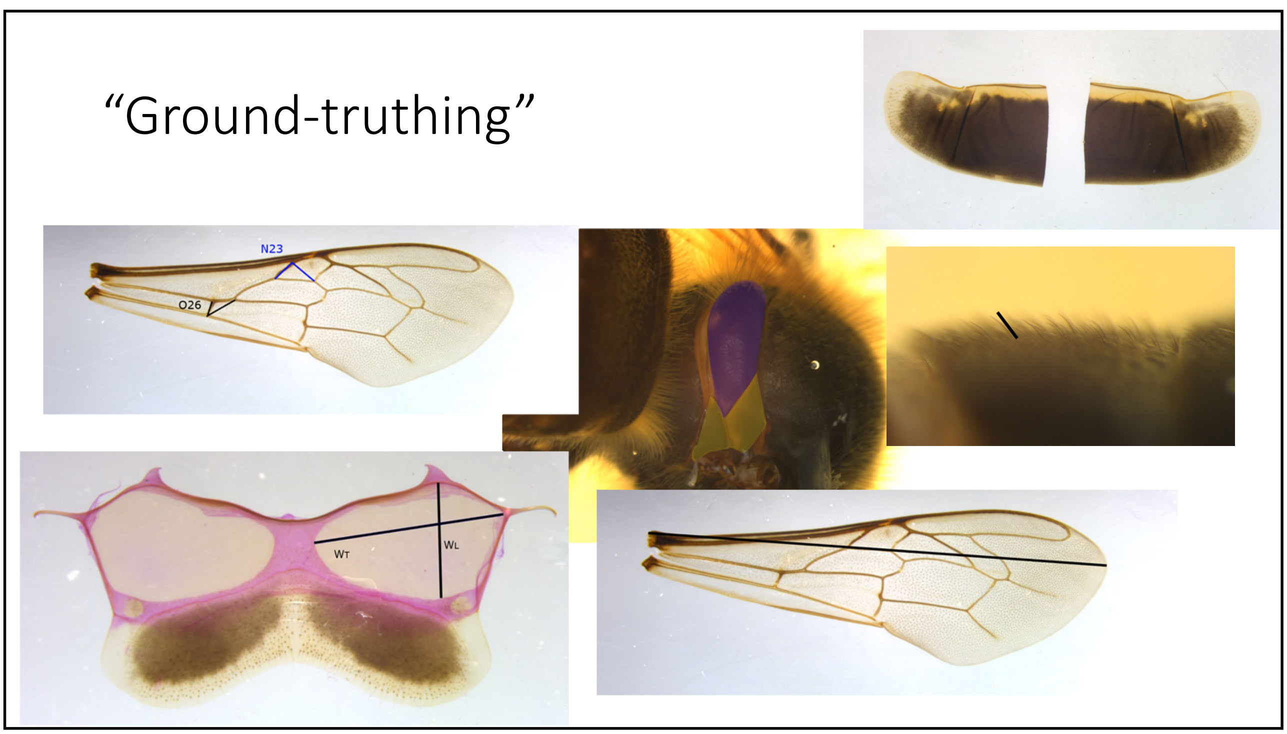
This is approximately how FABIS works!



Discriminating A.m. capensis vs A.m. scutellata: A more complex example

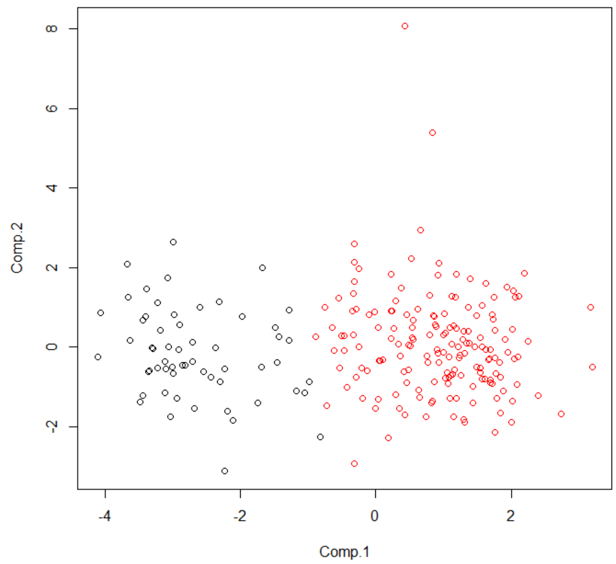
Establishing a sample population



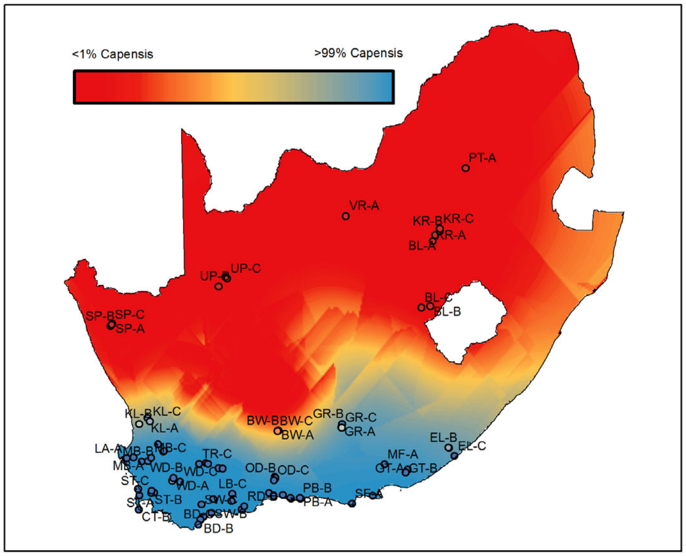


“Ground-truthing”
N23
O26
WT
WL

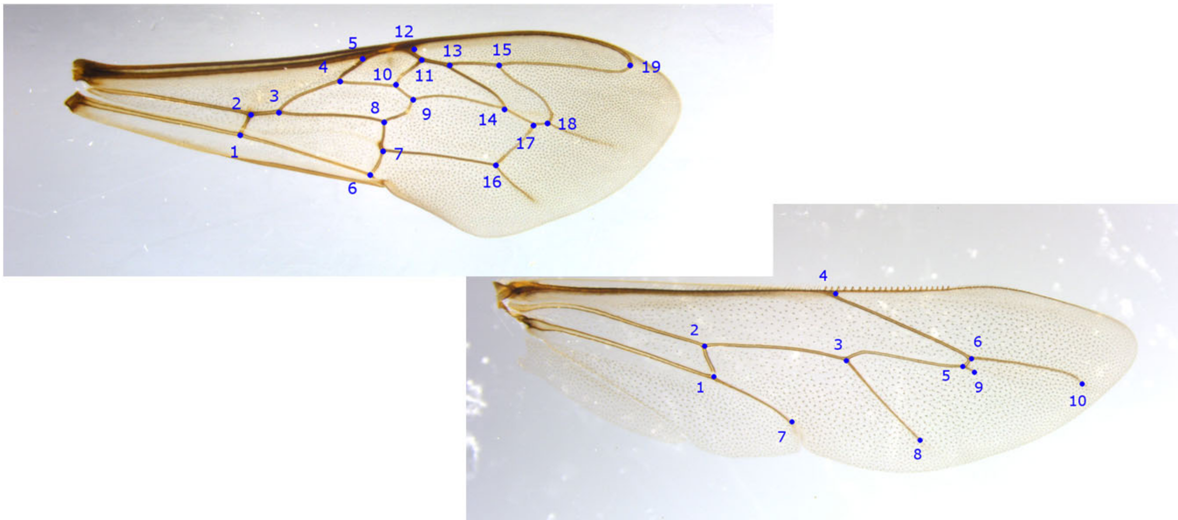
“Ground-truthing”



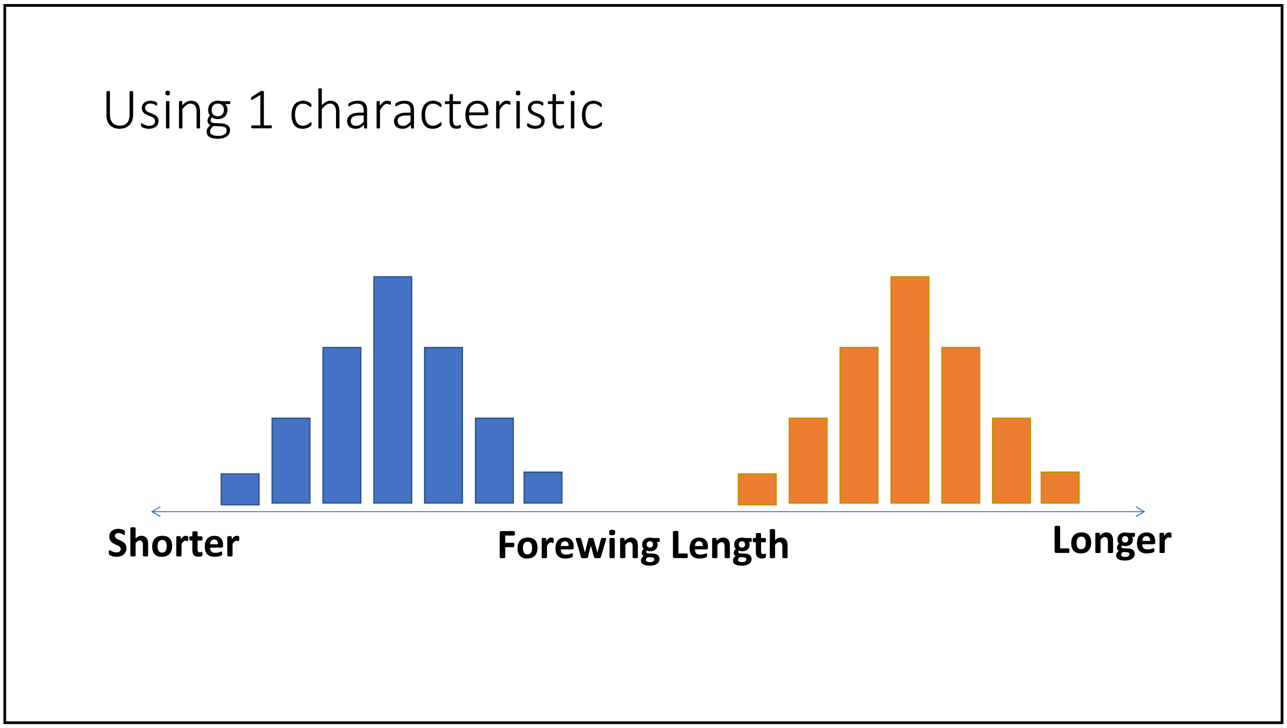
“Ground-truthing”

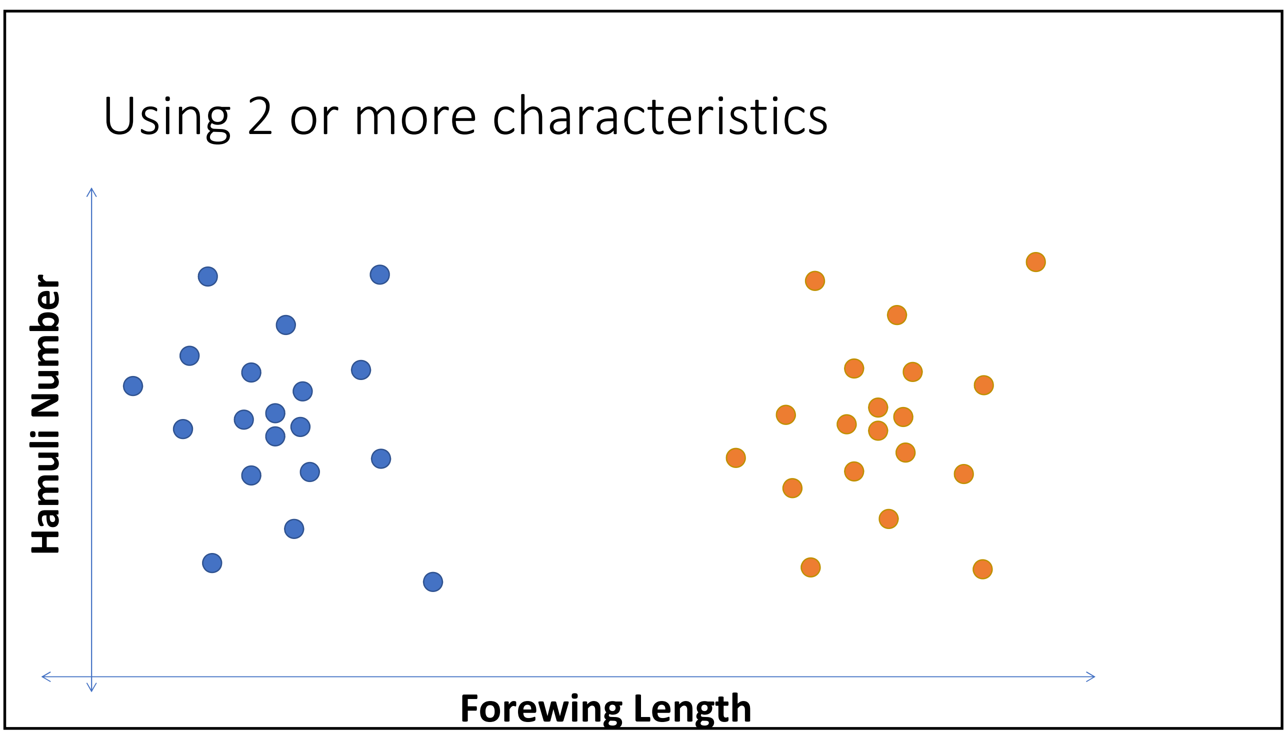


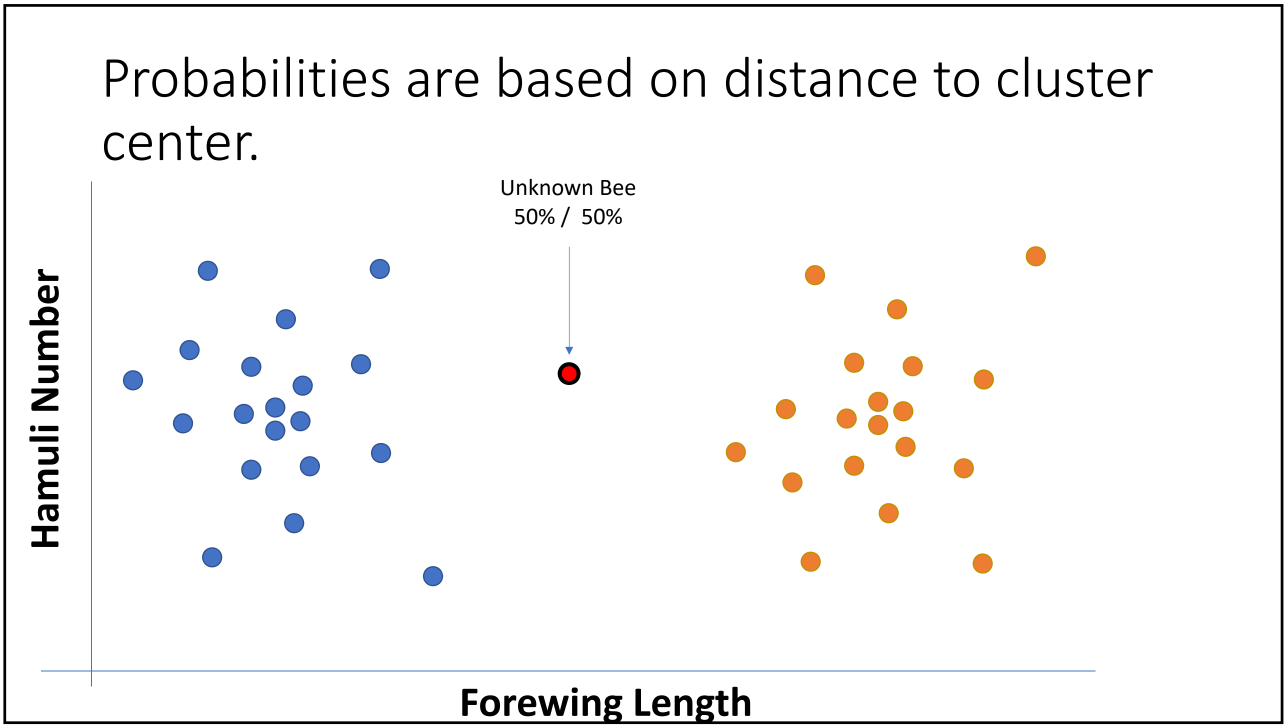
Testing geometric methods

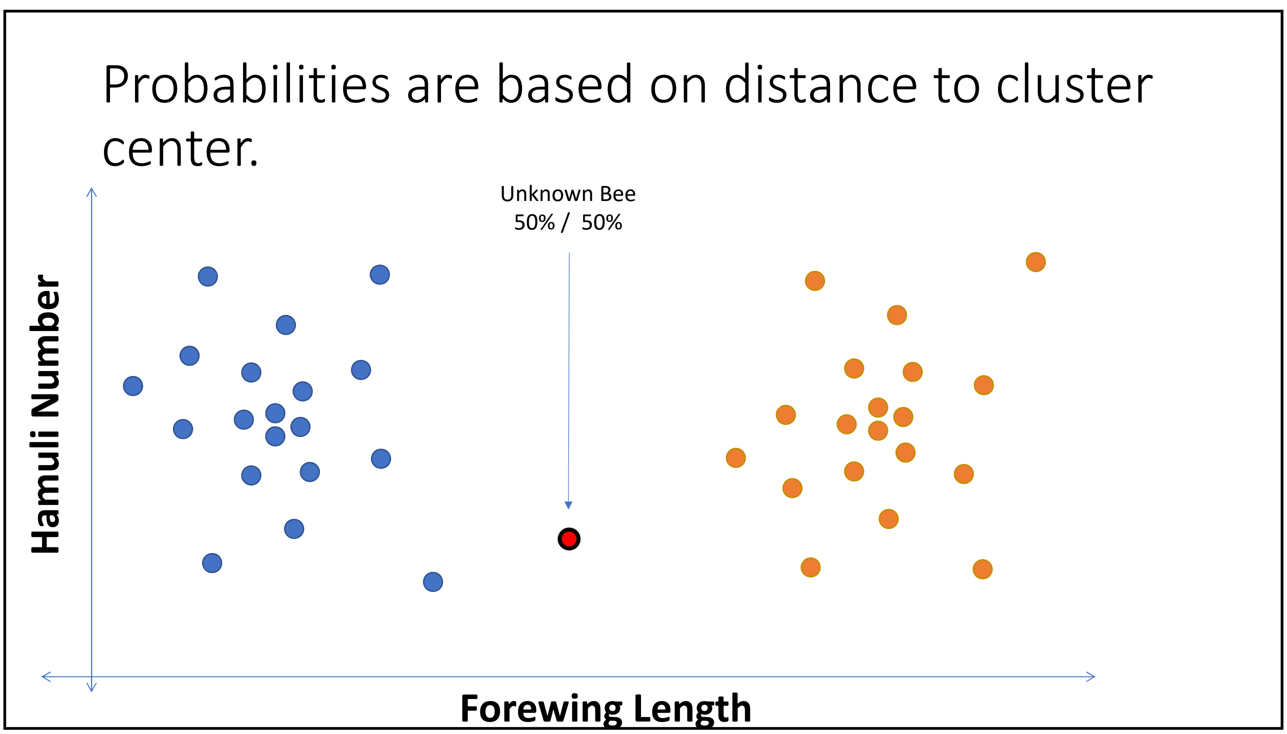


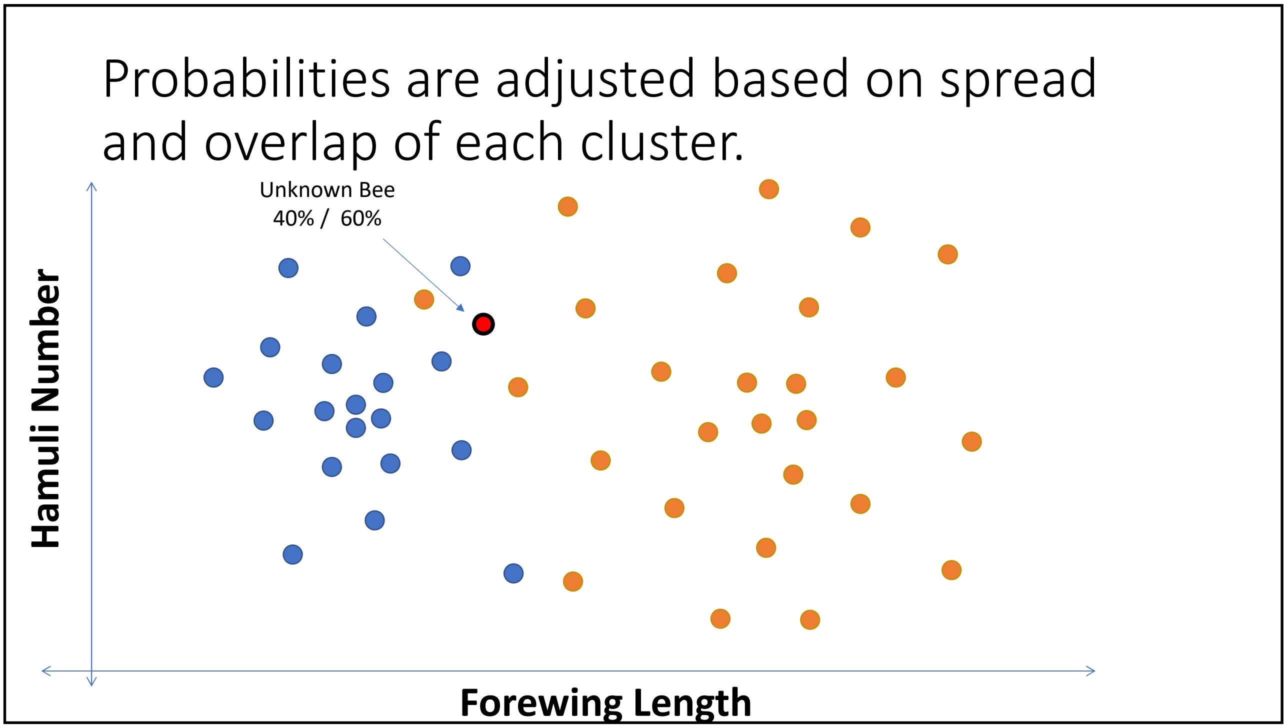
The analysis

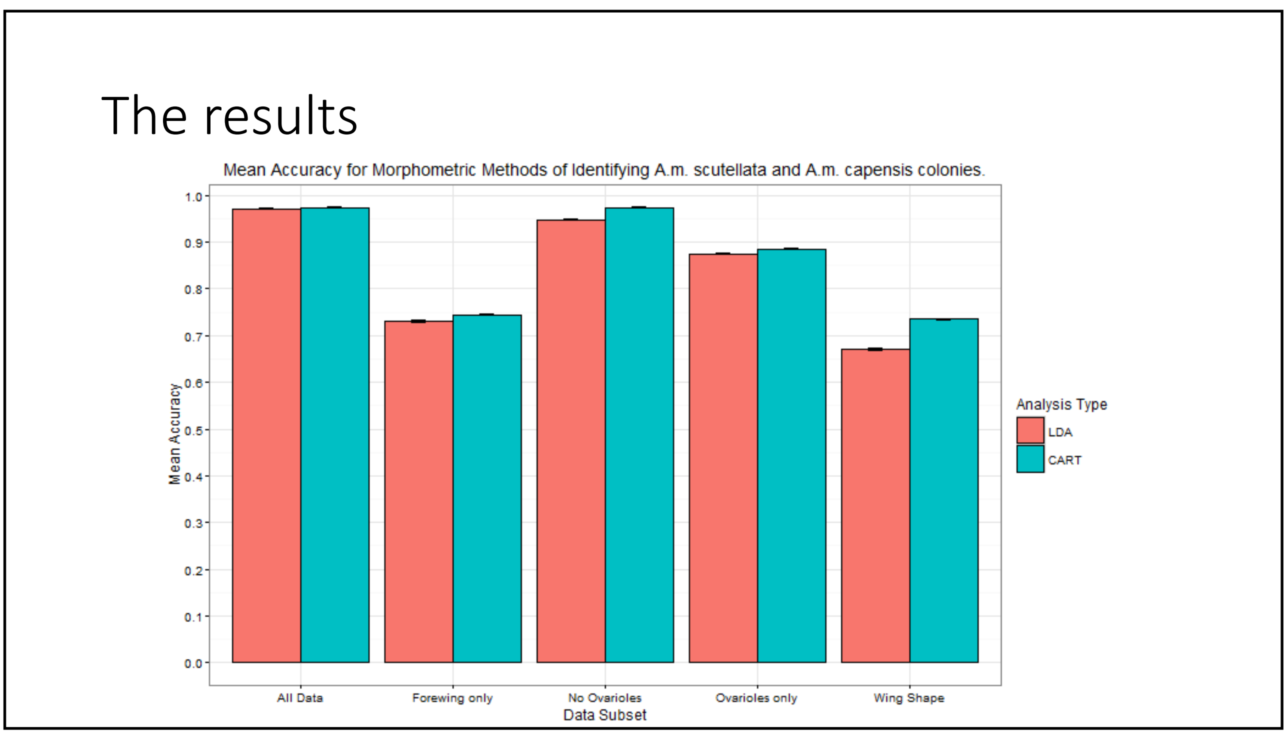

Using 1 characteristic
Shorter
Forewing Length
Longer

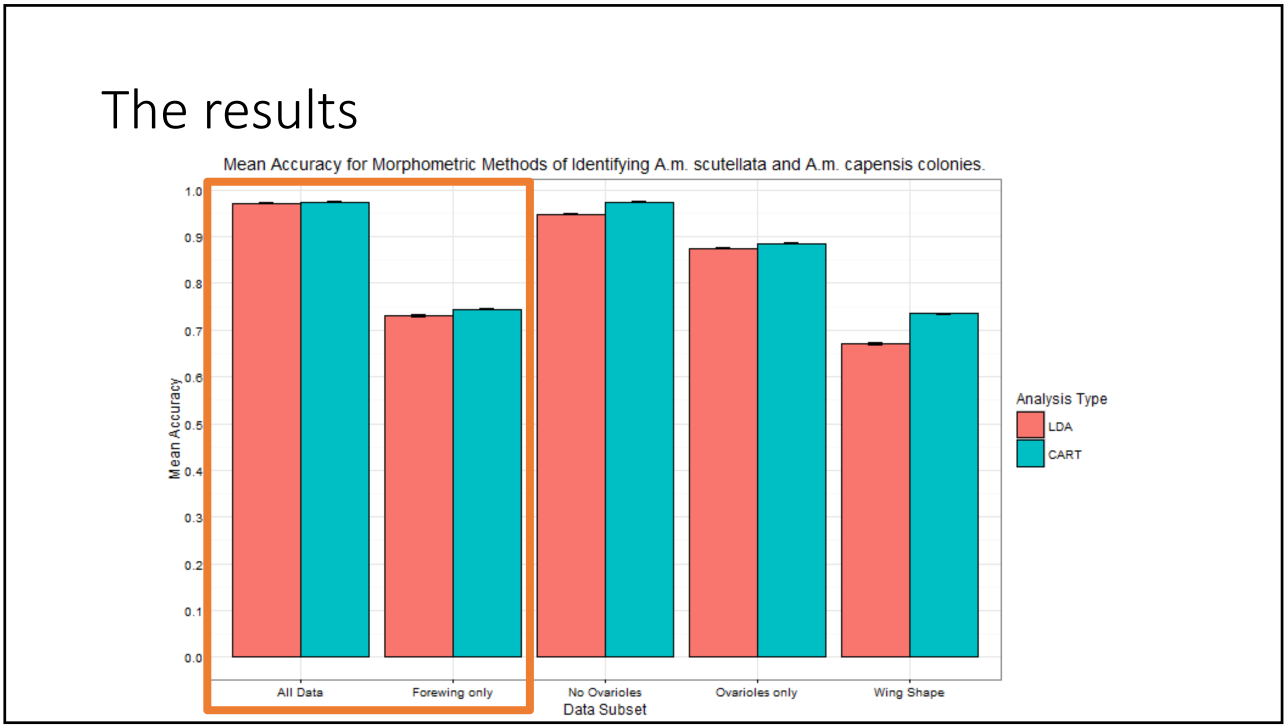

Using 2 or more characteristics
Hamuli Number
Forewing Length


Probabilities are based on distance to cluster center.
Unknown Bee
50% / 50%
Hamuli Number
Forewing Length


Probabilities are based on distance to cluster center.
Unknown Bee
50% / 50%
Hamuli Number
Forewing Length


Probabilities are adjusted based on spread and overlap of each cluster.
Unknown Bee
40% / 60%
Hamuli Number
Forewing Length


The results
Mean Accuracy for Morphometric Methods of Identifying A.m. scutellata and A.m. capensis colonies.
Mean Accuracy
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
All Data
Forewing only
No Ovarioles
Ovarioles only
Wing Shape
Data Subset
Analysis Type
LDA
CART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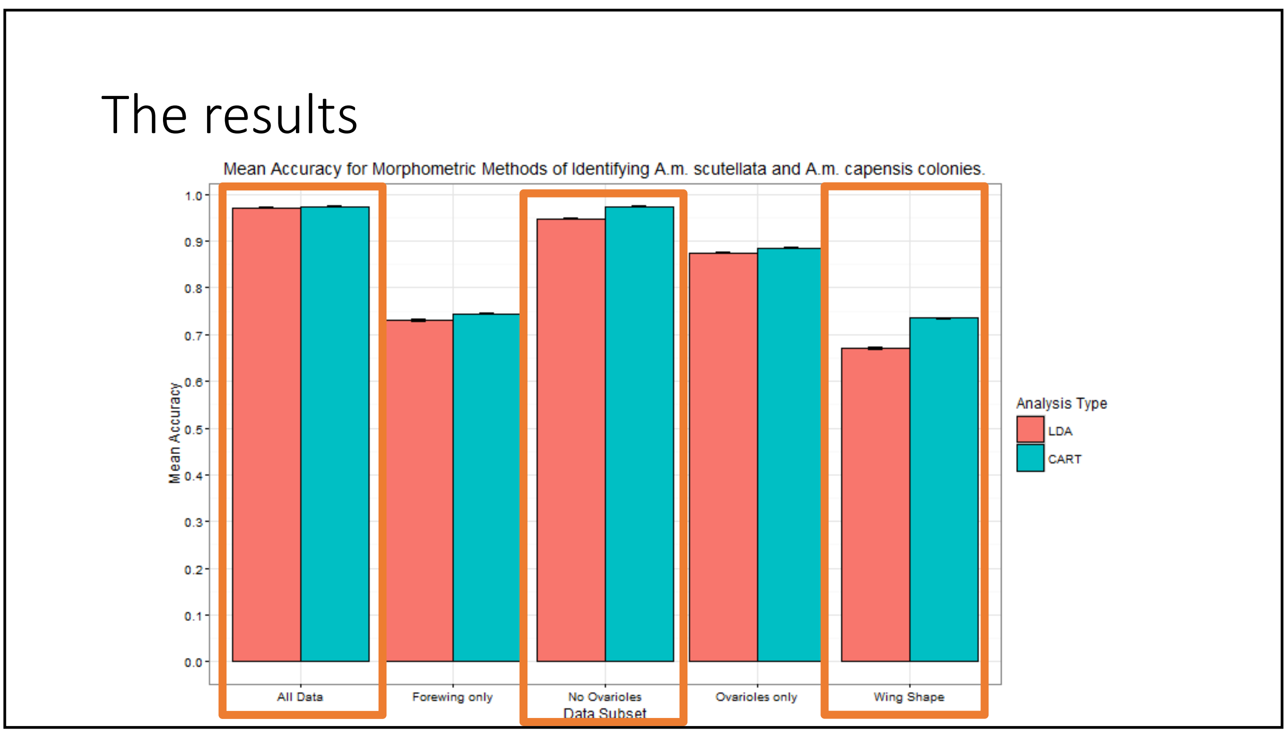
0.4
0.3
0.2
0.1
0.0
All Data
Forewing only
No Ovarioles
Ovarioles only
Wing Shape
Data Subset
Analysis Type
LDA
CART


The results
Mean Accuracy for Morphometric Methods of Identifying A.m. scutellata and A.m. capensis colonies.
Mean Accuracy
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
All Data
Forewing only
No Ovarioles
Ovarioles only
Wing Shape
Data Subset
Analysis Type
LDA
CART

Using Geometric Morphometrics to Identify Species

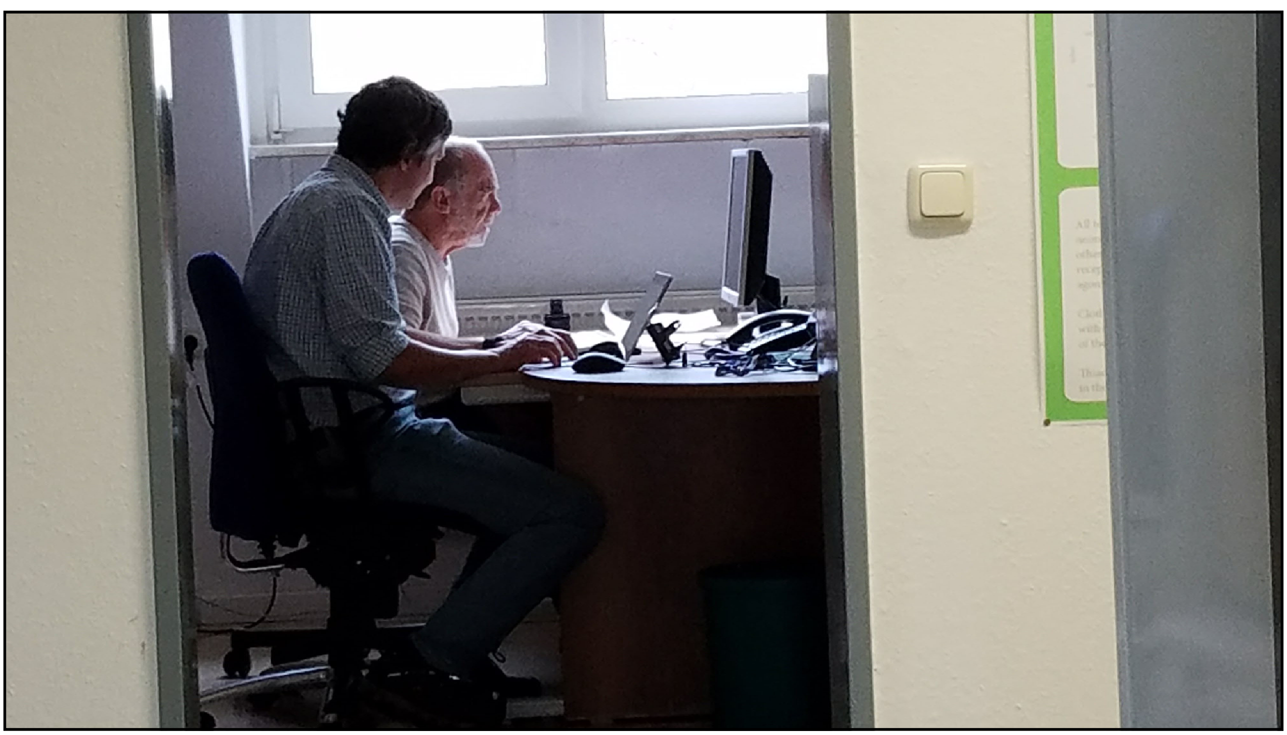
Review: Species… There are 9 of them!

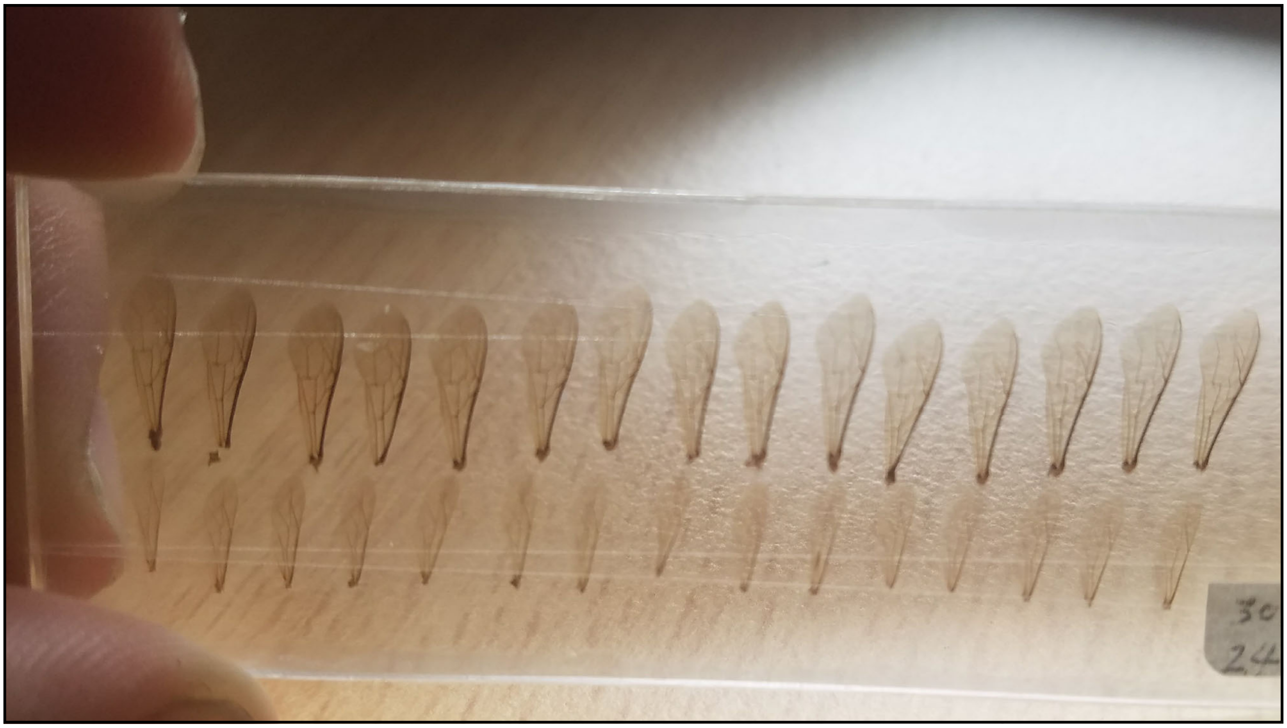
Micrapis
- Apis florea
- Apis andreneformis

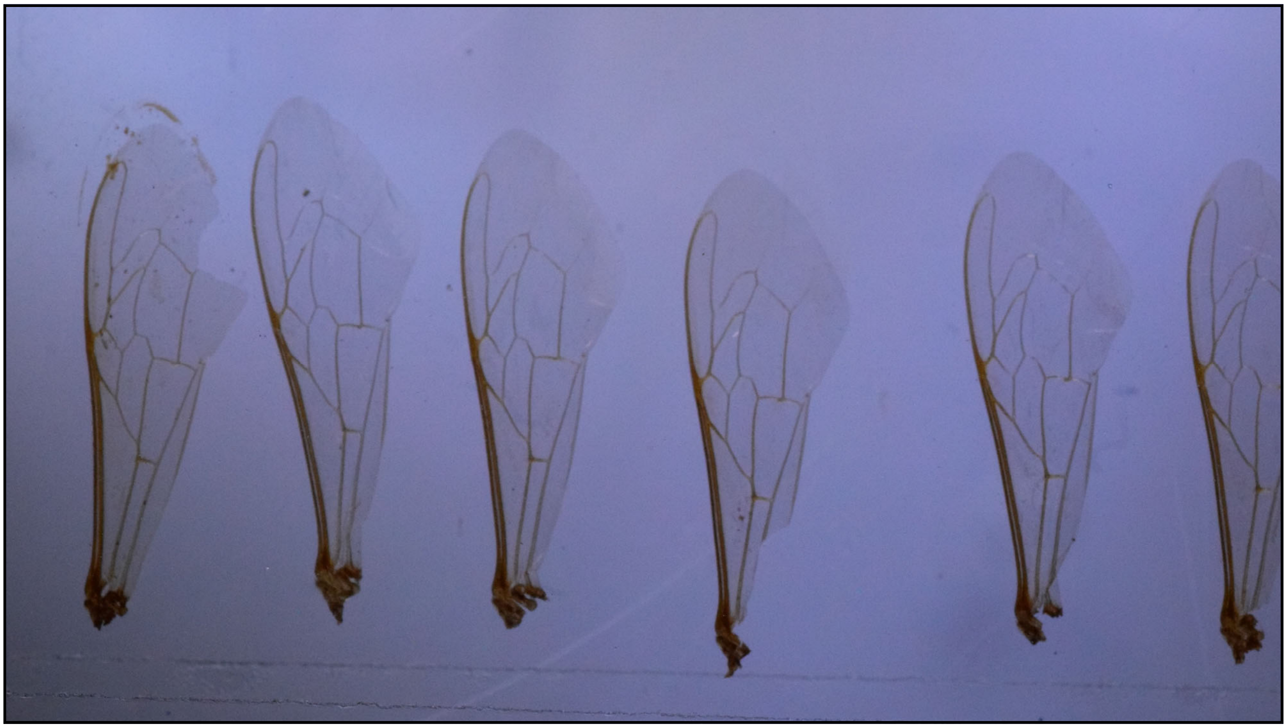
Megapis
- Apis dorsata
- Apis laboriosa

Apis
- Apis mellifera
- Apis cerana
- Apis nuluensis
- Apis koschevnikovi
- Apis nigrocincta

Establishing a sample population.

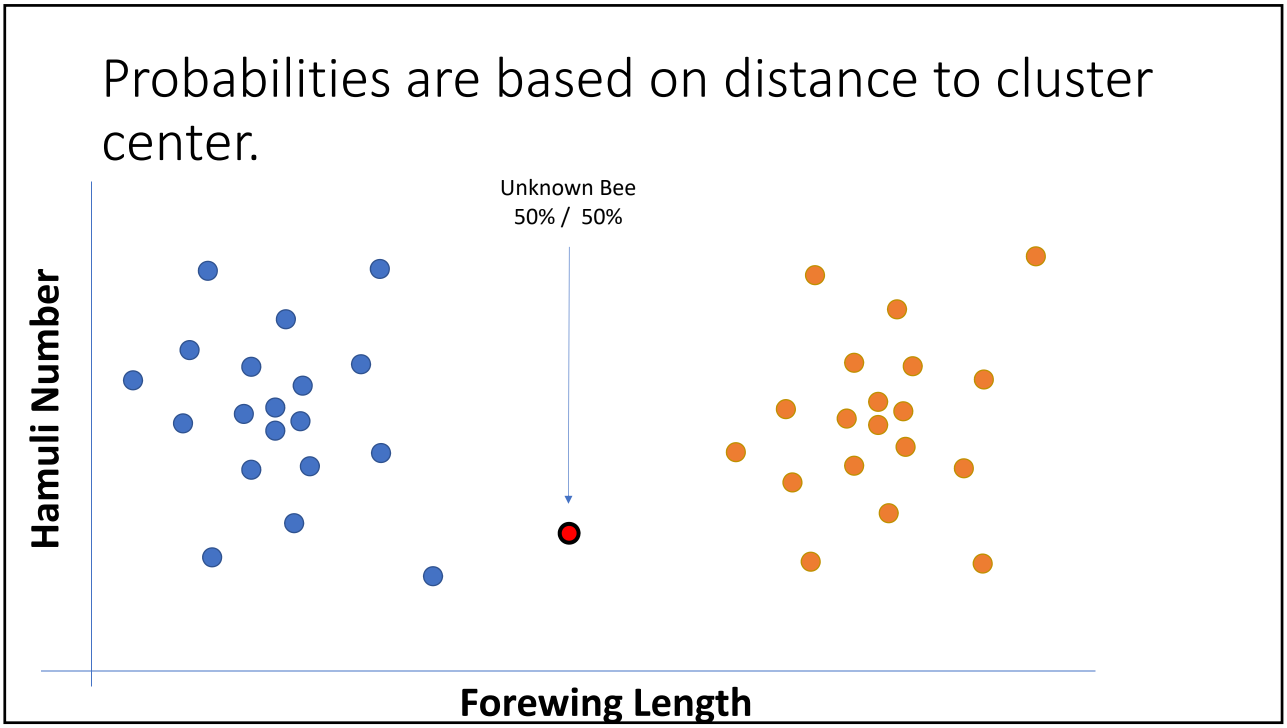


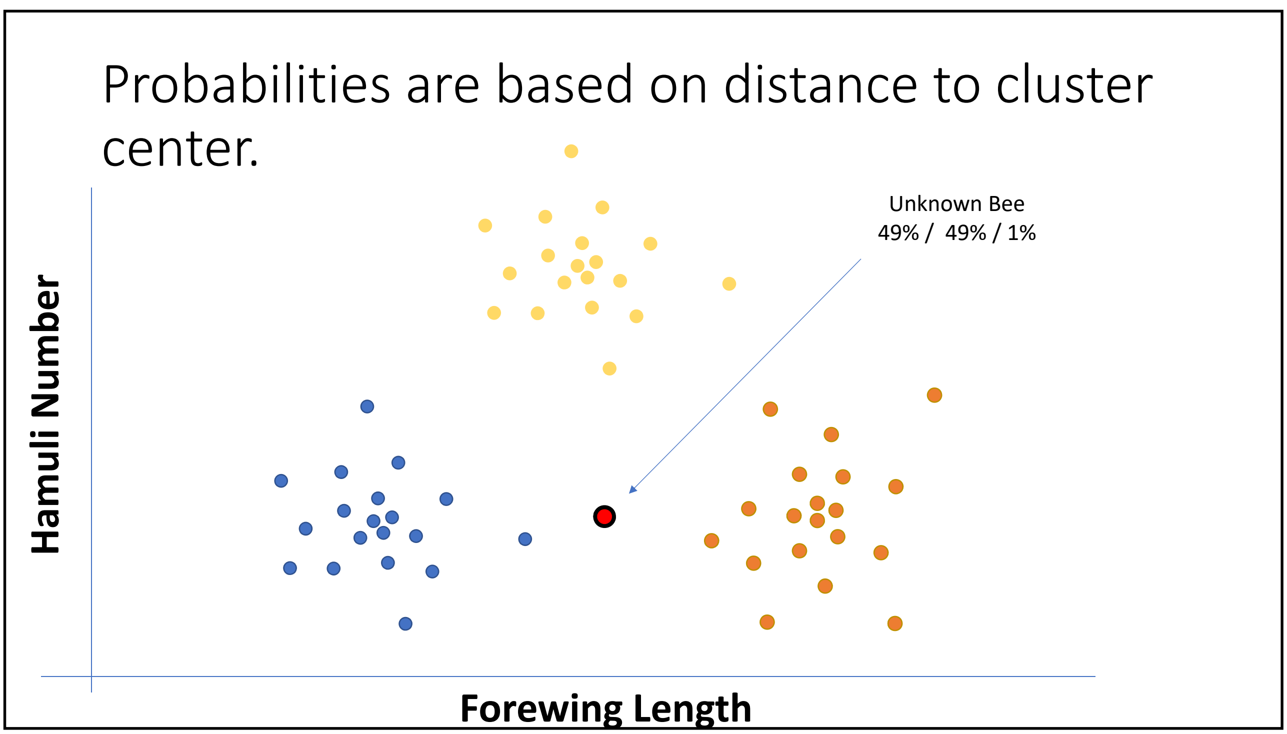


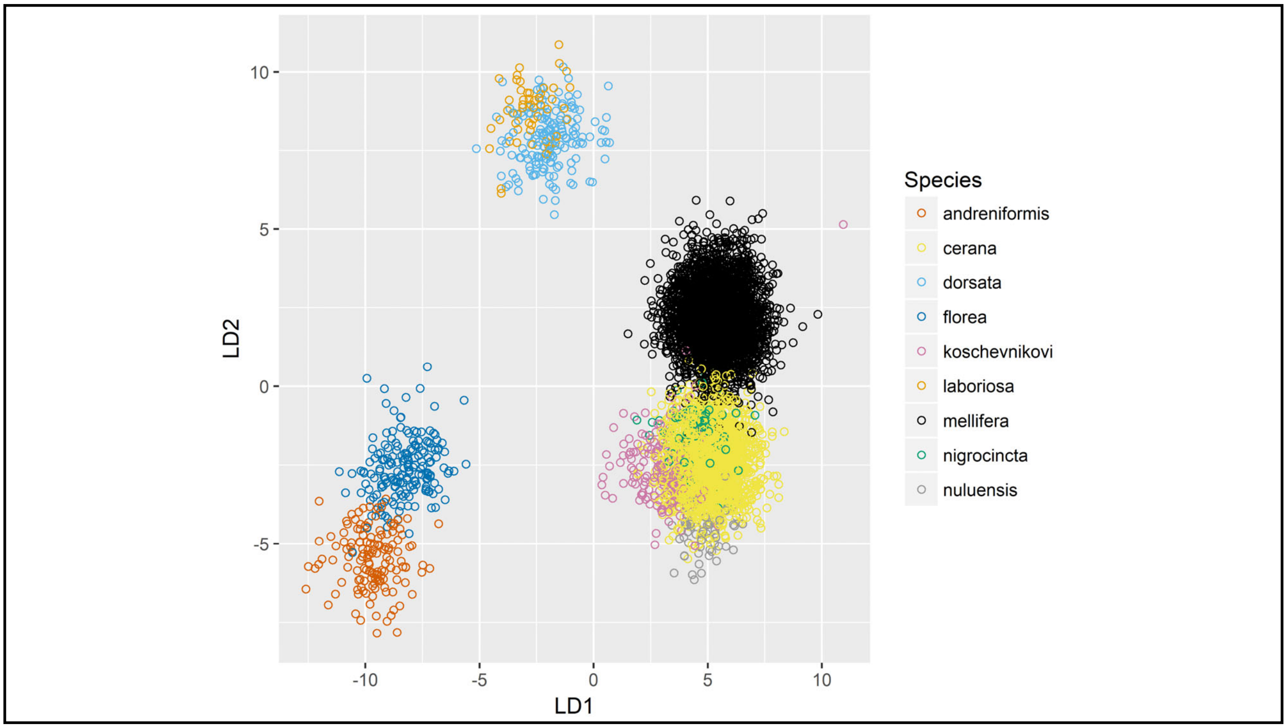


“Ground truthing”

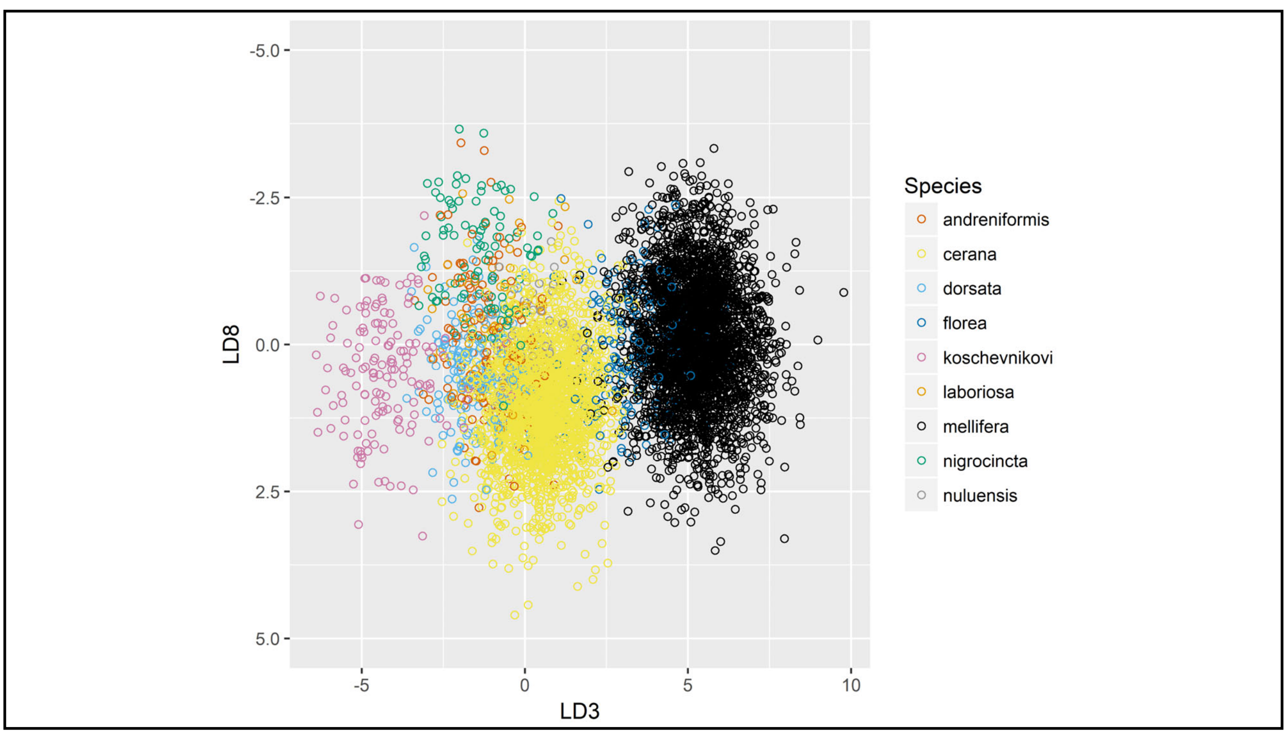
The analysis


Probabilities are based on distance to cluster center.
Unknown Bee
50% / 50%
Hamuli Number
Forewing Length


Probabilities are based on distance to cluster center.
Unknown Bee
49% / 49% / 1%
Hamuli Number
Forewing Length



10
5
0
-5
LD2
-10
-5
0
5
10
LD1
Species
andreniformis
cerana
dorsata
florea
koschevnikovi
laboriosa
mellifera
nigrocincta
nuluensis



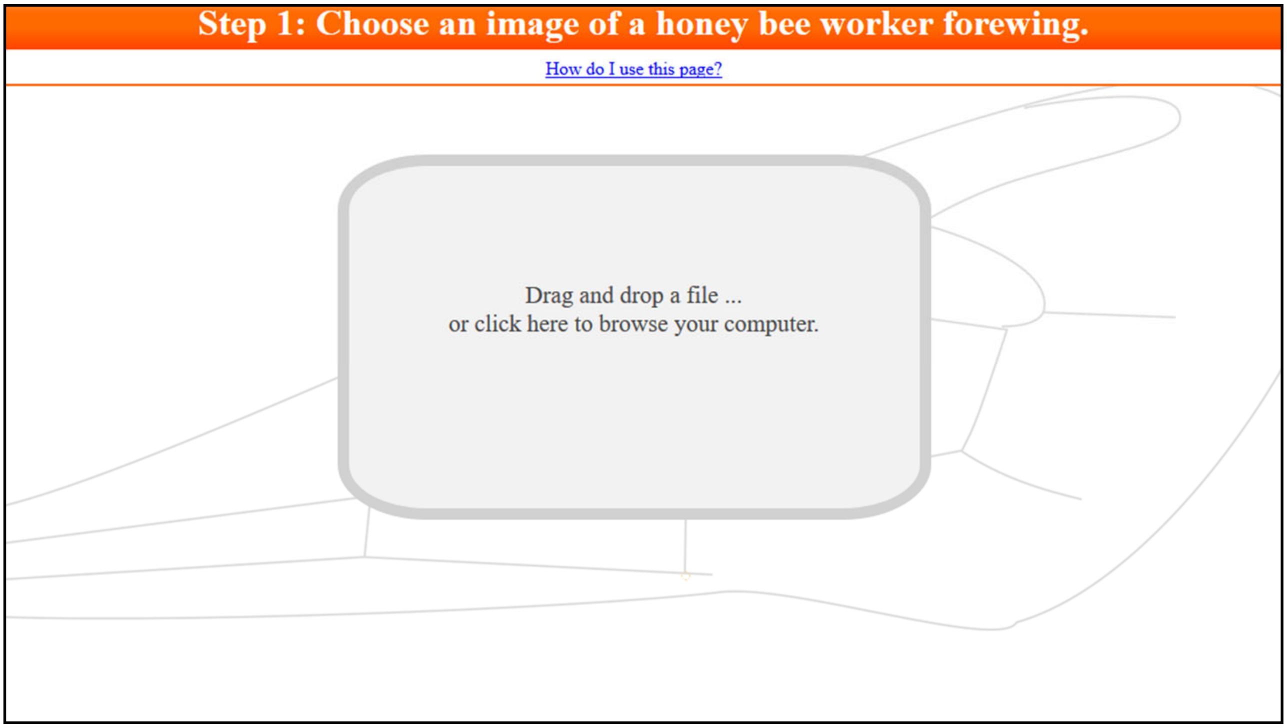
-5.0
-2.5
0.0
2.5
5.0
LD8
-5
0
5
10
LD3
Species
andreniformis
cerana
dorsata
florea
koschevnikovi
laboriosa
mellifera
nigrocincta
nuluensis

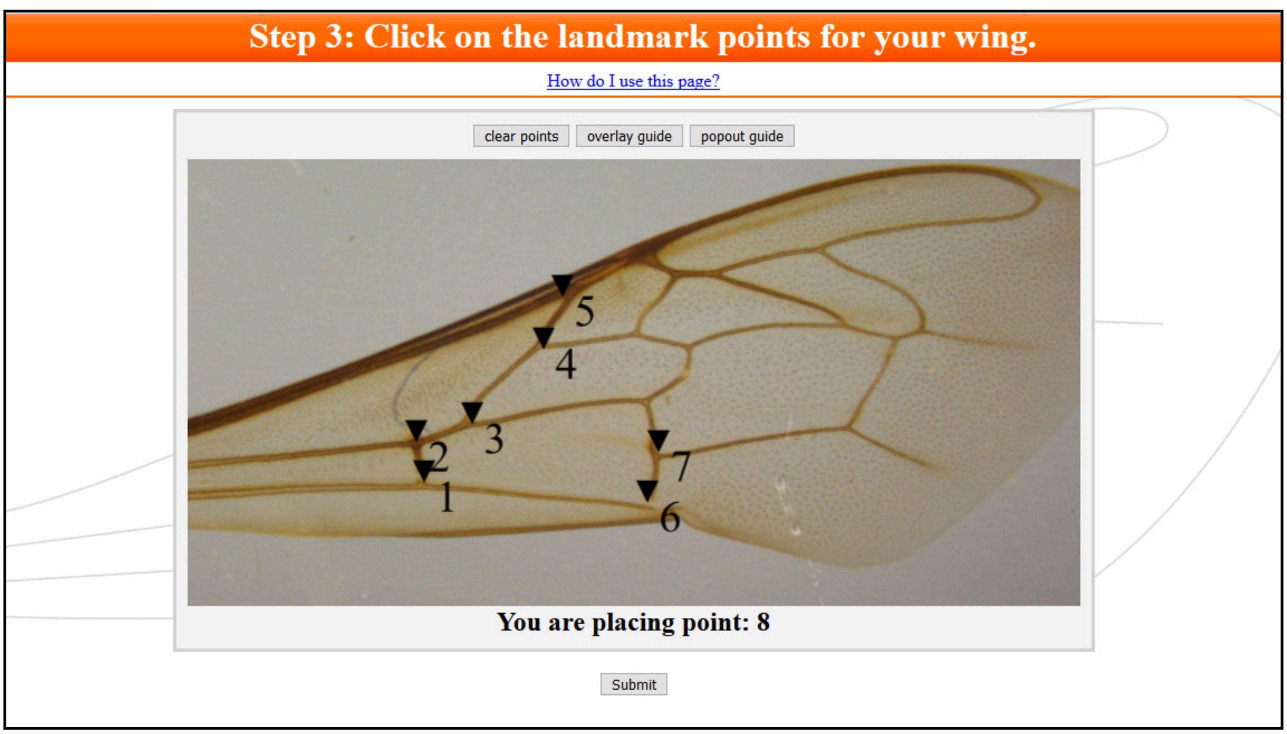
The results

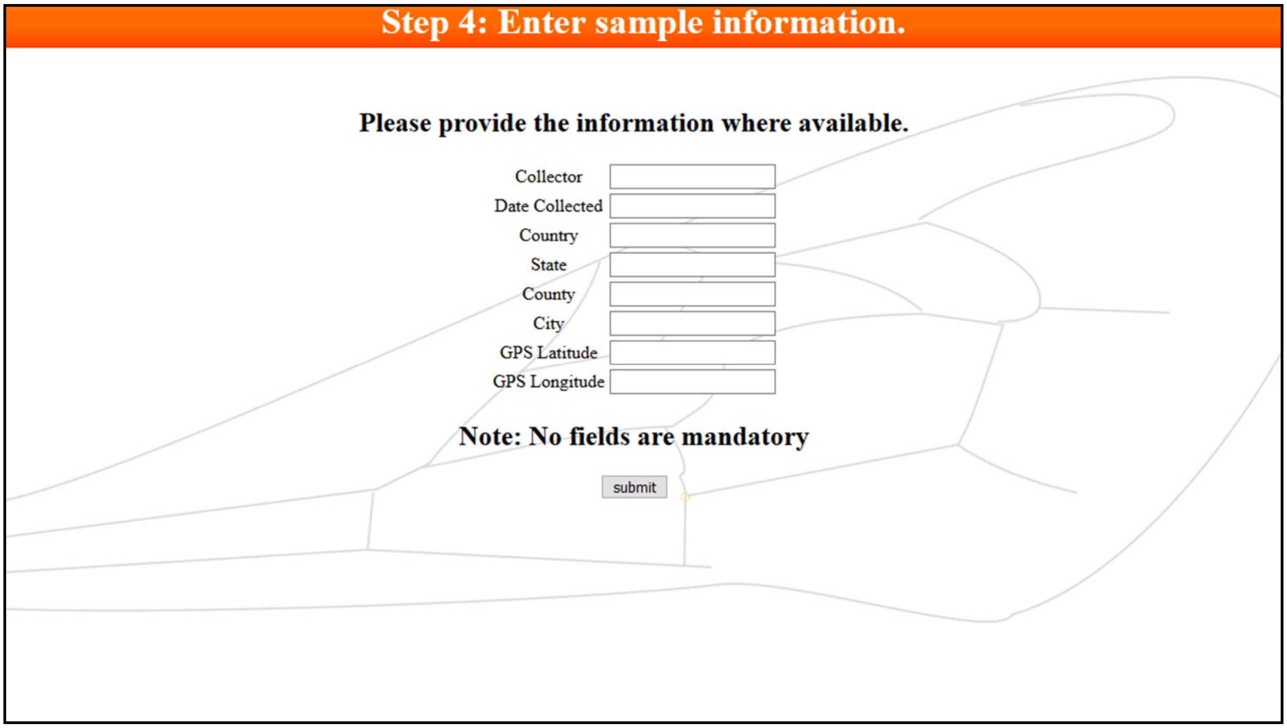
	Number	Correct	Incorrect
A. andreneformis	93	100%	0%
A. cerana	795	98%	2%
A. dorsata	55	100%	0%
A. florea	72	100%	0%
A. koschevnikovi	71	100%	0%
A. laboriosa	26	100%	0%
A. mellifera	1295	100%	0%
A. nigrocincta	53	100%	0%
A. nuluensis	32	100%	0%
Total:	2492	99.3%	.7%

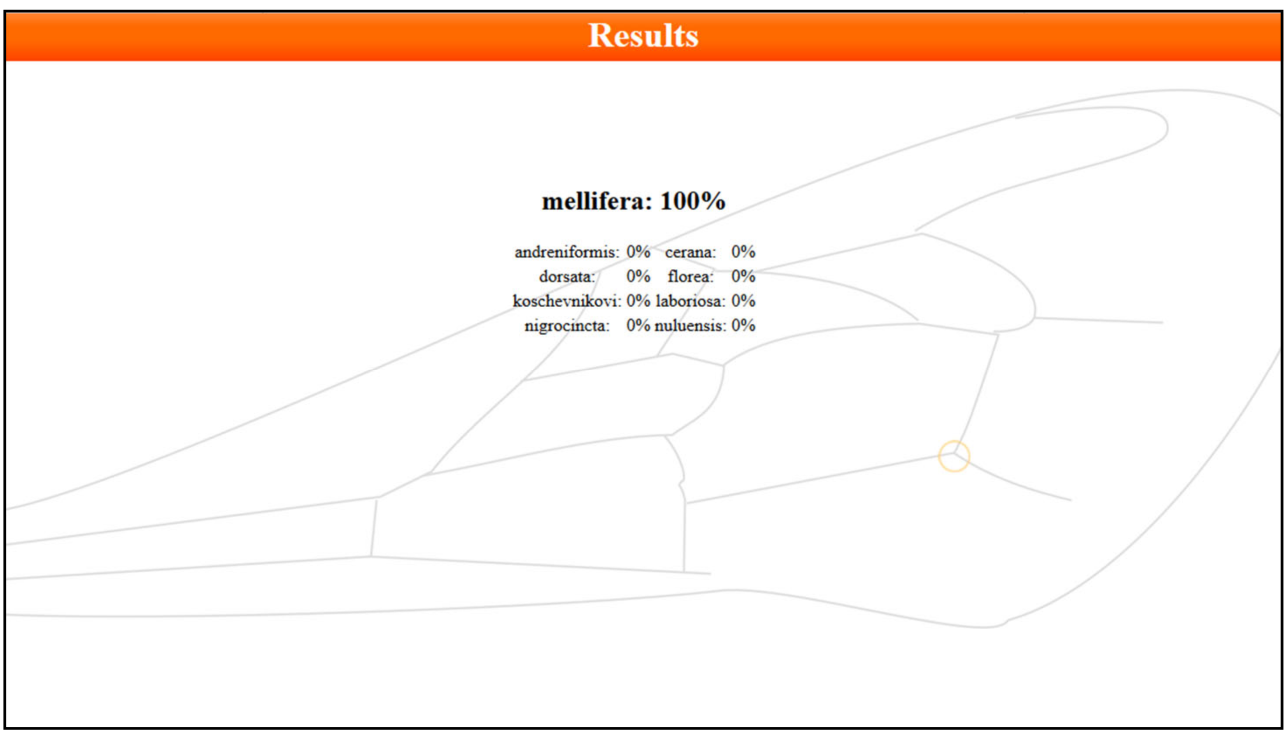
The results

	Number	Correct	Incorrect
A. andreneformis	93	100%	0%
A. cerana	795	98%	2%
A. dorsata	55	100%	0%
A. florea	72	100%	0%
A. koschevnikovi	71	100%	0%
A. laboriosa	26	100%	0%
A. mellifera	1295	100%	0%
A. nigrocincta	53	100%	0%
A. nuluensis	32	100%	0%
Total:	2492	99.3%	.7%


Step 1: Choose an image of a honey bee worker forewing.
How do I use this page?
Drag and drop a file ...
or click here to browse your computer.


Step 3: Click on the landmark points for your wing.
How do I use this page?
clear points
overlay guide
popout guide
5
4
3
2
1
7
6
You are placing point: 8
Submit


Step 4: Enter sample information.
Please provide the information where available.
Collector
Date Collected
Country
State
County
City
GPS Latitude
GPS Longitude
Note: No fields are mandatory
submit


Results
mellifera: 100%
andreniformis: 0% cerana: 0%
dorsata: 0% florea: 0%
koschevnikovi: 0% laboriosa: 0%
nigrocincta: 0% nuluensis: 0%

Thank you for your time - Questions?

UNIVERSITY of FLORIDA Honey Bee Research & Extension LABORATORY

SOLUTIONS for your LIFE

Research Update: Oxalic acid and pesticide research

Cameron Jack
Entomology and Nematology Department
University of Florida

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Oxalic Acid

- Compound has been used for decades in US (Johnson et al., 2010)
- Only recently registered by EPA as legal treatment in 2015
- Trickling most common method of application
- No reports of mite resistance (Maggi et al., 2017)

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Oxalic Acid Vaporization

- Becoming more popular in the United States
- EPA label directions state 1 g OA per brood chamber
  - Well below effective dose (2.25 g) found in UK
    (Al Toufialia et al. 2015)

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Brood Interruption + Oxalic Acid

- Artificial brood interruption disrupts normal *Varroa* reproduction.
- Often used in conjunction with oxalic acid
- Common treatment in Italy

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2016 Objectives

1. Determine whether artificial brood interruption coupled with oxalic acid vaporization can be used to effectively control *Varroa destructor*.

2. Evaluate the effects of these treatments on colony health.

2016 Objectives

1. Determine whether artificial brood interruption coupled with oxalic acid vaporization can be used to effectively control *Varroa destructor*.

2. Evaluate the effects of these treatments on colony health.

2016 Experimental Design

	Oxalic Acid (1 Application)	Oxalic Acid (3 Applications)	No Oxalic Acid
Queen Caging	**Group I**	**Group II**	**Group III**
No Queen Caging	**Group IV**	**Group V**	**Group VI**

- 10 colonies/group (single deep with solid bottom board and honey super)
- Positive control was application of Apivar (Amitraz)
- *Varroa* levels estimated by 72-h mite drop
- Colony strength parameters estimated prior to start, midway and end of experiment

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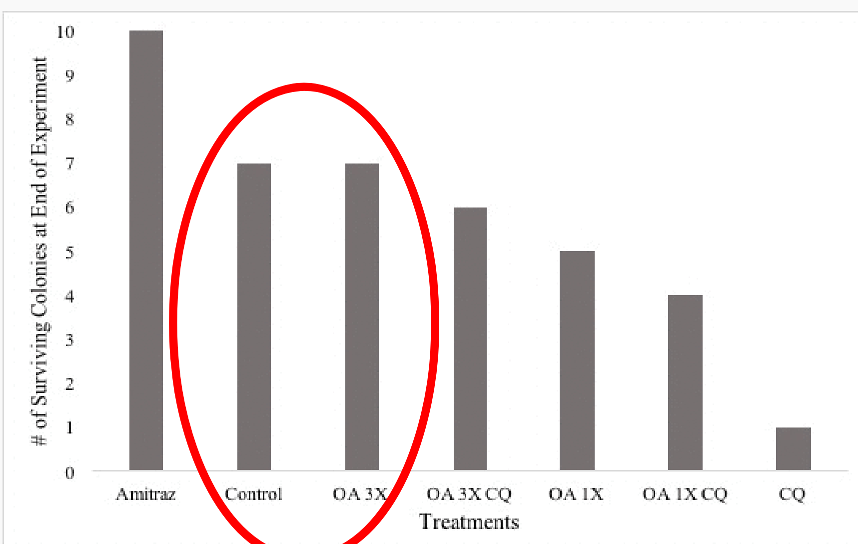
2016 Brood Interruption & Oxalic Acid Vaporization



Contingency Analysis

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2017 Objectives

1. Determine the effective dose of OA vaporization that will control the honey bee parasite *Varroa*.

2. Evaluate the effects of these OA doses on colony health.

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2017 Objectives

1. Determine the effective dose of OA vaporization that will control the honey bee parasite *Varroa*.

2. Evaluate the effects of these OA doses on colony health.

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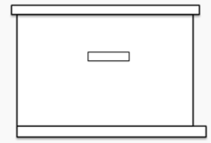
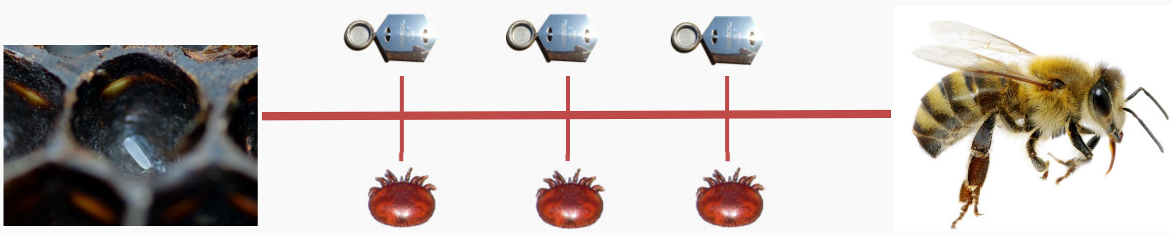
Experimental Design – Objective 1

1. OA 1g (Current legal dose)
2. OA 2 g
3. OA 4 g
4. Control

10 ×





21 Days

Experimental Design – Objective 2

Colony Strength Assessments:

- Performed weekly
  - Bees
  - Brood cells
  - Honey
  - Pollen

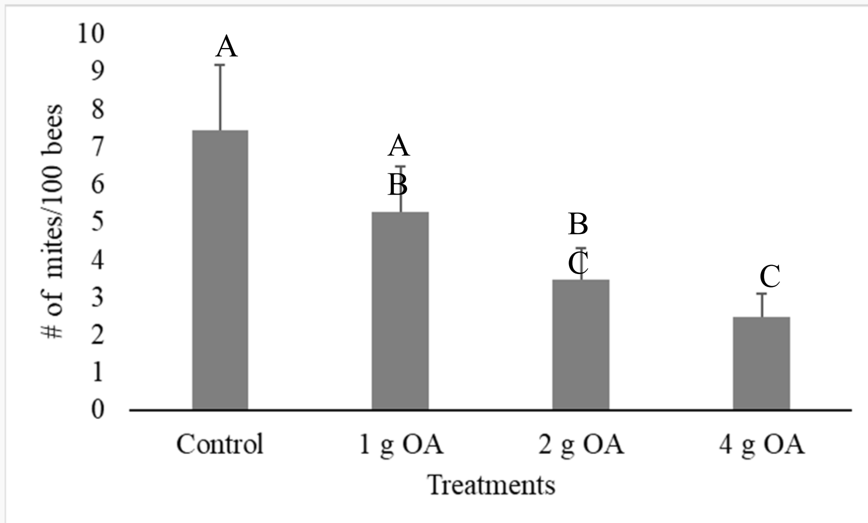
(Delaplane et al., 2013)

Mite Infestation

Statistical Analysis:

- Generalized Mixed Model
- Pairwise t-test

Effect	df	*p* value
Treatment	3	0.0157
Time	3	0.0206
Treatment*Time	9	0.1409



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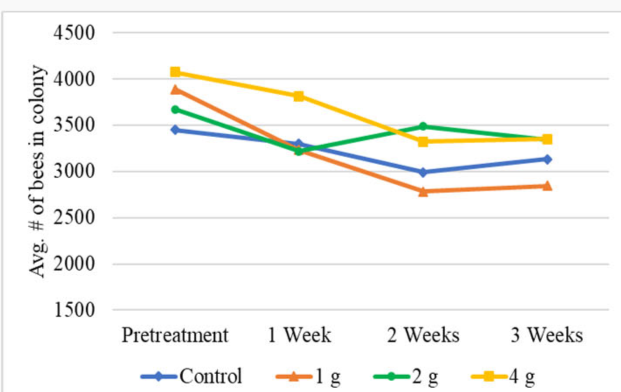
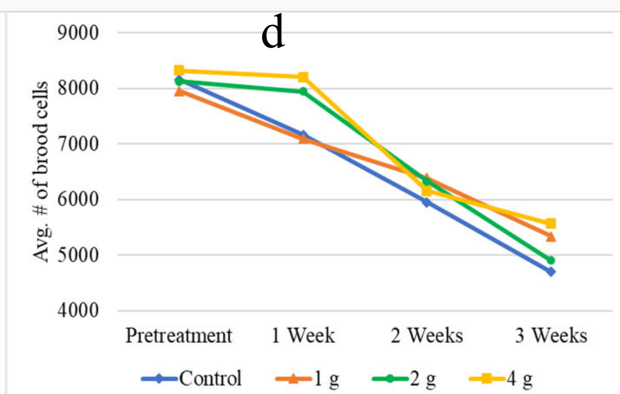
Bees



Effect	df	*p* value
Treatment	3	0.1289
Time	3	< 0.0001
Treatment*Time	9	0.5017

Broo d



Effect	df	*p* value
Treatment	3	0.9673
Time	3	0.0397
Treatment*Time	9	1.0000

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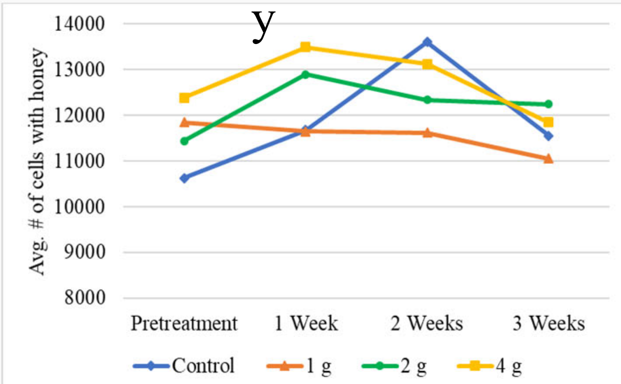
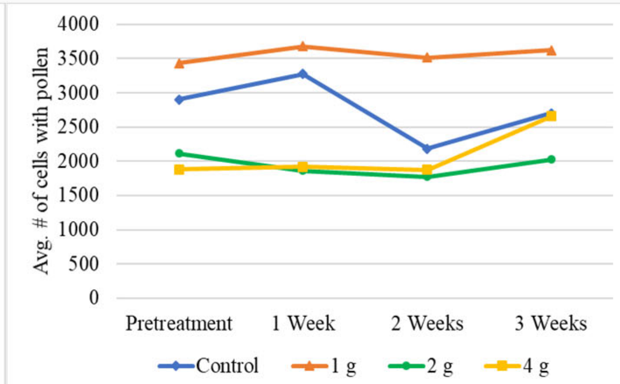
Hone
y



Effect	df	p value
Treatment	3	0.5811
Time	3	0.0054
Treatment*Time	9	0.2956

Pollen



Effect	df	p value
Treatment	3	0.3114
Time	3	0.1356
Treatment*Time	9	0.7817

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Conclusions

- Oxalic acid vaporization not effective at current legal dose
- Improved *Varroa* control at 2-4 g
- No deleterious effects to colony from 4 g OA treatment
- Data may support change to EPA label

Future work:

- Test higher doses to determine threshold
- How to integrate OA vaporization into *Varroa* IPM program

Honey Bee Research & Extension Laboratory — SOL for

Introduction:

Current EPA Tier 1 Testing for Honey Bees

- Honey bees are chronically exposed to pesticides present in the wax combs.
  (vanEngelsdorp 2009; Mullin et al., 2010)

- Current EPA Tier 1 tests for adult honey bees require:
  - Adult acute contact toxicity tests
  - Adult acute and chronic oral toxicity tests
    - ➢Only need to test pesticide in sugar solution
    - ➢Pollen is recommended

  (EPA, 2016)

Photo by: David Cappaert, Michigan State University

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Introduction:

Routes of Exposure to Field Chemicals

- There is a need for environmentally realistic toxicological studies.
  (Cresswell, 2011; Goulson, 2013)

- Honey bees are exposed to chemicals through:
  - Nectar
  - Pollen
  - Wax

- Combine oral and contact exposure by adding wax as a matrix.

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Introduction:

Goal and Objectives

Goal: Develop a method to test the impacts of pesticide residues in wax on honey bees using a 10-day adult chronic toxicity test.

Objective: Modify typical *in vitro* cages to accommodate the new matrix.

Objective: Determine the appropriate concentration of a toxic standard (dimethoate) needed in wax to kill 50% of honey bees (LC_{50}).

Honey Bee Research & Extension Laboratory, University of Florida

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Honey Bee Research & Extension Laboratory, University of Florida

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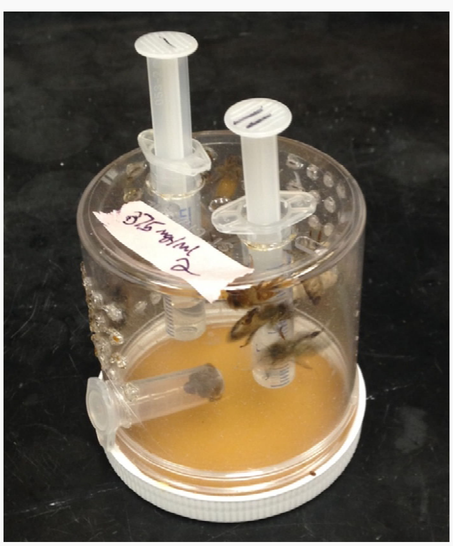
Materials and Methods:

Cage Design



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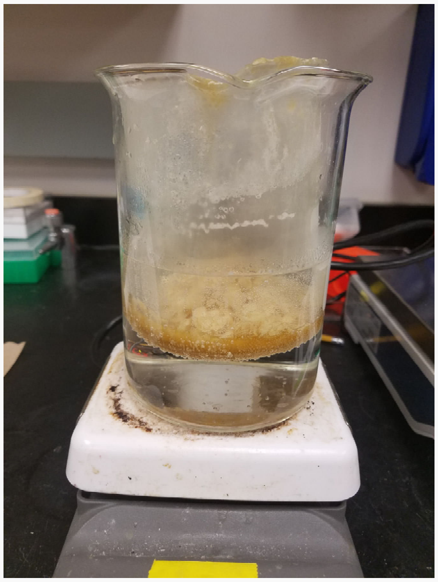
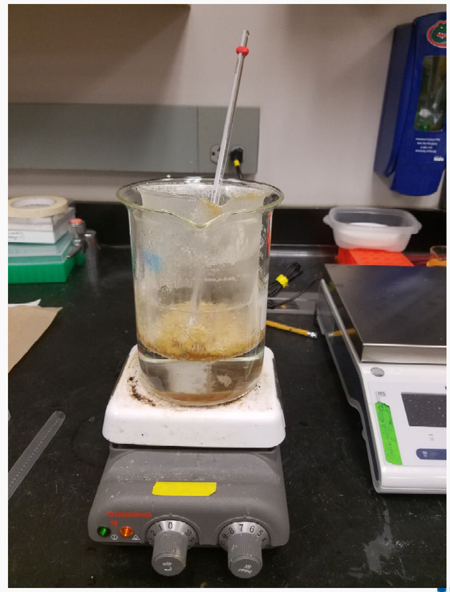
Materials and Methods:

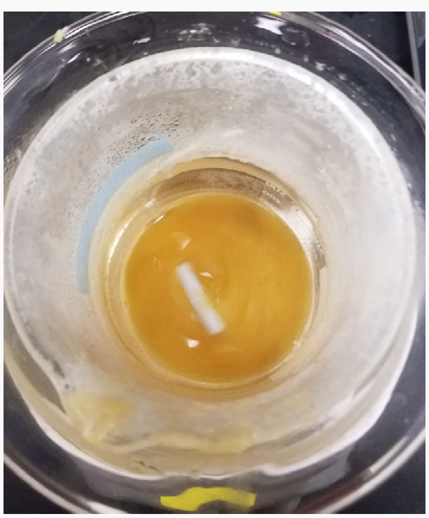
Wax Preparations





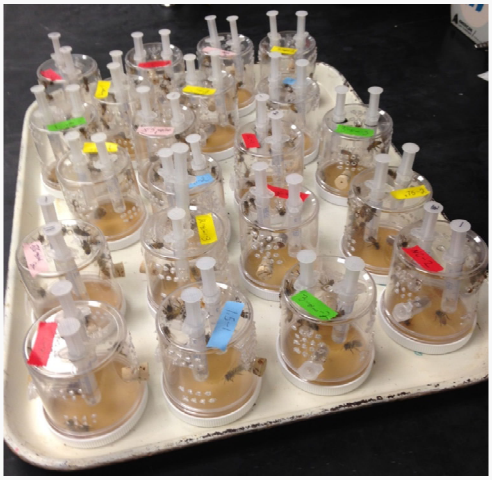
Materials and Methods:

Wax Preparations



Materials and Methods:

Experimental Design



- Doses –
  Wax: 7.5, 15, 30, 60, 120 µg/g
  Pollen: 12, 24, 48, 96, 192 µg/g
  Nectar: 0.1875, 0.375, 0.75, 1.5, 3 µg/g
- Design –
  – 3 cages/dose, 10 bees/cage
  – Mortality observed 24 h
- Data Analysis –
  – Kaplan-Meier Survival Analysis
  – Probit Analysis

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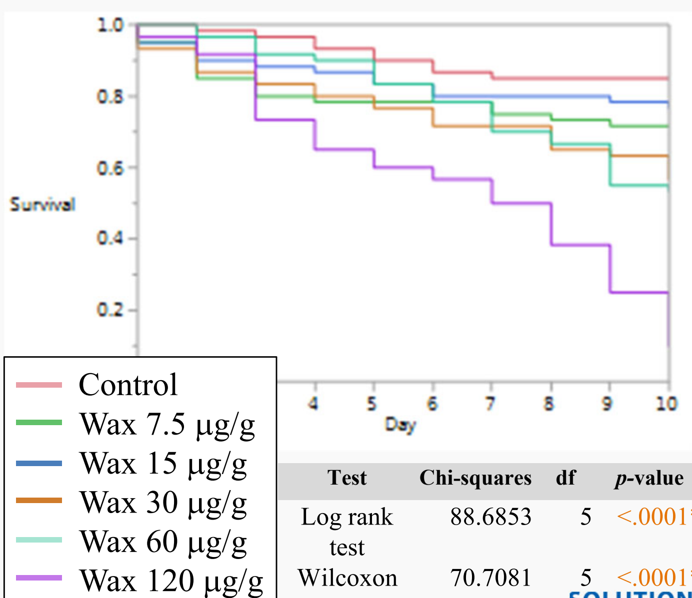
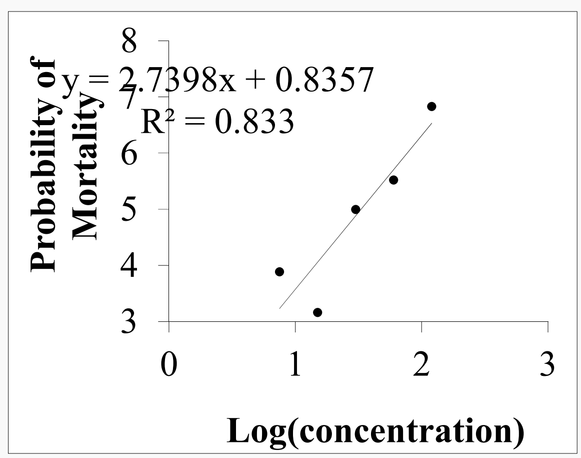
Results:

Wax: Survival and Probit Analysis





Test	Chi-squares	df	*p*-value
Log rank test	88.6853	5	<.0001*
Wilcoxon	70.7081	5	<.0001*

LC_{50} = 33.11 µg/g
SE= 3.28
95% CL= 27.27 – 40.2

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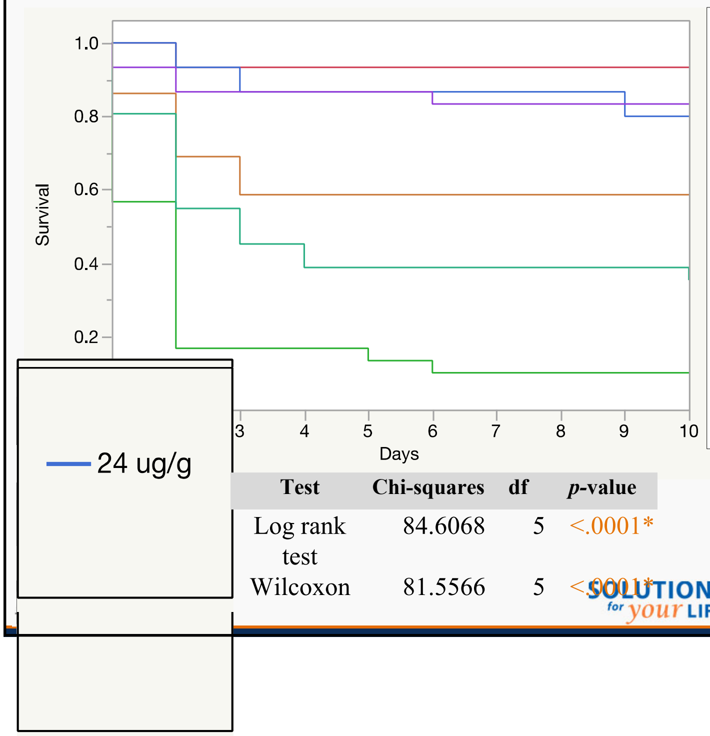
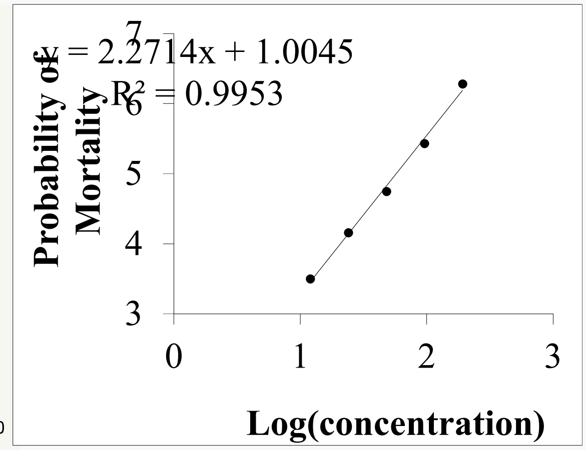
Results:

Pollen: Survival and Probit Analysis



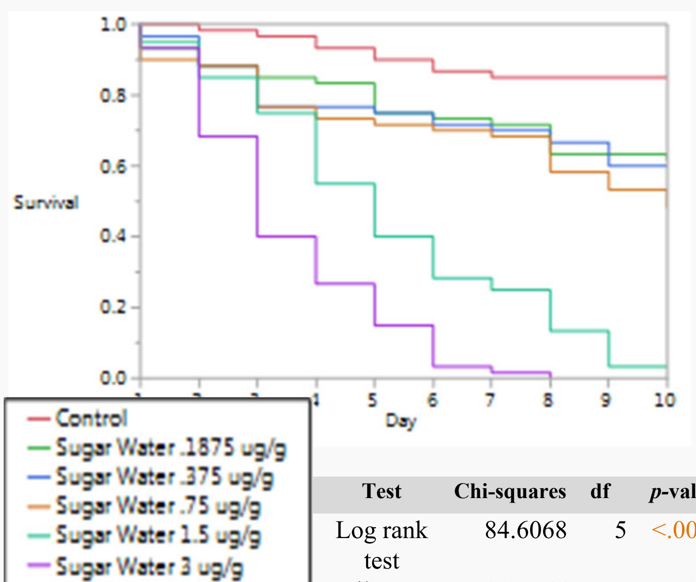


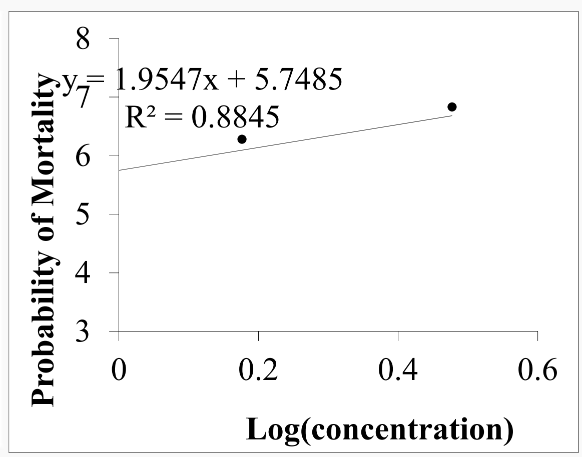
Test	Chi-squares	df	*p*-value
Log rank test	84.6068	5	<.0001*
Wilcoxon	81.5566	5	<.0001*

LC_{50} = 57.42 µg/g
SE= 5.61
95% CL= 47.41 – 69.54

Results:

Nectar: Survival and Probit Analysis





Test	Chi-squares	df	*p*-value
Log rank test	84.6068	5	<.0001*
Wilcoxon	81.5566	5	<.0001*

LC_{50} = .4141 µg/g
SE= 0.087
95% CL= 0.274 – 0.625

Discussion:

Design Improvements

- Addition of wax can increase the biological relevance of honey bee risk assessments.
- Future worst-case-scenario studies can be completed.

Photo by: Zachary Huang, Michigan State University

For more information visit:

UFhoneybee.com

cjack@ufl.edu

#Ufhoneybeelab

Bram Cornelissen SHB invasion ecology

Research update HBREL Bee College 2018

(Excerpt from PhD proposal)

A recent invasion of the SHB in Europe has revealed a lack of understanding of the beetle as an invasive species. The first notification of its presence in Southern Italy came months after it was introduced, resulting in an established (reproducing) population and ample means of spread. Several countries have now implemented the use of sentinel colonies (SC, or honey bee trap hives) as part of a monitoring strategy around vulnerable sites such as transport hubs. The concept entails a ring of SCs allowing SHB in the process of introduction to invade. These SCs are then inspected regularly for the presence of SHB. However, the effectiveness of SCs as part of an early detection strategy is unclear, because there is limited knowledge of the flight capacity and behaviour of SHB during invasion, making it difficult to anticipate SHB dispersal patterns. SHBs are considered good flyers, with anecdotal reports suggesting a distance of over 10 km per day can be covered and freshly emerged beetles have been released and recaptured using honey bee colonies in studies up to 200 m. However, no dedicated study has been performed to investigate the flight capacity at a larger spatial scale, more relevant to invasion. Also, many contextual factors can affect flight patterns in insects, including weather, season and physiology. Several studies highlight the ability of the small hive beetle to respond to host and conspecific cues. A recent study has highlighted that age-dependent attractiveness of SHB is involved in mating and aggregation. However, the attractiveness of host and conspecific cues has only been tested in comparative laboratory assays using unmated, freshly emerged SHBs with no flight experience. It is unclear how flight-experienced mated SHB perform. Furthermore, attraction to hosts and conspecifics has hardly been studied in field experiments and its relevance to invasion is largely unknown. One possible outcome could be that movement mostly takes place within the incipient population’s range as both conspecific and host cues are present and thus outward expansion is less attractive. On the other hand, newly emerged beetles might expand outward more readily than experienced flyers, due to a dispersal syndrome, which has been described for similar species, neglecting conspecific cues altogether. It is clear that the dynamics involved in dispersal are understudied. Therefore, increasing our understanding of SHB flight and dispersal and the factors involved are pivotal in anticipating invasions and could favour the management options for early detection and contingency.

Varroa Sensitive Hygiene: Breeding & Biology

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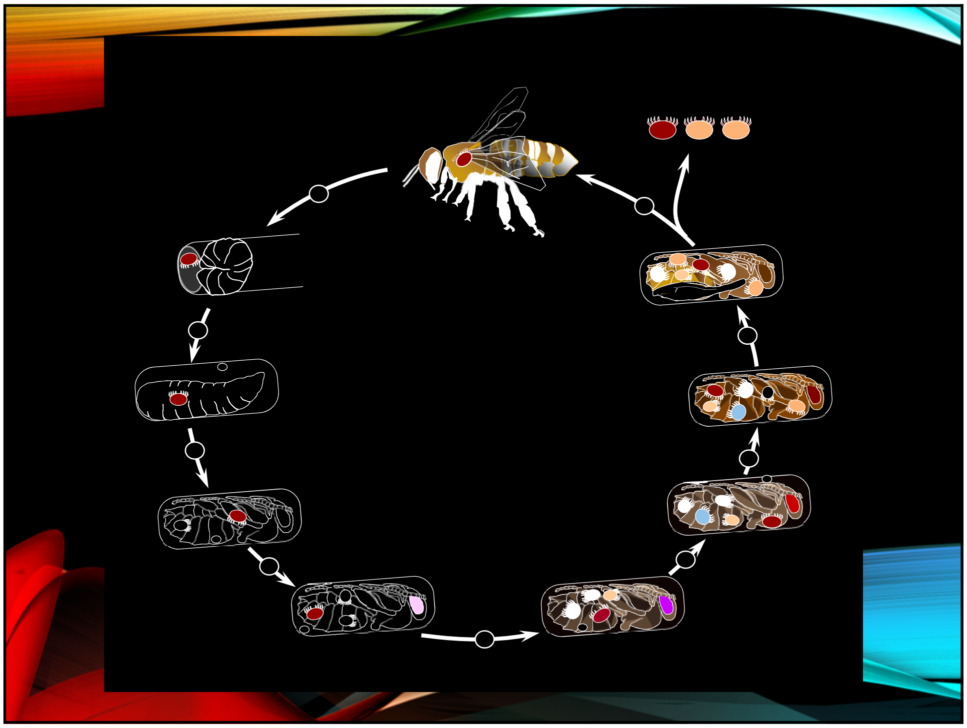
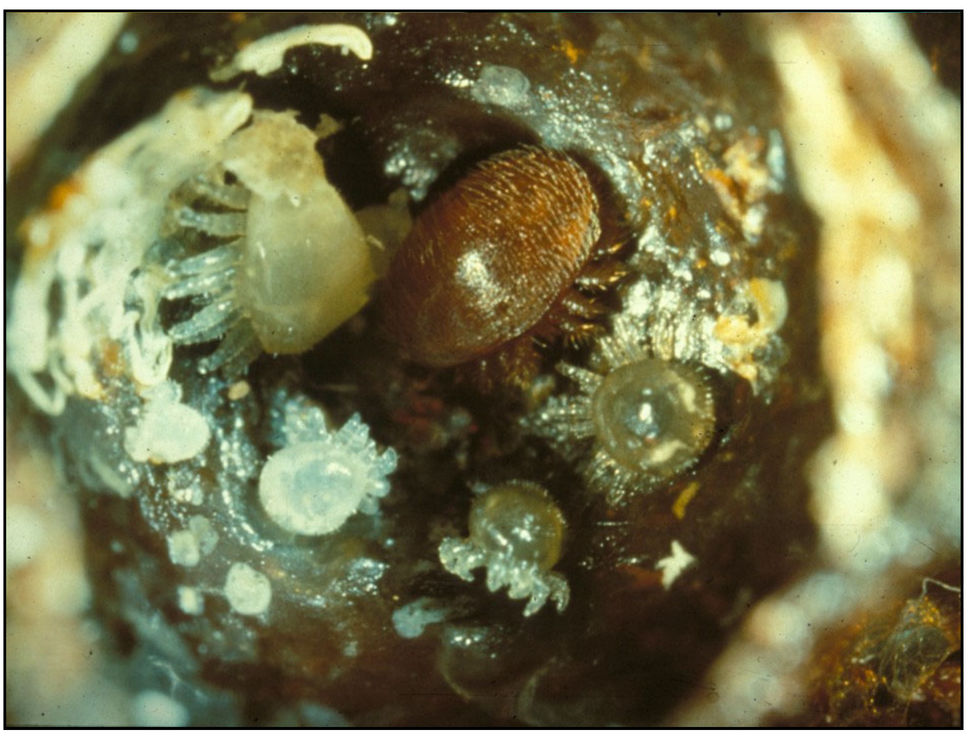
Mississippi State University Extension Service

MAFES
Mississippi Agricultural & Forestry Experiment Station





SHORTENS THE LIFE OF INDIVIDUAL BEES

MOST SERIOUS VIRUS DISEASES- SACBROOD, DEFORMED WING VIRUS, CHRONIC BEE PARALYSIS VIRUS, ACUTE BEE PARALYSIS VIRUS

DAMAGE TO BEES: VIRUSES!!!


Parasitic Mite Syndrome (the end is near)

CHRONIC BEE PARALYSIS VIRUS

- Paralysis
- Hairless Black Syndrome

APIVAR IS AMITRAZ
(NEUROTOXIN WITH RELATIVELY LOW RESIDUES)

- Higher kill rate than organic acids and thymol
- Mites are already resistant to this insecticide
- Questions about residue time for metabolites

Apivar

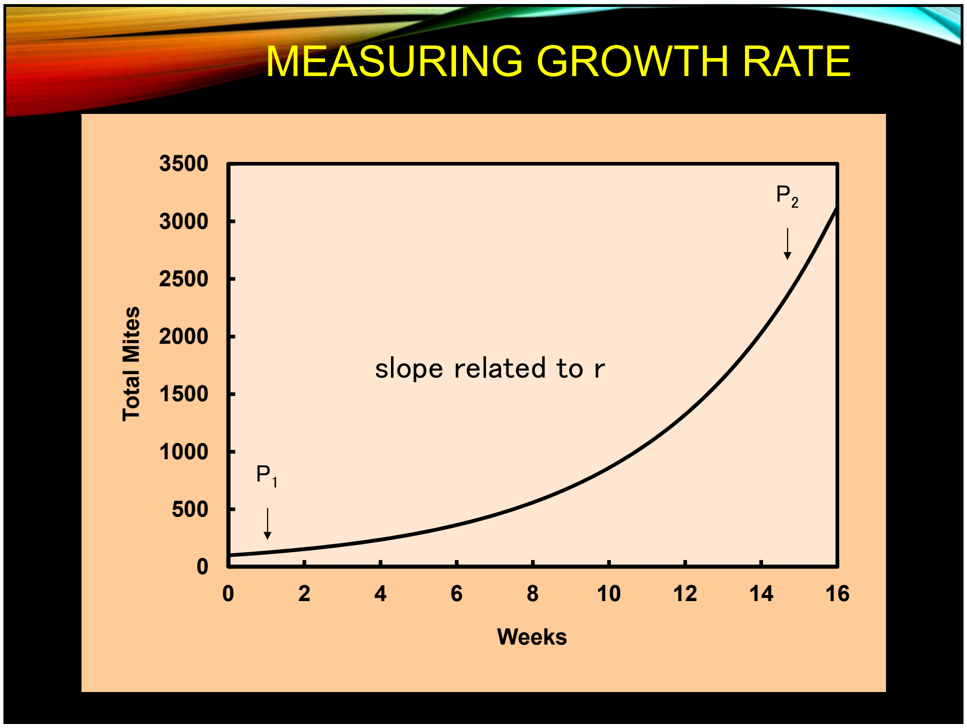
amitraz

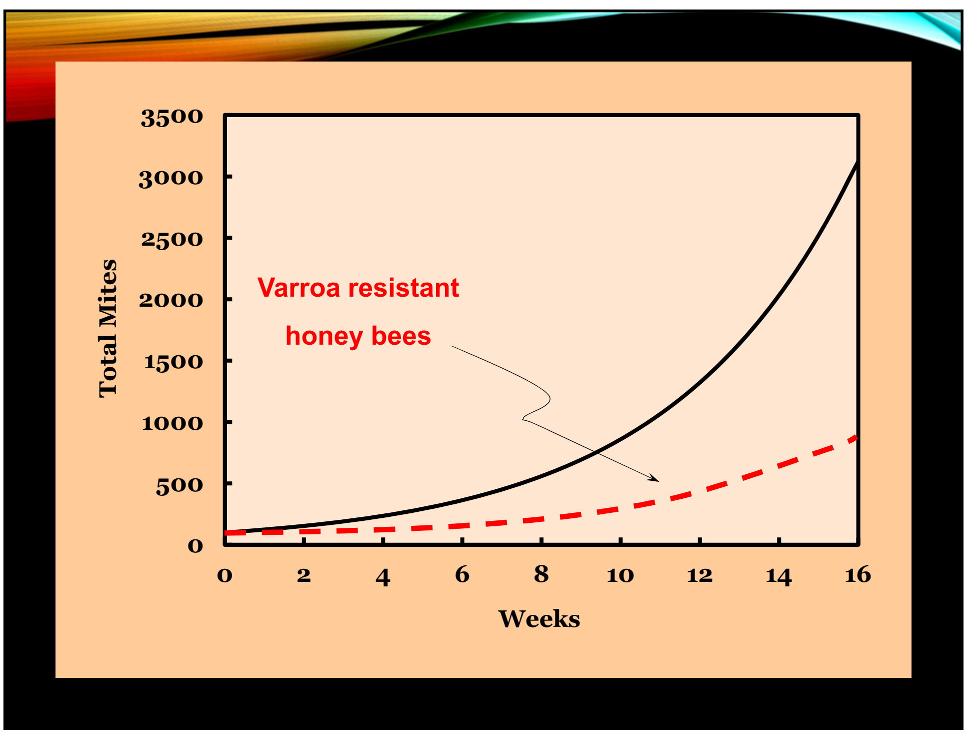
Breeding Objective

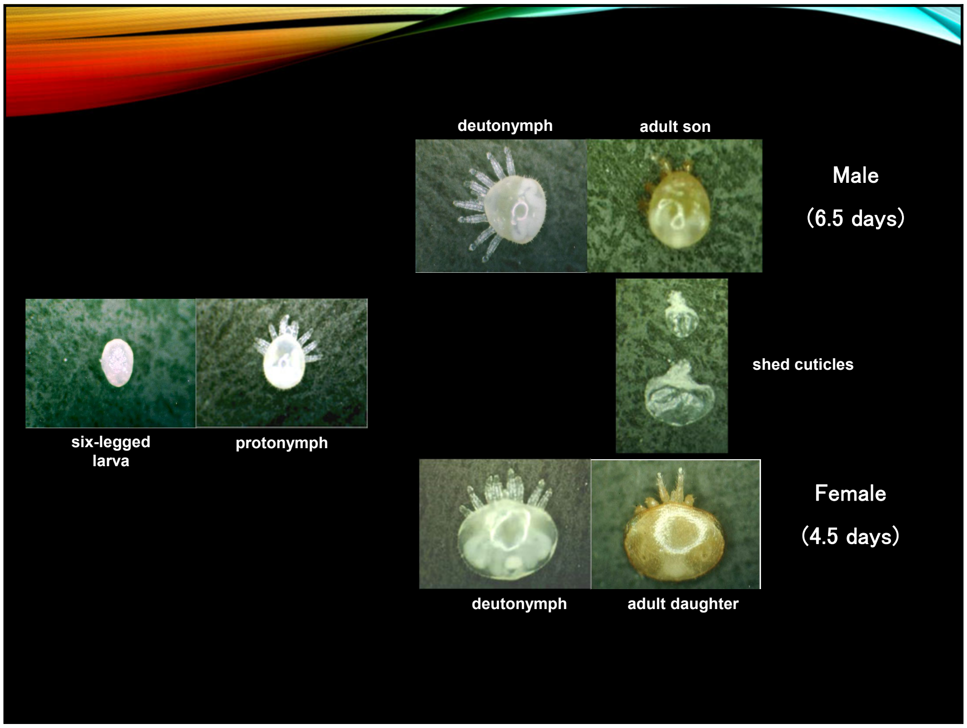
Reduce the rate of growth for populations of varroa mites

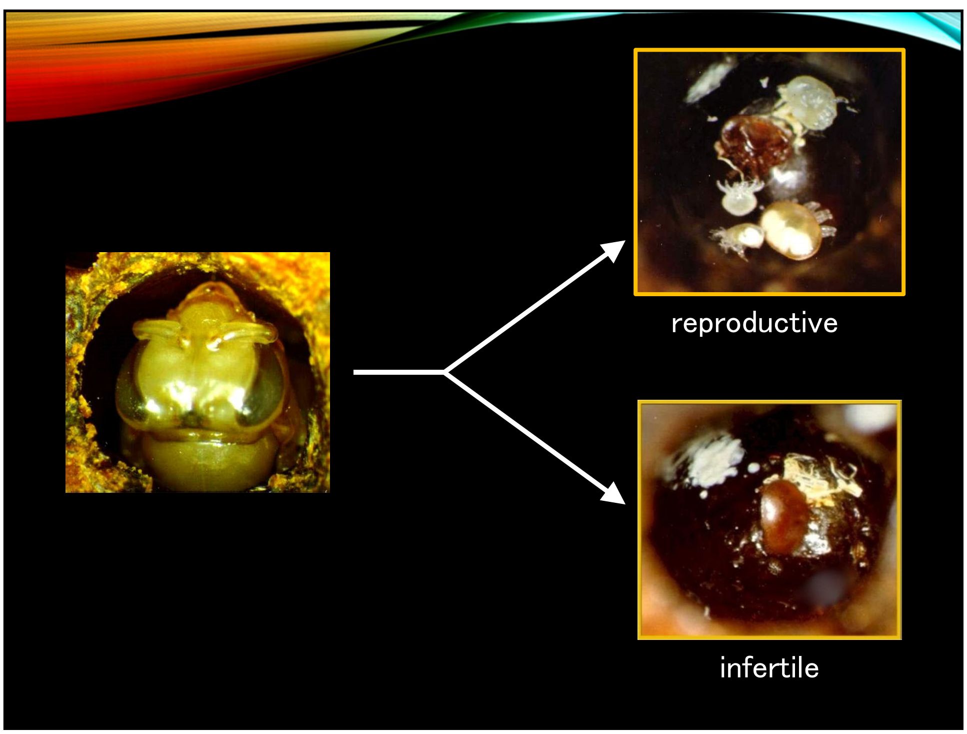
Single Drone Inseminations used early in breeding program to enhance low frequency genes

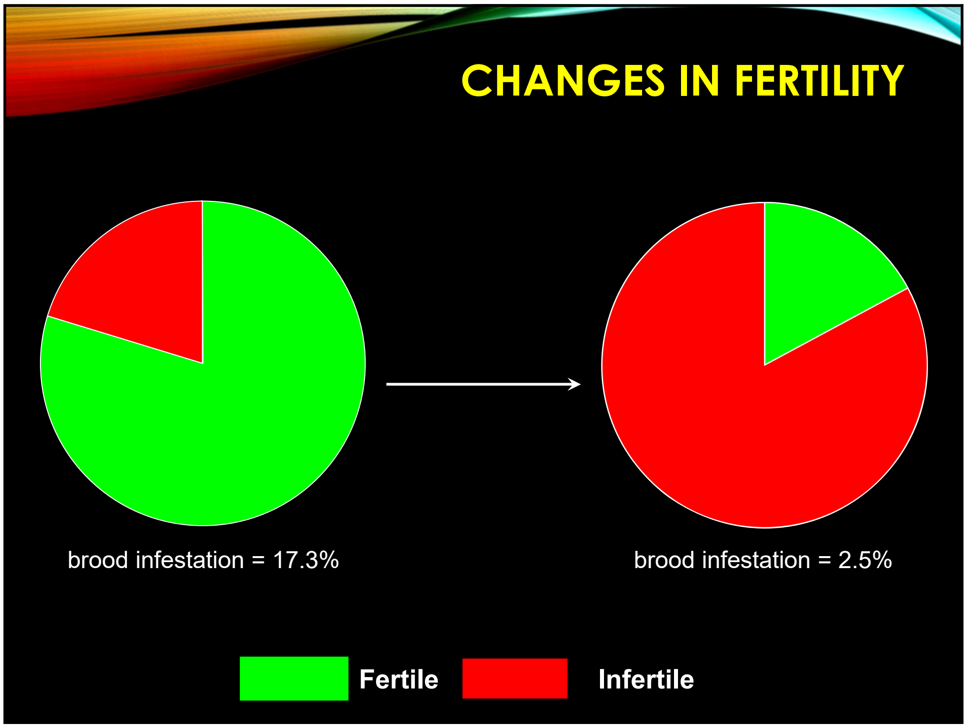

28


MEASURING GROWTH RATE
Total Mites
3500
3000
2500
2000
1500
1000
500
0
0
2
4
6
8
10
12
14
16
Weeks
P1
P2
slope related to r

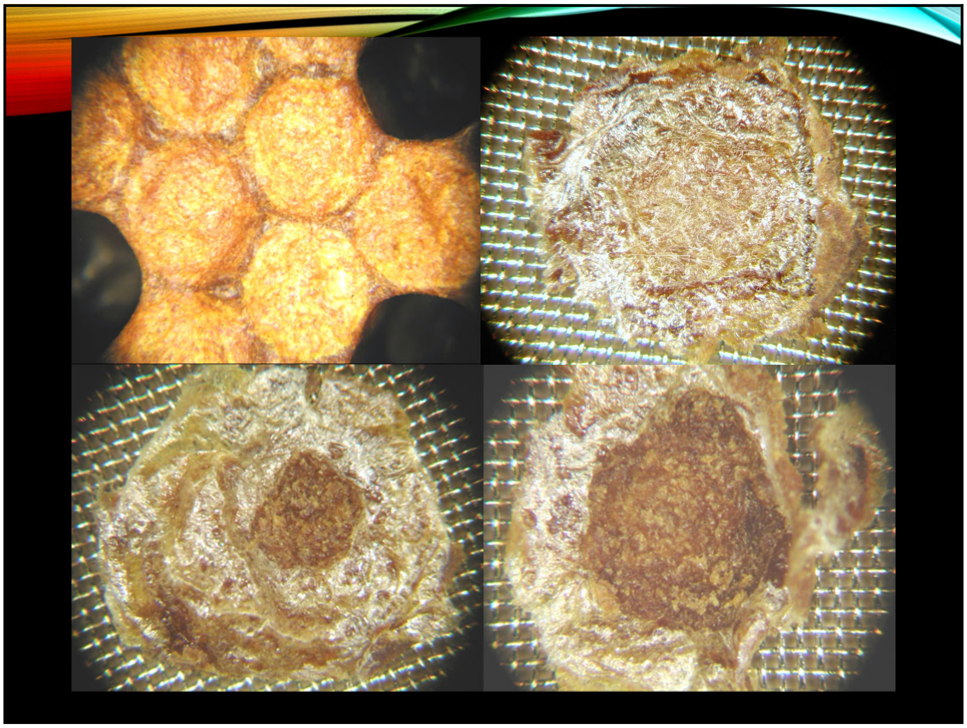

Total Mites
3500
3000
2500
2000
1500
1000
500
0
0
2
4
6
8
10
12
14
16
Weeks
Varroa resistant
honey bees

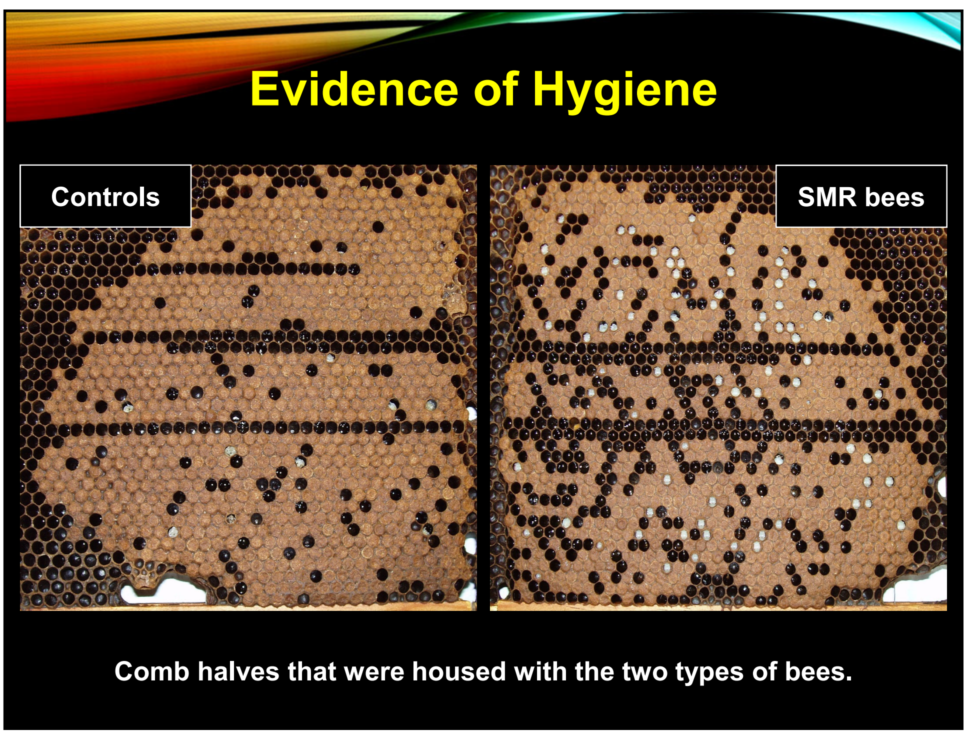

deutonymph
adult son
Male
(6.5 days)
shed cuticles
six-legged larva
protonymph
Female
(4.5 days)
deutonymph
adult daughter


reproductive
infertile


CHANGES IN FERTILITY
brood infestation = 17.3%
brood infestation = 2.5%
Fertile
Infertile

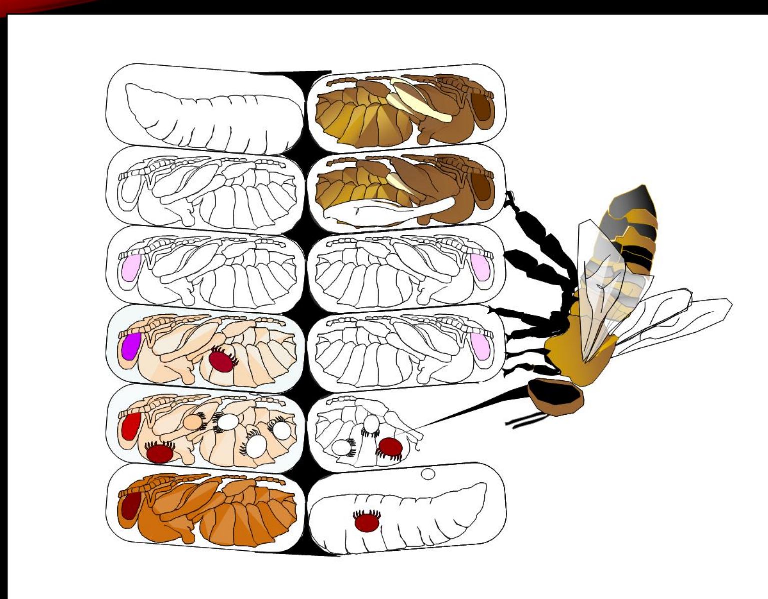

SUPPRESSED
MITE
REPRODUCTION
A varroa-resistance trait that can be added to any
stock of honey bees

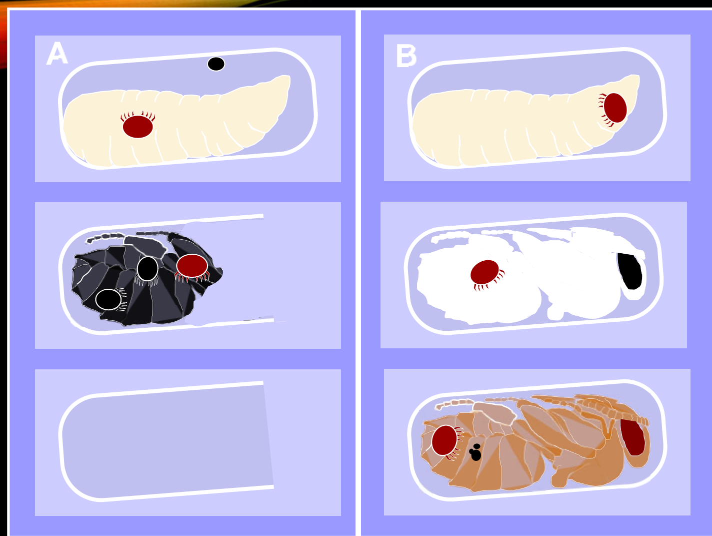



Evidence of Hygiene
Controls
SMR bees
Comb halves that were housed with the two types of bees.

SUPPRESSED MITE REPRODUCTION LINKED TO VARROA-SENSITIVE HYGIENE

Varroa Sensitive Hygiene

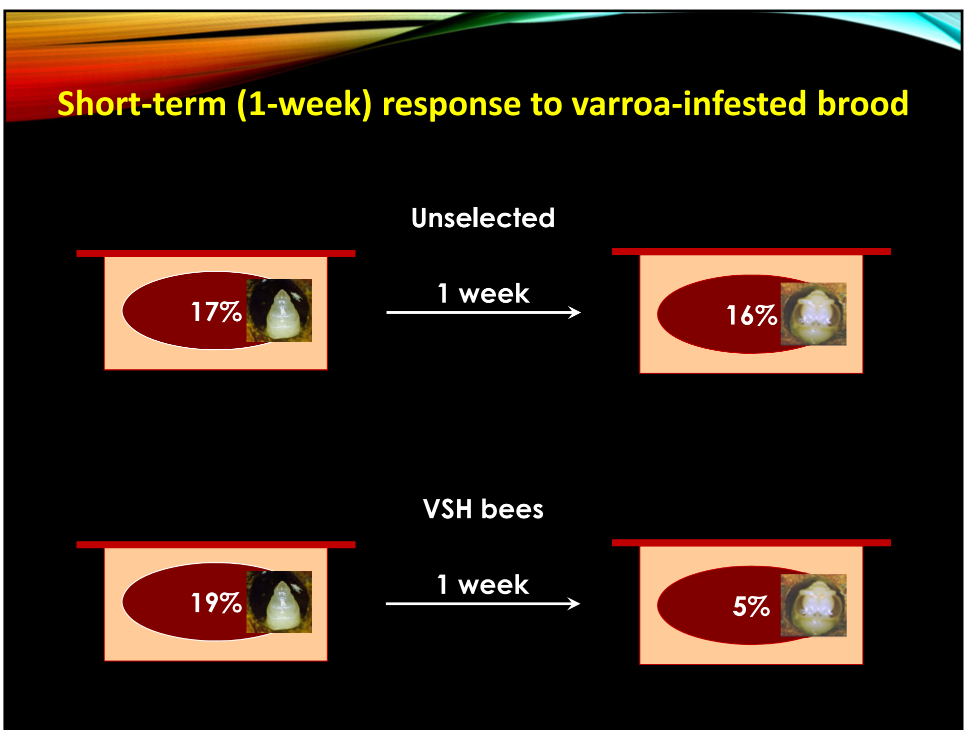




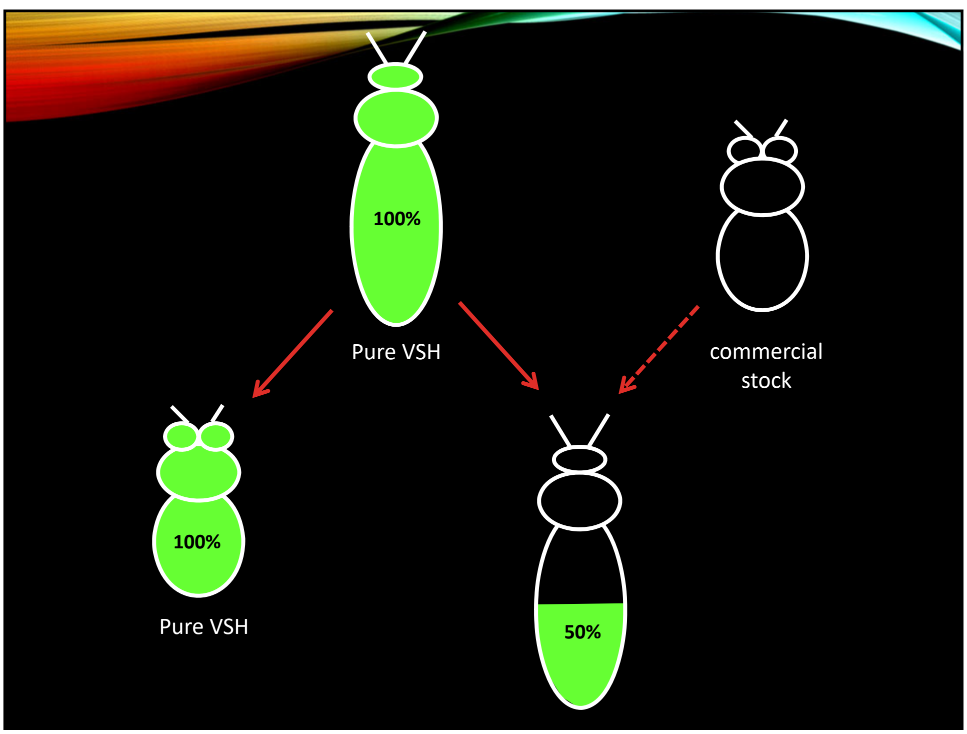
Bees with the VSH trait remove reproductive mites from capped brood cells (A), while leaving mites that do not lay eggs (B).

VSH BEHAVIOR AND MITE REPRODUCTION

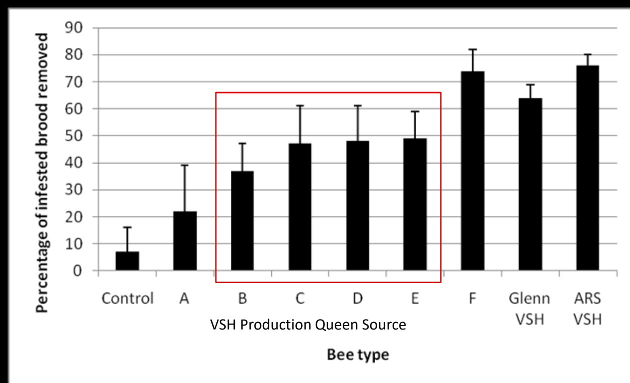
- Uncapping and recapping of pupae greatly reduces mite reproduction


Short-term (1-week) response to varroa-infested brood
Unselected
17%
1 week
16%
VSH bees
19%
1 week
5%


INBREEDING


100%
Pure VSH
commercial stock
100%
Pure VSH
50%

Varroa resistance in commercial VSH production queens



Danka, R.G., Harris, J.W. and J.D. Villa (2011) Expression of *Varroa* Sensitive Hygiene (VSH) in commercial VSH honey bees (Hymenoptera: Apidae). *J. Econ. Entomol.* 104(3): 745-749.

VSH BREEDING TIMELINE

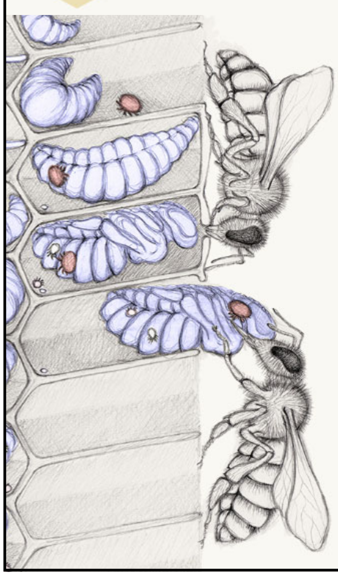
- **Selected for low Mite Population Growth, 1995-1998**
- **Selected for increased Mite Infertility, 1999-2005**
- **Selected for Removal of Parasitized Pupae, 2005-2012**

ADOPTION HAS BEEN SLOW!

- “Trickle Down” concept has not worked
- Commercial beekeepers rely on chemicals even if they use resistant stocks of bees
- None of the resistant stocks developed to date are “bullet proof”

Arista Bee Research

Foundation for breeding varroa resistant honey bees



The Board members Marcus Gravendyck (Vice-Chairman), Rolf Wildeman (Treasurer), Danny Goovaerts (Secretary) and BartJan Fernhout (Chairman) sign the official papers to establish the Arista Bee Research foundation.

WHAT ODORS TRIGGER VARROA SENSITIVE HYGIENE?

WHY IS THIS IMPORTANT?

- Chemicals that trigger VSH behavior could be used to develop a laboratory assay
- Chemicals could be used to test individual bees for their ability to smell and respond to the odors
- Differences in individual bees might be used to identify the genes that control VSH behavior – which may advance our breeding for this trait.

STIMULI TRIGGERING VSH BEHAVIOR

- Neither scent nor movement of Varroa mites triggers hygienic removal of mite-infested pupae

C. Martin (2001) *Insect Bio. Mol. Biol.* and *Physiol. Entomol.* (2002)

- Mites and mite offspring smell like the pupae on which they are feeding → MIMICRY

System for Collecting Volatiles from Frames of Capped Brood

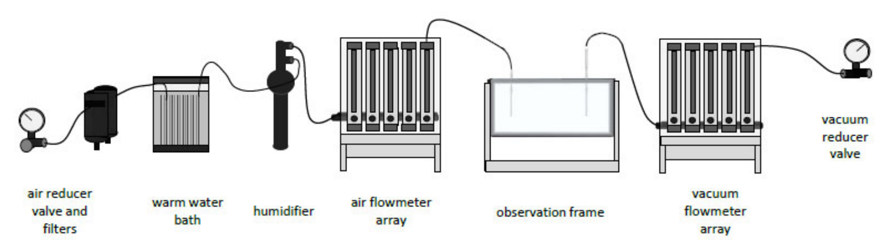


Diagram courtesy of Mark Carroll, USDA, ARS

air is warmed and moistened → ODORS FROM BROOD → air + odors recovered

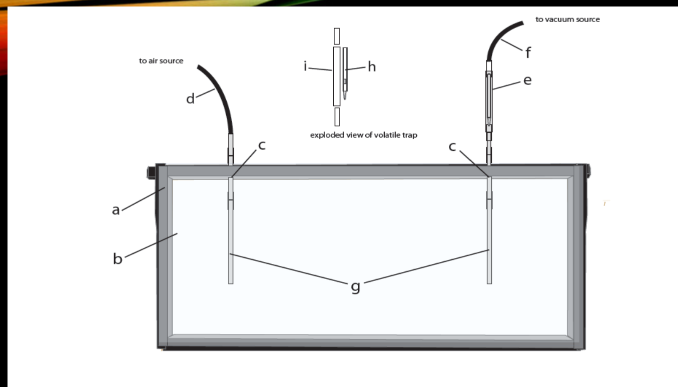
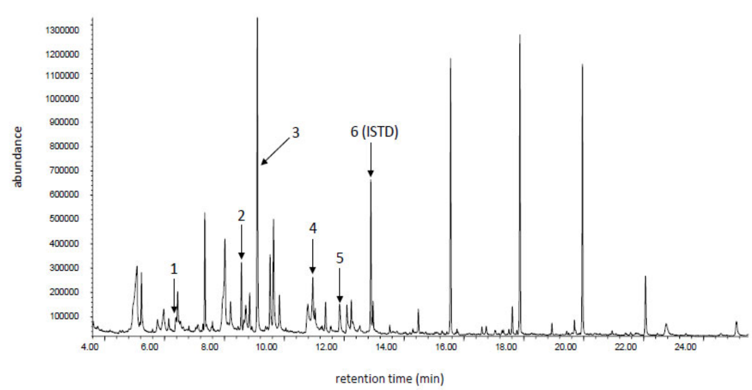


Diagram courtesy of Mark Carroll, USDA, ARS

- closed system formed by metal frame (a) and tempered glass (b) fitted over one side of a deep frame of capped brood.
- warm moist air pushed into observation hive (d)
- odors from brood mix with air in sealed space (g)
- volatile chemicals collected by a filter (h) in the vacuum line (e)

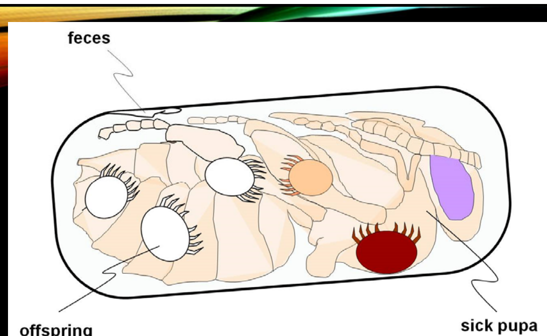
sample chromatogram courtesy of Mark Carroll, USDA, ARS



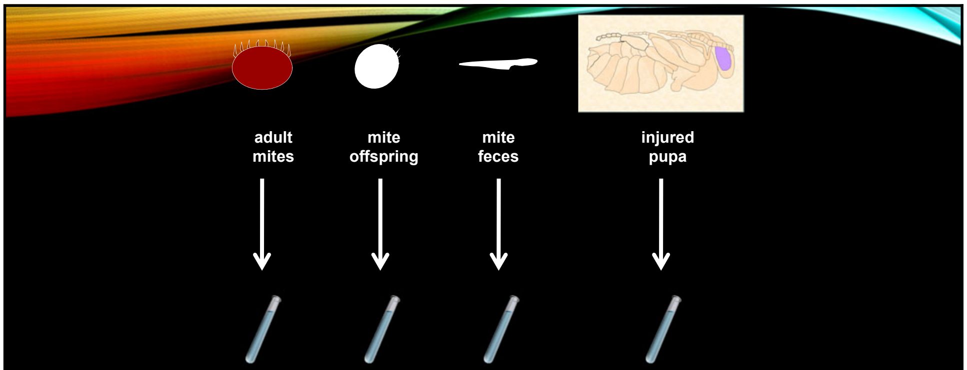
1. **2-heptanone**
2. **methyl benzoate**
3. **E-β-ocimene**
4. **octanoic acid**
5. **n-nonanal**
6. **nonyl acetate (ISTD)**

Volatiles from Mite-Infested Brood

- volatiles were collected from highly infested and non-infested brood
- many chemicals were identified in the airspace above capped brood
- adult honey bees reacted to some of these chemicals (electro-antennograms)
- BUT amounts of NONE of these chemicals varied significantly with mite levels



- **Open brood cells and separate all possible sources of odors that might trigger hygiene**
- **Extract chemicals from pooled samples of each source**
- **Apply extracts to brood to try and trigger hygiene**
- **Give chemists the extracts that produce a positive effect**

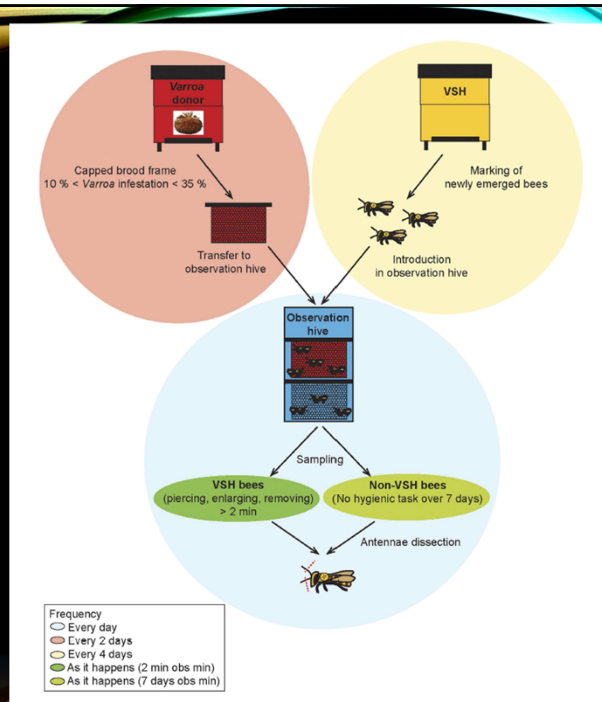


- hexane (non-polar) and dichloromethane (polar) used as solvents for extraction
- each extract applied to non-infested capped pupae with micro-syringe
- solvent controls applied to other pupae
- as a negative control, extracts of healthy pupae applied to other pupae
- positive result is the hygienic removal of treated pupae by VSH bees (if significantly greater than solvent and negative controls)

STIMULI TRIGGERING HYGIENIC BEHAVIOR

- **Death in insects characterized by volatile odors like oleic acid and β-ocimene**
- **Special proteins call odorant binding proteins are used to "smell" these odors**

VSH BEHAVIOR AND ANTENNAE



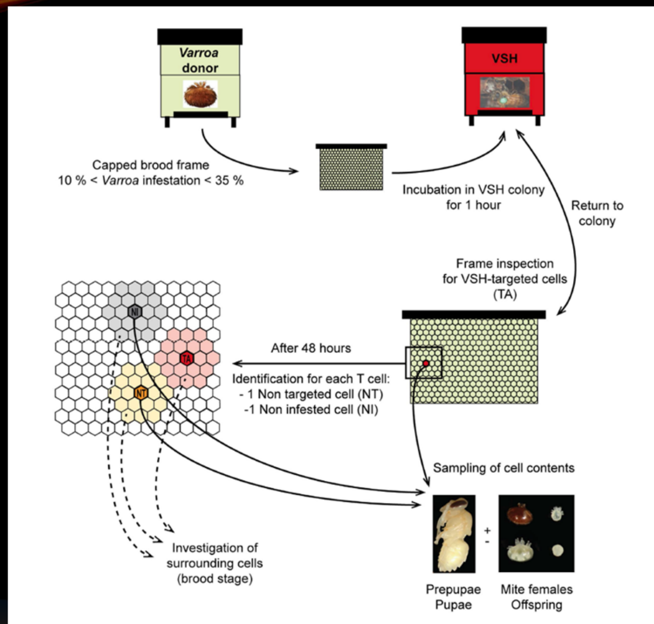
TRANSCRIPTOME ANALYSES (VSH BEES VERSUS NON-VSH BEES)

- Avg. age for VSH behavior = 11 ± 4 days
- 173 genes up regulated in VSH bees
- 85 genes down regulated in VSH bees
- Metabolism, motor activity and neuronal processing
- VSH bees were most similar in gene expression to NURSES
- 11-olfactory related genes were upregulated in antennae of VSH bees (including OBP3)

VSH BEHAVIOR AND STIMULI

Spe
hone
Varroa destr
brood.

Scientific Reports, Natur
6: 25444



STIMULI TRIGGERING VSH BEHAVIOR (TARGETED VERSUS NON-TARGETED PUPAE)

- Targeted pupae had greater mite numbers in cell
- Targeted pupae were UNDERDEVELOPED compared to nearest neighbors
- Targeted pupae over-produced Brood Ester Pheromone
- Kashmir virus (maybe DWV) may also trigger VSH

STIMULI TRIGGERING VSH BEHAVIOR

- VSH bees target the most compromised pupae (those infested by families)
- They also target the most highly infested patches of brood

Similar results from Harris (2008), Harbo and Harris (2009) and Harris et al. 2010

- VSH bees target pupae with reproductive mites (those with families) much more than pupae infested by an infertile mite

STIMULI TRIGGERING VSH BEHAVIOR

- Tritriacontene is a 33-carbon alkene that changes in the hydrocarbon profile of mite-infested pupae
- VSH bees smell and react to these changes in amounts of this chemical

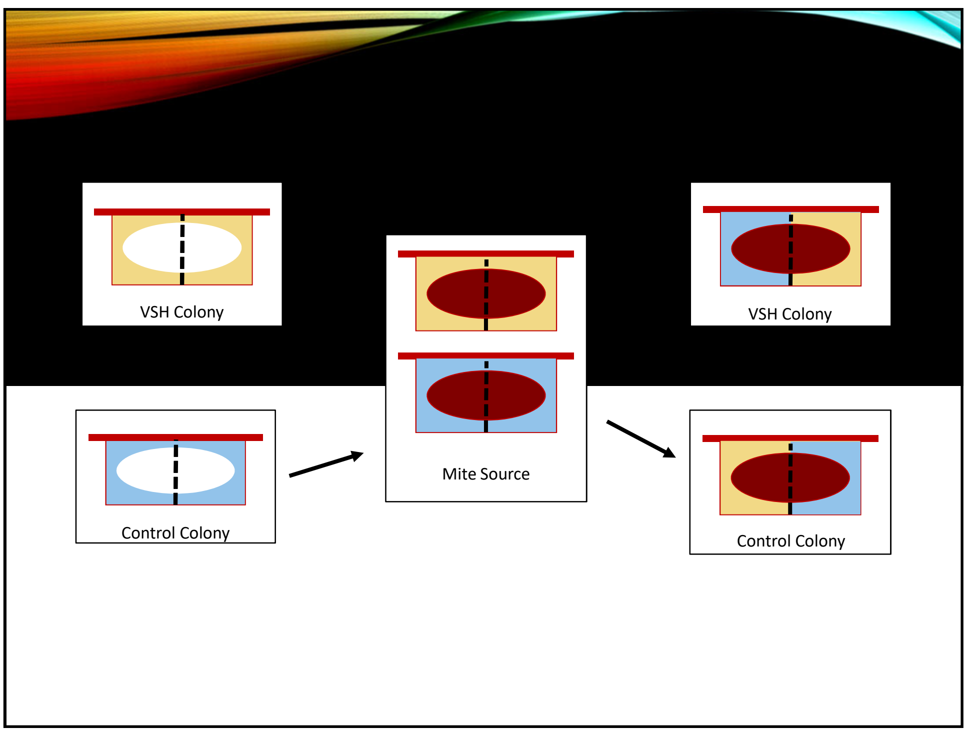
STIMULI TRIGGERING VSH BEHAVIOR

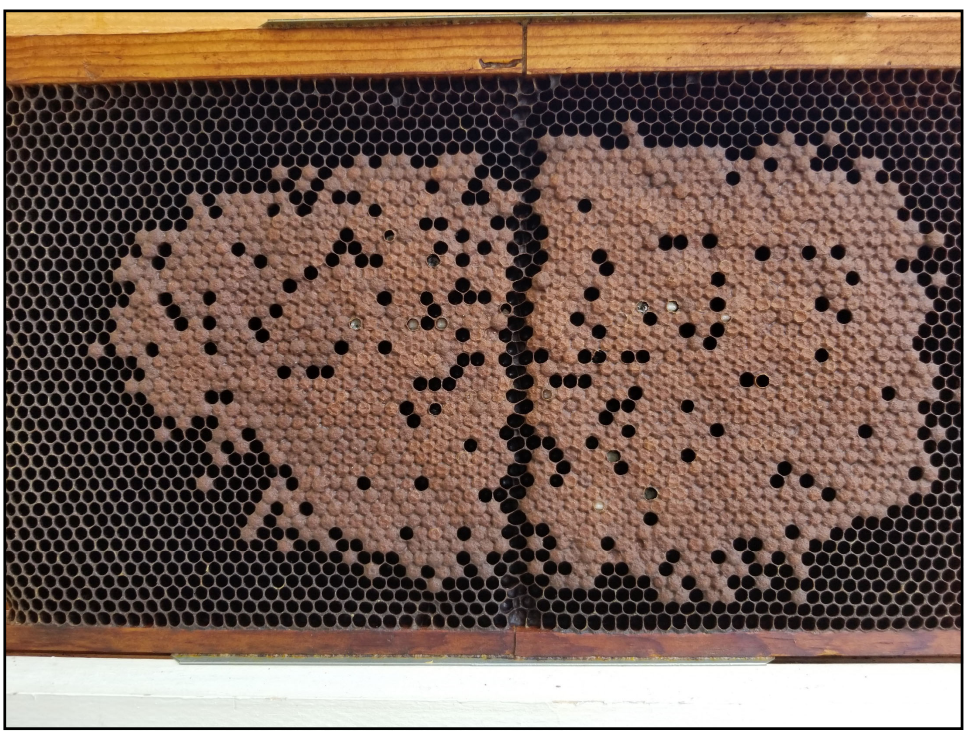
- Colonies of VSH bees remove mite-infested brood better from their own combs than from brood combs obtained from unrelated bees

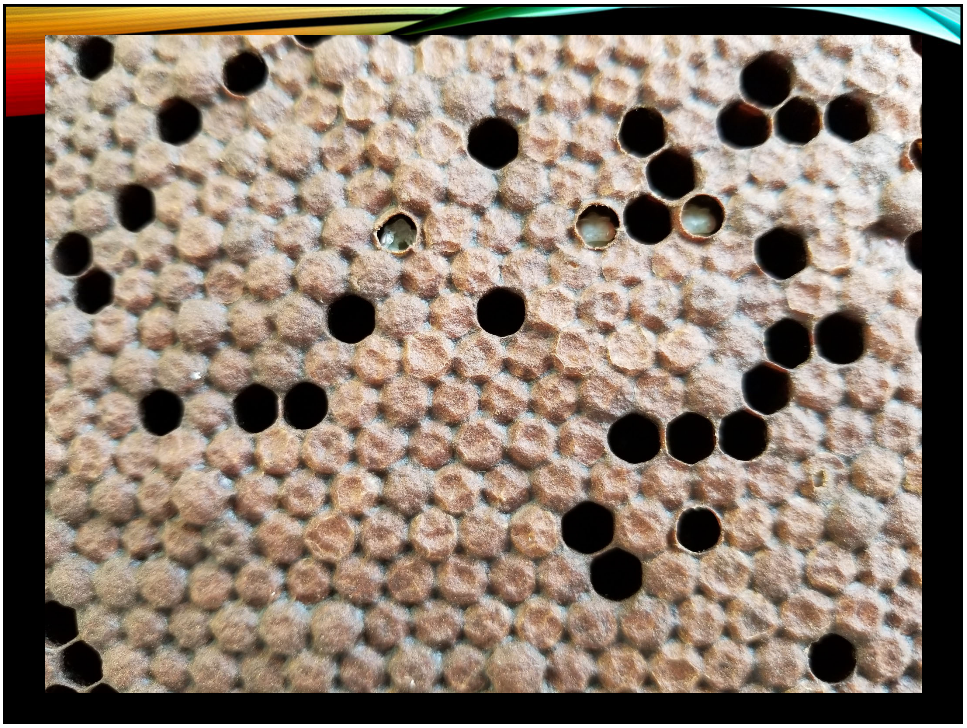
ANGUS L. CATCHOT, III (MASTER'S STUDENT)

OBJECTIVE 1

Do VSH bees really remove their own mite-infested pupae better than those from other stocks of bees?



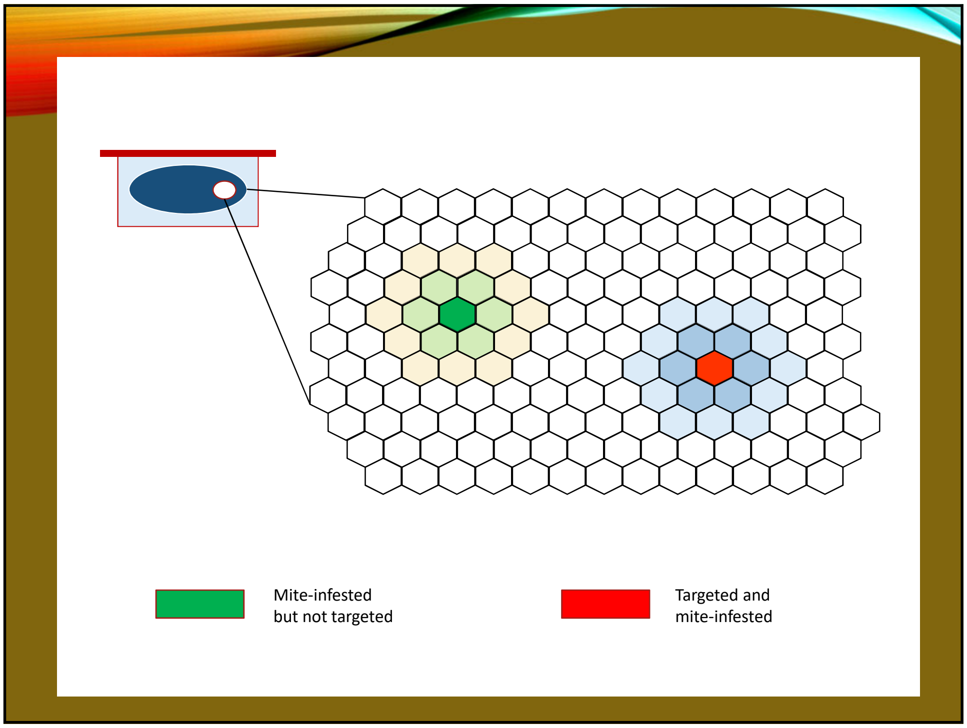




OBJECTIVE 2

Are there physiological differences between:

- ❑ Mite-infested pupae of VSH and non-hygienic stocks of bees
- ❑ Mite-infested pupae that are targeted by hygienic bees and mite-infested pupae that are not targeted from the same brood comb



ACKNOWLEDGEMENTS

- Dr. John Harbo (USDA, ARS retired)
- Dr. Bob Danka (USDA, ARS)
- Dr. Jose' Villa (USDA, ARS retired)
- Dr. Roger Hoopingarner (Michigan State Univ., retired)
- Dr. Tom Glenn (Glenn Apiaries, retired)
- Adam Finkelstein (VP Queens, SC)
- Adrian Duehl (USDA, ARS in Gainesville, FL)
- Fanny Mondet and Yves Le Conte's Lab (France)
- Kaira Wagoner and Olav Ruepell's Lab (Univ. North Carolina at Greensboro)

Thank You!

http://blogs.msucares.com/honeybees/

Viruses on Wax/Propolis

Dr. Humberto Boncristiani
Applied Honey Bee Researcher
Entomology & Nematology Department
Honey Bee Research & Extension Laboratory

Overview

- Viruses
  - What are they?
  - Misconceptions
  - Honey Bees Viruses
  - Why they are dangerous today
- Propolis/Wax
- Wax/Propolis as a transmission pathway of virus
- Conclusions.

What is a virus?

- A virus is a biological entity consisting of a genome of DNA or RNA encapsulated by proteins and in some occasions by a lipid membrane, that can only replicate inside a living cell of a host.
- Viruses do not have their own metabolism.

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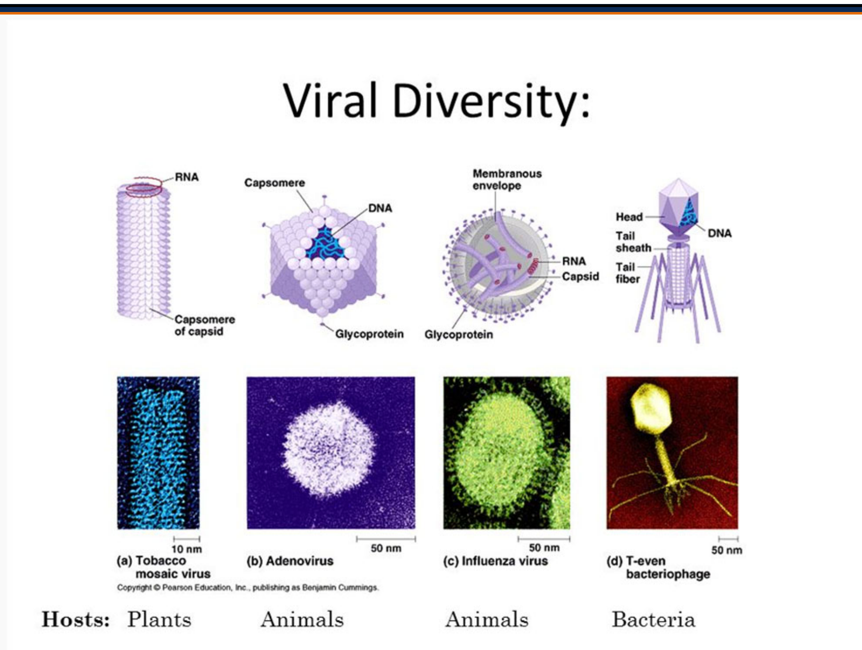

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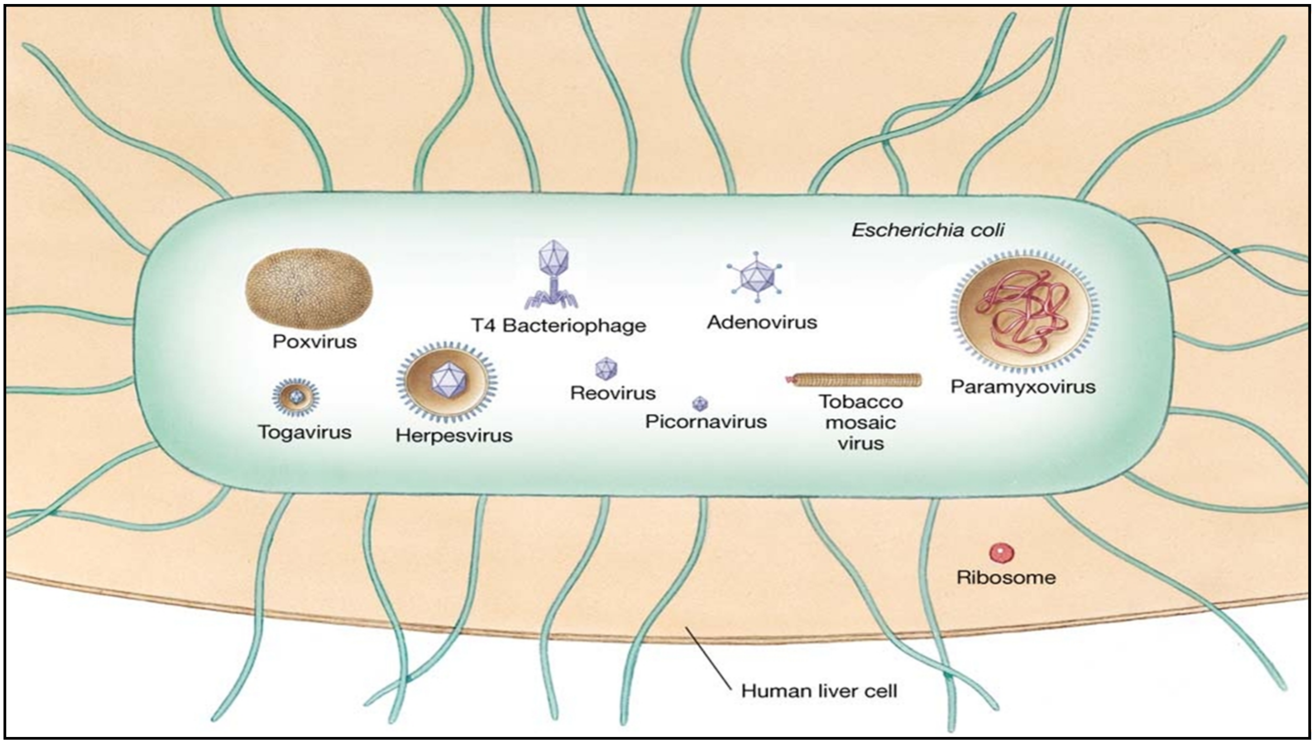
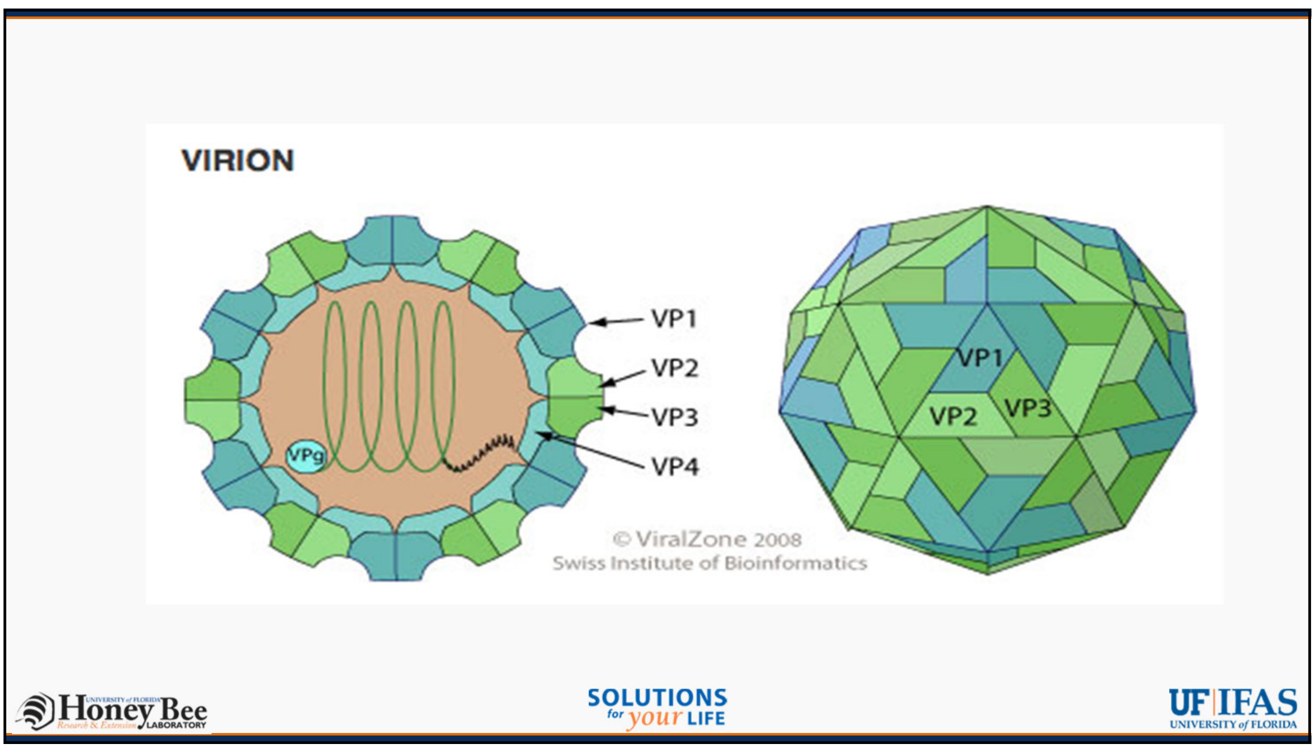

Escherichia coli
Poxvirus
T4 Bacteriophage
Adenovirus
Paramyxovirus
Togavirus
Herpesvirus
Reovirus
Picornavirus
Tobacco mosaic virus
Ribosome
Human liver cell


VIRION
VP1
VP2
VP3
VP4
VPg
VP1
VP2
VP3
© ViralZone 2008
Swiss Institute of Bioinformatics
Honey Bee LABORATORY
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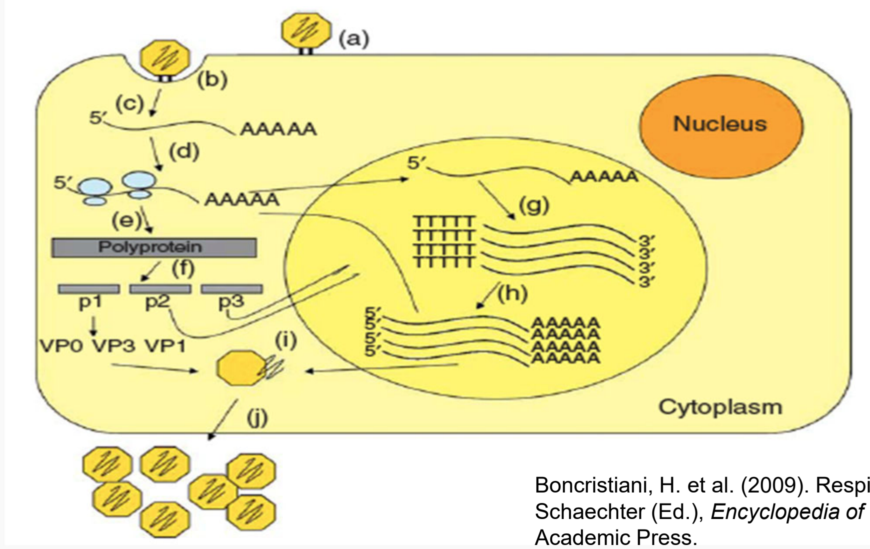
Picornavirus replication



Boncristiani, H. et al. (2009). Respiratory Viruses. In M. Schaechter (Ed.), *Encyclopedia of Microbiology* (p. 4600). Academic Press.

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Honey Bee Viruses

Dicistroviridae

Acute bee paralysis virus (ABPV)
Israel acute paralysis virus (IAPV)
Kashmir bee virus (KBV)
Black Queen Cell Virus (BQCV)
Sacbrood virus (SBV)
Cloudy Wing Virus (CWV)

Qhz#idp lo|#ri#ylxvhv

Fkurqlf#Ehh#Sdudo|vlv#
Ylux v#FESY,
Odnh#Vlqdl#ylxv#OVY,

Bonning, B. C., & Miller, W. A. (2010). Dicistroviruses. *Annual Review of Entomology*

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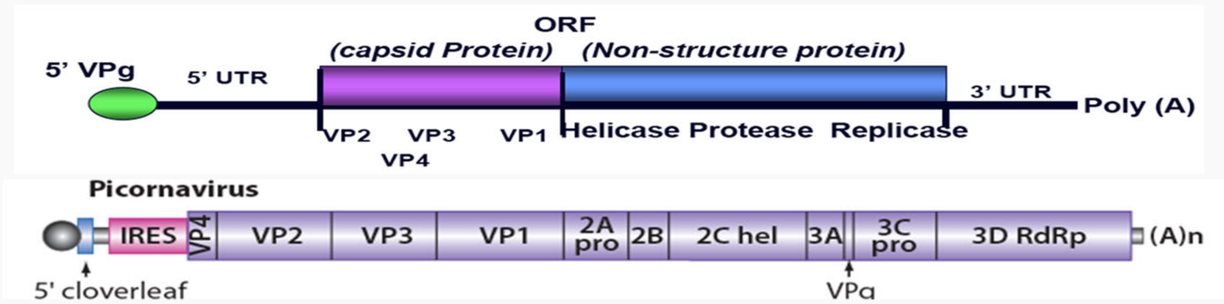
Honey Bee Viruses

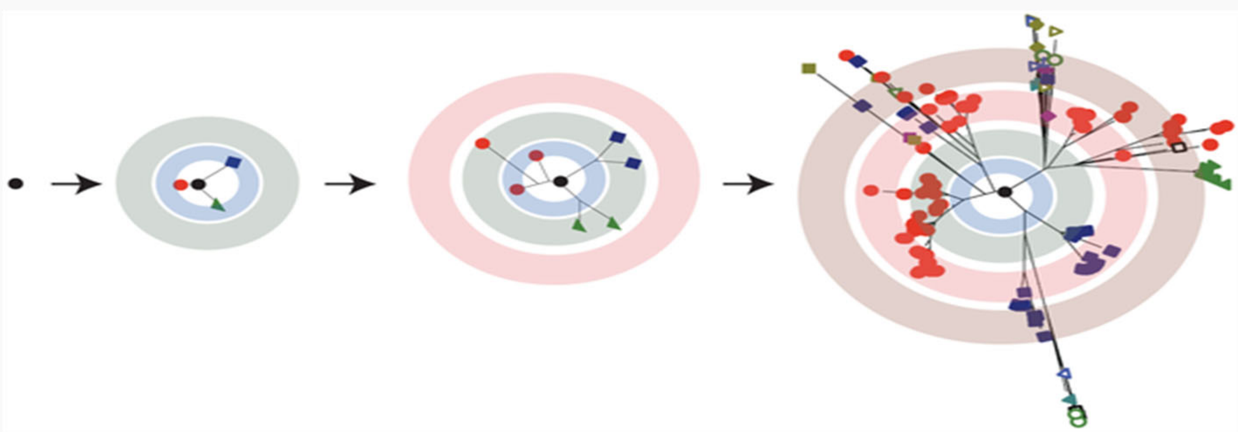
Iflaviridae

Deformed Wing Virus (DWV)
Kakugo virus (KV)
Varroa destructor virus 1



Chen, Y. P., & Siede, R. (2007).

Figure 1. RNA viruses exist as a quasispecies.



Lauring AS, Andino R (2010) Quasispecies Theory and the Behavior of RNA Viruses. PLoS Pathog 6(7): e1001005. doi:10.1371/journal.ppat.1001005

Honey Bees can handles viruses very well.

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Virus infection route

10,000 to
1000,000 times

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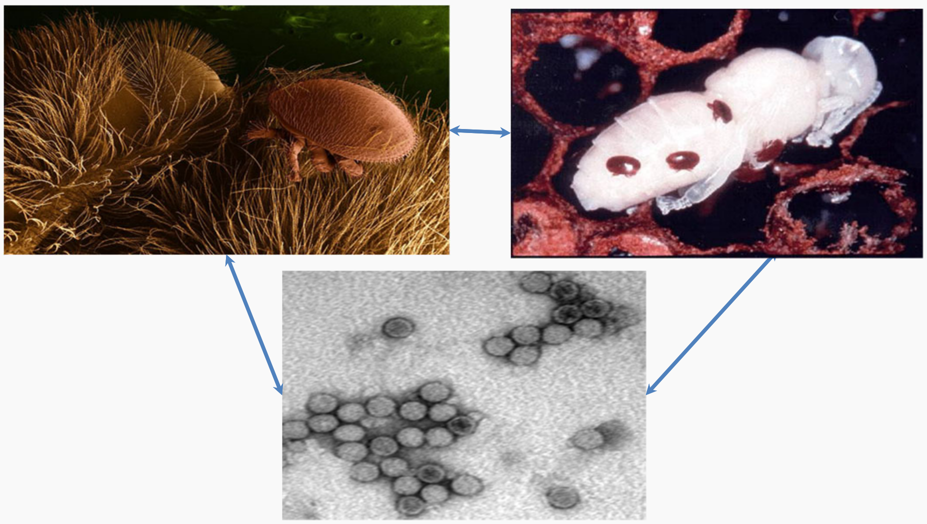
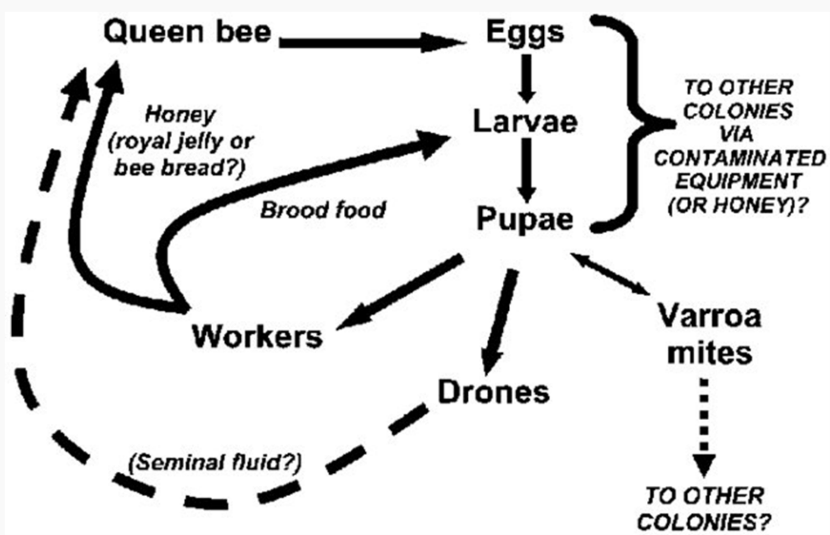
And that is why Varroa destructor is the biggest beekeeping problem today.



Honey Bee Viruses Transmission routes



Wax

Propolis

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Megan Colwell

"Impact of wax borne Honey Bee viruses and potential treatments"

https://vimeo.com/245970562

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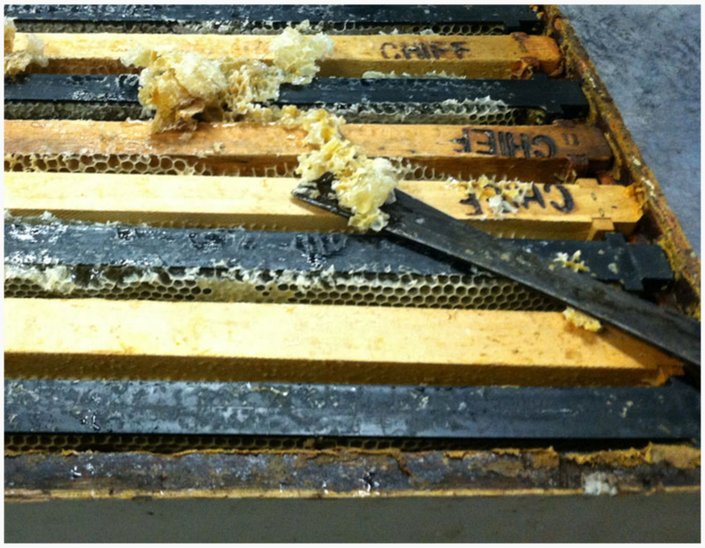

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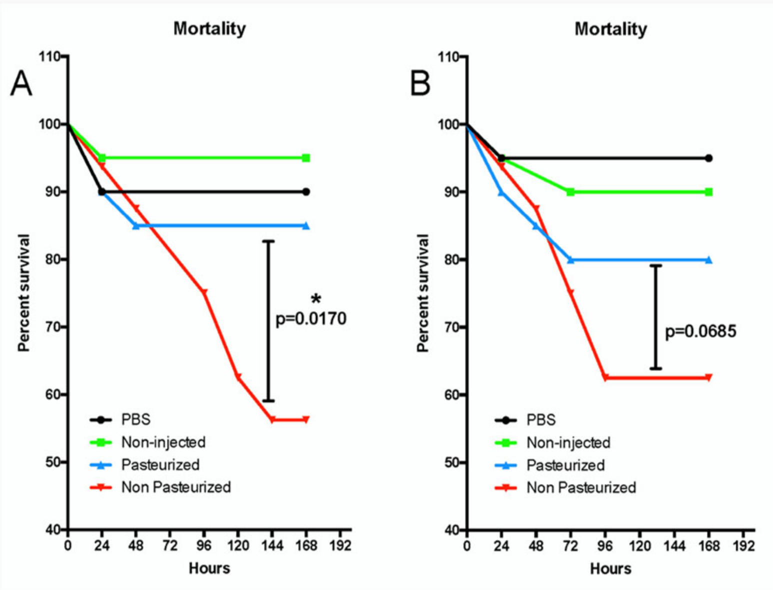

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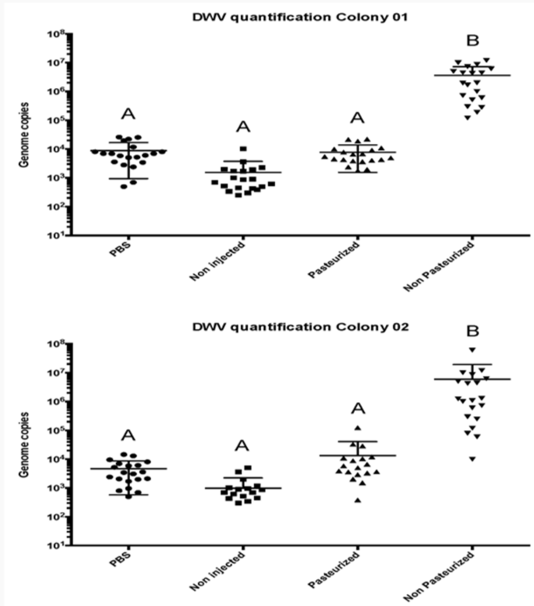
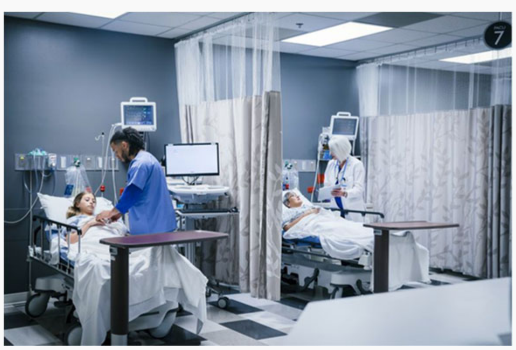


We know the basics to stop spreading diseases. Why do not apply it to Honey Bees?



Thank you!

USDA ars

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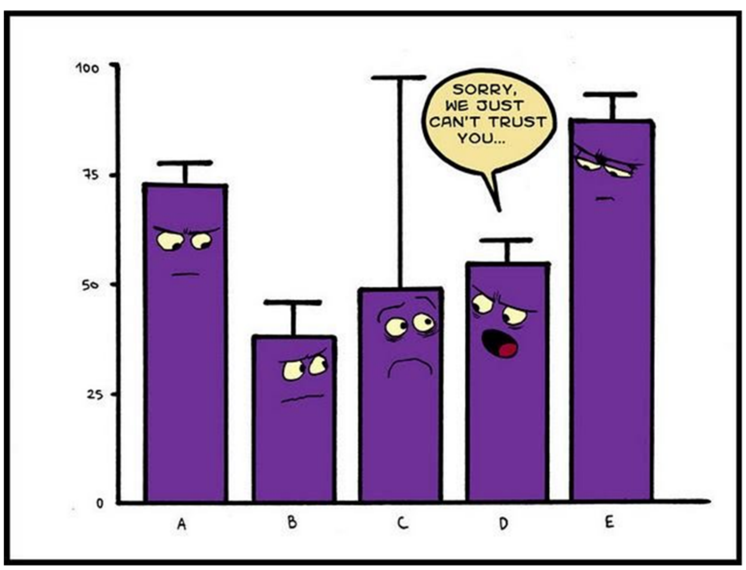
Questions?



SCALING UP; HONEY EXTRACTION FOR SIDELINERS

A **sideline beekeeper** is larger than a hobbyist, but smaller than a commercial beekeeper. The focus of a sideline beekeeper is to actively seek income and profit, while still having another source of income. Half your income from beekeeping.

41 – 100 HIVES

THINGS TO CONSIDER WHEN SCALING UP HONEY PRODUCTION

HONEY HOUSE – STAINLESS SINKS – BOTTLING TANKS

STATE FOOD HANDLING LICENSE

STORAGE BUILDING - EQUIPMENT

STORING HONEY; 55 GALLON DRUMS – DRUM WEIGHT 650 LBS

DRUM CART

UNCAPPING MACHINE

WAX MELTER – ELECTRIC or STEAM HEAT

HONEY SLUM

HONEY PUMPS

20 FRAME EXTRACTOR MIN –

MAKING THE TRANSITION

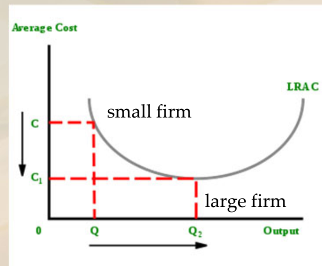
Cottage Food to Permitted Food Processor

OVERVIEW

	Cottage Food	Limited Food Processor	Food Processor
$ Threshold	$50,000	$15,000	Unlimited
Sales	Direct Retail	Retail/Wholesale/ Online	Retail/Wholesale/ Online
Facility	Home Kitchen only No Sheds, Trailers, Non-Residential Locations	Inspected Facility, Not in Home, Can use Commissary	Inspected Facility, Not in Home Can use Commissary
Inspection	Upon complaint	Routine	Routine
Food Manager Certificate	Not Required	Required	Required

REASONS TO GROW

- **Economics**
  - **Economy of Scale**
    - **Bulk purchases**
    - **Lower cost of finance**
    - **Lower cost of advertising**
    - **Lower transport rates**
    - **Reserve production capacity**
    - **More efficient machinery**
  - **More Marketing Options**
- **Logistics**
  - **Space limitations**
  - **Distribution**
  - **Labor**



BUSINESS PLAN

- Roadmap to success
  - Goals
  - Strategies
  - Measure Performance
  - Forecasting
  - Financial
- Resources
  - SBA
  - USDA/FSA
  - Universities
  - Local Chamber of Commerce
  - IFAS
  - FDACS
- *" A poor plan well-executed is better than a good plan poorly executed"*
  Sun Tzu

REGULATIONS

- Federal   USDA, FDA, OSHA, IRS
- State   FDACS, DOR
- Local   Zoning, Permitting, Business Tax Permits
- If Exporting-   International Regulations, Export/Import Procedures

FEDERAL REGULATIONS

- CFR 21 (Volumes 1-9)
- USC Title 21
- FDA Food Code
- Public Health Security and Bioterrorism Preparedness and Response Act of 2002 - **Food Facility Registration**
- **Food Safety Modernization Act**
- https://www.fda.gov/Food/
- IRS
  - Tax filings
  - Tax deposits

STATE REGULATIONS

- Food processing in Florida is regulated by FDACS Division of Food Safety
  - FS 500 Food Products
  - FL Administrative Code 5K-4 Food
- https://www.freshfromflorida.com/Divisions-Offices/Food-Safety
- https://www.flrules.org/gateway/ChapterHome.asp?Chapter=5K-4
- Florida Department of Revenue
  - FS 212.08
  - Honey is food and not taxed
  - Honey if part of a gift basket:
    - The application of the tax on a package that contains exempt food products and taxable nonfood products depends upon the essential character of the complete package.
    - If the taxable items represent more than 25 percent of the cost of the complete package and a single charge is made, the entire sales price of the package is taxable.

LOCAL REGULATIONS

- Occupancy permits
- Business Licenses
- Additional Local Regulations
  - Inspections
  - Permits

INSURANCE

- CONSIDERATIONS FOR INSURANCE
  - Business property insurance
  - General liability/product liability
  - Workers comp if you have employees
    - **Non-Construction Industry:** An employer in the non-construction industry, who employs four or more part- or full-time employees, must obtain workers' compensation coverage
    - **Agricultural Industry:** Agricultural employers with six or more regular employees and/or 12 or more seasonal employees, who work for more than 30 days, must obtain workers' compensation liability coverage for those employees
    - https://www.myfloridacfo.com/division/wc/pdf/WC-System-Guide.pdf
    - Florida Workers' Compensation law (Chapter 440, Florida Statutes)

PROCESSING OPTIONS

- Co-Packer
  - You contract out processing/packaging to third party processor
- In House
  - You handle the entire process

	PROS	CONS
CO-PACKING	• Don't need a physical plant • Don't need as much equipment • Reduced overhead	• Minimum quantities often required • Logistics to deliver and receive product from packer • Storage of finished product • Permits required

IN HOUSE	• Local
	• No minimums
	• Fewer logistic challenges
	• Packaging flexibility
	• Scheduling flexibility
		• Capital outlay
		• Finding suitable location
		• Operating overhead
		    • Utilities
		    • Maintenance
		    • Insurance
		    • labor

FACILITY CONSIDERATIONS

- Is it suitable for the product being produced
  - Must meet minimum construction standards set by FDACS
- Material handling requirements
  - Loading dock
  - Fork lift capacity
  - Hand truck accessible
- Raw product storage
- Finished product storage
- Utility requirements
  - Electrical, water, gas, sewage
- Waste disposal
- Growth considerations
  - 1,3,5 year plan

EQUIPMENT

- Investing in equipment
  - **Return on Investment (ROI):** a benchmark used to evaluate the gain on an investment in comparison to the initial amount invested.
  - **Pay Back Period (PBP):** an estimate of the number of years needed for the equipment to pay for itself.
  - **Useful Life:** the number of years a piece of equipment can operate
  - **Residual Value:** the value of the equipment at the end of its useful life
- Equipment capacity
  - Volume of Product to Process
  - Filling capacity of equipment
- General equipment
  - Bottlers
  - Strainers
  - Pumps
  - Shelving / Racking
  - Hand trucks / Carts
  - Labelers
  - Cappers

OTHER CONSIDERATIONS

- Space Requirements
  - How much space do you really need
    - Equipment Footprint
    - Raw Materials Footprint
    - Product Footprint
- Utility Requirements
  - Electrical Load
    - 120-240 volt
    - 1 Phase/3 Phase
  - Water Supply
    - Plumbing architecture and/or condition
  - Telephone/Internet

QUALITY

- “**Quality is generally transparent when present, but easily recognized in its absence**.” Alan Gillies
  - Quality Control Plan
    - 1 person operation QCP can all be in your head
    - As soon as 2 get involved there is likelihood for inconsistency
  - Employee Training
    - Food manager certification
    - Training plan
    - Documented Procedures
  - Honey show experience is valuable
  - A good quality control plan helps manage time and labor

INVENTORY MANAGEMENT

- Customers like choices
  - More Choices = More Inventory
- Inventory must be regularly turned to maintain quality
- Raw Materials
  - Market projection – How much will you need
  - How stored / accessed
  - Preservation of quality
  - Control crystallization
  - Raw material handling
    - Drums, buckets, totes

INVENTORY MANAGEMENT

- Supplies
  - Supply chain logistics
    - What do I need? When do I need it? Is it in stock? How long to get it?
  - Economies of scale
  - Containers
    - Packaging
      - Boxes - Labels - Shipping supplies
- Finished Product
  - Turnover rate
    - Stock rotation
  - Timeline to produce
  - Dated inventory management

MARKETING

- Know your competition
- Understand overhead costs
- Pricing Strategy
- Market strategy
  - Direct Retail : Brick & Mortar Store, Farmers Market
  - Indirect Retail:
    - Employee selling
    - Online Sales
  - Wholesale
    - Product delivery logistics
  - Consignment
    - Can expand your visibility
    - Vendor has no real incentive to promote or move product


MARKETING
• Promotion
– Websites
– Social Media
– Blogs
– Speaking events
– Educational opportunities
– Evaluate – Revise –Replace
– Keep your plan in a state of evaluation and review
– Understand your customers wants and needs
– Know your competition
– Does marketing plan align with business plan: Am I accomplishing my goals?

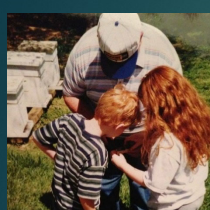
Teaching Bees to a non-beekeeper audience

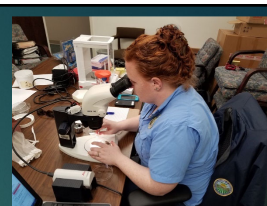
CAITLIN GILL

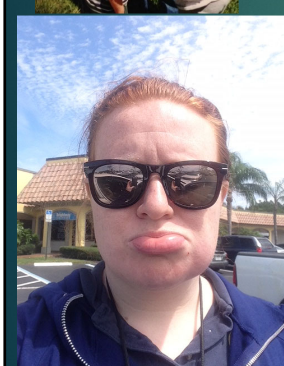
RPCV PARAGUAY 2010-2012

GRADUATE STUDENT OF ENTOMOLOGY AND NEMATOLOGY M.S.

Caitlin Gill







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CUERPO DE PAZ PEACE CORPS PARAGUAY

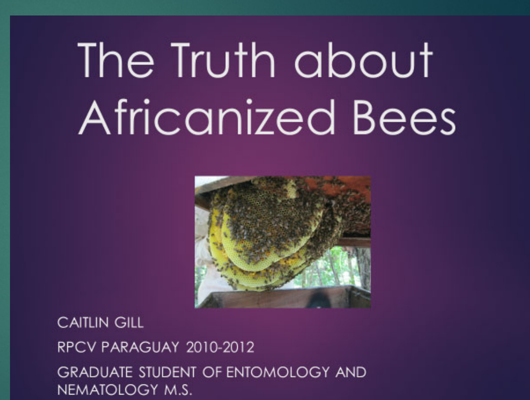
Why are we discussing this topic?

- To gain a clear picture on how to approach speaking to non-beekeepers about honey bees
- A lay out of a typical presentation
- Tips and advice

- What are your goals? What do you hope to learn? Feel free to ask questions at any time!

Where to begin?

- What type of presentation are you going to have?
  - Is a PowerPoint presentation appropriate?
    - Consider the setting

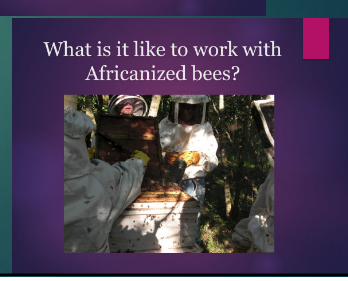


Know your audience

- Who are speaking to?
  - Adults
  - Children
  - College students
- Note: With each audience, the information you will need to provide will be different because the interest might also be different.

Key Point or Points

- What is the main idea that you want the audience to walk away knowing or understanding?
- Make a quick list of those points
  - Expand upon each of them
  - Possibly include pictures and/or examples
  - i.e. history, what impact honey bees have, how you can become a beekeeper.

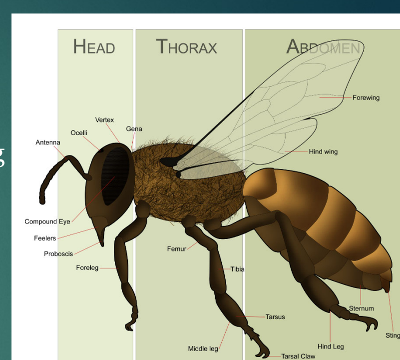


Lets say you are teaching “Honey Bee/Beekeeping 101”

- **What areas should be your focus? Remember the audience!**
- Biology
- Behavior
- Honey bee needs
- Hive products
- Beekeeping Equipment
- Key pests and diseases
- Management tips
- Laws & regulations
- Sting care

Honey Bee Biology

- “All insects are bugs but not all bugs are insects!”
- Honey biology can be very time consuming for any talk.
- Think again about the basic information you really want the audience to know or understand
  - Anatomy
  - Honey Bee Castes
  - Developmental time
  - Particular attention to the queen
  - Swarming



Honey Bee Biology

- Pictures and infographics!

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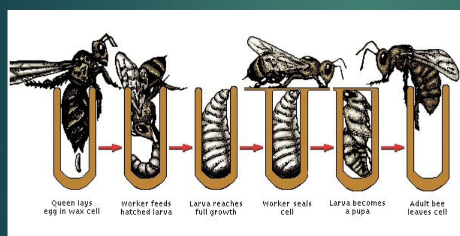

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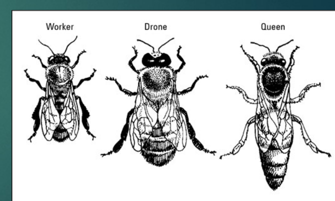

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Reminders

- Keep it simple without getting too complicated
- This way the information is clear and not confusing
- This is a lot of information for most folks!

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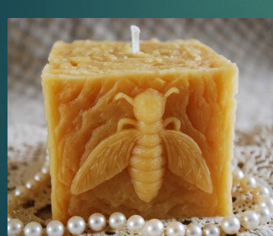
Honey Bee Behavior

- Describe some interesting facts about behavior.
- Honey bees change jobs based on their ages
- You can alternatively discuss swarming here also
- Discuss the importance of the smoker
- Behavior to be cautious of when working with a colony

Hive products

- Honey
- Wax
- Pollen
- Propolis
- Royal Jelly

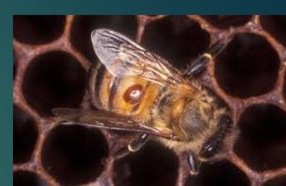


Beekeeping Equipment

- Go through the main essentials – Veil, hive tool, smoker
- The elements that make a hive (Brood box, bottom board)
- Show the 2 main types: Langstroth & Top Bar
- What they really need to know:
  - Necessary items?
  - How much?
  - Where to purchase!

Key pest and diseases

- Talk about the main issues!
- VARROA mites, hive beetles etc.
- Diseases
  - Show some pictures of different types
  - (AFB, EFB, Nosema etc.)
  - Explain the resources that can help with diagnosis including FDACS apiary inspection.

Pictures: UF Honey Bee Lab

Hive Management tips

- Very Basic
- Think about questions you would ask as a newbee:
  - How often should I check the bees?
  - What do I look for when I open it?
  - Discuss varroa mite checks
  - Again, discuss the resources available



Rules and Regulations

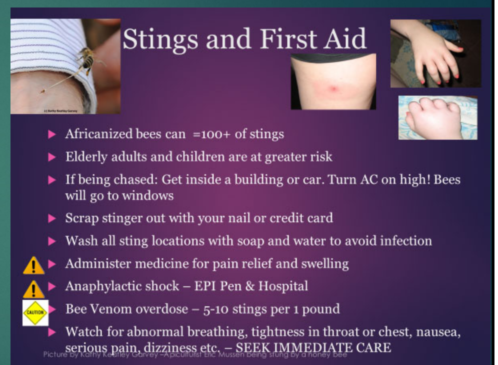
- Briefly discuss the rules and regulations around beekeeping.
  - All beekeepers must be registered
  - FDACS Apiary inspection

Apiary Inspection

- All Beekeepers in the State of Florida must be registered.
- It is illegal for any person to knowingly keep and manage AHB hives (5B-54.004 Unwanted Races of Honeybees)
- Re-queening Swarms with EHB (Beekeeper Compliance Agreement- Best Management Requirements for Maintaining European Honey Bee Colonies *193.461, 586.10 (1), FL statues and Chapter 5b-54 FL administrative code)*
- AHB Testing (Queen Certification)
- FABIS – Fast Africanized Bee Testing System
- Bait Hives – Monitoring Ports

The Good and the Bad

- Especially with a “newbee” audience, explaining about honey bee stings is important!
  - Remove the stinger by scraping
  - Abnormal sings post sting



Tips and Advice

PowerPoint?

- Make sure the text is viewable from the back of the room!
- Make sure the background isn't busy
- Include pictures where applicable – keeps the audience's attention
- Even videos!

No PowerPoint? No problem!

- Use other visuals!
  - i.e. large displays, virtual hives, observation hives
    - Hint: If teaching children, keep observation hive covered! Keep their attention on you!
- It is always good to have a back-up plan incase the PowerPoint doesn't work!

Play to your strengths!

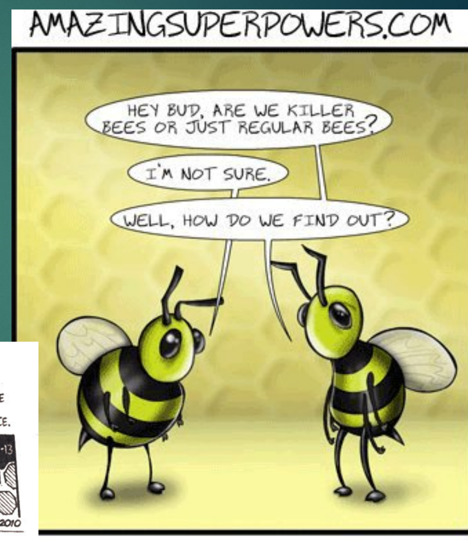
- Talk about your favorite topics
- Tell a story that can relate back to your topic
- Making things relatable makes them easier to understand

Nervous Public Speaker?

- Arrive early to the presentation location
- Meet with your audience ahead of time
- Take deep breaths and take pauses
- Have water available
- Practice makes perfect
- Most importantly remember you have the knowledge!

Consider Humor

- Keeps the audience engaged
- Relates to the subject matter
- Personal anecdotes
- It has to be said: Make sure it is appropriate



Include your references

- Make sure to give credit where credit is due!
- **Always** use reliable resources!

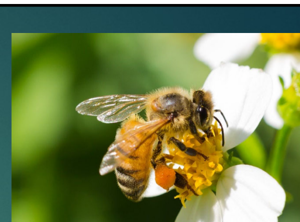
References & Further Reading

- **African Honey Bee: What you Need to Know** by H.Glenn Hall, Catherine Zettel- Nalen and James D. Ellis. This document is Fact Sheet **ENY-114** (MG113), a series of the Entomology and Nemotology Department, UF/IFAS Extension. Reviewed: March 1995. Revised: August 2010 and December 2014
- **Differences Between European and African Honey Bees**[1] M. K. O'Malley, J. D. Ellis and C. M. Zettel Nalen[2]. This document is **ENY-147**, one of a series of the Entomology and Nematology Department, UF/IFAS Extension. Original publication date December 2008. Revised June 2013 and October 2013
- **African Honey Bee, Africanized Honey Bee, Killer Bee, *Apis mellifera scutellata* Lepeletier (Insecta: Hymenoptera: Apidae)**[1] James D. Ellis and Amanda Ellis[2] This document is **EENY 429**, one of a series of the Entomology and Nematology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date February 2009. Revised December 2012.
- **G-34 Peace Corps Beekeeping Extension Volunteer MANUAL : 2010**
- **Pictures: Breton Homewood** – current Peace Corps Volunteer, Asuncion, Paraguay
- **Kathy Keatley Garvey** –Apiculturist Eric Mussen being stung by a honey bee
- **Google Maps** provided Continent and Apiary location pictures
- www.freshfromflorida.com -Florida Department of Agriculture and Consumer Services
- http://entnemdept.ifas.ufl.edu/honeybee/ -Honey Bee Research Extension Lab

Offer additional resources:

- Create a handout of helpful resources
- List links at the end of your presentation

Questions?



- **Leave time for questions**
- **What should you do if you don't know the answer to a question?**
    - Take their information and get back with them
    - Better than giving out false information!
- **Prep yourself for the common questions!**
  - Colony Collapse Disorder
  - Are bees really dying out?
  - What is really the biggest threat to honey bees?
  - What is the status on killer bees?
  - Is it illegal to kill honey bees?

Contact Information

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Understanding native bees of Florida: Biology and Behavior

Dr. Rachel Mallinger
Bee College 2018
Gainesville, FL

Outline

- Why are they important
- Bee diversity
- Bee behavior
  - Sociality
  - Nesting
  - Foraging
- Bee declines

Learning objectives

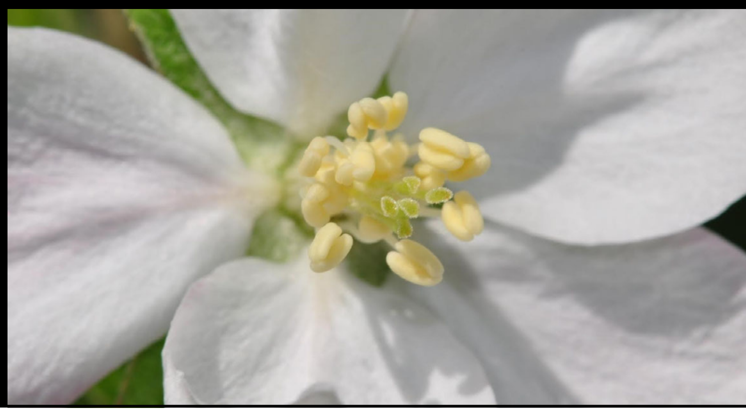
1. Understand the importance of pollinators
2. Recognize the diversity of bees in the world and in FL
3. Describe the nesting and foraging behaviors of native bees in FL
4. Describe the biology of native bees in FL including sociality and life cycle
5. Identify factors potentially contributing to bee declines

Pre-class Activity

Write down 3 things you know about bees

Pollination

- Plant reproduction
- Movement of pollen from anthers to stigma
- Some plants require cross pollination
- Gravity, agitation, wind, animals



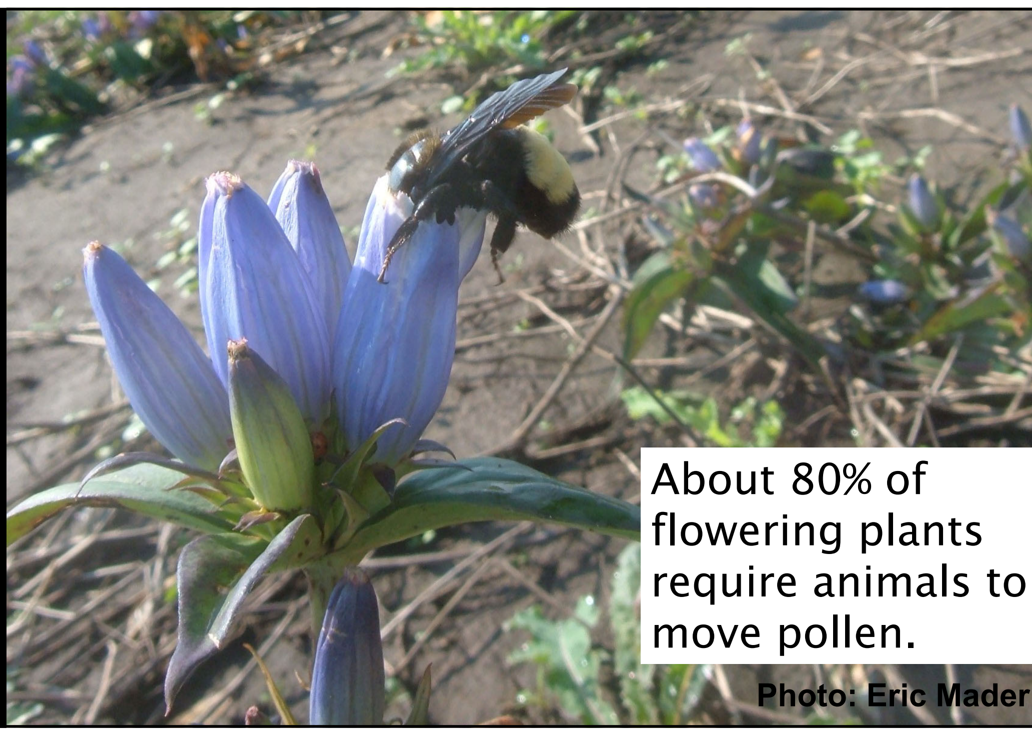
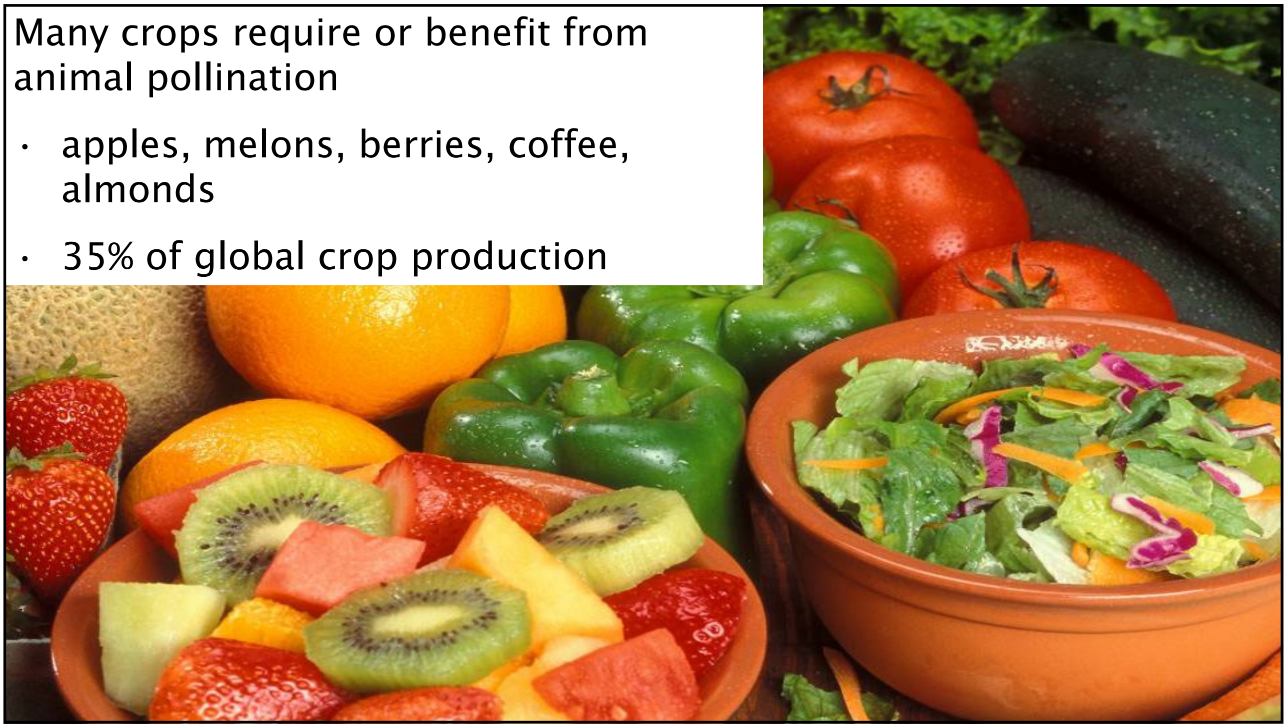


Photo: Eric Mader

Many crops require or benefit from animal pollination

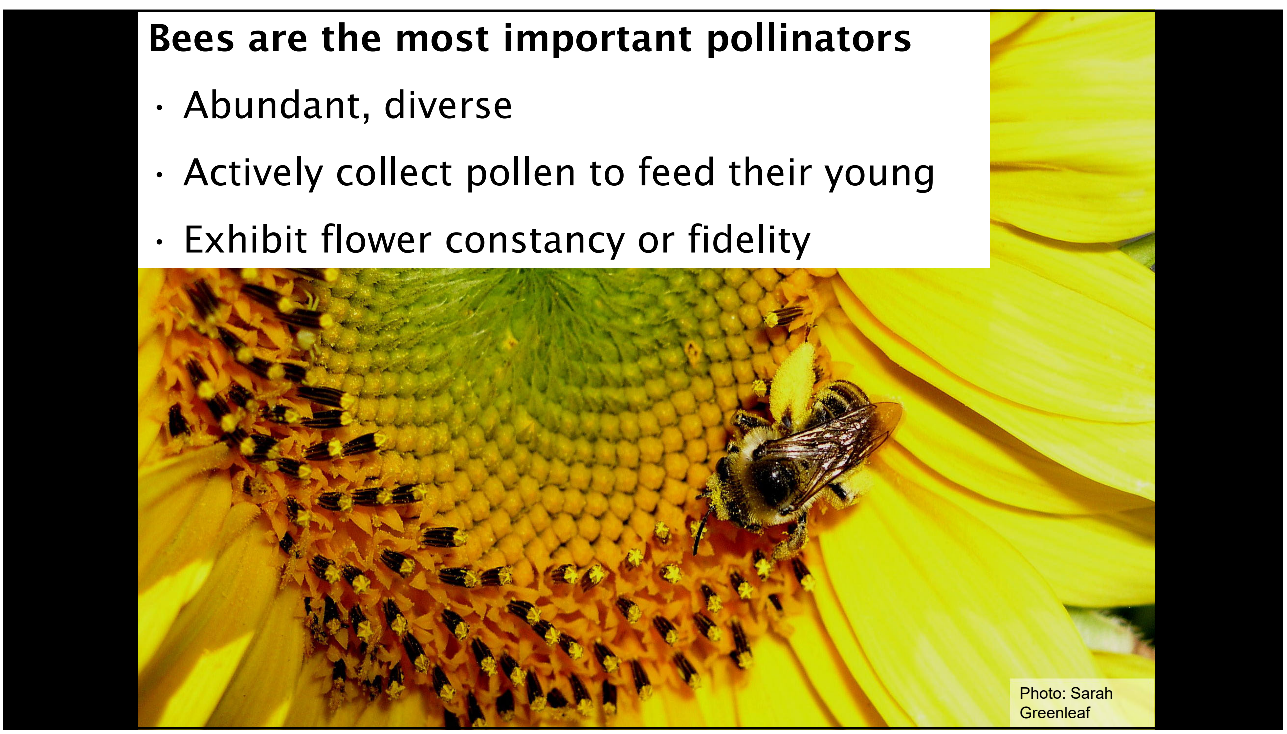
- apples, melons, berries, coffee, almonds
- 35% of global crop production



Pollinators in natural habitats

- Maintain plant diversity
- Seed and fruit production
- Birds and mammals eat seeds and fruit

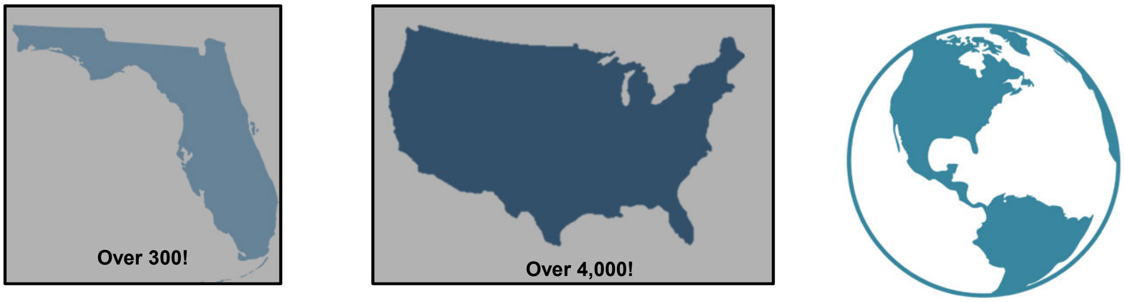

Photos: Mace Vaughan, Bob Hammond, David Inouye,
Bruce Newhouse


Bees are the most important pollinators
• Abundant, diverse
• Actively collect pollen to feed their young
• Exhibit flower constancy or fidelity
Photo: Sarah Greenleaf

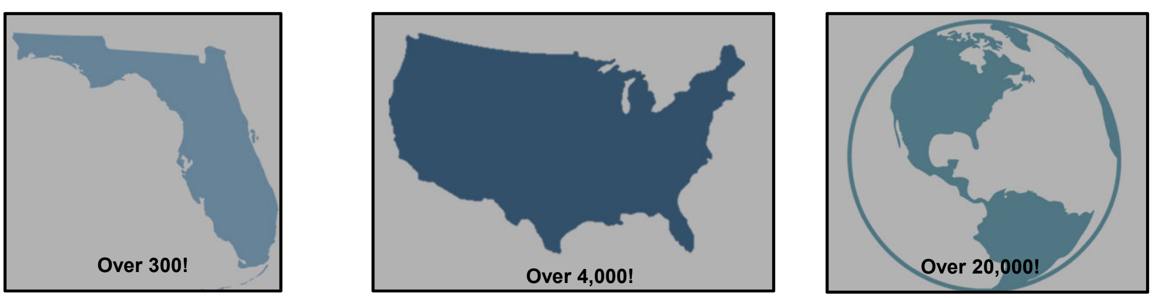
How Many Bees?

How Many Bees?

How Many Bees?



How Many Bees?



Native wild bees

- Range of sociality, foraging & nesting behaviors
- Effective pollinators for crop and wild plants
- No significant honey production

Florida Native Bees

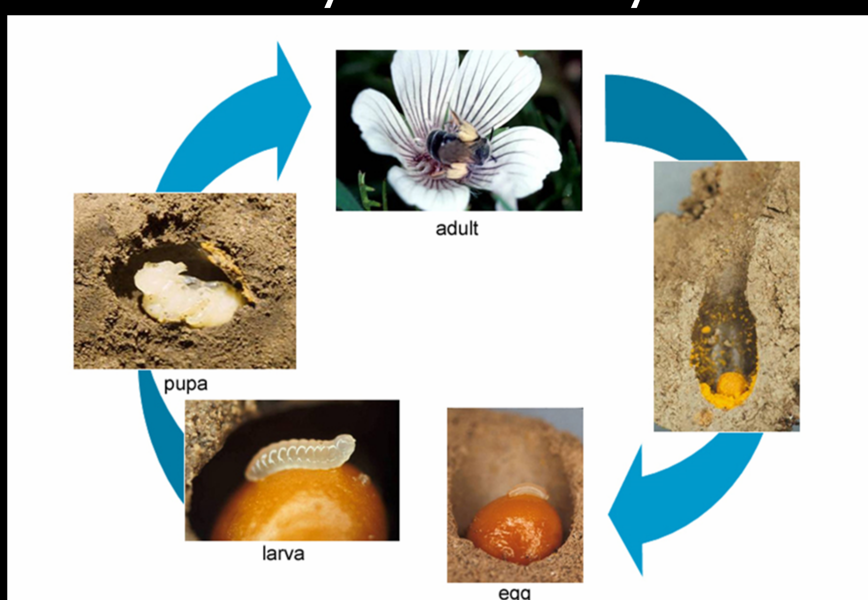
Main groups:

- Mining bees
- Plasterer bees
- Leafcutter bees
- Mason bees
- Resin bees
- Sweat bees
- Bumble bees
- Long-horned bees
- Carpenter bees
- Cuckoo bees

Sociality

- Majority solitary
    - No division of labor/reproduction, no large colonies
- Exceptions: bumble bees, some sweat bees

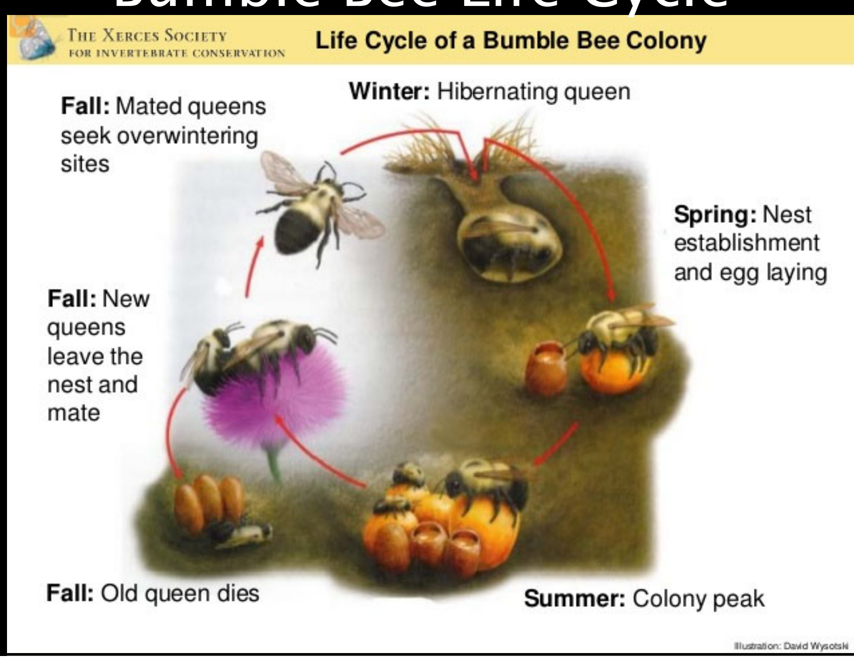
Solitary bee life cycle



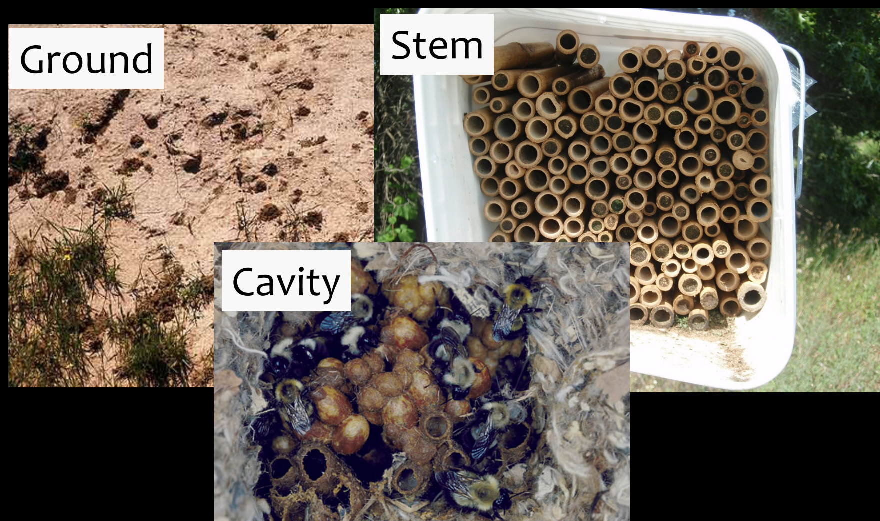
Solitary bee life cycle

- Typically one generation per year
- Sometimes 2-3 generations
- Adults live a few weeks to a couple months
- Rest of year is spent as egg, larva, pupa
- Typically spend a dormant or overwintering period as prepupa

Bumble Bee Life Cycle



Native wild bee nesting



Native wild bee nesting

Majority (70%) nest belowground

- Mining bees
- Plasterer bees
- Sweat bees
- Long-horned bees

Native wild bee nesting

Minority (~30%) nest aboveground
- Mason bees
- Carpenter bees
- Leafcutter bees
- Some sweat bees
- Some resin bees

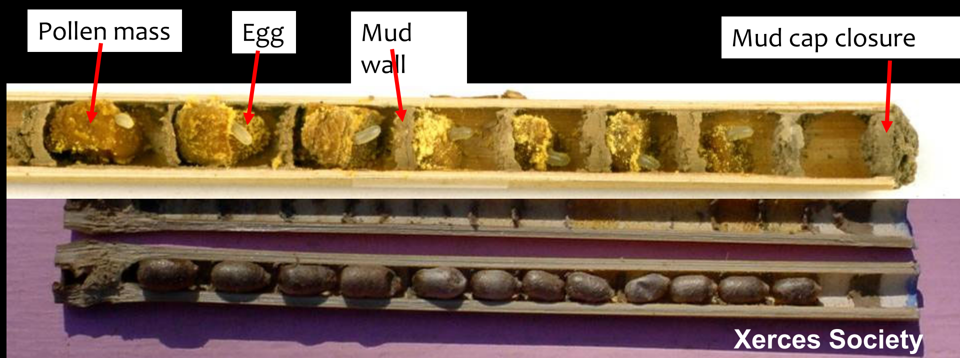
Most use pre-existing cavities
Carpenter bees excavate
Resin bees exposed substrates

Native wild bee nesting

Bumble bees typically nest at or below ground level
- abandoned rodent nests
- Tufts of grass
- Underneath structures

Native wild bee nesting

Mason bees nest in stems, reeds, beetle burrows or other long cavities; use mud



Native wild bee nesting

Leafcutter bees nest primarily in stems, reeds, beetle burrows or other long cavities; use leaves

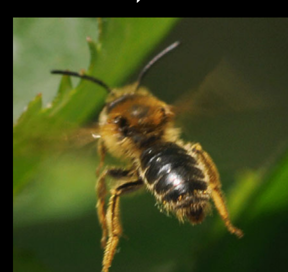
Native wild bee nesting

Some bees use petals to make cells

Foraging behaviors

- Central-place foragers
- No migration
- Majority generalists in temperate and sub-tropical regions (70-85%)
- Equal number specialists in xeric regions (43 – 60%)

Foraging range



Bees of Florida

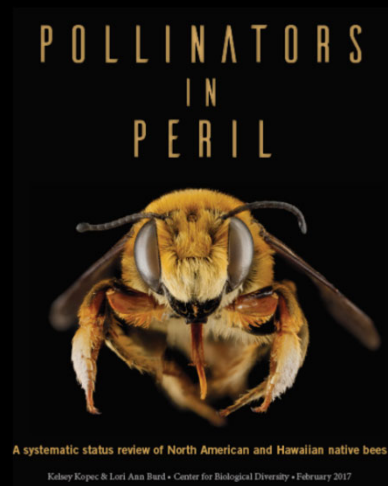
- 26 endemic species or subspecies (found only in Florida)
- Many cuckoo or kelptoparasitic bees (20% or ~65 species)
- Many sand-nesting bees
- High diversity of leafcutter bees (*Megachile* spp.) and mining bees (*Perdita* spp.)

Pollinator declines

European honey bee | Other bees | Other pollinators

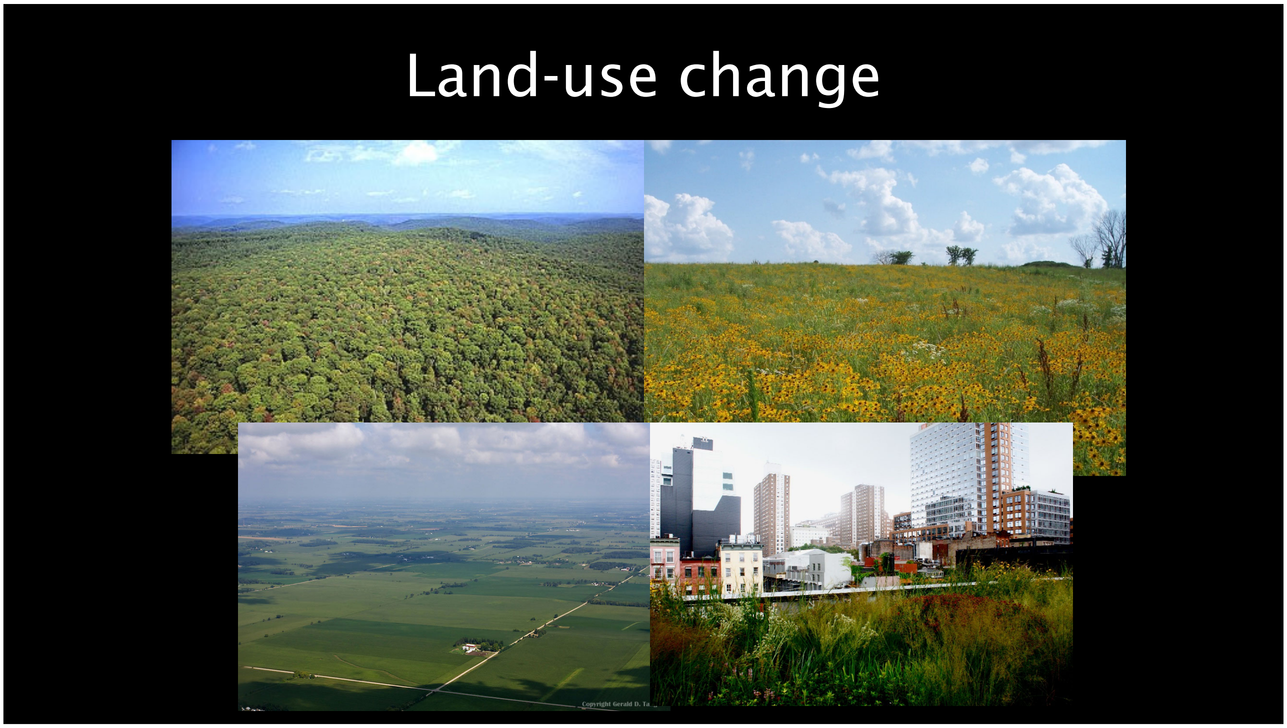
Native wild bee declines

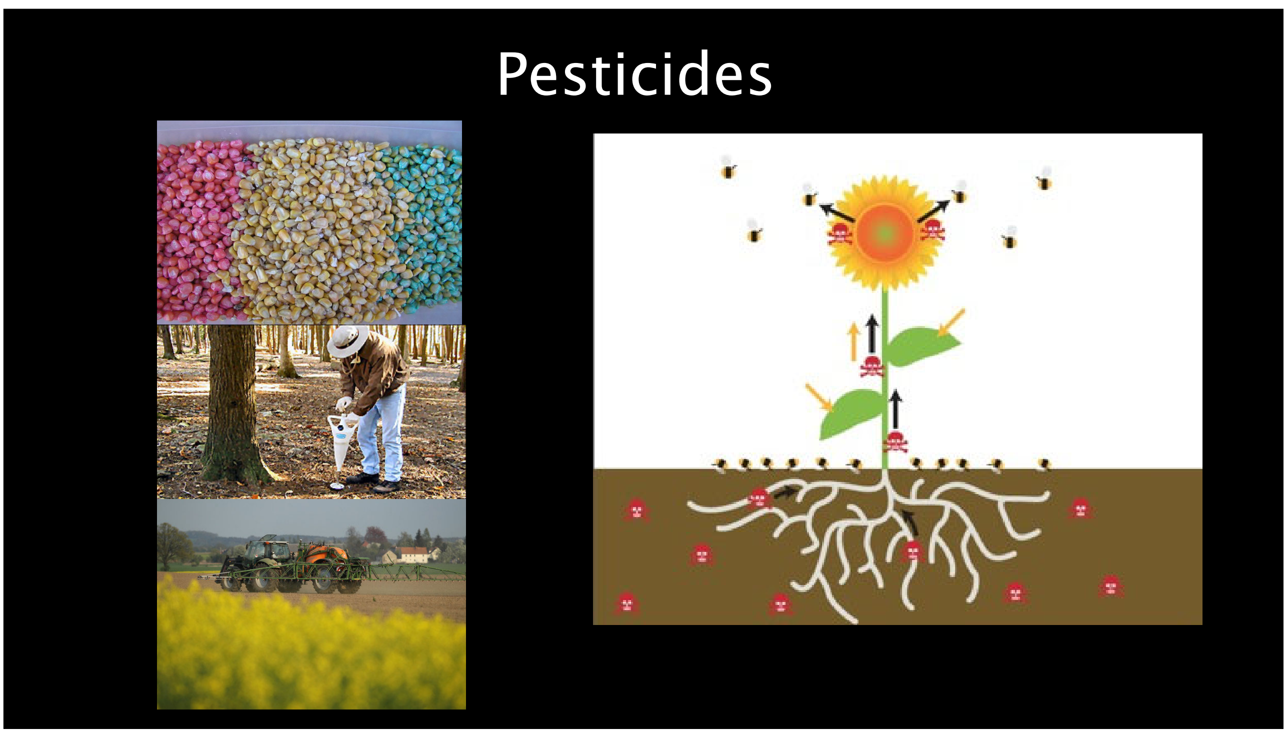
- 1,437 (of 4,337) species assessed
- 749 (over half) are declining
- 347 (1 in 4) are imperiled



Causes of native wild bee decline

1. Land-use change
2. Pesticides
3. Managed bee use
4. Pathogens
5. Invasive plants
6. Climate change

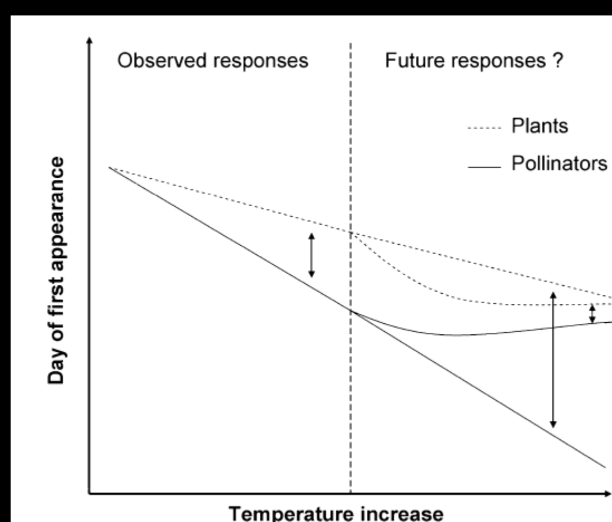

Land-use change


Pesticides

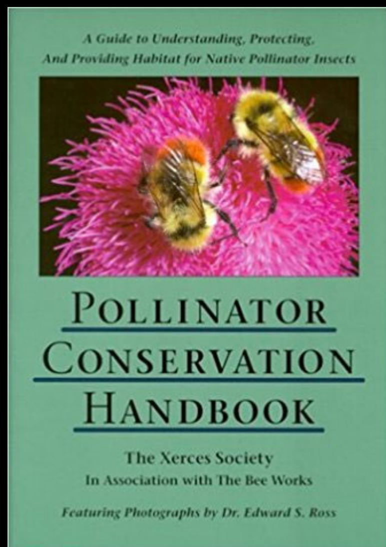
Invasive Plants and Pollinators

Climate Change

1. Change in flower density
2. Change in plant ranges
3. Change in flower timing
4. Plant-pollinator mismatch
5. Plant nutritional value



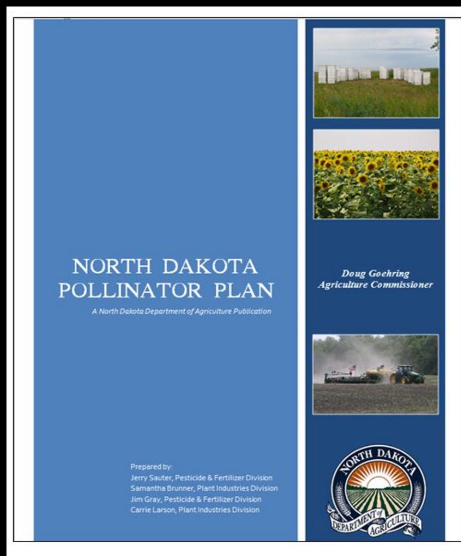
Pollinator Conservation



National Pollinator Protection Plan

1. Reduce honey bee colony losses
2. Increase monarch butterfly numbers
3. Restore or enhance millions of acres of land for pollinators

State Pollinator Protection Plans



Florida honey bee protection program: http://www.freshfromflorida.com/Business-Services/Bees-Apiary/Honey-Bee-Protection-in-Florida

What 3 new things did you learn about bees/pollinators?

Understanding *Nosema*

Cameron Jack
Entomology and Nematology Department
University of Florida

Learning Objectives for this Lesson

After completing this lesson, you should be able to:

1. Identify how *Nosema* show up in honey bee colonies.
2. Describe the biology of *Nosema spp*.
3. Discuss the importance of monitoring for *Nosema*.

Introduction to *Nosema*

Nosema ceranae at 400x magnification

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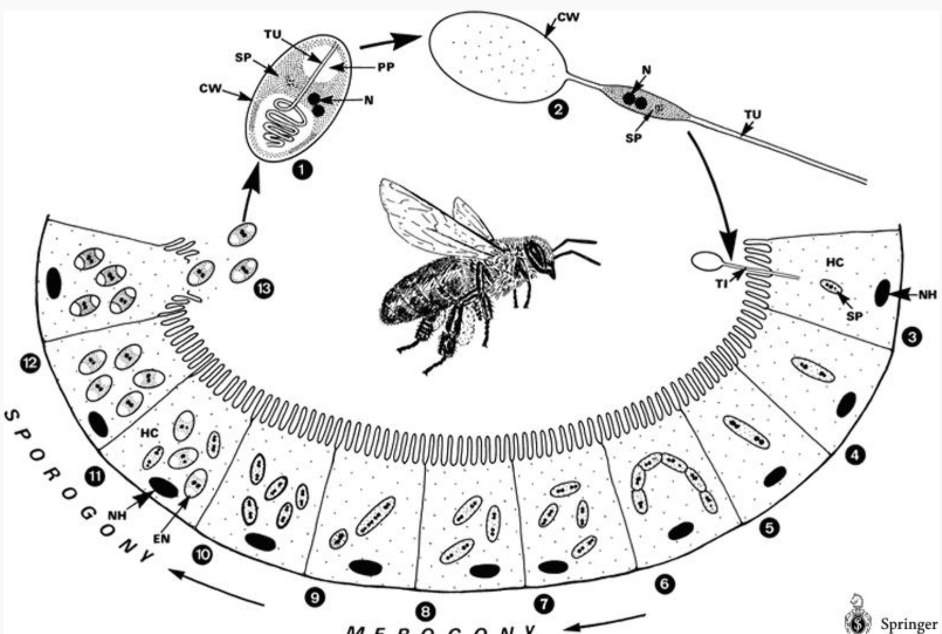

Honey Bee Research & Extension LABORATORY

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Illustration: © Springer Life

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Nosema species in Honey Bees (*Apis mellifera*)

Nosema apis

Nosema ceranae

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Effects of *N. ceranae* Infection

- *N. ceranae* disrupts protein metabolism
- Shortens lifespans
- Causes precocious foraging
- Decreases colony population
  - causes higher winter mortality
  - decreases honey production

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Effects of *Nosema ceranae* Infection

- *Nosema* and IAPV are shown to be correlated with CCD
- *Nosema* and Imidacloprid have synergistic effect.

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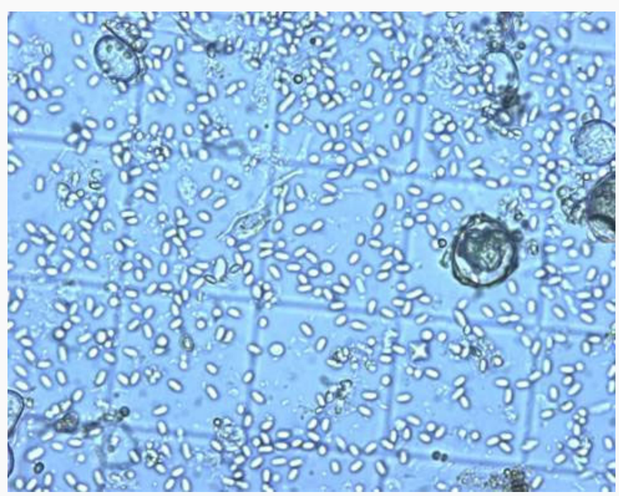
Nosema Identification and Monitoring

- Traditionally identified using light microscopy.
- Number of spores are estimated to determine colony infection status.
- Most protocols only sample forager bees from the hive entrance.



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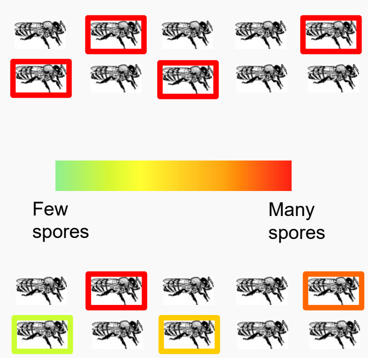
Understanding the colony level prevalence and intensity of *Nosema ceranae*

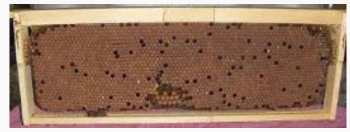
- Prophylactic treatment with fumagillin has dramatically increased hive management costs.
- More reliable *Nosema* sampling protocols will provide realistic view of colony infection level.

Understanding the colony level prevalence and intensity of *Nosema ceranae:* Research Objectives

1. Determine the prevalence and intensity of a *Nosema ceranae* infection at the colony level.



Experiment 1 Methods: Sampling Bees of Known Ages



50 bees collected from known ages:

1. Recently emerged
2. Nurse bees
3. Forager bees

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Experiment 1 Methods: Background Bee Collection

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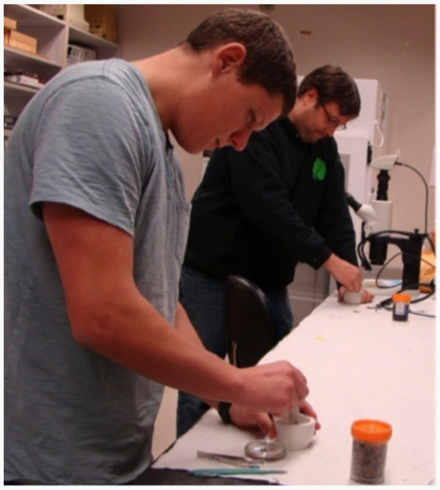
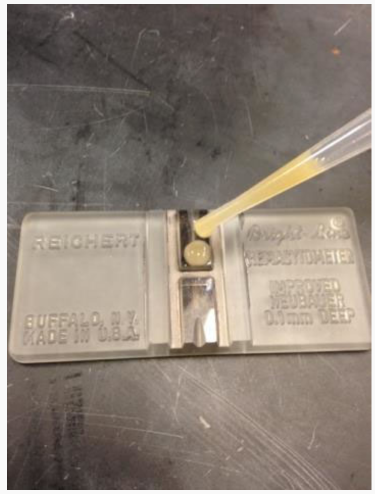
Experiment 1 Methods: *Nosema* Analysis





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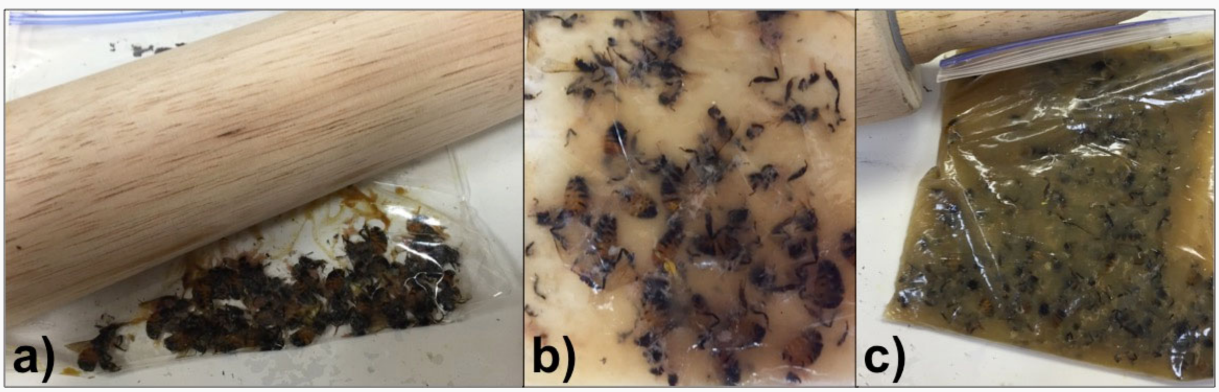
Monitoring



1 ml of water/bee (100 bees = 100 ml of water)

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Monitoring

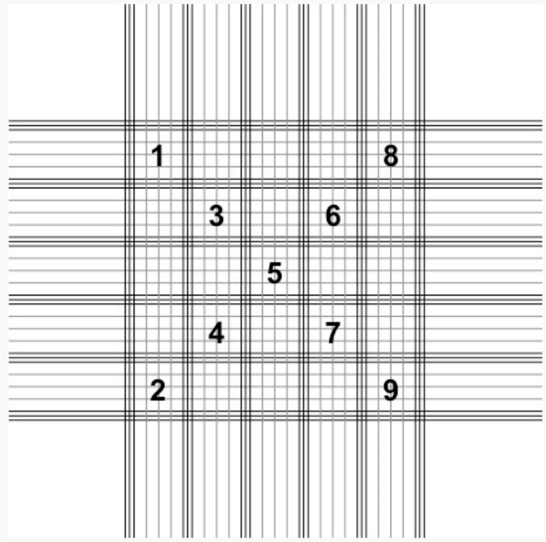
Calculation

There are 16 squares within each block (5 × 16 = 80). So the *# of squares counted* = 80.

In those 5 *blocks* you counted a total of 30 spores (the raw spore count 5 *blocks*)

30 × 50,000 = 1,500,000 (or 1.5 million) spores per bee

Action may be necessary over 1 mil.



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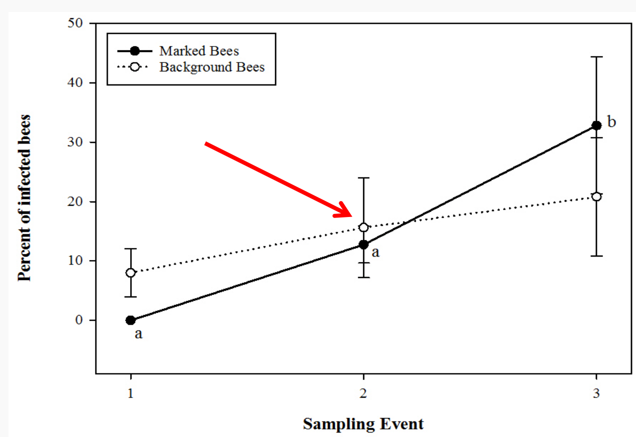
Experiment 1 Results: *N. ceranae* Prevalence

- *N. ceranae* not detected in recently emerged bees.
- Background bees were not different between sampling dates or from marked bees.



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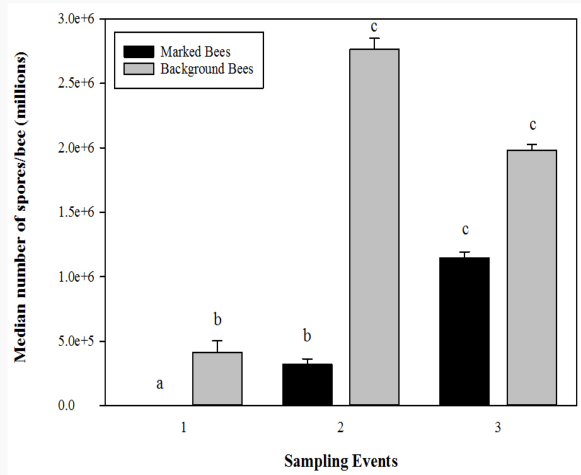
Experiment 1 Results: *N. ceranae* Intensity

- Median *N. ceranae* infection intensities were significantly different
- There is a large difference in spore intensity in the 2nd sampling events.
- No correlation (r = 0.29, $P > 0.05$) between the prevalence and intensity in a composite sample.



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Experiment 2 Methods: Creation of Nucleus Colonies

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Experiment 2 Methods: Creation of Nucleus Colonies

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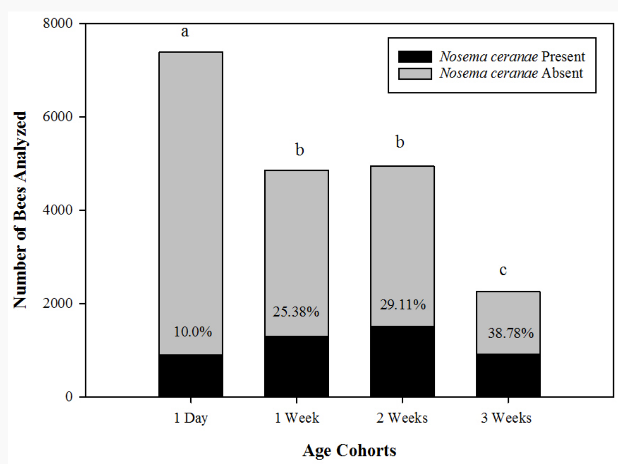
Experiment 2 Results: *N. ceranae* Prevalence

- *N. ceranae* prevalence did not depend on year
- Significant difference between some age cohorts



* Age cohorts are actually 2 weeks older at time of analysis

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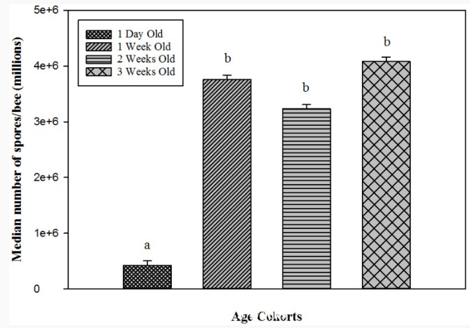
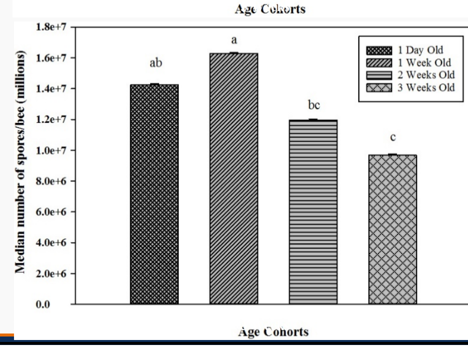
Experiment 2 Results: *N. ceranae* Intensity

- Intensity depended on the year
- Much higher *N. ceranae* intensities in 2014.

2013



2014



Understanding the colony level prevalence and intensity of *Nosema ceranae*

- Composite sampling is not effective.
- Prevalence and intensity are significantly influenced by age.
- Forager bees have the highest prevalence.
- Sampling the prevalence of individual bees of mixed ages may be more accurate.

Pollen nutrition dynamics in *Nosema ceranae* infection and survival in honey bees

- Several Oregon beekeepers suggested that feeding their colonies improved survival during *N. ceranae* infection.
- Not much is known concerning the relationship between nutrition and *N. ceranae*.

Honey Bee Nutrition

- Pollen is the main source of protein, lipids, vitamins and minerals.
- Pollen quality affects survival.
- Pollen deficiencies influence tolerance to stresses.

Honey Bee Nutrition

- Land management practices influence the forage available to bees.
- Rapid decline in pollen diversity in agricultural areas.
- Often confronted with lack of food diversity.

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Experiment 3 Experimental Design

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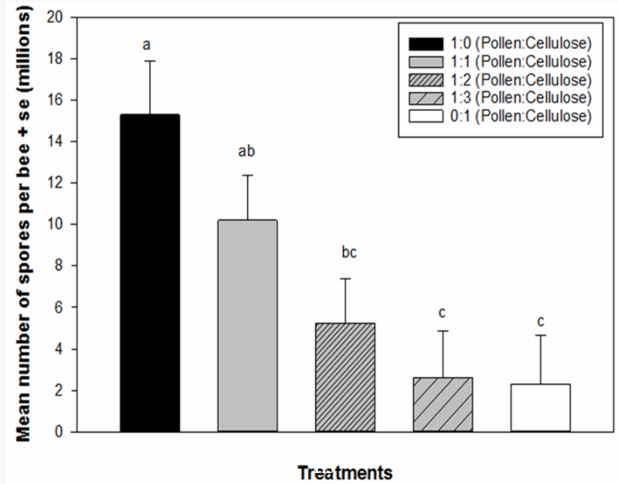
Experiment 3 Experimental Design

- 250 bees per cage
- 6 Treatments **Pollen : Cellulose** (Control, 1:0, 1:1, 1:2, 1:3, 0:1)
- Inoculated bees with *Nosema ceranae* via sugar syrup
- 6 Replicates
- 4 Weeks
- Collected 20 bees 16 days after inoculation for *Nosema*.

Experiment 3 Results: *N. ceranae* Intensity

- Significant differences in *Nosema* intensities
- Bees fed higher amounts of pollen had more spores than those with less pollen.
- No difference in *N. ceranae* prevalence



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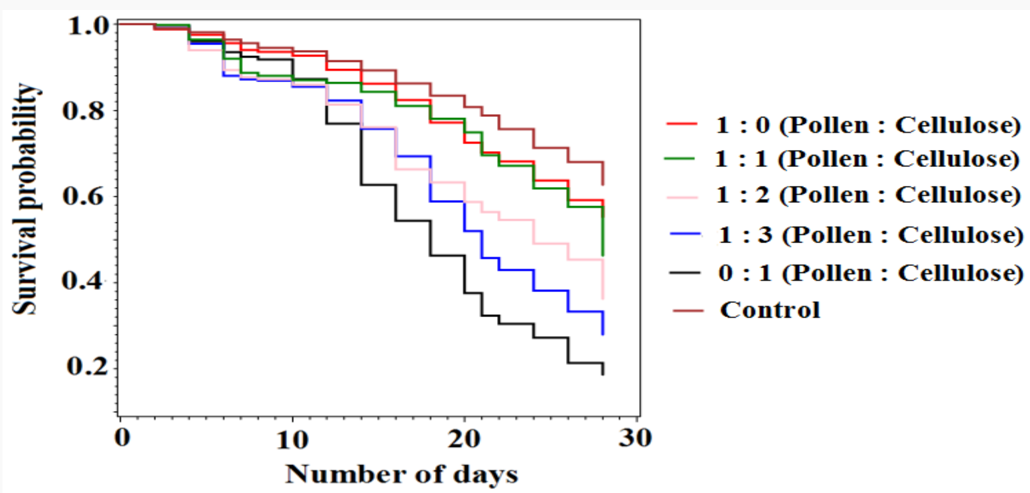
Experiment 3 Results: Honey Bee Survival



Control > 1:0 > 1:1 > 1:2 > 1:3 > 0:1 pollen: cellulose ratio diets

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Pollen nutrition dynamics in *Nosema ceranae* infection and survival in honey bees

- Shows that *Nosema* spore level may not indicate how sick bees actually are.
- Feeding colonies protein during periods of serious *N. ceranae* infection may increase colony survival.

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For more information visit:

UFhoneybee.com

cjack@ufl.edu

#Ufhoneybeelab

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Understanding Pesticide Labels

University of Florida
Master Beekeeper Program
Advanced level Training

- People who use pesticides have the **LEGAL** responsibility to read, understand and follow the label directions.
- **Protection of people and the environment from harmful effects of pesticides is based primarily on three factors.**

- Pesticides must be registered by the U.S. Environmental Protection Agency and FDACS before they can be sold or applied.
- Pesticide labels provide necessary information to pesticide users for safe handling.
- Pesticides must be used according to label instructions to achieve effective pest control and safe handling.

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Product name

- Every pesticide has a product name, brand name or trade name.

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GardStar® 40% EC

Type of Pesticide

- The label must indicate what type of pesticide the product is or what types of pests it will control.

Livestock & Premise Insecticide

- For Agricultural/Commercial, Vector Control Agency, Pest Control Operator Use Only.
- For Control of Flies, Lice, Mites, and Ticks on livestock and their premises.
- Can be used on Lactating and Non-Lactating Dairy Cattle and Goats, Beef Cattle, Sheep, Swine, Poultry and Horses.
- Can be used in all areas of Dairy Barns, including Milk Rooms.
- For Control of Fleas and Ticks on Dogs as spray, dip wash or dip tank.
- For Control of Fire Ants as a mound drench.
- For aid in Control of Small Hive Beetles around Honey Bee Hives.

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Types of Formulations

- E or **EC - Emulsifiable Concentrate**
- F, L, or FL - Flowables
  ULV - Ultra Low Volume
  D - Dusts
  B - Baits
  G - Granulars
- MC - Microencapsulated
  P or PS - Pellets
  W or WP - Wettable Powders
  S or SP - Soluble Powders
  DF - Dry Flowables
  WDG - Water Dispersable Granules
  WDL -Water Dispersable Liquids

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Types of Formulations

- ***Other less common formulations include:***
  AF -Aqueous Flowables
  AS - Aqueous Suspensions
  ES - Emulsifiable Solutions
  MTF -Multiple Temperature Formulation
  OL - Oil-soluble Liquids
  SL -Slurrys

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EPA Registration Number

- Indicates that the pesticide product has been registered and its label was approved for sale by the Environmental Protection Agency (EPA).

- **EPA Est. No. 39578-TX-1**
- **EPA Reg. No. 39039-8**

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EPA Establishment Number

- Identifies the facility that produced the product.
- **EPA Est. No. 39578-TX-1**
- **EPA Reg. No. 39039-8**

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Manufacturer Name and Address

- Provides the manufacturer's contact information in case you want more information about the product,
- Safety Data Sheet (SDS) that provides detailed toxicity information, chemical properties, and precautions needed for emergency personnel.

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- **Nac No.** 13440070
- **Y-TEX CORPORATION**
  1825 BIG HORN AVENUE, P.O. BOX 1450, CODY, WY, 82414
  Telephone: 800-443-6401
  Website: www.ytex.com
  Email: ytexinfo@ytex.com

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Ingredient statement

- Each pesticide label must include the active and inert ingredients in the product. The statement shows what the active ingredients are and the amount of each.
- The ingredient statement must list the official chemical names or common names for all active ingredients.
- Inert ingredients need not be named, but the label must show what percent of the total contents they comprise.

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Active Ingredients:

Permethrin* (3-Phenoxyphenyl)methyl(±)cis/trans3-(2,2-dichloroethenyl)-2,2-dimenthylcyclopropanecarboxylate.	40%
Inert Ingredients**	60%
Total:	100%

**cis/trans ratio: Min. 35%(±)cis and Max. 65%(±) trans*

***Contains Petroleum Distillate.*

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Keep out of reach of children KOOROC

- Keep out of reach of children statement is required on all pesticide containers.
- Keep pesticides and other home products out of the reach of children and pets.

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Signal word

- **DANGER-POISON** along with a skull and crossbones symbol: products are highly toxic and potentially *deadly* at low doses.
  Danger-Poison will always be in red.
- **DANGER** (no poison) products are corrosive and can cause irreversible eye damage or severe skin injury.
- **WARNING** products are moderately toxic or can cause moderate eye or skin irritation.
- **CAUTION** products are slightly toxic or may cause slight eye or skin irritation.

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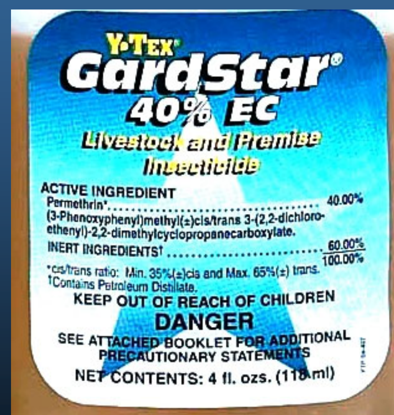
Net Contents

- The amount a full container holds.



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First Aid or
Statement of practical treatment

- Statement of practical treatment lists the first aid treatment for someone accidentally exposed to a pesticide
- ALWAYS call the National Poison Center Hotline (1-800-222-1222)

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- **Statement Of Practical Treatment:**

  If Swallowed: Call a physician or Poison Control Center. Do not induce vomiting. Drink promptly a large quantity of milk, egg-whites, gelatin solution, or, if these are not available, drink large quantities of water. Avoid alcohol. This product contains a petroleum distillate and may pose an aspiration hazard.
- **If In Eyes:** Hold eyelids open and flush with a steady, gentle stream of water for 15 minutes. Get medical attention.
- **If On Skin:** Remove contaminated clothing and wash affected areas with plenty of soap and water. Get medical attention if irritation persists.
- **If Inhaled:** Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

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Note to physician

- Note to physician provides emergency medical personnel with poison treatment information and suggests antidotes. It often provides an emergency phone contact for further information.

- ***Note To Physician:*** This product contains a pyrethroid and a petroleum solvent. The possibility of aspiration pneumonia must be considered. The product can cause severe eye damage; ophthalmology consultation recommended. Probable mucosal damage may contraindicate the use of gastric lavage.
- In case of medical emergencies or health and safety inquiries, or in case of fire, leaking or damaged containers, information may be obtained by calling: 1-800-255-3924 (CHEM-TEL, INC).
- For product information, call 1-307-578-0240 (Y-Tex Corp.).

Precautionary statements

- Precautionary statements identify potential hazards and recommend ways to minimize or avoid risks.
- Types of precautionary statements include
  - "Hazards to Humans and Domestic Animals,“
  - "Environmental Hazards,"
  - "Physical or Chemical Hazards."

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Hazards to humans and domestic animals

- The signal word is listed, followed by statements indicating which routes of entry (month, skin, lungs, eyes) are the most likely routes of exposure which result in harm and must be particularly protected.
- The label indicates whether the major concern is irritation, corrosiveness, or illness. The label provides specific actions that can prevent overexposure to the pesticide.
- *Protective clothing and equipment* required to handle or apply the pesticide is listed here, as are laundering instructions.

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- **Danger:**
  Corrosive. Causes irreversible eye damage. Do not get in eyes, or on clothing. Wear goggles, face shield or safety glasses. Harmful if swallowed. Avoid contact with skin. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse. Certain medications can interact with pesticides. Consult a veterinarian before using on medicated animals. Do not use this or any other pesticide on sick, old or debilitated animals.

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Environmental hazards

- Environmental hazards section of the label warns of pesticide risks to wildlife, birds, fish, bees or to the environment, including water quality.
- It provides practical ways to avoid harm to organisms and the environment.

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- **Environmental Hazards:**
  This product is extremely toxic to fish and other aquatic organisms. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the high water mark. Drift and runoff from treated areas may be hazardous to aquatic organisms in treated areas. Do not contaminate water when disposing of equipment washwaters. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds while bees are actively visiting the treatment area.

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Physical Hazards

- **Physical Hazards:**
  Do not use or store near heat or open flame.

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Directions for use

- "It is a *violation of Federal law* to use this product in a manner inconsistent with its labeling."
- Pests which the manufacturer knows the product controls;
- Crop, animal, or site which the product is approved for use;
- When, where, how, and in what form the product may be applied;

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Directions for use

- Proper application equipment to use;
- Correct dosage;
- Mixing directions;
- Compatibility with other often used products;
- Re-entry time - Minimum time between the application and entry into the treated area for unprotected persons; and
- Possible plant injury problems.

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Target Species	Use	Dilute (No. Treated)	Application Rate
For Aid in Control of the Small Hive Beetle, Aethina tumida.	Sprinkler can.	5 ml to 1 gal. water. 0.05% AI.	For treatment of existing infestations, apply as soon as beetles or larvae are observed in or around the hive. Thoroughly wet ground in an area 18-24 inches wide in front of each hive (1 gal. per 6 hives). Apply in late evening after bees become inactive.
	Sprinkler can, hand pump sprayer or other low pressure sprayer.	5 ml to 1 gal. Water. 0.05% AI	For pre-placement cleanup of apiary, apply to entire ground surface 24-48 hrs. prior to hive placement.

- **Note:** Permethrin is highly toxic to bees and extreme caution must be taken to avoid contact by spray or spray drift with the bees, hive, or any other surfaces that bees may contact. When hives are present, applications may only be made with a sprinkler can.
- Hand pump sprayers may only be used when hives are not present and only for pre-placement cleanup of apiary. Do not contaminate any water or food source that may be in the area or apply during windy conditions. For better soil penetration and improved efficacy, cut grass around hive prior to application.

Directions for use

- Labels for pesticides used on food plants often list the days-to-harvest or preharvest interval (PHI), which is the minimum number of days between the last pesticide application and crop harvest.

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Storage and disposal

- All pesticide labels contain general instructions for the appropriate storage and disposal of the pesticide and its container.

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- **Storage and Disposal:**
  Do not contaminate water, food or feed by storage or disposal.
- Pesticide Storage And Spilt Procedures: Store upright at room temperature. Avoid exposure to extreme temperatures. In case of spill or leakage, soak up with an absorbent material such as sand, sawdust, earth, fuller's earth, etc. Dispose of with chemical waste.
- Pesticide Disposal: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your state Pesticide or Environmental Control Agency, or the Hazardous Waste Representative at the nearest EPA Regional office for guidance.
- **Container Disposal:**
  Do not reuse empty container. Wrap container in several layers of newspaper and discard in trash.

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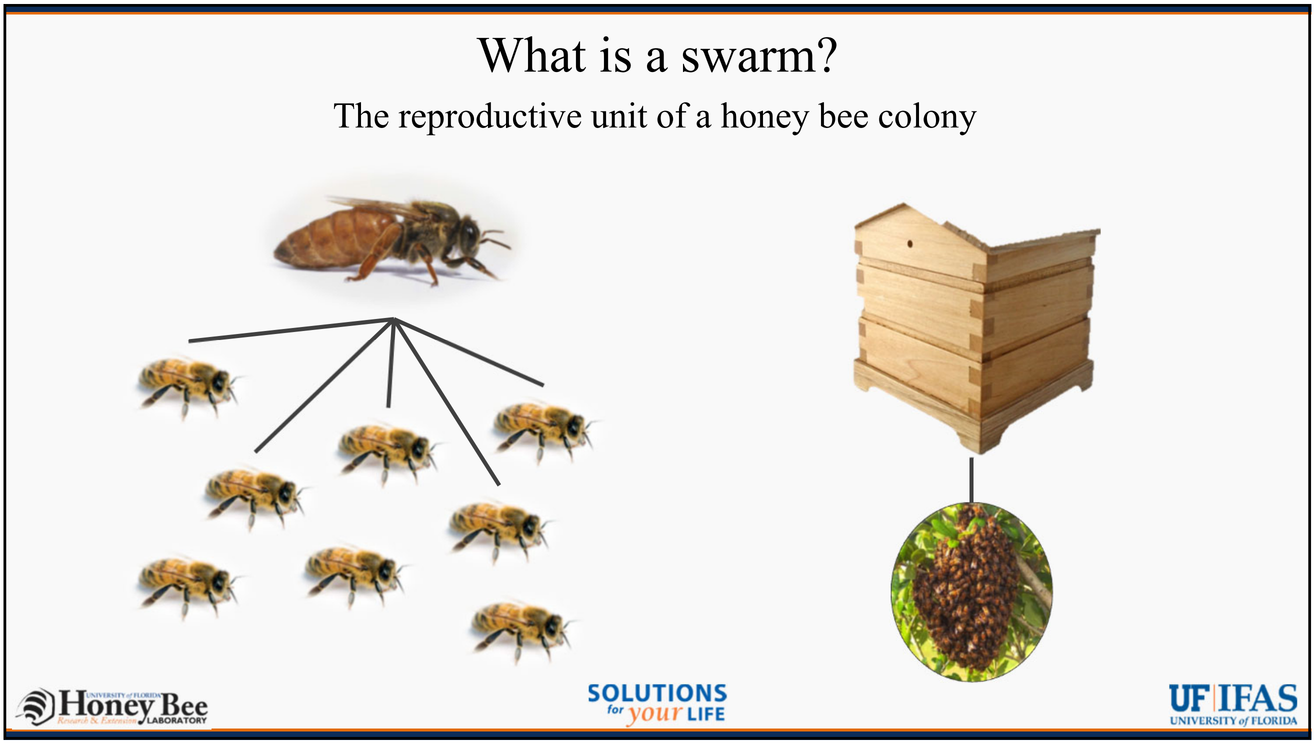
Understanding Swarming and How to Control It

Brandi Simmons
Florida Department of Agriculture
Division of Plant Industry

Learning Objectives for this Lesson

After completing this lesson, you should be able to:

1. Identify the factors that can stimulate a colony to swarm.
2. Recognize five ways to help prevent honey bee swarming:
   – Provide adequate brood space
   – Equalize colonies
   – Create splits
   – Clip queen
   – Requeen


What is a swarm?
The reproductive unit of a honey bee colony
Honey Bee
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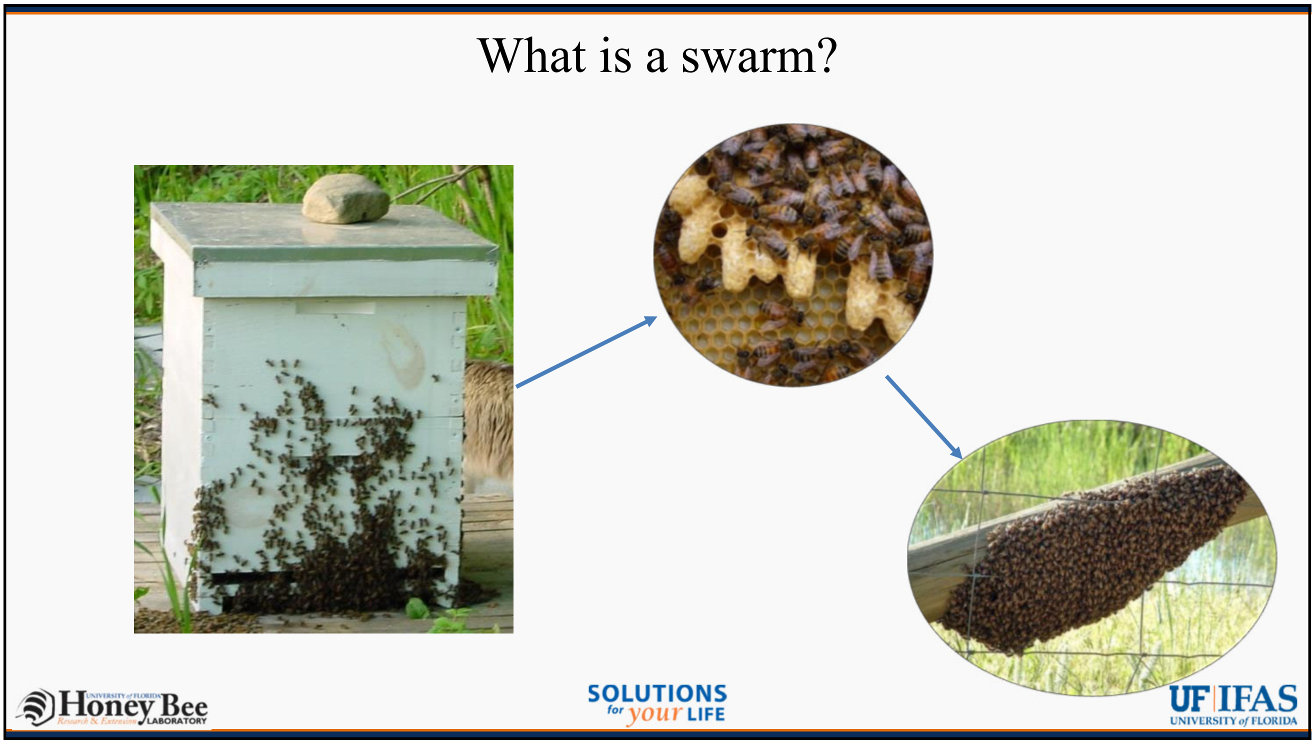
What is a swarm?
Honey Bee
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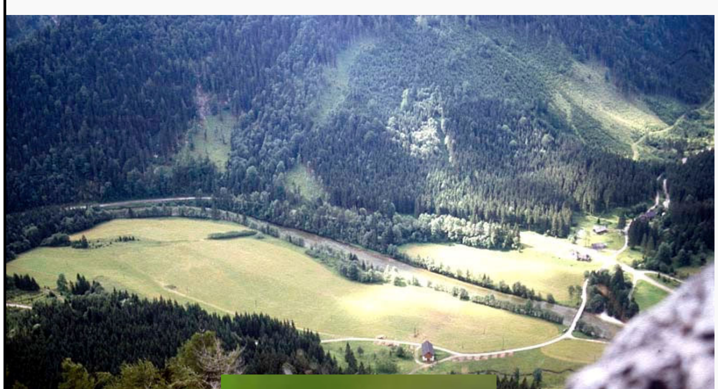
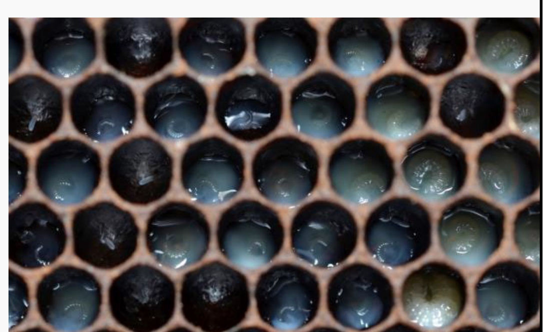
Meanwhile in the Colony

Meanwhile in the Colony





Why do we care about swarming?

Decreases productivity of your colony.

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Why do we care about swarming?

Decreases productivity of your colony

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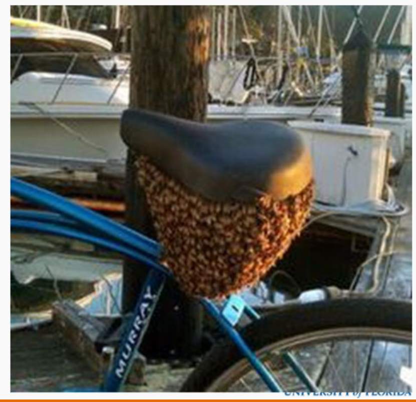
Why do we care about swarming?

Produces feral honey bee colonies that could be a nuisance in your community



What stimulates a colony to swarm?

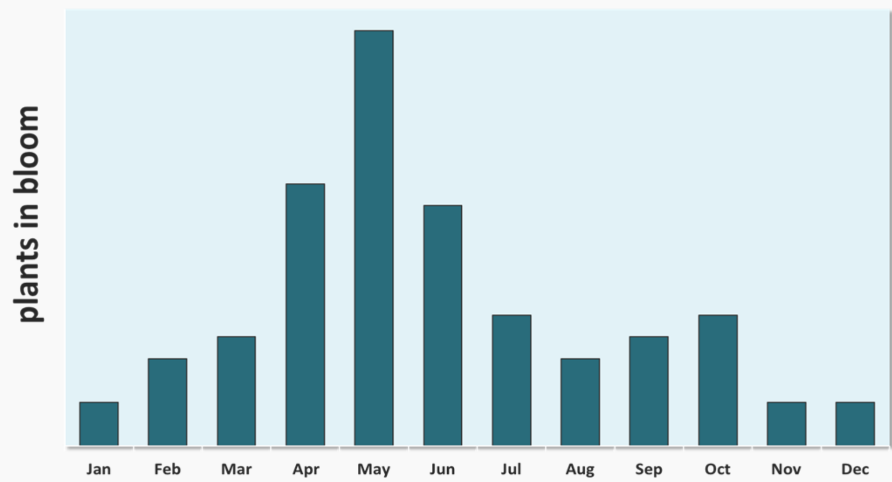
Congestion

Lack of open cells

Queen Mandibular Pheromone

When will a colony swarm?

Be mindful of your regional swarm season



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How to Prevent Swarming

Clip Queens

(~1/3 of 1 forewing)

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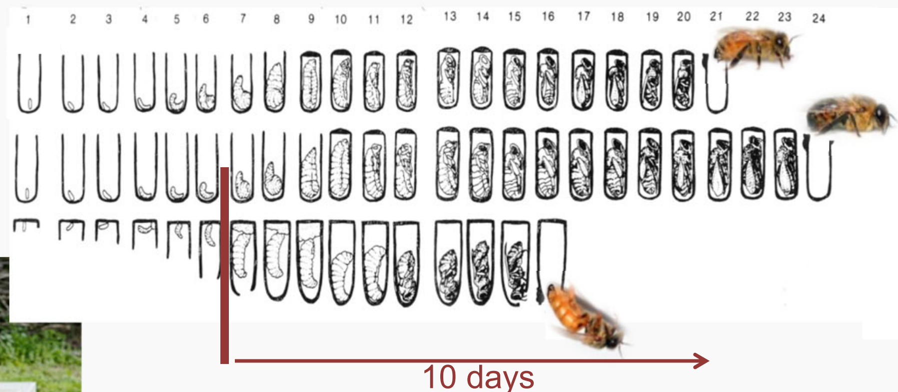
How to Prevent Swarming

Inspect your hive every 7-9 days



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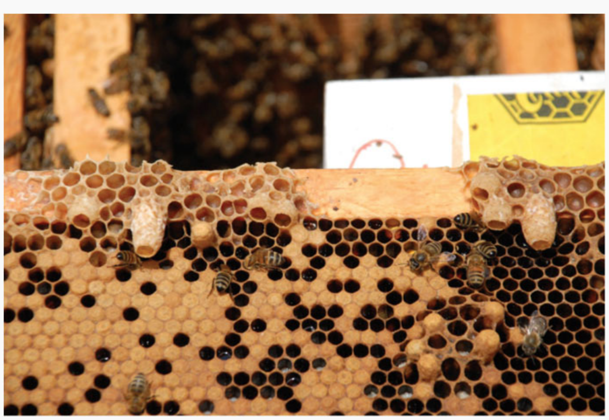
How to Prevent Swarming

What to look for: Queen Cells

Cells vs Cups



Supersedure

Swarm

Honey Bee LABORATORY

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How to Prevent Swarming

What to do:

Cut uncapped queen cells

Determine if colony has already swarmed

How to Prevent Swarming

What to look for: Crowding

How to Prevent Swarming

What to do:

Add a super

Rotate combs

Equalize colonies

How to Prevent Swarming

What to do:

– **Make a Split**

5 x

How to Make a Split

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How to Make a Split

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Parent Colony:

Foundation
Foundation
Foundation
Pollen/Honey
Brood
Brood
Brood
Pollen/Honey
Foundation
Foundation

New Nuc:

Pollen/Honey
Brood
Brood
Brood
Pollen/Honey

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How to Make a Split

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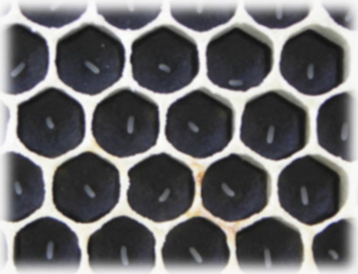
Relocate the Split?

Split Remains in Apiary

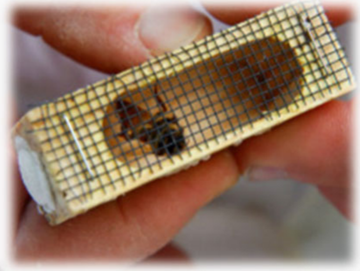
Pollen/Honey
Brood
Brood
Brood
Pollen/Honey

Requeening the Parent Colony



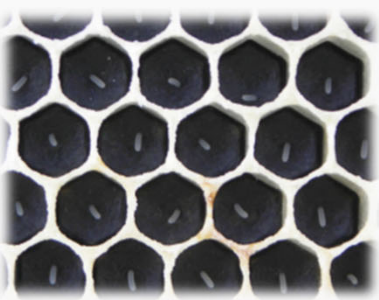
From Eggs

From Cells



Mated Queen

From Eggs (30-38 days)



From Swarm Cells (21–30 Days)

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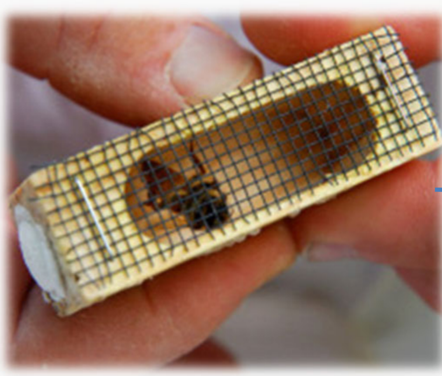
From Mated Queen

Queen caged for 3-4 days
~1 day after release



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Questions?

www.ufhoneybee.com

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The Melitto Files Blog

Brandi.Simmons@FreshFromFlorida.com

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ENY155

Florida Master Beekeeper Program Requirements[1]

James D. Ellis, Jerry Hayes, Catherine Zettel Nalen, William H. Kern, Ray Zerba, Brad Burbaugh, and Jeanette Klopchin[2]

Requirements and General Information (MBP Manual)

The Master Beekeeper Program (MBP) is a five-year (minimum) beekeeper training and certification program provided by the University of Florida. One must already be a beekeeper to enter the program (please see apprentice requirements, below). Entry into the program is attained by meeting the apprentice requirements and passing the apprentice examinations on exam day. There is no age limit for entry into the program although the examination may be too difficult for children under 12 years of age. All students must enter the program at the Apprentice Beekeeper level and no students are permitted to skip levels.

The program offers four levels of training and advancement: Apprentice Beekeeper, Advanced Beekeeper, Master Beekeeper, and Master Craftsman Beekeeper. All ranks take a minimum of one full year to complete with the exception of Master Level, which takes two years. Opportunities for advancement in the program only occur on exam days, upon meeting all the requirements for the level of advancement which one is trying to obtain.

The MBP trains and educates beekeepers on new techniques, equipment, potential problems, and tips and tricks to improve their beekeeping skills. Perhaps most importantly, it keeps beekeepers around the state and country connected. MBP participants serve as bee ambassadors to beginning beekeepers, the public, and our community, by teaching and serving as an extension of the UF Honey Bee Research and Extension Laboratory (HBREL).

Examinations are held twice a year and all dates are announced in our quarterly newsletter, the Melitto Files, as well as on our website, www.UFhoneybee.com. Our spring examinations are held the Thursday before the annual UF Bee College, during the University of Florida's spring break (generally, this falls in the first two weeks of March). Our fall examinations are held the Thursday before the annual Florida State Beekeepers Association (FSBA) Convention (generally the last two weeks of October) (www.floridabeekeepers.org).

The training and examination day consists of two parts: material review and examinations. In the morning (8 am–12 pm) there are review lectures on important beekeeping topics and in the afternoon there are the written and practical examinations (2 pm–6 pm). The exam days are when Advanced, Master, and Master Craftsman Beekeepers submit their required documentation of public service work to the MBP board. Please see Appendix F for examination information. Additionally, we hold award ceremonies to recognize all those individuals who have passed the exam at

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2. James D. Ellis, associate professor, Department of Entomology and Nematology; Jerry Hayes, former state bee inspector, Florida Department of Agriculture and Consumer Services; Catherine Zettel Nalen, former Extension assistant, Department of Entomology and Nematology; William H. Kern, associate professor, Department of Entomology and Nematology, UF/IFAS Ft. Lauderdale Research and Education Center; Ray Zerba, emeritus Extension agent IV, UF/IFAS Extension Clay County; Brad Burbaugh, former Extension agent I, UF/IFAS Extension Duval County; and Jeanette Klopchin, Extension technician, Department of Entomology and Nematology; UF/IFAS Extension, Gainesville, FL 32611.

that season's respective conference. In spring we do this at the Bee College awards ceremony and in the fall we do this at the FSBA's banquet dinner. Attendance at these award ceremonies is not required, but is encouraged (information is always announced on www.UFhoneybee.com).

On the next two pages are lists of requirements necessary for a candidate to fulfill in order to achieve each level in the Master Beekeeper Program. It is important that candidates read the requirements closely and make certain that all requirements are met in order to advance in the program. Additional program stipulations (program status, limitations, guidelines, and re-tests) are now listed in Appendix G. Master Beekeeper of the Year requirements and information are listed in Appendix H. Please refer to the summary table on the last page of this document for more information and for MBP board member information.

If at any point you wish to discontinue the program, please contact a board member directly. Please also be sure to keep us informed of your current mailing address, email address, and phone number in case we need to contact you during your enrollment.

I) Apprentice Beekeeper

A. must be a Florida registered beekeeper or a registered beekeeper in home state, registered either individually or as a member of a family.

B. must own at least one colony of honey bees for at least one full year.

C. must score 70% or higher on a written examination. The written test can include but is not limited to materials covered during previous UF Bee College lectures and labs, information on the Florida Department of Agriculture and Consumer Services-Division of Plant Industry (FDACS-DPI) Apiary website (http://www.freshfromflorida.com/Agriculture-Industry/Search-by-Industry/Bees-Apiary/Apiary-Inspection) or the UF Honey Bee Research and Extension Laboratory (HBREL) website (www.UFhoneybee.com), and material from books/other literature on the Apprentice Beekeeper reading list (see Appendix E).

D. must score 70% or higher on a practical examination. The practical examination *can* include but is not limited to describing the physical parts of a beehive (common terms, not regional nomenclature); lighting and properly using a smoker; recognizing the various stages of brood, different castes of bees, and finding or at least describing the queen; differentiating between brood, pollen, and capped honey; recognizing propolis and describing its functions; describing the layout of a brood nest (placement of honey, pollen, and brood), etc.

II) Advanced Beekeeper

A. must have held the Apprentice Beekeeper rank at least one full calendar year and have been a practicing beekeeper for at least two years. Also, must be a Florida registered beekeeper or a registered beekeeper in home state.

B. must show proof of having passed six computerized honey bee training modules (with a score of 80% or higher on each). These will be available at participating county Extension offices throughout Florida, online (at www.UFhoneybee.com, click "Extension," then "Master Beekeeper Program," and scroll down to "modules"), or by request to the UF Honey Bee Research and Extension Laboratory. They will include modules on (1) honey bee pests/parasites/pathogens, (2) honey bee anatomy and behavior, (3) pollination biology, (4) pesticides and honey bees, (5) African honey bees, and (6) honey judging.

C. must score 70% or higher on a written examination. The written test *can* include but is not limited to materials covered during previous UF Bee College lectures and labs, information on the FDACS-DPI Apiary website (http://www.freshfromflorida.com/Agriculture-Industry/Search-by-Industry/Bees-Apiary/Apiary-Inspection), or the HBREL website (www.UFhoneybee.com), Melitto File articles, and material from books/other literature on the Advanced Beekeeper reading list (see Appendix E). This examination will cover more information than that required at the Apprentice Beekeeper level. The testable material will closely adhere to information taught in the computerized honey bee training modules ("B" above).

D. must score 70% or higher on a practical examination. The practical examination can include but is not limited to: identifying pests, parasites and pathogens; reading pesticide labels and determining which is the safest to use around bees; identifying several beekeeping items; examining honey labels for errors; distinguishing between bees, wasps, hornets, etc.; and identifying anatomical structures of a bee, flower, etc.

E. must perform and be able to document participation in five public service credits (see Appendix A). The Public

Service Credit Documentation Form is only a supporting document and should not be the only evidence of a completed PSC. Please see Appendices A and G for documentation guidelines and Addendum 1 for the form.

III) Master Beekeeper

A. must have held the Apprentice and Advanced Beekeeper ranks one year each and have been a practicing beekeeper for at least three years. Must be a Florida registered beekeeper or a registered beekeeper in home state.

B. must demonstrate/document 10 additional public service credits beyond that required for the Advanced Beekeeper level (see Appendix A). Please see Appendices A and G for documentation guidelines and Addendum 1 for the form.

C. choose and declare major (see Appendix C) and demonstrate/document expertise in 3 of 10 credits within the major. We refer to these as "major credits." Please see Appendix G for documentation guidelines and Addendums 2 and 3 for the forms.

D. must demonstrate/document expertise in five credits outside the major. We refer to these as "core credits." The core credits can be chosen from Appendix B or students may choose non-overlapping credits from other majors to fulfill core credits. Please see Appendix G for documentation guidelines and Addendum 3 for the form.

E. must score 70% or higher on a written examination. The written examination can include but is not limited to materials covered during previous UF Bee College lectures and labs, information on the FDACS-DPI Apiary website (http://www.freshfromflorida.com/Agriculture-Industry/Search-by-Industry/Bees-Apiary/Apiary-Inspection), the HBREL website (www.ufhoneybee.com), and material from books/other literature on the earlier reading lists.

IV) Master Craftsman Beekeeper

A. must have held the Master Beekeeper rank at least two years and have been a beekeeper at least five years. Must be a Florida registered beekeeper or a registered beekeeper in home state.

B. must have 15 additional public service credits beyond that required for a Master Beekeeper (see Appendix A). "Extra" public service credits obtained while certifying for the Master Beekeeper level cannot be applied to the 15 total public service credits needed to achieve Master Craftsman status. Please see Appendices A and G for documentation guidelines and Addendum 1 for the form.

C. must satisfy five additional new credits toward declared major for a total of eight "major" credits (three credits having been completed in the Master Beekeeper level). We refer to these as "major credits." Students changing majors must re-declare the new major with the MBP board or advisors and still satisfy eight total credits toward the new major unless previously acquired credits overlap with the new major.

D. must demonstrate expertise in eight additional new credits outside declared major for a total of 13 "core credits" (five credits having been completed in the Master Beekeeper level). The core credits can be chosen from Appendix B, or students may choose non-overlapping credits from other majors to fulfill core credits. Please see Appendix G for documentation guidelines and Addendum 3 for the form.

E. must demonstrate communication skills (see Appendix D).

F. must pass an oral examination. Nominee is tested by at least three individuals on the review board. The candidate is tested on one specific area of his or her choice (major) as well as on general knowledge of those areas related to honey bees and beekeeping.

G. must develop and execute a UF (or other university), FDACS-DPI, or USDA-affiliated research project or UF/IFAS Extension affiliated Extension program. We require that you identify an individual within one of these institutions to advise you throughout the project. Master Craftsman candidates will spend a minimum of two years at the Master Level. Please see Appendix I for project/program guidelines.

Appendix A

Public Service Credit Requirements

(ADVANCED, MASTER, AND MASTER CRAFTSMAN LEVELS)

Candidates for the Advanced Beekeeper rank or higher must document a certain number of public service credits. "Public service" is defined as volunteer service or educational activity oriented around bees and beekeeping and conducted for the benefit of the public (non-beekeeping audience). Educational activities in conjunction with commercial ventures generally do not qualify (i.e., selling honey).

One public service credit (PSC) equals a single, documented event of a qualified public service. Multiple repetitions of a particular activity may count, but only if they involve separate events or invitations. For example, two presentations to fifth-grade science classes may qualify as two PSCs but not if they are two successive class periods on the same day to the same audience.

The key to PSCs is adequate documentation of the event. Primary documentation is represented by original media: conference programs, testimonial letters from third parties, newspaper clippings, photographs, or video recordings. Secondary documentation may lack material evidence of the activity, but must at least include a written statement with the title of the event, date, place, time topic, target clientele group and number attended, description of the activity, and its outcome. In general, documentation must be material evidence, in writing; and more detail is better than less. Board members reserve the right to accept or reject documentation during program audits. Candidates for Advanced Beekeeper must present documentation to the Master Beekeeper Program Board prior to taking the written examination. Please see Appendix G for documentation guidelines and Addendum 1 for the form.

The following activities are pre-approved for satisfying PSC requirements. Other activities may be admissible, but candidates are advised to contact program officers about specific cases.

1. Presenting a bee-related lecture or workshop to non-beekeeping group (youth or adult).

2. Holding office in a local beekeeping association.

3. Assisting members of youth organizations (4-H, Scouts, FFA), etc. with project work.

4. Mentoring a new beekeeper through at least one complete season.

5. Giving a public demonstration on beekeeping topic at fair, festival or similar public event

6. Providing a hive of bees to pollinate a public garden.

7. Establishing and maintaining an observation hive for school or civic group.

8. Becoming an expert contact on bee-related questions for a UF/IFAS County Extension office (see points below).

- Must contact your county agent *and* the MBP board to offer your expertise.
- Must have scored an average of 80% on most recent practical and written exams (contact the HBREL for confirmation and we will forward scores to your agent).
- Must be a beekeeper in the county for which you have been appointed an expert contact (counties may have multiple expert contacts).
- Must follow BMPs for keeping European colonies (have an inspector document your participation).
- Must provide a clear channel of communication open to the county, the agent, and the public (e.g., telephone, email, social media, etc).
- Must receive a positive evaluation from Extension agent stating: your dates of service, the value of your performance to the office, and the approximate time you dedicated to position, and any additional comments.

(It may be possible to act as an expert contact for another municipal agency. Appointments are at the discretion of the MBP board and the agency in question.)

Appendix B

Core Credits

Core Credit Requirements—Advanced Beekeepers must document completion of five credits outside their major before they can be considered for advancement to the Master Beekeeper level. Master Beekeepers must complete an additional eight core credits for a grand total of 13 core credits to qualify for Master Craftsman level. You can choose any of the following credits not in your declared major to fulfill this requirement. You may choose non-overlapping credits from other majors to fulfill your core credits. A form to document your core credits is available in Addendum 3.

1. Winning first or second place in an authorized competition in extracted honey, comb or cut-comb honey, crystallized (spun or creamed) honey, or beeswax.

2. Publishing an article in a beekeeping publication (excluding newsletters).

3. Publishing an article in a non-beekeeping publication (with at least state-wide distribution).

4. Being recognized as a beekeeping authority in your local area by appearing on radio or television.

5. Documenting training in life-saving treatment of persons suffering from allergic reactions to insect stings.

6. Attending at least three beekeeping meetings (these must be regional, multi-state, national or international).

7. Conducting a program or workshop at a state, regional, national or international meeting or convention.

8. Demonstrating competence in small-scale queen rearing.

9. Completing a course on artificial queen insemination.

10. Acquiring private pesticide applicator's license.

11. Show evidence that you maintain a legally licensed honey processing facility.

12. Participating/volunteering in a beekeeping research or Extension project at an approved institution.

13. Acquiring other certified bee-related training as approved by the MBP board.

14. Serving two or more years as an officer in a bee organization at state level or higher (need not be consecutive nor in the same organization).

15. Documenting culture/maintenance of other bee species (bumble bees, halictids, etc.).

16. Mentoring a beekeeping group in a rural/underprivileged/international community.

17. Acquiring international beekeeping experience with clear, documented benefits to the international group and to Florida.

18. Maintaining a public blog, public journal, or public forum on honey bees. The resource must be informative; science-based, easily accessible, and advertised; and you must be able to show the number of site visits it receives during the year.

19. Volunteering at least 40 hours with a commercial beekeeper or organized university apiary.

** Some bee-related activities not listed above may also be determined to fulfill the core credit requirements. Consult the MBP board prior to activity.

Appendix C

Majors and Major Credits

Major Credit Requirements—Advanced Beekeepers must document completion of three credits within their major before they can be considered for advancement to the Master Beekeeper level. Master Beekeepers must complete an additional five major credits for a grand total of eight major credits to qualify for Master Craftsman level. Beekeepers must be able to document activities—contact the MBP board if you have questions about any of the requirements. Other suggested majors/credits will be considered. A major must be declared to the board before achieving Master Beekeeper status. A form to declare your major is available in Addendum 2. A form to document your major credits is available in Addendum 3.

1. **Diagnosis and treatment of honey bee pests, parasites, and pathogens**

   a. Pass (with a score of 70% or higher) a tutorial on diseases of the honey bee.

   b. Pass (with a score of 70% or higher) a tutorial on pests/parasites of the honey bee.

   c. Present a lecture on bee pests/diseases at state beekeepers meeting or higher.

   d. Switch to and document use of IPM (integrated pest management) in personal beekeeping operation.

   e. Serve as "local expert" and assist other beekeepers in proper disease/pest diagnosis in their colonies.

   f. Acquire a pesticide applicator license.

   g. Create reference collection (sterile) of bee pests and diseases.

   h. Research and review one pest or disease of honey bees. The review will be published on the HBREL's website. The written review must be accompanied by a slide show presentation.

   i. Pass (with a score of 70% or higher) a practical, hands-on examination of bee pests/diseases.

   j. Document attendance at three training workshops on bee pests/diseases.

2. **Pollination ecology and bee botany**

   a. Provide pollination services to a gardener (not yourself) or commercial fruit/nut/vegetable grower. (Must document.)

   b. Plant a bee-friendly garden in a public area (such as library, town square, etc.).

   c. Present a lecture on pollination ecology or bee botany at a state, regional, national, or international beekeepers meeting.

   d. Produce a handout to describe local honey production plants and when they bloom for local (county or regional) clientele.

   e. Pass (with a score of 70% or higher) practical examination on bee plants.

   f. Research and review one plant that is a major honey production plant in Florida. The review will be published on the Honey Bee Research and Extension Laboratory's website. The written review must be accompanied by a slide show presentation.

   g. Become a certified Florida Master Gardener.

   h. Document training in the identification of pollen present in honey samples.

   i. Document work educating the general public about pollinators.

   j. Create a museum-quality plant collection of regional honey production plants.

3. **Honey judging**

   a. Judge a honey show (state level or higher).

   b. Become a certified Welsh Honey Judge at UF Bee College or the Young Harris Institute in Georgia.

   c. Win first or second place in any category at a state or higher level honey show.

   d. Document ability to produce mead.

   e. Pass (with a score of 70% or higher) a practical examination on honey judging.

   f. Research and review one type of honey important to the Florida beekeeping industry. The review will be published on the HBREL's website. The written review must be accompanied by a slide show presentation.

   g. Educate the public about hive products and their uses at a fair booth or similar event.

   h. Show evidence that you maintain a Florida licensed honey house.

   i. Document training in the identification of pollen present in honey samples.

   j. Document knowledge of honey production/processing and other products of the hive.

4. **Beekeeping for rural development**

   a. Document knowledge of alternative methods of queen rearing.

   b. Pass (with a score of 70% or higher) a practical, hands-on examination of bee pests/diseases, including non-chemical control of these disorders.

   c. Document knowledge of honey production/processing and other products of the hive, including value adding theory.

   d. Demonstrate proficiency in hive equipment assembly.

   e. Demonstrate proficiency in another language

   f. Volunteer for a nonprofit charitable organization with agricultural interests such as Winrock International or Partners of the Americas.

   g. Become a certified Florida Master Gardener.

   h. Pass (with a score of 70% or higher) a written examination on beekeeping for rural development.

   i. Win first or second place in any category at a state or higher level honey show.

   j. Document knowledge of pollination ecology, general honey bee biology, and colony management for honey production.

5. **Queen production**

    a. Document that you are rearing queens according to FDACS-DPI best management practices (BMPs).

    b. Attend an instrumental insemination course.

    c. Pass (with a score of 70% or higher) an examination of mating biology and bee genetics.

    d. Research and review alternative queen rearing methods for industry. The review will be published on the Honey Bee Research and Extension Laboratory's website. The written review must be accompanied by a slide show presentation.

    e. Volunteer 40 or more hours with a professional queen breeder.

    f. Research and review one race of honey bee. The review will be published on the Honey Bee Research and Extension Laboratory's website. The written review must be accompanied by a slideshow presentation.

    g. Serve as "local expert" and assist other beekeepers with queen production. Must document service.

    h. Pass (with a score of 70% or higher) a tutorial on Africanized honey bees.

    i. Document that you have mentored/trained others in the dynamics of queen rearing.

    j. Document that you are selecting for resistance traits in your own queen rearing operation.

6. **African honey bees**

    a. Document proficiency in FABIS or USDAID bee identification methods.

    b. Generate African bee Extension information (presentations, etc.) for a specific target audience (pest control operators, Master Gardeners, etc.).

    c. Pass (with a score of 70% or higher) a tutorial on Africanized honey bees.

    d. Pass (with a score of 70% or higher) an examination of mating biology and bee genetics.

    e. Acquire a pesticide applicator license.

    f. Document knowledge and participation in colony bait hive service.

    g. Document a trip to another area of the world having African bees and your work with the bees in that area.

    h. Serve as "local expert" and assist other beekeepers with African bee-related issues.

    i. Keep personal bee colonies according to FDACS-DPI best management practices (BMPs).

    j. Present a lecture on African honey bees at a state, regional, national, or international beekeepers meeting.

7. **Advanced bee husbandry**

    a. Switch to and document use of IPM (integrated pest management) in your personal beekeeping operation.

    b. Pass (with a score of 70% or higher) a practical, hands-on examination of bee pests/diseases.

    c. Provide pollination services for a community garden or commercial fruit/nut/vegetable grower.

    d. Plant a bee-friendly garden in a public area such as a library or a town square.

    e. Become a certified Florida Master Gardener.

    f. Document knowledge of honey production/processing and other products of the hive, including value adding theory.

    g. Document that you are rearing queens according to FDACS-DPI best management practices (BMPs).

    h. Attend an instrumental insemination course.

    i. Document proficiency in the Fast Africanized Bee Identification System (FABIS) or USDA-ID.

    j. Pass (with a score of 70% or higher) an examination of mating biology and bee genetics.

8. **Native bee apiculture**

    a. Build a native bee nest habitat for a community garden or commercial fruit/nut/vegetable grower.

    b. Build a native bee nest habitat in a public area such as a library, a town square, or a school.

c. Present a lecture on (1) native bee diversity or (2) how to create native bee habitats at a state, regional (multi-state), national or international beekeepers meeting.

d. Produce an educational color pamphlet or brochure of local native bees for local (county or region) clientele. (All photos used must be cited and permissions granted by the photographer or copyright holder; a reference list is required.)

e. Pass (with a score of 70% or higher) a practical examination on bee and wasp identification.

f. Research and produce a review of one species of native Florida bee. The review will be published on the Honey Bee Research and Education Lab's website. The written review must be accompanied by a slideshow presentation.

g. Participate in a university study about native bees and show documentation.

h. Conduct a survey using native bee monitoring techniques, and report on the local native bees present in your area with a digital photograph collection of regional bees and wasps complete with an index that provides date/location/identification information for each photo or a museum-quality insect collection of regional bees and wasps complete with collector and species identification labels.

i. Document work to provide native bee education to the general public.

j. Write an article centered around a specific native bee or around native bees in general to be published in a popular journal, magazine, or website.

9. **Apiculture education**

a. Develop an original, bee-related educational slideshow presentation (check with the MBP board for a topic) for a 45-minute lecture accompanied by a script and a cover page identifying a target audience, and listing accompanying resources and resources for further reading. (All photos used must be cited and permissions granted by the photographer or copyright holder; a reference list is required.)

b. Produce an educational pamphlet or brochure detailing an aspect of beekeeping (extracting honey, building equipment, etc.) for distribution among beekeepers. (All photos used must be cited and permissions granted by the photographer or copyright holder; a reference list is required.)

c. Produce an original educational pamphlet or brochure explaining a bee-related issue for distribution to a specific target audience. (All photos used must be cited and permissions granted by the photographer or copyright holder; a reference list is required.)

d. Write an article about one of the following topics: education using bees, safety and beekeeping, bee-related laws and regulations, bee anatomy and biology, integrated pest management practices for beekeeping, or other approved topic for a popular journal, magazine or newsletter (i.e. Melitto Files).

e. Pass (with a score of 70% or higher) a module on apiculture education basics.

f. Document attendance at least three state, regional, national, or international beekeeping seminars (such as the Florida State Beekeepers Association Annual Meeting, the Annual Meeting of the American Beekeeping Federation, etc.).

g. Develop a bee-related teaching module (for beekeepers) accompanied by an evaluation tool (something with which you can judge the success of your teaching module).

h. Provide documentation of successful beekeeping mentorship (i.e., the individual you are mentoring is showing clear progress due to your instruction) via self-created pre- and post-tests, and other evaluations to document growth and progress.

i. Attend one seminar on how to be an effective educator. (Contact the MBP board for assistance finding seminars.)

j. Provide documentation of participation in peer review of Extension presentations by other beekeepers, accompanied by a feedback evaluation form signed by the reviewer, presenter and outreach contact.

Appendix D

Communication Skills

APPLICABLE FOR MASTER LEVEL ONLY

The nominee must present a program at state beekeeper conference. The program may be in the form of a general presentation, workshop, or similar activity.

The nominee must complete two of the following activities:

- Prepare and publish an article in a beekeeping journal.
- Prepare and publish an article on bees or beekeeping in a non-beekeeping publication.
- Be interviewed on a radio or television program regarding honey bees and/or beekeeping.
- Be featured in a newspaper article regarding honey bees and/or beekeeping.

Appendix E

Reading Lists

SUGGESTED READING LIST FOR APPRENTICE LEVEL EXAMINATIONS

Books

1. Honey Bees and Beekeeping: A Year in the Life of an Apiary, 3rd Edition—Keith Delaplane (2007)

2. The Beekeeper's Handbook, 4th Edition—Diana Sammataro, Alphonse Avitabile, Dewey M. Caron (2011)

3. First Lessons in Beekeeping—Keith Delaplane (2007)

4. The Backyard Beekeeper, Revised and Updated: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden—Kim Flottum (2010)

5. Honey Bee Biology and Beekeeping—Dewey Caron (2013)

Periodicals

1. American Bee Journal

2. Bee Culture

3. Melitto Files Newsletter

SUGGESTED READING LIST FOR ADVANCED LEVEL EXAMINATIONS

(in *addition* to those listed for the Apprentice Level Examination)

Books

1. The Hive and the Honey Bee—Dadant and Sons, Inc. (1992)

2. ABC & XYZ of Bee Culture—A.I. Root (2007)

3. Honey Bee Pests, Predators, and Diseases, 3rd Edition—A.I. Root (Morse and Flottum, eds.) (1998)

4. The Biology of the Honey Bee—Mark Winston (1991)

5. Bee Pollination in Agricultural Ecosystems—Rosalind James and Theresa L. Pitts-Singer (2008)

Websites

1. All "honey bee" entries (search for "honey bee") at: http://edis.ifas.ufl.edu/

2. Honey Bee Research and Extension Laboratory website: www.UFhoneybee.com

3. Florida Department of Agriculture and Consumer Services—Division of Plan Industry, Apiary Section website: http://www.freshfromflorida.com/Agriculture-Industry/Search-by-Industry/Bees-Apiary/Apiary-Inspection

4. The University of Florida AFBEE website: www.AFBEE.com

5. Honey Bee Parasites, Pests, Predators, and Diseases website https://agdev.anr.udel.edu/maarec/honey-bee-biology/honey-bee-parasites-pests-predators-and-diseases/

Appendix F

Examinations

To become Apprentice or Advanced Beekeepers, participants must take a written and practical examination (two hours per exam). Candidates for Master Beekeepers take only a written exam. The written tests may consist of multiple choice, true/false, short answer, and matching questions. The practical tests contain multiple choice, true/false, and matching questions, but also include identification of hive parts, tools, and diseases/pests of honey bees. Candidates must receive a score of 70% or higher on both the practical and written examinations to achieve the next level in the program. Passing candidates will receive their certificate of accomplishment at the respective awards ceremony (fall or spring) or by mail. Generally, the apprentice level test will cover the following subject areas: general beekeeping, history of beekeeping, honey bee biology, basic bee anatomy, honey production and products, pests and diseases (common names, causes and treatments), beekeeping equipment use and terminology, and important historical facts (especially people who contributed to the development of beekeeping). Advanced level testing will include all of the apprentice level subjects with the addition of scientific names of pests/diseases and honey bee species, pollination, native bee information and identification, pesticides and Africanized bees. Be sure to review the materials in the reading lists provided, and attend the review sessions held prior to the examinations.

Appendix G

Program Status, Limitations, Presentation, and Documentation Guidelines and Re-Tests

PROGRAM STATUS

1. **Active Status—**An "active beekeeper" is any Master Beekeeper Program participant who is actively pursuing the next level in the program with no more than two years elapsing before testing to obtain the next level (special exceptions: no more than three years between the Master and Master Craftsman Levels). Anyone wishing to maintain active beekeeper status must complete a yearly activity report. Active beekeepers will receive invitations to MBP-only training events and socials, and emails regarding PSC opportunities. Only active beekeepers are eligible to receive a Beekeeper of the Year Award.

2. **Inactive Status—**Any Master Beekeeper Program participant who takes longer than two years to test for the next level in the program (three years if testing for the Master Craftsman level) is considered inactive. Participants who fail to submit a yearly activity report will lose their active status. Active beekeepers will receive invitations to MBP only training events and socials, and emails regarding PSC opportunities. Only active beekeepers are eligible to receive a Beekeeper of the Year Award.

3. **Activity Report—**Master Beekeeper Program participants will now be required to submit a yearly activity report. This report will be part of the documentation used to determine the Master Beekeeper of the Year Award. An activity report should consist of a list of credit-worthy activities completed during the calendar year. Please include the name and a short description of the activity, the date when you performed it, your audience (middle school students, master gardeners, county fair attendees, etc.), and the number of people you reached. Participants are encouraged to use the cover sheets (available in Addendum 4) to assist in organizing this information. These reports will be accepted yearly. The annual deadline is January 31st.

LIMITATIONS

1. The UF Master Beekeeper Program represents a UF/IFAS Extension public education program. One should avoid having association with commercial products or implying UF/IFAS Extension endorsements of any product or place of business.

PUBLIC SERVICE CREDITS PRESENTATION GUIDELINES

1. Be punctual, trustworthy, and reliable. Follow through on your commitments and responsibilities. Call if you will be delayed or cannot attend the event. Make a reasonable effort to find a replacement speaker if you are going to miss a commitment.

2. Maintain a friendly, warm, and courteous attitude toward the public.

3. Communicate effectively with clients, staff and fellow Master Beekeeper Program students.

4. Dress appropriately for the volunteer activity in which you are involved.

5. **Follow UF/IFAS Extension affirmative action policies which forbid discrimination against anyone because of their race, color, gender, nation of origin, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations.**

DOCUMENTATION GUIDELINES

Advanced level and higher are required to complete public service credits throughout the year and turn in documentation. All documentation is due by noon on exam day. For each credit, present a "Documentation of Public Service Credits Form" and at least one additional piece of evidence that shows you completed the requirements for the credit. All levels must use the appropriate cover sheets to organize and summarize their credits, which are included as addendums 4–6 of this document. The key to presenting all credits, public, major, and core, is adequate documentation of the event/activity. Primary documentation is represented by original media: conference programs, testimonial letters from third parties, newspaper clippings, photographs, or video recordings. Please organize documentation materials neatly and present them professionally. Board members reserve the right to accept or reject documentation during program audits.

RE-TESTS

1. All participants are welcome to re-take any test on which they failed to achieve a passing score. Re-tests will be proctored at the participant's local county Extension office. Contact the MBP board to schedule a re-test. Re-tests are offered at no charge.

2. Re-tests must be taken within a year of the original exam. Those re-tests taken within eight weeks of the original exam will be certified as passing on the original exam date. Those taken more than eight weeks after the original exam date will be certified at the next exam date. This stipulation maintains the prior caveat that each participant must hold each rank for at least one year before being allow to test to advance in the program.

Appendix H

Program Awards

CATEGORIES

1. Apprentice Beekeeper of the Year Award *(will be awarded to the apprentice who has worked most diligently towards achieving Advanced Beekeeper level)*

2. Advanced Beekeeper of the Year Award

3. Master Beekeeper of the Year Award

ELIGIBILITY

1. Time frame eligible: January 1–December 31 of the current year.

2. Considerations will be given to any active member by January 31 following award year.

3. Must have held respective rank during majority of that calendar year.

For example:

a. If you tested for and advanced to the Advanced Beekeeper level in March, then you would apply for "Advanced Beekeeper of the Year" because you held the advanced level for the majority of the year.

b. However, if you tested for and advanced to the Advanced Beekeeper level in October, then you would apply for "Apprentice Beekeeper of the Year" because you held the apprentice level for the majority of the year.

AWARDS WILL BE BASED ON THE FOLLOWING CRITERIA

1. Combined average scores on the written and practical examinations taken at each respective level

2. Number of public service credits (PSCs) completed (more is better).

3. Number of necessary requirements exceeded for each level.

4. The total number of people reached through PSCs and other required activities (such as major and core credits, the research project, and/or Extension project).

5. Quality and impact of PSCs and other required activities (such as major and core credits, the research project, and/or Extension program).

Publications, program development work, and other reproducible materials will be generally of greater value to the program than materials designed to benefit only the participant or "one time only" activities the program cannot use again to assist future aspiring beekeepers.

TO BE CONSIDERED

1. Submit your activity report (see appendix G) to MBP Board.

Awards will be given at the annual UF Bee College awards ceremony.

Appendix I

Master Craftsman Research Project or Extension Program Outline

We suggest the following timeframe to ensure your project is proceeding in a timely manner.

RESEARCH PROJECT

Year 1

1. Choose project focus area and subject (such as pest/pathogen control [focus area] and small hive beetles [subject]); develop title

2. Literature Review—journals, books, interviews, popular articles
    a. What is known about your proposed topic?
    b. b. How have others executed similar projects?
3. Seek and affirm project affiliate (i.e. what institution and individual [advisor] will provide project oversight?)
4. Write a project proposal (3–5 pages maximum)
    a. Title
    b. Objective
    c. Background
    d. Materials and methods
    e. Expected outcome
    f. Potential impact
    g. References
5. Allow advisor to review proposal
6. Submit proposal to MBP Board—the proposal must be approved by the MBP Board prior to project initiation
7. Collect preliminary data
    a. Acquire/construct necessary materials required for project
    b. Use proper data collection methods (lab notebook, spreadsheets, etc.)
    c. Modify research project based upon preliminary data
8. Review first year's progress with advisor

Year 2

1. Review project progress with advisor
2. Project execution
    a. Data collection
    b. Continued literature review: any recently published studies on the topic?
3. Preliminary data analysis—must be approved by MBP Board to proceed
4. Analyze and synthesize the results
    a. Photographs
    b. Data tables, graphs, and figures
    c. Statistical analysis
5. Review project with advisor
6. Prepare final paper, submit to advisor for review
    a. Title
    b. Abstract
    c. Introduction
    d. Materials and methods
    e. Results
    f. Discussion
    g. Conclusion
    h. Acknowledgments
    i. References
7. Project timeline
    a. First draft of final paper to be submitted to MBP Board three months before anticipated advancement date (MBP exam day). Multiple drafts or edits may be necessary.
    b. Oral exam may be scheduled (on exam day – either fall or spring MBP session) once first draft of project report is submitted.
    c. Submit final, approved, and edited manuscript to MBP Board on exam day.
    d. Thirty-minute oral presentation to of research project be given to the MBP Board with an accompanying slide show on exam day.

EXTENSION PROGRAM

We require that you identify an individual within your local county Extension office to advise you throughout the project. Extension programs will also require oversight directly from a MBP Board Member. This outline may be modified to suit your individual program.

First six months:

1. Read the following EDIS document on Extension programs
    a. "Planning or Refining an Extension Program" http://edis.ifas.ufl.edu/fy1229
    b. Program planning overview/review
2. Contact an Extension professional (They will review this outline in detail, prior to project initiation.)
3. Proposal development
    a. Determine target audience and their program needs
        i. Is your idea something that the target audience needs?
        ii. Conduct a needs assessment (e.g. survey)
        iii. Read the article "Determine Program Priorities" http://edis.ifas.ufl.edu/wc105
        iv. What is your intended participant outcome?
    b. Designing your program

i. What is known about your proposed topic?

ii. How have others executed similar programs?

iii. Background research

    a. Research literature, documents, popular articles, journals (e.g., The Journal of Extension)
    b. Determine local knowledge, identify conflicts and possible barriers, conduct interviews
    c. Identify networks and partners
        i. Who shares your commitment to the program?
        ii. Which officials can serve as stakeholders?
        iii. Past, current, or potential participants, content experts, staff, volunteers, supervisors, colleagues
    d. Review organizational support
    e. Determine goals and objectives
        i. Specific—Is the objective specific and clear about what will be achieved?
        ii. Measurable—Is the objective measurable?
        iii. Achievable—Is the objective achievable given the time, resources, and programming?
        iv. Relevant—Is the objective relevant and clearly linked to the desired result?
        v. Time-Limited—Is the objective stated so it is clear when it will be achieved?

4. Develop educational program, approach, and materials
    a. What are your available resources?
    b. Are there curricula available already?
    c. Do you have funding? Is there funding available?
5. Write program proposal
    a. Title
    b. Objective
    c. Background
    d. Program goals
    e. Expected outcome
    f. Potential impact
    g. References
6. Allow advisor to review proposal
    a. Submit proposal to MBP Board—the proposal must be approved by the MBP Board before you initiate the project
    b. Modify extension program based upon comments from board

Next 12 Months

1. Develop program evaluation
   a. "Evaluation Situations, Stakeholders and Strategies" http://edis.ifas.ufl.edu/wc090
   b. Ensure collection of quantitative data
   c. Strategy for delivering, collecting, and analyzing evaluations
2. Program implementation
   a. Location
   b. Logistical support, staffing
   c. Advertisement, marketing
   d. Financial support
   e. Registration
   f. Calendar of events
3. Deliver the program
   a. Systematically collect feedback and evaluation information
4. Evaluate and analyze report
5. Review program with advisor

Last 6 Months

1. Learn, modify, and improve
2. (Re-) Deliver the program
   a. Systematically collect feedback and evaluation information
3. Evaluate and analyze report
4. Prepare final paper and submit it to advisor for review
   a. Title
   b. Abstract
   c. Introduction
   d. Materials and methods
   e. Results
   f. Discussion
   g. Conclusion
   h. Acknowledgments
   i. References
5. Project timeline
   a. First draft of final paper to be submitted to MBP Board three months before your anticipated advancement date (MBP exam day). Multiple drafts or edits may be necessary. Oral exam may be scheduled (on exam day, either fall or spring MBP session) once first draft of project report is submitted.
   b. Submit final approved and edited manuscript to MBP Board on exam day.
   c. Thirty-minute oral presentation of research project to be given to the MBP board with an accompanying slideshow on exam day.

University of Florida Master Beekeeper Program Board Members

Dr. Bill Kern, UF/IFAS Department of Entomology and Nematology; whk@ufl.edu

Mr. Ray Zerba, County Extension Agent, UF/IFAS Extension Clay; rzerba@ufl.edu

Dr. Jamie Ellis, UF/IFAS Department of Entomology and Nematology; jdellis@ufl.edu

Ms. Jeanette Klopchin, UF/IFAS Department of Entomology and Nematology; jklopchin@ufl.edu

Ms. Judy Ludlow, Extension Agent, UF/IFAS Extension Calhoun County; judy.ludlow@ufl.edu

Mr. Roy Lee Carter, Extension Director, UF/IFAS Extension Gulf County; rlcarter@ufl.edu

Mrs. Aparna Gazula, Extension Agent, UF/IFAS Extension Alachua County; agazula@ufl.edu

Summary of Requirements for the UF Master Beekeeper Program.

Level	Registered Beekeeper	Written Exam	Practical Exam	Oral Exam	Modules	Public Service Credits	Core Credits	Major Credits	Research/ Extension Program
Apprentice	x	x	x	-	-	-	-	-	-
Advanced	x	x	x	-	x (6)	5	-	- *	-
Master	x	x	-	-	-	10	5	3	x (project approval)
Master Craftsman	x	-	-	x	-	15	8	5	x
Credit totals	-	-	-	-	-	30 (minimum)	13**	8**	-

*Anyone holding the Advanced level must declare a major to the MBP board to begin earning major credits toward the Master level.
** Core and major credits cannot be repeated. If a credit is completed for the Master level, it cannot be used again for the Master Craftsman level.

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UNIVERSITY of FLORIDA

Master Beekeeper Program
University of Florida

Level of Program Testing for: ____________________________________
(Advanced, Master, Master Craftsman)

Candidate should retain completed form to turn in on day of exam.

Documentation of Public Service Credits

UNIVERSITY OF FLORIDA MASTER BEEKEEPER PROGRAM

(to be completed with assistance from Master Beekeeper Program candidate and signed by representative from organization sponsoring/hosting the event)

On this date: __________, (name) ______________________________, a candidate for the University of Florida's Master Beekeeper Program, provided or completed an act of public service, which covered the following subject matter related to beekeeping, honey bee pollination, or honey production:

(**Please circle applicable areas**)

1. Presenting bee-related lecture or workshop to non-beekeeping group
2. Holding office in a local beekeeping association
3. Assisting members of youth organizations with project work
4. Mentoring a new beekeeper through at least one complete season
5. Presenting a public demonstration on beekeeping topic at fair, festival or similar public event
6. Providing a hive of bees to pollinate a public garden
7. Establishing and maintaining an observation hive for school or civic group
8. Becoming an expert contact on bee-related questions for a UF/IFAS Extension County office (please see Appendix A)

Other: ____________________________________

Organization name: ____

Name of event: ____ Date: ____________

General description of event: ____

____

____

Estimated number of participants/attendees:

Printed name/title of representative/witness: ______________________________________

Signature of representative/witness: ____

Contact information (phone and/or email) for signee: _______________________________

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UNIVERSITY of FLORIDA

Major Declaration Form

UNIVERSITY OF FLORIDA MASTER BEEKEEPER PROGRAM

Name: ______________________________________

Address: ____________________________________

____

E-mail address: ______________________________

Phone #: ____________________________________

For the following, **please only choose 1**. Clearly mark your selection below:

______ Diagnosis and Treatment of Honey Bee Pests, Parasites, and Pathogens

______ Pollination Ecology and Bee Botany

______ Honey Judging

______ Beekeeping for International /Rural Development

______ Queen Production

______ Africanized Honey Bees

______ Advanced Bee Husbandry

______ Native Bee Apiculture

______ Apiculture Education

______ I would like to propose my own major and will contact the Master Beekeeper Board for approval. My proposed major is ____.

I, ______________________________, have chosen a major as indicated above. Should I choose to change my major, I will promptly contact the board at honeybee@ifas.ufl.edu and resubmit my form.

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UNIVERSITY of FLORIDA

Master Beekeeper Program
University of Florida

Level of Program Testing for: ______________________________
(Advanced, Master, Master Craftsman)

Candidate should retain completed form to turn in on day of exam.

Documentation of Core/Major Credits

UNIVERSITY OF FLORIDA MASTER BEEKEEPER PROGRAM

(to be completed with assistance from Master Beekeeper Program candidate and signed by representative from organization sponsoring/hosting the event)

On this date(s): ___________, (name) ______________________, a candidate for advancement in the University of Florida's Master Beekeeper Program, provided or completed a service/duty/act which qualifies as a core or major credit as outlined in the MBP Manual (Appendix B or C). The service covered the following subject matter related to beekeeping, apiculture, education, agriculture or other relevant topic as outlined in the MBP Manual:

Major Credit / Core Credit (circle one)

Please list Appendix, relevant subheadings, and credit description (as written in the manual):
I.e.: Appendix C: 2:Pollination Ecology and Bee Botany; J: create museum-quality plant collection of regional honey plants.

Description of specific action taken to earn credit:

Relevant quantification: *(i.e., number of hours, people, publications, etc. your activity reached.)*

Printed name & title of representative/witness: ______________________________

Signature of representative/witness: ______________________________

Contact information (phone and/or email) for signee: ______________________________

UF | IFAS Extension
UNIVERSITY of FLORIDA

Master Beekeeper Program
University of Florida

Last Name First Name

Advanced Level Cover Sheet

UNIVERSITY OF FLORIDA MASTER BEEKEEPER PROGRAM

Date Apprentice Level Achieved: ____________________
Month/Year

PUBLIC SERVICE CREDITS

Please use a few words to describe the event, the date it occurred and the number of people reached for each of the 5 credits. There is space provided to list credits achieved above the required minimum. If necessary, please list any additional credits on another sheet of paper.

Description of Public Service Credit	Date	# people reached
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Please sign and date below to certify that all of the above information is correct and accurate to the best of your knowledge.

(signature) (date)

UF | IFAS Extension
UNIVERSITY of FLORIDA

Master Beekeeper Program University of Florida

Last Name First Name

Master Level Cover Sheet - UNIVERSITY OF FLORIDA MASTER BEEKEEPER PROGRAM

Date Apprentice Level Achieved: ______________________
Month/Year

Date Advanced Level Achieved: ______________________
Month/Year

PUBLIC SERVICE CREDITS

Please use a few words to describe the event, the date it occurred and the number of people reached for each of the 10 credits. Please list additional credits (those above the required 10) on another sheet of paper.

Description of Public Service Credit	Date	# people reached
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

MAJOR CREDITS

DECLARED MAJOR: ______________________

Description of Major Credit	Date	# people reached
1.		
2.		
3.		

CORE CREDITS

Description of Core Credit	Date	# people reached
1.		
2.		
3.		
4.		
5.		

Please sign and date below to certify that all of the above information is correct and accurate to the best of your knowledge.

(signature) (date)

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UNIVERSITY of FLORIDA

Master Beekeeper Program
University of Florida

Last Name First Name

Master Craftsman Level Cover Sheet - UNIVERSITY OF FLORIDA MASTER BEEKEEPER PROGRAM

Date Apprentice Level Achieved: ____________________
Month/Year

Date Advanced Level Achieved: ____________________
Month/Year

Date Master Level Achieved: ____________________
Month/Year

PUBLIC SERVICE CREDITS

Please use a few words to describe the event, the date it occurred and the number of people reached for each of the 15 credits. Please list additional credits (those above the required 15) on another sheet of paper.

Description of Public Service Credit	Date	# people reached
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		

MAJOR CREDITS

DECLARED MAJOR: ____________________

Description of Major Credit	Date	# people reached
1.		
2.		
3.		
4.		
5.		

Master Craftsman Form cont....

CORE CREDITS

Description of Core Credit	Date	# people reached
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

COMMUNICATION SKILLS

Program/Interview/Article Name	Affiliation (TV station name, newspaper title etc)	Date
1.		
2.		

RESEARCH/EXTENSION PROJECT

Project title	Affiliation (UF, FDACS, etc)	Dates (begin/end)

Oral Examination Score ____________________ Date __________ Officiator Signature ___________________________

Please do not mark this area, for MBP Board use only

Please sign and date below to certify that all of the above information is correct and accurate to the best of your knowledge.

____

(signature) (date)

University of Florida
Master Beekeeper Program
MANUAL

Mission
To improve honey bee health and the sustainability of beekeeping globally through beekeeper training and public outreach

Goals
1) Beekeepers in the UF MBP will learn and adopt research-based beekeeping best management practices.
2) Beekeepers in the UF MBP will provide research-based education to the non-beekeeping public and serve as mentors to new beekeepers.

Overview
The University of Florida (UF) Master Beekeeper Program (MBP) is a five-year (minimum) certification program managed by the UF Honey Bee Research and Extension Laboratory (HBREL). It is composed of four levels: Apprentice, Advanced, Master, and Master Craftsman.

Note: The UF MBP is *not* a Master's of Science or other degree-granting program.

Individuals who want to join the UF MBP can do so at any time by registering for the online Apprentice course through Canvas Catalog. The course will be housed on Canvas, an online learning management system (Appendix A). Registration instructions and UF E-Learning tutorials can be found at http://entnemdept.ifas.ufl.edu/honey-bee/extension/master-beekeeper-program/. All participants must enter the program at the Apprentice level; no one, regardless of experience, can skip levels.

Joining the program does NOT require an application, beekeeping experience, or specific educational requirements. There are NO maximum or minimum age limits to participate in the UF MBP. **To join the program, you must 1) be interested in keeping honey bees and 2) have access to a computer or mobile device with an internet connection.**

Program Requirements
To become an Apprentice Beekeeper:

1. **Complete the online UF MBP Apprentice course.**

Candidates for Apprentice Beekeeper must complete the training lessons and associated learning activities within the online Apprentice course (Appendix A). Lessons are grouped together in a series of modules; at the end of each module, participants must take an assessment and receive a perfect score. Each assessment can be taken as many times as is necessary to pass.

The MBP Board encourages you to begin the online Apprentice course before you ever acquire your first hive of bees, though this is not required.

2. **Maintain at least one honey bee colony for at least one full year.**

   Before becoming an Apprentice beekeeper, you must have already kept honey bees for at least one year. This can happen at any point before being certified at the Apprentice level. Your one-year minimum does not necessarily need to be the year directly before being certified.

   You will be asked to honestly complete an agreement form within the online Apprentice Course in order to fulfill this requirement.

3. **Currently keep bees.**

   You must own or fully manage at least one honey bee hive at the time of being certified as an Apprentice Beekeeper.

   You will be asked to honestly complete an agreement form and submit a photo of you working your bees within the online Apprentice Course in order to fulfill this requirement.

4. **Register as a beekeeper in your state or country.**

   You must be registered as a beekeeper if the municipality, state, or country in which you keep bees has a mandatory *or* voluntary beekeeper registration. You are exempt from this requirement if registration is not possible in your area. You will be required to show proof of your beekeeper registration within the online Apprentice Course.

   Anyone maintaining honey bee colonies in Florida must register his/her colonies with the Florida Department of Agriculture and Consumer Services (more information can be found at http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry/Business-Services/Registrations-and-Certifications/Beekeeper-Registration). In many cases, families can register together, rather than as individuals; this can satisfy the registration requirement for all members of the family.

5. **Score 80% or higher on a hive inspection practical assessment.**

   This is the final requirement of the Apprentice level; all other Apprentice requirements *must* be completed before taking/submitting the practical assessment. Apprentice candidates can complete the practical assessment in one of two ways: in-person or via a video submission. In both instances, participants will be asked to demonstrate their ability to light a smoker, inspect/correctly work a honey bee colony, and identify various components in the hive/colony. A standard rubric will be used for grading all Apprentice level practical assessments regardless of the practical format that you choose to use. See the online course for the grading rubric.

In-person: In-person practical assessments can be administered by UF HBREL staff, Florida Department of Agriculture and Consumer Services Apiary Inspectors, certified Florida Master Beekeepers, and certified Florida Master Craftsman Beekeepers. These assessments will be administered at least twice per year at the UF HBREL Bee College events (visit http://entnemdept.ifas.ufl.edu/honey-bee/extension/bee-college/ for details on these events). Other dates may be made available throughout the year at the discretion of the MBP Board.

Video submission: Participants also can choose to upload a recorded video of their hive inspection practical assessment, which can be submitted within the online Apprentice course. See the course for specific details on how to record and submit practical videos.

Advanced, Master, and Master Craftsman requirements will be posted at a future date. Check back later for updates.

Appendix A: UF/IFAS Canvas, the MBP Learning Management System

All instruction within the UF MBP is offered through UF/IFAS Canvas, the online learning management system used by the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS). Each level of the MBP (Apprentice, Advanced, Master, and Master Craftsman) has a corresponding online course that participants are required to take. Multiple instructional modules make up the online course for each level; these modules are ordered by content and are composed of three to ten lessons each. Each lesson starts by specifically listing the objectives for the lesson, so that you know exactly what the given lesson is intended to teach you. Lessons are made up of instructional content (narrated presentation, video, document, etc.) followed by interactive learning activities. Each lesson also includes additional resources that reinforce the topics covered in the lessons. Information found in the Additional Resources section of each lesson will not be "testable" material unless that information was already covered in the lesson's instructional content. Each module will end with a critical thinking assessment.

UF | IFAS Extension
UNIVERSITY of FLORIDA

Varroa Mite, *Varroa destructor* Anderson and Trueman (Arachnida: Acari:Varroidae)[1]

James D. Ellis and C. M. Zettel Nalen[2]

Introduction

Varroa destructor (Anderson and Trueman), is the world's most devastating pest of Western honey bees, *Apis mellifera* Linnaeus (Hymenoptera: Apidae). Although the *Varroa* complex includes multiple species, *Varroa destructor* is the species responsible for the vast majority of the damage attributed to mites from this genus. Until 2000, it was believed that *Varroa jacobsoni* Oudemans was the mite responsible for widespread honey bee colony losses. However, taxonomic work published in 2000 (Anderson and Trueman 2000) indicated that a previously-unidentified species of *Varroa* (*Varroa destructor*) was responsible for the damage, while *Varroa jacobsoni* was shown to be only moderately harmful to western honey bees. This publication is limited to *Varroa destructor*.

Varroa are ectoparasites that feed on the hemolymph of immature and adult honey bees. *Apis mellifera*, the Western honey bee, is not the mite's natural host. In fact, the mite is native to Asia, where it parasitizes another cavity-dwelling honey bee, *Apis cerana* Fabricius (the eastern or Asian honey bee). *Apis cerana* is believed to have some natural defenses against the mite and consequently rarely is affected negatively by the mite. Only when colonies of *Apis mellifera* were brought to Asia did people begin to realize how devastating the mites could be. *Varroa's* host shift did not occur instantly, as evidence suggests that it may have taken 50–100 years (Webster and Delaplane 2001). Since that time, the mite has spread around the world and has become nearly cosmopolitan in distribution. Those countries not hosting *Varroa* maintain strict quarantine procedures to lessen the chance of an accidental importation of the mite.

Distribution

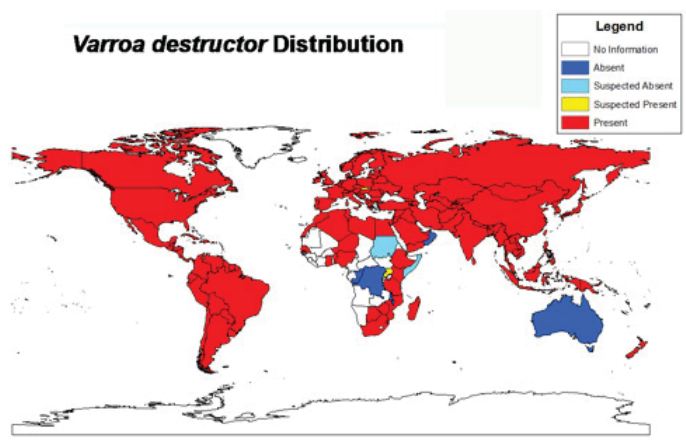

Figure 1. *Varroa* distribution reported in peer-reviewed scientific literature as of 2014.
Credits: Chase Kimmel, University of Florida using Esri ArcGIS 10.2: The world map layer is from Natural Earth and the data was acquired from a review of the scientific literature

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Description

Adults

The adult female mites are reddish-brown to dark brown and oval in shape, measuring 1.00 to 1.77 mm long and 1.50 to 1.99 mm wide. Their curved bodies fit into the abdominal folds of the adult bee and are held there by the shape and arrangement of ventral setae. This protects them from the bee's normal cleaning habits. Adult males are yellowish with light tan legs and spherical body shape measuring 0.75 to 0.98 mm long and 0.70 to 0.88 wide. The male chelicerae are modified for transferring sperm.

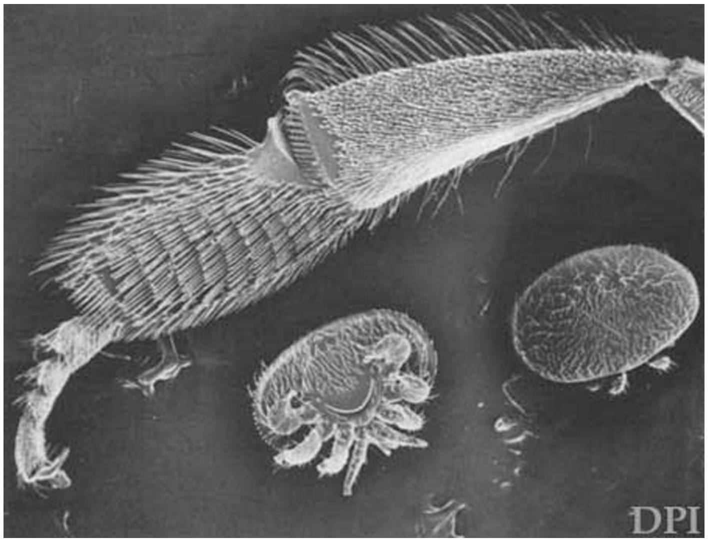

Figure 2. Adult female *Varroa destructor* Anderson & Trueman, ventral (left) and dorsal (right) views (lower right), with a honey bee's metathoracic leg (top) for scale.
Credits: FDACS—Division of Plant Industry

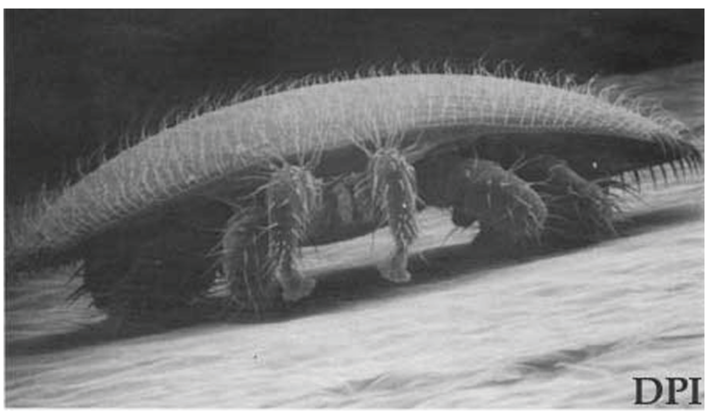

Figure 3. Adult female *Varroa destructor* Anderson & Trueman, anterior view, showing curvature of body.
Credits: FDACS—Division of Plant Industry

Eggs

The eggs are oval in shape and white in color, and are laid singly on a cell wall. Eggs are approximately 0.30 mm long and 0.23 mm wide. Eggs generally cannot be seen by the unaided eye.

Figure 4. Dorsal view of *Varroa destructor* Anderson & Trueman.
Credits: Scott Bauer, USDA

Nymphs

Male and female protonymphs are indistinguishable without dissection. Protonymphs have eight legs, pointed chelicerae (mouthparts) and are a transparent white color. The body appears circular, as they do not develop the oval shape until the deuteronymph stage. After the protonymph molts, the mite becomes a deuteronymph which resembles the adults with a reduction in setae. The mite will molt once again, into the final adult stage.

Life Cycle

Although *Varroa destructor* is a natural parasite of the Asian honey bee, most of its biology has been determined using the Western honey bee due to the mite's importance as an economic pest on this honey bee species. With that in mind, most of the following discussion will relate to *Varroa*'s presence on Western honey bees rather than on Asian honey bees.

Adult female *Varroa* can be found either on adult or immature honey bees. They must, however, reproduce on honey bee brood (developing larvae or pupae). Immature *Varroa* can be found only on capped brood and male *Varroa* will never leave these brood cells.

Although small, a *Varroa* female is one of the largest ectoparasites known when considered in relation to its host. Because *Varroa*-associated damage is caused by female mites, the remaining discussion of the life cycle will proceed from the female *Varroa*'s perspective.

Adult females undergo two phases in their life cycle, the phoretic and reproductive phases. During the phoretic phase, female *Varroa* feed on adult bees and are passed from bee to bee as bees walk past one another in the colony. During phoresy, the female *Varroa* live on adult bees and usually can be found between the abdominal segments of the bees. *Varroa* puncture the soft tissue between the segments and feed on bee hemolymph through the punctures.

Anatomically, female *Varroa* are well-adapted bee parasites. Their flattened shape allows them to fit between the abdominal segments. Furthermore, they have claws that allow them to grasp the bee and ventral setae that allow them to remain attached to the bee. The mite's cuticle has a chemical pattern similar to that of the bee's, possibly allowing it to escape notice while on the bee. Additionally, the cuticle is highly-sclerotized, thus occasionally protecting it from bee aggression.

Phoretic *Varroa* also can be passed between colonies when infested bees drift into another colony. This happens frequently in managed honey bee situations where individual bee colonies are located within meters of one another. It is common for bees in this situation to return (drift) to the wrong colony. Interestingly, it has been shown that bees from colonies heavily infested with *Varroa* drift more than bees from uninfested colonies (Schmid-Hempel 1998). *Varroa* passing within a colony from bee-to-bee and between colonies by drifting demonstrate that the mites are transmitted horizontally.

Varroa also may pass between colonies in other ways. First, beekeepers often aid weak colonies by adding bees or brood from a healthier colony, and this practice helps spreads the mite. Second, beekeepers may transport colonies from one area to another, facilitating the spread of *Varroa* regionally. Third, individual colonies may swarm, moving to a new location and spreading *Varroa* simultaneously. Finally, mites may spread between colonies as bees from the colonies rob (steal honey from) one another. It is common for strong colonies to rob weaker colonies in periods of nectar scarcity. Mites pass easily from bee to bee in these instances. All of these methods have contributed to *Varroa*'s global distribution as a honey bee pest.

The phoretic period of the mite appears to contribute to the mite's reproductive ability. Although mites artificially transferred to brood cells immediately after they mature are able to reproduce, their reproductive rate is lower than that of mites undergoing a phoretic period. The phoretic period may last 4.5 to 11 days when brood is present in the hive or as long as five to six months during the winter when no brood is present in the hive. Consequently, female mites living when brood is present in the colony have an average life expectancy of 27 days, yet in the absence of brood, they may live for many months.

In order to reproduce, phoretic mites must enter bee brood cells. Honey bees construct a waxy matrix in which they form hexagonal compartments or cells. Queen bees oviposit in these cells, and three days later a bee larva emerges from the egg and begins to develop. Once the larva reaches a certain age, worker bees in the colony construct a waxy capping over the entrance to the cell. The larva develops into a prepupa and then a pupa under the capping. After an egg is oviposited, an adult worker, drone, or queen bee emerges from the cell 21, 24, or 16 days later (aged respectively).

Varroa females must enter a brood cell before the bees seal it. In Western honey bee colonies, they may enter either a worker or drone cell, but mites are more attracted to drone brood. A mite that is ready to reproduce will leave the adult bee on which it is feeding and crawl down the wall of the cell to the honey bee larva at the bottom of the cell. At this point, the female mite is referred to as a foundress mite. Only larvae ready to be capped are attractive to the mite. After crawling under the larva, the female mite will submerge itself in the brood food under the larva where it will remain until the cell is capped by other worker bees. While submerged, the mite erects its peretrimes which serve as breathing tubes, allowing the mite to breathe while it is submerged.

Once worker bees have capped the cell, the larva consumes the remaining brood food, thus freeing the mite. The freed mite climbs onto the larva and begins feeding. The mite defecates on the upper part of the cell wall while feeding on the bee. Shortly thereafter, the mite lays its first egg on the surface of the cell wall. The egg is unfertilized and will develop into a male mite. Subsequent fertilized eggs are oviposited by the female mite toward the back of the cell approximately every 25 to 30 hours. These hatch into female mites.

The newly-emerged protonymphs join their mother on the ventral side of the developing bee pupa around the bee's 5th abdominal segment. Here, the mother and offspring alternate between periods of feeding on the bee and defecation on the base of the cell. The developing protonymphs molt into deutonymphs and then into adult mites. The entire process from egg to adult mite takes six to seven days for both sexes of the mite.

Unless more than one foundress enters the cell prior to capping, mite offspring are forced to mate with their siblings. When male *Varroa* undergo their final molt, their piercing mouthparts change into hollow tubes. The male mite uses this structure to transfer packets of sperm to openings in the female, at the base of her third pair of legs. Although the adult female *Varroa* can infest and reproduce in more than one cell, it mates only in the cell in which it was born. Shortly after mating, the sperm transport system of the female *Varroa* degenerates, thus prohibiting future matings.

Considering mortality in brood cells and improper mating, the average foundress mite produces about one offspring per worker cell she enters, and about two offspring per drone cell. Drones take longer to develop so more mites are produced in drone cells. Therefore, in the average temperate climate, mite populations can increase 12-fold in colonies having brood half of the year and 800-fold in colonies having brood year-round. This makes the mite very difficult to control, especially in warmer climates where colonies maintain brood year-round.

Economic Importance

Varroa have affected the apiculture industry negatively in every country that it has been introduced. Individuals reporting the effects of *Varro*a after they arrived in the US stated that honey bee colonies would not survive unless beekeepers intervened with a chemical treatment (Webster and Delaplane 2001).

Accurate estimates of the effect of *Varroa* on the apiculture industry are hard to find, but it is safe to assume that the mites have killed hundreds of thousands of colonies worldwide, resulting in billions of dollars of economic loss. *Varroa* have caused beekeeper production costs to rise, thus lowering the profit margin in beekeeping.

Varroa also have affected the feral (wild) population of bees in many areas. Since feral colonies were not managed for *Varroa* and the colonies were left unprotected, the loss of feral colonies quickly resulted as *Varroa* continued to spread. On the other hand, feral colonies that survived *Varroa* infestations have slowly developed resistance mechanisms that have allowed them to persist in the presence of the mite. This did not happen with managed colonies because beekeepers started treating chemically for *Varroa* almost instantly, thus keeping alive susceptible populations of bees. This practice is changing.

Varroa weakens and ultimately kills colonies by outreproducing their host. Typically, bee populations peak in late spring/mid summer with a steady decline in population occurring in mid-late summer. *Varroa* population increase is similar to that of the bees but is offset by a number of weeks. Therefore, *Varroa* populations are just beginning to peak when bee colony populations typically begin to decline. This is usually the start of significant mite problems.

Varroa rarely kill adult bees, but they do shorten the lifespan and may even alter bee behavior. *Varroa* can kill immature bees, and their ability to do so is correlated with the number of *Varroa* foundresses that enter a brood cell prior to it being capped. The more mite foundresses in a cell, the less likely the immature bee will develop successfully and emerge as an adult.

For some time, scientists have known that honey bees host a number of viruses. There is evidence that some of these viruses are associated with *Varroa* presence and levels in a colony (Webster and Delaplane 2001). It now is believed that *Varroa* can transmit multiple viruses to their hosts and that these viruses, not the mites themselves, may cause the majority of the damage that bees experience while hosting the mites (Webster and Delaplane 2001).

To illustrate this point, one of the most telling signs of a *Varroa* presence in a colony is the occurrence of newly-emerged adult bees with misshapen wings. A virus, called deformed wing virus (DWV) and present in immature bees, is responsible for this symptom. Bees with this virus are unable to use their wings and will die or be killed by the other workers within a few days of emergence. Deformed wing virus can be so prevalent in maturing bees that they can emerge without any wings at all. Researchers suspect that other viruses play an important role in the *Varroa* mite/honey bee relationship, but the roles of these viruses are not well understood.

Figure 5. Newly emerged worker honey bee exhibiting symptoms of Deformed Wing Virus, which is transmitted by *Varroa destructor* Anderson & Trueman.
Credits: University of Florida

Detection

The detection and treatment of *Varroa* is an ever-changing science. Since the mite's spread around the world, methods to accomplish both have been investigated and refined. Because detection and treatment are dynamic topics, this treatise will focus only on general methods rather than specific techniques.

Although small, *Varroa* can be seen on adult bees with the naked eye. They often are found feeding between segments on the bees' abdomens or crawling quickly elsewhere on the bees' bodies.

Figure 6. A female *Varroa destructor* Anderson & Trueman, feeds on the hemolymph of a worker bee. The mite is the oval, orange spot on the bee's abdomen.
Credits: James Castner, University of Florida

Varroa look very similar to another bee commensal, the bee louse, (Diptera: Braulidae), and this has led to mistaken identifications. Despite this, identifying them is simple if one remembers that the bee louse is a wingless fly with six legs, while *Varroa* is a mite with eight legs.

Figure 7. Dorsal views of an adult bee louse, *Braula coeca* Nitzsch, (left); and an adult *Varroa destructor* Anderson and Trueman, (right). *Varroa* are more oval in shape and have eight legs as compared to the bee louse, which has six legs.
Credits: Bee louse (left)—University of Florida; *Varroa* (right)—Scott Bauer, USDA.

A much better way to look for *Varroa* in a colony is to examine bee brood. It is easier to find mites on drone brood (although finding them on worker brood is possible) because (1) *Varroa* are attracted to drone brood more strongly than they are to worker brood and (2) drone brood is easier to remove from the cells. Immature bee brood is white, making it very easy to see the reddish-brown *Varroa*.

Figure 8. Two female adult *Varroa destructor* Anderson & Trueman feeding on the hemolymph of a honey bee pupa.
Credits: James Graham, University of Florida

Management

Even though *Varroa* can be detected visually on adult and immature bees, the number of mites on each only gives one an index rather than an accurate measurement of *Varroa* populations in the hive. Measurements have become more accurate with the advent of sampling tools, the most popular of which is sticky screens, ether rolls, or sugar shakes.

Varroa sticky screens are pieces of cardboard coated in a sticky substance. The cardboard is then covered with a wire mesh that prohibits bees from touching the sticky substance but allows *Varroa* to fall through the mesh. These screens can be inserted under the honey bee nest and used to trap falling mites. *Varroa*, both living and dead, regularly fall off their host bees. This may be facilitated by the grooming activity of the bees, but it probably occurs naturally as well. When a sticky cardboard insert and screen are present underneath the nest, the falling *Varroa* will pass through the screen and get trapped on the sticky surface of the cardboard. Researchers have been able to correlate mite fall in 24-, 48-, and 72-hour-periods with actual *Varroa* populations in the colony (Delaplane and Hood 1997). Sticky boards are useful because they sample the entire colony for the presence of *Varroa*, rather than any subset of bees within the colony.

Figure 9. Anderson & Trueman attached to a sticky board removed from the bottom of a beehive.
Credits: Peggy Greb, USDA

Ether rolls yield quicker results than sticky traps but can be less accurate because only a subset of the entire colony is sampled. In an ether roll, about 300 adult bees are collected in a glass jar and sprayed with ether. After the ether is added to the jar, the jar is lightly shaken for 30 seconds, during which time *Varroa* present on the adult bees will adhere to the inside walls of the jar, facilitating their quantification. A newer version of this sampling protocol has been developed using powdered sugar rather than ether. Once the dusted bees are shaken, the bees can be released (they are alive) and the sugar can be dumped into water. After contacting the water, the sugar dissolves, thus facilitating *Varroa* quantification.

The sampling methods were not used very often traditionally because treatment for *Varroa* was recommended twice yearly, regardless of the number of mites in a colony. Recently, investigators around the world have tried to employ an integrated pest management (IPM) approach to *Varroa* control. Sampling devices are paramount in this management scheme where treatment is recommended after *Varroa* populations in a colony reach an economic threshold. A sampling device is needed in order to determine when an economic threshold is reached.

Many studies have been conducted in an effort to determine the economic threshold for *Varroa* in a colony but results have varied. Factors affecting the economic threshold include temperature, colony strength, geographic location, the presence of other pests/pathogens, level of colony resistance to *Varroa*, etc. As such, an economic threshold for *Varroa* probably will not be universal and will have to be determined regionally. In the US, independent studies have suggested that the economic threshold for *Varroa* is around 3000 mites/colony (Delaplane and Hood 1997). Again, this number will vary depending on a number of factors, including those listed above. With the establishment of economic thresholds and sampling devices, *Varroa* management has become easier, although IPM is not as widely-practiced by beekeepers as one would hope.

Traditionally, *Varroa* have been controlled chemically. In fact, chemical-based, in-hive treatments have followed *Varroa* everywhere the mite has been introduced. Pyrethroids, organophosphates, essential oils, and organic acids have been used by many countries to control *Varroa*. Initially, the pyrethroid fluvalinate showed high levels of efficacy (>90%) against *Varroa*. However, the mites have a demonstrated ability to become quickly resistant to this and other synthetic acaricides. This has made many acaricides useless in areas where *Varroa* resistance to chemicals has developed. Further exacerbating this is the issue that many of the synthetic chemicals used inside of bee colonies to control *Varroa* double as insecticides in other pest-management schemes. So, *Varroa* have required beekeepers to put insecticides into insect colonies, the results of which are only just beginning to be understood. The effects of chemical *Varroa* treatments on honey bees include reduced longevity of queen bees, reduced sperm loads in and longevity of drones, brood death, and reduced queen laying patterns. Many more effects are believed to exist.

Because of the reduced efficacy of chemicals used to control *Varroa*, attention has turned to the application of non-chemical methods for limiting *Varroa* populations. For example, *Varroa* are attracted disproportionately to drone brood. This has led some beekeepers to practice selective removal of drone brood from bee colonies after it has been capped. This practice eliminates a cohort of mites from colonies. Also popular is the use of screened bottom boards to lower mite populations. Although its level of efficacy is debated, replacing solid bottom boards of a bee colony with screen mesh can reduce *Varroa* populations as much as 14%.

A number of other non-chemical methods purported to lower *Varroa* populations are used by beekeepers, with varying degrees of success (some do not work at all). Some, such as placing colonies in full sunlight, modestly reduce *Varroa* populations. Others, such as dusting the adult bees in the colony (often with powdered sugar), fogging mineral oil and other liquids into the colony, and using small-cell comb, have been shown to have little or no effect on overall *Varroa* populations. It is important to note that although concrete data supporting the efficacy of these methods is lacking, future research may establish a benefit from these and other similar practices.

Without question, the most significant advancement toward controlling *Varroa* non-chemically has come in the realm of bee breeding. A number of bee defensive responses to *Varroa* have been identified and selected for in natural and artificial breeding programs; the most notable of these are hygienic behavior and grooming behavior. Bees that exhibit grooming behavior use their legs to comb themselves. They do this both to themselves and to other bees in the colony. This behavior can increase the number of *Varroa* that fall off of the bees, thus lowering the number of *Varroa* in a colony.

Hygienic behavior is the most studied of all of the natural defenses against *Varroa*. Although it is not a behavior specifically targeting *Varroa*, its manifestation can lower *Varroa* populations within a colony. Bees that are hygienic can detect many problems that affect brood (American foulbrood, *Varroa*, chalkbrood, etc.), even if the brood is capped, and remove the affected brood. Because *Varroa* go into cells immediately prior to the cell being capped, hygienic bees are given little time to find *Varroa* before the cell is capped. As a result, hygienic bees have a refined ability to detect *Varroa* in capped cells, remove the capping, and abort the brood. Often, this behavior can lead to the death of the mite, thus lowering *Varroa* populations. It is interesting to note, a heightened form of hygienic behavior called *Varroa* Sensitive Hygiene (VSH) has been found in some bees. VSH bees are able to detect *Varroa* in capped cells and remove only those *Varroa* that are reproducing.

Effort also has been concentrated in finding races of bees that are generally resistant to *Varroa*. This includes bees that do not have a single defensive behavior targeting *Varroa* yet maintain a very low mite population in the colony. Probably the most successful of these programs includes the Russian honey bee program headed by the United States Department of Agriculture honey bee genetics lab in Baton Rouge, Louisiana, USA. Russian bees are a European subspecies of honey bee introduced into eastern Russia over 100 years ago. Because *Varroa* are native to the area, Russian bees have developed a general resistance or tolerance to the mite. Russian bee queens were introduced into the US in 1997 and are gaining popularity among beekeepers.

Many feel that *Varroa* control is maturing holistically even though this approach is slow to be adopted by beekeepers. Ample research has shown that an IPM-based approach to *Varroa* control is more economical than the conventional methods heavily relying on chemical pesticides (Webster and Delaplane 2001). For example, using any combination of the non-chemical *Varroa* controls mentioned above can lower *Varroa* populations in a colony >40%. Despite this, holistic Varroa control will continue to mature and can be improved.

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Varroa Biology

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Learning Objectives for this Lesson

After completing this lesson, you should be able to:

1. Illustrate the lifecycle and impacts of *Varroa destructor* in the honey bee colony.
2. Discuss the importance of regular monitoring for *Varroa*.

Introduction to *Varroa*

- *Varroa destructor* (Anderson and Truemann) is a pest of the Western Honey Bee (*Apis mellifera* L.)
  - Thought to be *V. jacobsoni* Oudemans until 2000.
- First detected in the United States in 1987
- One of the largest ectoparasite to host ratios
- Thought to feed on the hemolymph of immatures and adults

Damage

- Reduction in feral colonies
  - Many areas of the United States have exclusively managed colonies
- Hard to estimate colony loss
  - Likely have killed hundreds of thousands worldwide
  - Billions of dollars in economic loss

Damage

- Shorten lifespan of adults and kill immatures
  - Spread numerous diseases, including Deformed Wing Virus (DWV), Sacbrood Virus (SBV), and Israeli Acute Paralysis Virus (IAPV)

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Ubiquitous Distribution

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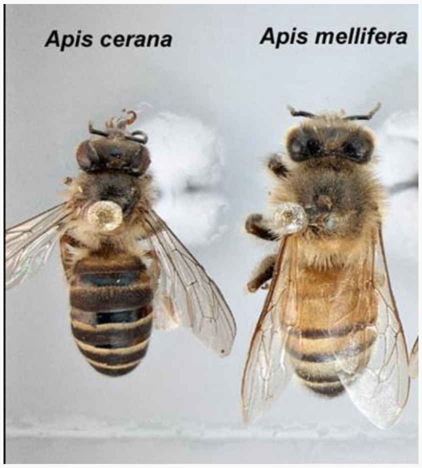
Spread of *Varroa*

- Native to Asia
- *Apis cerana*- native host
  - Not a pest
    - Only affects drones
      - Entomb mites in capped cells
    - Workers kill mites with mandibles



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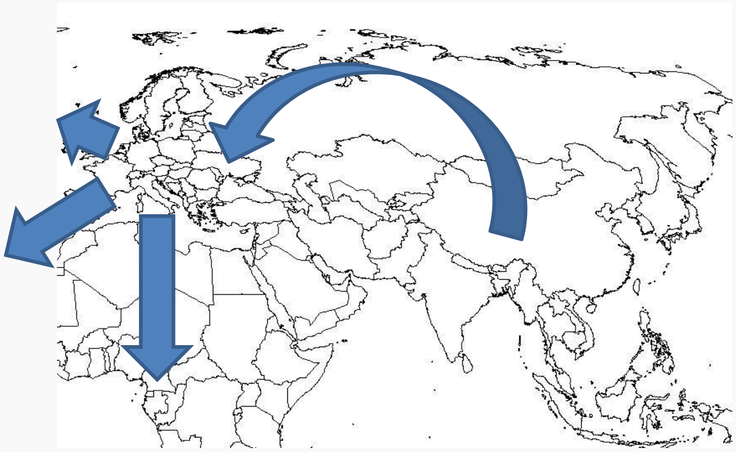
Spread of *Varroa*

In 1970s, *Varroa* was discovered in *Apis mellifera*

- *Originally introduced to Europe*



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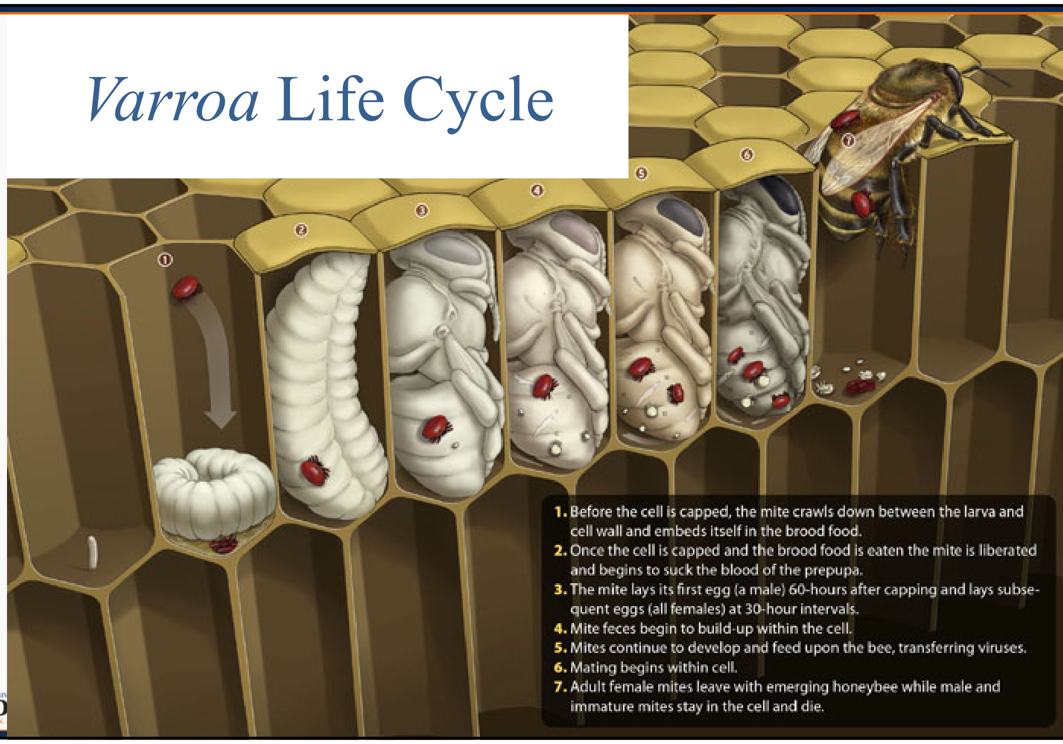
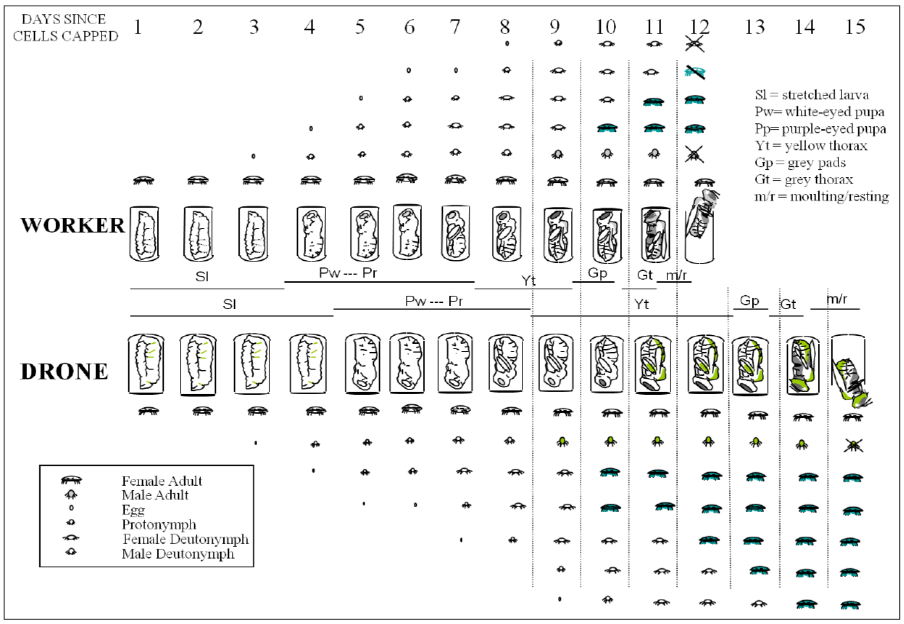
Spread of *Varroa*

- Robbing
- Drifting
- Introducing bees to colonies- splits, strengthening, etc.
- Migratory Beekeepers
- Reproduction (Swarming)

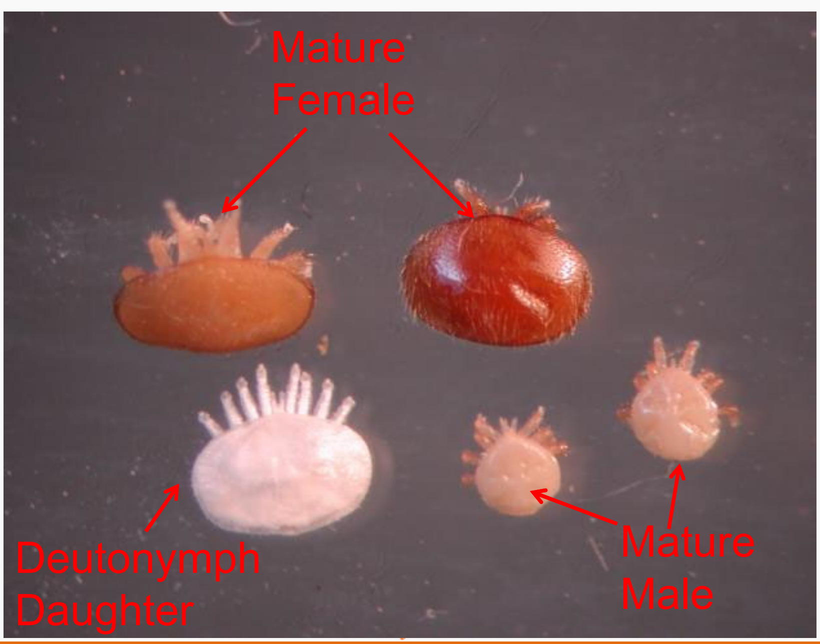
Varroa Life Cycle



Mite Reproduction



Mite Reproduction



Huang 2013

When to Monitor?

- Plan to monitor *Varroa* populations **at least 6x/year** – should monthly
- Before and after treatment to determine efficacy

Economic Thresholds

Colony Phase	Acceptable Further control not needed	Caution Control may be warranted	Danger Control promptly
Dormant with brood	<1%	1-2%	>2%
Dormant without brood	<1%	1-3%	>3%
Population Increase	<1%	1-3%	>3%
Peak Population	<2%	2-5%	>5%
Population Decrease	<2%	2-3%	>3%

Acceptable: *Current mite populations are not an immediate threat.*

Caution: *Mite population is reaching levels that may soon cause damage; non-chemical control might be employed while chemical control may be needed within a month; continue to sample and be prepared to intervene.*

Danger: *Colony loss is likely unless the beekeeper controls Varroa immediately.*

Table from Honey Bee Health Coalition – Tools for *Varroa* Management; http://honeybeehealthcoalition.org/)

Factors Influencing Thresholds: Size of Colony

Factors Influencing Thresholds: Time of Year

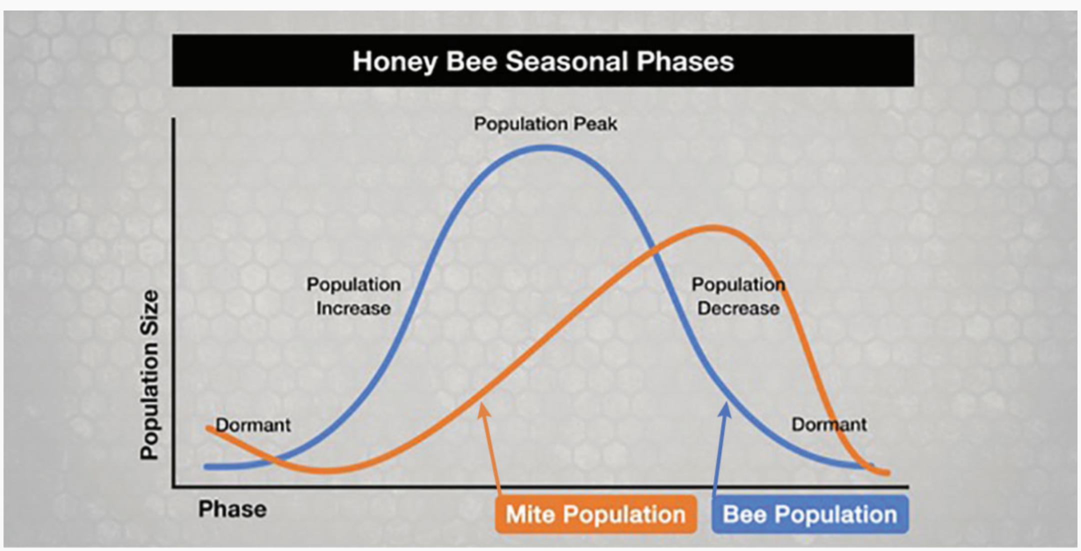


Figure from Honey Bee Health Coalition – Tools for *Varroa* Management; http://honeybeehealthcoalition.org/)

Factors Influencing Thresholds: Purpose



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Factors Influencing Thresholds: Preferred Treatment



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Ineffective Monitoring Strategy

Visual Inspection

- –Mites reproduce in brood cells
- – ~70% of colony's mites are within brood cells

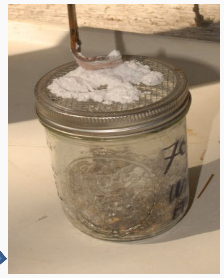
Effective Monitoring Strategy

Ether Roll

- –Quick, easy subset of bees sampling
- –Mason jar (1/8" mesh), ether
- –Collect ~1/2 cup adult bees from brood frames
- –Disadvantage: Small subset of bees, destructive, **FLAMABLE**

Effective Monitoring Strategy

Powder Sugar Shake



- Quick, easy, relatively non destructive
- Mason jar (1/8” mesh), powder sugar, pan
- Collect ~1/2 cup adult bees from brood frames
- Disadvantage: Small subset of bees

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Effective Monitoring Strategy

Alcohol Wash

- Accurate sampling on a subset of bees
- Place ½ cup bees in a closed container
- Wash bees with alcohol and use a sieve to collect mites
- Disadvantage: Small subset of bees, destructive

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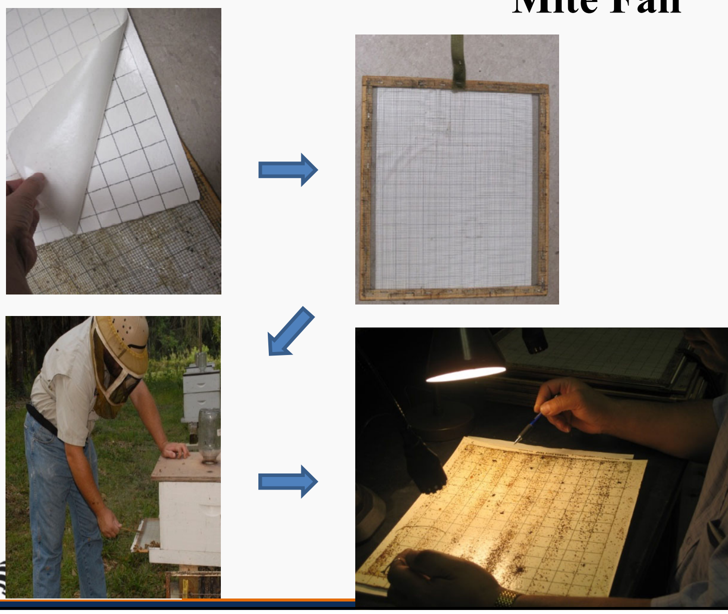
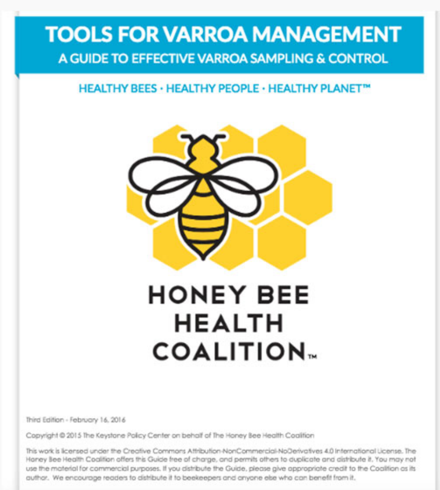
Effective Monitoring Strategy

Mite Fall



- Comprehensive look at colony
- Requires sticky sheet & bee guard or screened bottom board
- Disadvantages: time consuming
- <u>Threshold ~ 50 mites/24 h</u>
  - Should be lower

Conclusion



https://honeybeehealthcoalition.org/varroa/

- Good beekeepers closely monitor their *Varroa* levels
- *Varroa* monitoring will influence treatment options and timing
- Use reliable monitoring methods

For more information visit:

UFhoneybee.com

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Varroa Control

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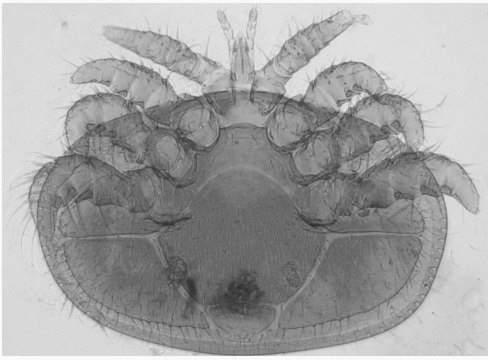
Learning Objectives for this Lesson

After completing this lesson, you should be able to:

1. List the chemical and non-chemical treatment options for controlling *Varroa.*
2. Recognize the limitations of *Varroa* control options.

Varroa Control



3:100 mites:bees = 1,200 mites in a 40,000 bee colony

Types of control

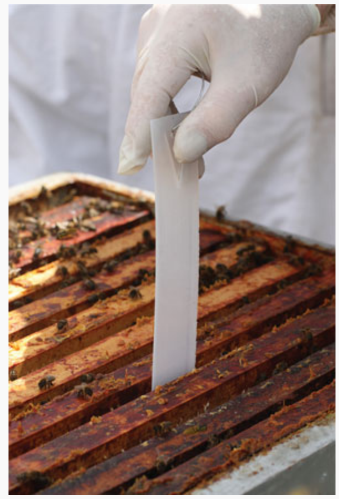
- –Chemical control (in-hive)
  *Do not use during honey flow! Always wear gloves!
- –Mechanical control

Varroa Control

1. “Natural” chemicals do not necessarily mean that they are safe.
2. Always follow the label.
3. Rotate your treatments so that mites do not become resistant.

"Hard" Chemical control

- Apistan (fluvalinate-pyrethroid)
- Checkmite (coumaphos-organophosphate)
- Apivar (Amitraz-formamidine



"Hard" Chemical Control

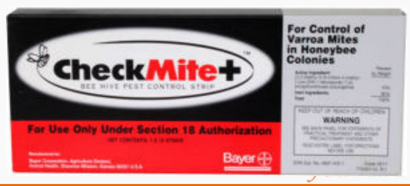
Apistan

- tau-Fluvalinate (pyrethroid)
- Registered in 1990 for honey bee use
- Use 1-2 strips per brood chamber
- Leave strips in hive for 6-8 weeks

“Hard” Chemical Control

Checkmite

- Coumaphos (organophosphate)
- Registered in 1998 for honey bee use
- Use 1-2 strips per brood chamber
- Leave strips in hive for 42-45 days
- Very effective against small hive beetle



“Hard” Chemical Control

Apivar

- Amitraz (formamidine)
- Registered in 2013 for honey bee use
- Use 1-2 strips per brood cover
- Leave strips in hive for 42 days, remove

"Soft" Chemical Control

- Apiguard & Apilife Var (Thymol)
- Mite-Away II (Formic acid)
- Oxalic acid
- Essential oils

"Soft" Chemical Control

Apilife Var

- Thymol
- Best in early spring or late fall (between 68° and 86°)
- Place tablet (broken into four pieces) on brood nest
  - Replace every 7-10 days for a total of 3 applications

Apiguard

- Thymol
- Spring or Late Fall
- 2 Applications
  - 2 weeks, replace and leave on the colony for another 2-4 weeks

"Soft" Chemical Control

Mite-Away II

- Formic Acid
- Use in early spring or late fall (50°-79°F)
- Place inner pouch (holes down) on top of brood box frames for a period of 21 days
- Be sure to remove entrance reducers to provide adequate ventilation

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"Soft" Chemical Control

Oxalic Acid

- Vaporization
- Trickle
  - Need to wear personal protective equipment

"Soft" Chemical Control

Other chemical controls

- Hops (Hopguard II)
- Other Essential Oils

"Soft" Chemical Control

Essential Oils

- EO does not confirm safety
  - Generally considered less toxic, but still may pose a risk
  - Lack of standardized procedures
    - Including testing, application descriptions, and re-application times
  - Hive residues
  - Needs more investigation

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Mechanical Control

- Drone Removal
- Screened bottom boards
- Powder sugar packages

Mechanical Control

Drone comb

- *Varroa* preferentially attracted to drone brood
- Place combs in colony
- Wait until drone brood is capped
- Remove frame and place in freezer
  - Kills brood and *Varroa*
- Replace comb in colony and repeat
  - Workers will remove dead brood, mites

Drone Removal

Mechanical Control

Screened bottom boards

- Reduces *Varroa* numbers in colonies (~ 14%)
- Natural mite fall exits hive and is unable to reenter.

Mechanical Control

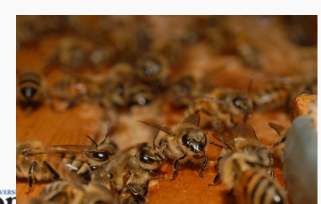
Powder sugar packages

- Pour ~1 cup powder sugar on new packages
- Wait a few minutes and shake packages for ~ 1 minute to dislodge any mites attached to bees
- Not terribly effective
  - Use only when mite populations are very low

Current *Varroa* Research

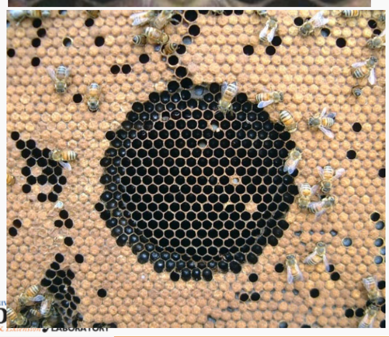
- *Varroa-resistant* honey bees
- Honey bee breeding-hygienic and grooming behaviors
- RNA Interference (RNAi)

Varroa Resistant Honey Bees



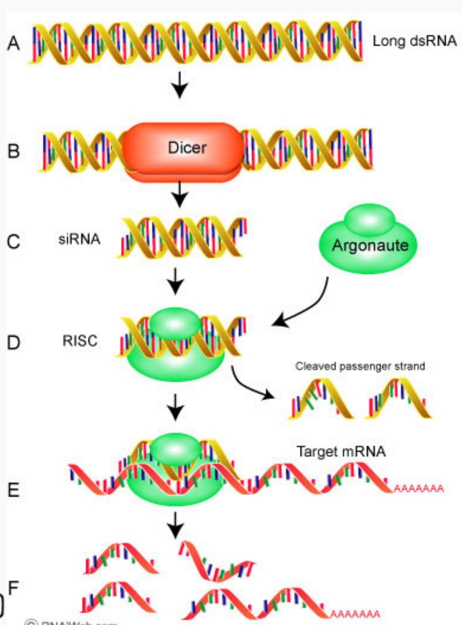
- Colony monitoring strategy
  - select for the strongest bees
  - Record honey yields, brood patterns, survival, swarming behavior
- Breed queens from strong colonies to begin new colonies
- "Survival of the fittest"
- Disadvantage: time consuming

Hygienic Honey Bees



- Breeding programs aimed at hygienic and grooming behaviors
- Not only helps to eliminate *Varroa*, but other brood related maladies
  - AFB, EFB, chalkbrood, etc.
- *Varroa* Sensitive Hygiene (VSH)
  - Developed at USDA-ARS Baton Rouge Bee Lab
  - Particularly good at removing *Varroa*-infected brood
- Breeding resistant lines appears very promising

RNA Interference



Control at the molecular level

- siRNAs interfere with *Varroa* physiological processes. Targets can include:
  - Reproduction
  - Pesticide resistance

Conclusion

https://honeybeehealthcoalition.org/varroa/

- Good beekeepers closely monitor their *Varroa* levels
- *Varroa* monitoring will influence treatment options and timing
- Use safe, legal and reliable treatment methods

For more information visit:

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TOOLS FOR VARROA MANAGEMENT

A GUIDE TO EFFECTIVE VARROA SAMPLING & CONTROL

HEALTHY BEES · HEALTHY PEOPLE · HEALTHY PLANET™

HONEY BEE
HEALTH
COALITION™

First Edition 2015

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TABLE OF CONTENTS

Every honey bee colony in the continental United States and Canada either has Varroa mites today or will have them within several months. Varroa mite infestation represents one of the greatest threats to honey bee health, honey production, and pollination services. When honey bee colonies are untreated or treated ineffectively colonies can fail and beekeepers can incur major economic losses, and, ultimately, agricultural food production may be impacted. In addition, colonies with Varroa are a source of mites that can spread to other colonies, even in other apiaries, through drifting, robbing, and absconding activity of bees.

All beekeepers should remain vigilant to detect high Varroa mite levels and be prepared to take timely action in order to reduce mite loads. Effective mite control will reduce colony losses and avoid potential spread of infectious disease among colonies.

This Guide will explain practical, effective methods that beekeepers can use to measure Varroa mite infestations in their hives and select appropriate control methods. The Honey Bee Health Coalition offers this Guide free of charge and asks that you please reference the Coalition if distributing.

This Guide represents the current state of the science regarding Varroa Mites. It will be updated as new products or information become available.

DESCRIBING VARROA MITE LEVELS

The most accurate way to describe Varroa mite infestation is the **number of mites per 100 adult bees.** For brevity, this Guide expresses mite levels as a percentage.

For example: "3 mites per 100 adult bees" is written as "3 percent" in this Guide.

Integrated Pest Management and Varroa Mite Control

The information presented in this Guide will best help beekeepers who recognize that optimum management of Varroa is based on understanding:

» The life cycles of both the honey bee colony and the mite.

» The number of mites present in the colony at any point in time.

» How tactics to control mites vary according to the season and type of beekeeping operation.

Successful Varroa control solutions are proactive. They control Varroa before the mites reach levels that threaten colony productivity and survival, rather than respond after the damage has occurred. ***Integrated Pest Management (IPM)*** is a set of proactive, non-chemical and chemical methods that offers beekeepers the best whole systems approach to controlling Varroa.

This Guide presents information about IPM techniques that integrate:

» Rigorous monitoring of mite populations to detect increases in the number of mites early and to assess the effectiveness of controls.

» Use of cultural practices (i.e., breeding, screen bottom board, removal of drone brood, etc.) to deter mite population build-up.

» Rotation of chemical products that considers mite/bee population dynamics and minimizes potential development of mite resistance caused by repeated use of any one chemical control.

IPM techniques can help beekeepers maintain a colony's Varroa mite levels below 2 to 5 mites per 100 adult bees (i.e., a 2 to 5 percent infestation level). Current data suggest that using these treatment thresholds may be a successful strategy for decreasing overall colony losses.

There is no "one-size-fits-all" solution for Varroa management. This Guide also reviews the efficacy, application, advantages, and disadvantages of a wide variety of control methods. This allows beekeepers to choose an approach suited to their individual circumstances and risk tolerance.

Doing nothing about Varroa mites is not a practical option for most beekeepers. Honey bees are not capable of surviving or thriving unless the beekeeper prevents Varroa from reaching damaging levels. If the beekeeper does not control Varroa, a colony will most likely die and, in the process, spread mites and infections to other colonies in the same apiary and surrounding area.

ABOUT VARROA MITES

The Varroa mite, Varroa destructor, is a parasite that lives on the outside of its host. The mite feeds on the brood and adults of western (European) honey bees, *Apis mellifera*. When left untreated, colonies with high levels of Varroa may die within months. Varroa mites reduce overall colony vigor as well as transmit and enhance diseases, such as honey bee viruses. Varroa, which is present on all continents, except Australia and Antarctica, is the most damaging honey bee pest and a major factor responsible for colony losses worldwide.

Adult Varroa mites are phoretic – they move around the environment by attaching themselves to adult bees. They readily spread among colonies and apiaries through natural drift of workers and drones, robbing of weak colonies by stronger ones, swarming, and absconding, or through human-aided exchange of bees and brood frames between colonies. Mites do not live longer than a few days without their host; so unoccupied bee equipment does not harbor live mites.

Even after a colony has been treated, Varroa mites remain and mite populations can increase quickly and unexpectedly. As a rule of thumb, in colonies with brood, ***mite populations double about once a month*** -- and even quicker when the colony has large amounts of drone brood, or when Varroa are transmitted from neighboring colonies. Therefore, beekeepers should have an IPM plan in place to frequently and regularly monitor and manage Varroa mites in their colonies.

Honey Bee and Varroa Mite Seasonal Development

Honey bees and their Varroa mite parasites cycle through four temporal phases. In some locations, there is one cycle per year and, in other locations, more than one cycle. The phases are:

» Dormant

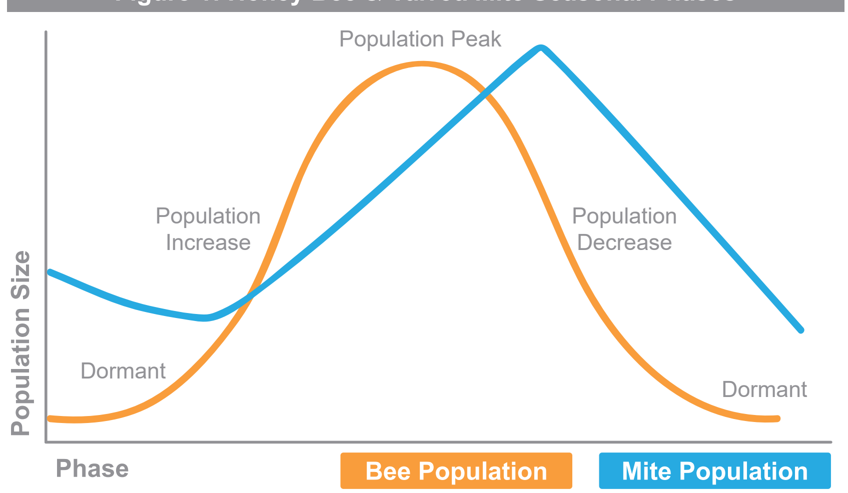
» Population Increase

» Population Peak

» Population Decrease

Varroa mite populations increase and decrease in synchrony with the seasonal pattern of honey bee development. Mite populations reach their highest levels soon after the brood and adult honey bee populations reach their peak, when there are more brood bees on which Varroa reproduce. When the bee population and the amount of bee brood decline, the phoretic mite numbers drastically increase on the adult bees as the amount of bee brood decreases. Eventually, Varroa numbers decrease, along with the adult bee population. The size of the mite population at the start of Population Decrease is critical because the colony needs to be healthy enough to rear sufficient numbers of bees to survive the dormant phase. During broodless periods, all mites are carried on adult bees, except in locations where reduced brood rearing may be continuous during this phase (see Figure 1).

Figure 1: Honey Bee & Varroa Mite Seasonal Phases



For details on the Varroa Life Cycle consult:
www.extension.org/pages/65450/varroa-mite-reproductive-biology

MONITORING VARROA MITE POPULATIONS

Bee colonies can tolerate a low number of mites, but will decline or die as mite numbers rise. Monitoring (sampling) for Varroa mites enables a beekeeper to detect a colony's mite population. Accurately assessing and understanding mite population is the basis of an IPM control strategy.

Waiting too long to confirm elevated mite population numbers is risky. A delay in treatment can reduce a colony's likelihood of survival over the winter and contribute to spreading mites to other colonies.

Beekeepers can assess mite populations during any of the phases of bee/mite population cycles. ***Generally, a beekeeper should perform Varroa monitoring assessments at least four times during the year, beginning with the Population Increase phase.***

During the Population Decrease phase, mite levels should be re-checked to confirm that mite numbers are low going into the Dormant phase. During the Dormant phase, sampling should continue, if possible. However, if it is too cold to safely remove and sample bees from the cluster, wait until milder conditions permit sampling.

Also, ***repeat sampling after treatment*** to confirm the effectiveness of the treatment that was performed.

Aggressively treat colonies whenever sampling results warrant.

Recommended Sampling Methods

Two sampling methods provide the best estimates of mite populations. Both involve removing mites from the bodies of adult bees, then counting the mites to establish a standard percentage measure of mite numbers (i.e., number of mites per 100 adult bees). The recommended sampling methods are the ***powdered sugar shake and the alcohol or soap wash.***

This section also evaluates alternative sampling methods that are less reliable than those recommended, but are capable of providing, and should only be used as, a secondary confirmation of the Varroa levels indicated by more accurate methods.

See the References and Additional Resources section for journal articles on sampling methods.

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Equipment Needed:

- Wide mouth jar, such as quart Mason canning jar
- Solid lid replaced with modified # 8 screen mesh
- Powdered sugar, or
- Alcohol (any of the following): ethanol, ethyl alcohol, or isopropyl (rubbing) alcohol, or
- Soap: automotive windshield washer fluid
- White plate, tray, or similar device. (Paper boards or sheets can be used for the powdered sugar shake method.)
- Water mister (to dissolve powdered sugar)

Collecting the Sample (Both Methods)

Collect a sample of approximately 300 adult bees from one to three brood-nest combs (avoiding the queen). Three hundred bees are equivalent to about ½ cup of lightly packed bees.

- Mark a wide-mouthed, open neck glass or plastic collection jar with a line at ½ cup.
- Select a brood frame. Look for the queen. If she is present, move her to another frame.
- Collect 300 adult bees directly into the collection jar from a brood frame by moving collection jar downward over adult bees so they fall backwards. Or shake bees directly from two or three brood frames into a larger collecting container (honey bucket, cardboard container, or lipped tray) and scoop up ½ cup of bees and quickly pour them into the quart jar.

Experiment with your collection technique to consistently obtain a 300-bee sample.

The powdered sugar shake method is non-lethal, so the bees may be returned to the hive after testing. With the alcohol or soap wash method, the bees will be sacrificed.

Powdered Sugar Shake Method

1. Add approximately two tablespoons of powdered sugar to the jar.
2. Vigorously shake the jar for at least one minute to cover the bees in sugar and dislodge the mites from the bees. To improve the consistency of mite counts, shake the jar for a consistent length of time for every sample.
3. Set the jar down and wait three to five minutes. (Rushing the process increases the risk of undercounting the mites.)
4. Invert the jar and shake it like a saltshaker, capturing the falling mites onto a clean plate or pan below. Shake the inverted jar until mites stop falling out.
5. Spray the powdered sugar deposit in the plate or pan with a water mist to dissolve the sugar.
6. Count the mites that remain.
7. Add an additional tablespoon of sugar to the jar, shake and roll the bees again for 30+ seconds, and repeat steps 4, 5, and 6 to improve the accuracy of the count.
8. Count the number of mites in the plate or pan.
9. Calculate the mite number per 100 adult bees. (See *Counting the Mites*)
10. Sampled bees can be released back into the top of their colony or at colony entrance.

For best results, sift the powdered sugar through a flour sifter to ensure a fine texture. ***Do not perform this test in high humidity or during strong nectar flow, because dampness will cause the sugar and mites to adhere to the bees.***

Alcohol or Soap Wash Method

Perform the alcohol or soap wash away from the hive.

1. Add enough alcohol (inexpensive rubbing alcohol works well) or soap (use a low-sudsing soap, such as automotive windshield washer fluid) to completely cover the bee sample in the jar.
2. Vigorously shake the jar for at least one minute to dislodge the mites from the bees. To improve the consistency of mite counts, shake the jar for a consistent length of time for every sample.
3. After shaking, empty the liquid contents into a clear plate or white shallow pan through a mesh screen that traps the adult worker bodies.
4. Add more alcohol or soap to the jar and repeat steps 2 and 3. (This increases the accuracy of the count.)
5. Count the number of mites in the plate or pan.
6. Calculate the mite number per 100 bees. (See Counting the Mites.)

Counting the Mites (Both Methods)

The goal of mite assessment is to determine the number of Varroa mites per 100 adult bees, expressed as the percentage of infestation.

Counting steps:

» Count the number of mites collected in the plate or pan.

» Divide that number by the number of bees in the sample.

» Multiply by 100 to yield a percentage.

Example:

A beekeeper samples 300 adult bees and counts 12 mites in the pan.

12 mites ÷ 300 bees = .04 X 100 = 4% (4 mites per 100 adult bees)

To increase the accuracy of the assessment, count the actual number of bees in each sample. As you gain experience with sampling, your sample sizes will become more consistent.

How many colonies to sample for Varroa mites?

If an apiary has fewer than ten colonies, sample each colony. For larger apiaries, sample 300 adult bees collected from one brood frame in a minimum of eight randomly selected colonies in each apiary (or 3 percent to 5 percent of total colonies within multiple apiaries).

Interpreting Sample Findings

When using the recommended powdered sugar shake or alcohol or soap wash sampling methods we suggest ***using the following guidelines (Figure 2) to determine when a colony needs treatment and to evaluate treatment.***

Figure 2: Treatment Thresholds by Phase;(%=Number of mites/100 adult bees)

Colony Phase	Acceptable Further control not needed	Caution Control may be warranted	Danger Control promptly
Dormant with brood	<1%	1-2%	>2%
Dormant without brood	<1%	<2-3%	>3%
Population Increase	<1%	<2-3%	>3%
Peak Population	<2%	<3-5%	>5%
Population Decrease	<2%	<2-3%	>3%

Acceptable: *Current mite populations are not an immediate threat.*

Caution: *Mite population is reaching levels that may soon cause damage; non-chemical control might be employed while chemical control may be needed within a month; continue to sample and be prepared to intervene.*

Danger: *Colony loss is likely unless the beekeeper controls Varroa immediately.*

When mite levels are below 2 percent, the mite numbers are considered to be reasonably low, so immediate control is not needed. If sampling was done after treatment, this low level means that the treatment was successful in reducing the mite population below damaging levels.

When mite levels are between 3 percent and 5 percent, further control efforts may or may not be needed or the beekeeper may decide to wait a week or so before taking another sample. The variable rate of 3 to 5 percent is based on beekeeper risk tolerance – a 3 percent level represents a lower risk of mite damage or colony loss compared to 5 percent or higher levels.

When mite levels are above 5 percent, apply mite control immediately, using a proven, effective, seasonally appropriate treatment method (See Figure 4: Control Options by Seasonal Phase). If post-treatment tests show that mite numbers remain above 5 percent after treatment, apply another control chemical or method without delay.

Recommendations on when to treat, and at what percent infestation rate to treat, have recently changed. Beekeepers should stay current with future changes based on new research findings. Older recommendations often suggested waiting until higher infestation levels are reached (10 percent to even 20 percent) before treating, whereas current recommendations emphasize treatment thresholds of 2 percent, 3 percent, or 5 percent.

Colony Losses Associated with Varroa Mite Levels

Various studies have found that winter colony losses increase with higher levels of Varroa mite infestation. Losses can be expected even at a 3 percent infestation, and can increase rapidly with higher infestation levels. Some colony losses are inevitable, but treatment of Varroa can keep losses at sustainable levels for most beekeepers.

Use Caution When Interpreting Assessment Results

Be very careful interpreting results from any single sampling technique. Inexperience with sampling procedures will affect results. Mite infestations vary from one colony to the next. The same level of mite infestation poses different risks during different phases of the bee/mite annual cycle.

Sample Often

Sampling several times throughout the year helps reduce sampling error and increase confidence in sampling results. Frequent sampling can detect mite increases at critical times of the season.

For example, mite populations can rapidly surge after honey harvest, or when colonies stop rearing brood and adult bee population decreases. This is a time when the colony must be healthy enough to successfully rear more bees to survive the Dormant phase. A single sample may not detect a rapid transition of mites from brood to adult bees during this period. A good rule of thumb is, "If in doubt, resample."

It is also important to sample after treatment to assess control effectiveness.

Alternate Sampling Methods for Varroa Assessment

While the two most accurate ways to determine numbers of Varroa mites present during any seasonal phase of a honey bee colony are the powdered sugar shake method and the alcohol or soap wash method, some beekeepers continue to use methods that are less efficient and less accurate. The Honey Bee Health Coalition does not recommend relying on the methods identified in the following (Figure 3) table.

Figure 3: Less Reliable Sampling Methods

Less Reliable Sampling Methods	
Method	Concern
Ether Roll	▪ Only detects 50 to 60 percent of mites. ▪ Material is highly flammable.
Drone Brood Assessment	▪ Difficult to interpret results of percent of brood infested. Drone brood is not always present when sampling is needed.
Visual Inspection of Mites on Adults	▪ Unless mites are on thorax or top of abdomen, they are not easily seen. ▪ Finding mites on adults indicates that a high total mite population already exists.
Sticky (debris) Board	▪ Ants or other scavengers might remove mite bodies and interfere with estimates. ▪ Difficult to interpret number of mites per hour or per day to estimate total mite population.

SELECTING CONTROL METHODS

As stated in the Introduction to this Guide, there is no "one-size-fits-all" solution to Varroa mite management. Each beekeeper should select the control methods that are right for them. Success may require experimentation with several methods. It is important to seek to integrate methods and not simply rely on one chemical or non-chemical control. Relying on a single chemical or family of chemicals for treatment will hasten development of resistance in mite populations.

Newly established colonies, whether from splits or captured swarms, generally have low mite levels the first year and may not need treatment. Older colonies typically have higher mite populations and need highly proactive treatment.

Depending on a colony's level of Varroa infestation, beekeepers should begin to integrate Varroa control methods on colonies exhibiting high mite levels during the Population Increase phase (see Figure 1).

The most critical time to administer Varroa treatment(s) is after honey supers are removed (i.e., at or just after the Population Peak phase).

While mite densities may vary across colonies, all colonies in an apiary should be treated at the same time with the same chemical or non-chemical technique. If sampling results indicate high mite populations in one colony within an apiary, do not delay treatment. Delay increases the risk of harm to the colony and the spread of Varroa mites to other colonies.

Note:

» Beekeepers should assure that all control products are legal for use. Legal restrictions are changing and vary from state to state. ***Read the product label and follow all label instructions and precautions. Federal law prohibits the use of any registered pesticide in a manner not permitted by the labeling.***

» The efficacy of the various products and treatments identified in the tables and product descriptions below are based on published studies, Bee Informed Partnership Management Surveys (http://beeinformed.org/national-management/), and the collective professional judgment of the principal drafter and HBHC subgroup members. Information presented in the tables below should not be construed as an endorsement or recommendation of any product or treatment.

Summary of Controls Discussed in this Guide

Chemical Control Products

» Synthetic Chemicals

- Apivar® (amitraz) see page 13
- Apistan® (fluvalinate) see page 14
- CheckMite+® (coumaphos) see page 14

» Essential Oils

- Apiguard® or Thymovar® (Canada) (thymol) see page 15
- Api Life Var® (thymol + eucalyptol, menthol, and camphor) see page 15

» Acids

- Mite-Away Quick Strips® [MAQS®] (formic acid) see page 16
- Oxalic Acid (oxalic acid dihydrate) see page 16
- HopGuard® II (hops beta acids) see page 17

Non-Chemical Controls

» Screen Bottom Board see page 17

» Sanitation (comb culling/biosecurity)see page 18

» Drone Brood Removal see page 18

» Brood Interruption see page 19

» Requeening with Resistant Stock see page 19

» Powdered Sugar see page 20


PHOTO COURTESY OF THE BEE INFORMED PARTNERSHIP

See details on each of these controls in the "Descriptions of Controls" section below.

Control Options by Seasonal Phase

Different control options are appropriate for each of the four population phases of the honey bee/Varroa mite seasonal cycle. Below is a summary of options for each seasonal phase.

Figure 4: Control Options by Seasonal Phase

Dormant Phase	
Bees are clustered; no brood in northern locations with reduced brood rearing in southern locations; all or most Varroa mites are phoretic (i.e., on adult worker bodies, as there is little to no developing brood) and both populations are in decline because there is little or no reproduction occurring within the colony.	
Highly Effective Options: ▪ Oxalic acid (fumigation method) ▪ Winter or broodless period	Notes: ▪ Oxalic acid is best used when there is no brood. ▪ Varroa mortality over extended broodless period is high.
Moderately Effective Options: ▪ HopGuard® II ▪ In beekeeping regions with brood during this phase, Apiguard, or Api Life Var®, or formic acid (MAQS®) provided temperatures are within optimal ranges.	Notes: ▪ Little or no independent test results are available for HopGuard® II during the Dormant phase. The formulation has changed each of the last two years. ▪ The effectiveness of Apiguard®, Api Life Var® and formic acid (MAQS®) during the Dormant phase is unknown.
Least Effective Options: ▪ Anything that risks colony success through this phase ▪ Screen bottom board	Notes: ▪ Screen bottom board removes a small percentage of mites that fall from adult bodies. It is best used in combination with other techniques.

Population Increase	
Seasonal colony buildup; colony brood population growing rapidly and adult worker population increasing; Varroa mite population usually low but increasing; pre-honey flow supering of colonies.	
Highly Effective Options: ▪ Apivar® ▪ Apiguard® or Api Life Var® ▪ MAQS® (formic acid) ▪ Drone brood removal	Notes: ▪ Terminate Apivar® after 42 to 56 days of treatment, at least two weeks prior to adding supers. ▪ Terminate Apiguard® treatment before adding supers. ▪ Terminate Api Life Var® after two or three treatments (7-10 days each). Remove Api Life Var® tablets from the hive at least one month before harvesting honey or, if not using the colony for honey production, treat for full treatment period. ▪ It is legal to use MAQS® when storing honey. ▪ Strong, populous colonies tolerate drone brood removal two to three times.
Moderately Effective Options: ▪ HopGuard® II ▪ Colony division ▪ Requeening using hygienic stock ▪ Basic sanitation	Notes: ▪ The effectiveness of HopGuard® II has not been widely tested. ▪ Dividing the colony during the Population Increase phase will most likely negatively affect surplus honey production. ▪ Hygienic queens are not always available. ▪ Basic sanitation may help reduce other stressors.
Least Effective Options: ▪ Screen bottom board ▪ Powdered sugar ▪ Mineral oil ▪ Failure to perform managements	Notes: ▪ A screen bottom board is marginally effective. ▪ There is little evidence that powdered sugar or mineral oil has any effect on mite populations.

Population Peak	
Period of nectar flow and rental of colonies for pollination services; bee population (both adult & brood) at peak; mite populations increasing, nearing peak; often honey supers on colonies.	
Highly Effective Options: ▪ MAQS® ▪ Apivar® or Apiguard® or Api Life Var® (Use is permitted only if no supers are present or colonies are not producing honey.)	Notes: ▪ MAQS®, Apiguard® and Api Life Var® are not suitable for use in all temperatures. See the detailed descriptions of products below for temperature ranges for use of these products. ▪ Apivar® (amitraz) is highly effective. Be cautious about using it too often to avoid risk of developing resistance.
Moderately Effective Options: ▪ Requeening with hygienic stock ▪ Division of colonies ▪ HopGuard® II ▪ Oxalic acid drip	Notes: ▪ Requeening or dividing may negatively affect honey production (if colonies are strong enough to produce surplus). Hygienic or locally selected stock is not widely available. ▪ The effectiveness of HopGuard® II has not been widely tested. ▪ Oxalic acid is best used when there is little or no capped brood in the colony during the Dormant Phase or because of queen replacement that interrupts brood rearing.
Least Effective Options: ▪ Screen bottom board ▪ Drone brood removal	Notes: ▪ A screen bottom board removes a small percentage of mites that fall from adult bodies. Use it in combination with other techniques. ▪ Drone brood removal is restricted in this phase by the absence of sufficient drone brood and the difficulty of accessing the brood nest beneath honey supers.

Population Decrease	
Post-honey harvest; bee population decreasing; colonies rearing overwintering bees. Varroa mite populations growing, peaking, and then declining until eventually only phoretic mites on adult bees after colonies become broodless	
Highly Effective Options: ▪ Apivar® ▪ MAQS® ▪ Apiguard® or Api Life Var® ▪ HopGuard® II	Notes: ▪ Apivar® should not be used until surplus honey is removed. ▪ MAQS®, Apiguard® and Api Life Var® are not suitable for use in all temperatures. See the detailed descriptions of products below for temperature ranges for use of these products. ▪ HopGuard® II manufacturer's test data supports its effectiveness
Moderately Effective Options: ▪ Requeening with hygienic bees ▪ Dividing colonies ▪ Oxalic acid drip	Notes: ▪ Hygienic stock is not widely available. ▪ Requeening and dividing colonies may be difficult. ▪ Oxalic acid is most effective if there is little to no capped brood present.
Least Effective Options: ▪ Apistan® or CheckMite+® ▪ Drone brood removal ▪ Screen bottom board ▪ Sanitation	Notes: ▪ Mite resistance to Apistan® and CheckMite+® is well established. ▪ Colonies are unlikely to raise drones during this phase. ▪ Basic sanitation may help relieve stress.

Non-Reliable, Non-Tested Methods and Illegal Chemicals

Several treatments are ***ineffective*** for Varroa mite control, including:

» Low-dosage mineral oils

» Additional acids (such as lactic acid)

» Food stimulants and supplements

» Powdered sugar

» Small cell, "natural" comb for the rearing of smaller bees

Beekeepers should never use a non-registered chemical to control mites. Such use may violate both federal and state laws and is not a viable option for treating bee colonies.

Other methods that beekeepers may read or hear about should be adequately tested before adoption and should only be used with extreme caution. Always check for efficacy during and after use.

DESCRIPTIONS OF VARROA CONTROLS

More detailed descriptions of Varroa mite controls appear below.

Bee Informed Partnership

The descriptions include "BIP results" from the Bee Informed Partnership (BIP). BIP is a national effort to provide beekeepers with real-world, practical management information. BIP is funded through a five-year grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA). The objective of BIP is to reduce honey bee colony losses by facilitating communication between beekeepers and researchers through anonymous information sharing.

BIP gathers information about current management practices using both participant surveys and data gathering efforts of Tech Transfer Teams (trained field agents who offer regular, on-site hive inspections and sampling for large commercial beekeepers and queen breeders). BIP correlates the survey results and other data with colony health.

The website www.beeinformed.org shares the resulting information about honey bee colony management practices with beekeepers in a user-friendly format and database. The information presented in the BIP results is an analysis of four years of beekeeper winter loss and management practices survey. The results compare colony loss rates between those using a given management practice in a given year and those that do not. BIP results show correlations that are not necessarily evidence of causation, so they should be interpreted with caution.

Chemical Controls

The registered chemical control products listed in this table, must be used according to their label. Misuse or not used in accordance with the label may result in colony loss or damage, and is a violation of federal law. Always read and follow the safety instructions from the label during handling and application of these control products and work in a safe environment.

Synthetic Chemicals

Apivar®	
Name	Apivar® (Vetó-pharma)
Active Ingredient	Synthetic miticide (amitraz)
Formulation	Apivar®: Applied as slow-release impregnated rigid polymer strip
Mode of Action	Contact
Treatment Time/ Use Frequency	42 to 56 days, then remove strips; Treat all hives in apiary at same time.
Time of Year	**Population Increase:** Only if colonies will NOT be supered within 8 weeks; **Population Decrease:** Immediately following peak population once honey harvested.
Effectiveness	Up to 95% effective. Please note that this depends on mite resistance and previous exposure. Please see label for mite resistance management.
BIP Results	35 to 47% fewer overwintering colony losses with use in three consecutive survey years.
Conditions for Use	Place strips in cluster, 2 strips per brood box.
Restrictions	Do not use more than 2x per year; rotate with other chemical controls; do not use when colonies are supered for honey; do not add supers for 2 week period following removal.
Advantages	Safe and highly effective unless there is mite resistance.
Disadvantages	Low levels of break-down residue detected in beeswax & honey; potential for mites to develop resistance.
Considerations	The only legally permissible amitraz formulation is Apivar®; do not reuse strips; store unopened packages at room temperature; perform resistance test and/or monitor mite levels following use to confirm control effectiveness. (See Bibliography & Resources for information on resistance testing.)

Apistan®	
Name	Apistan® (Wellmark International)
Active Ingredient	Tau-fluvalinate (pyrethroid)
Formulation	Impregnated strip
Mode of Action	Contact
Treatment Time/ Use Frequency	42 days (6-8 weeks); Treat all hives in apiary at the same time.
Time of Year	**Population Increase:** Before flow if 2 weeks or more until supering; **Population Decrease:** Following honey harvest
Effectiveness	95 to 99% if no mite resistance
BIP Results	No difference in survivorship between treated & untreated colonies in 3 of 4 years; 31% fewer overwintering colony losses with use in one survey year.
Conditions for Use	Temperatures > 50°F (10°C); Do not use during nectar flow.
Restrictions	Best if daytime temperatures > 50°F; do not use when colonies are supered for honey.
Advantages	Highly effective with susceptible mite populations (Note: mite resistance has been well documented).
Disadvantages	Widespread mite resistance; contamination of hive components; long half-life; residues common in beeswax; continued use may affect brood development; negative synergistic interactions with other pesticides can occur and jeopardize colonies.
Considerations	Negatively impacts queen and drone reproductive health; wear latex gloves; perform resistance test before use and/or monitor mite levels following use to confirm control effectiveness. (See Bibliography & Resources for information on resistance testing.)

CheckMite+®	
Name	CheckMite+® or Perizen (Europe)
Active Ingredient	Coumaphos (organophosphate)
Formulation	Impregnated plastic strip
Mode of Action	Contact
Treatment Time/ Use Frequency	Treatment time 6 weeks; Use 2x/year
Time of Year	**Population Increase:** Only if colonies will NOT be supered within 6 weeks **Population Decrease:** After honey harvest
Effectiveness	85 to 99% (if no mite resistance).
BIP Results	No difference in colony survivorship between treated & untreated colonies in 3 of 4 years; 24% fewer overwintering colony losses in 1 survey year.
Conditions for Use	N/A
Restrictions	Do Not use in queen rearing colonies; Do Not use when colonies are supered for honey.
Advantages	Effective and easy to use when mite populations are susceptible (note: extensive mite resistant pops in United States); can be used to control small hive beetle adults (utilized in different manner).
Disadvantages	Mite resistance; organophosphate; contamination of hive components; long half-life; negative activity with other products; negatively affects reproductive health of queens (rearing) & drones (sperm production).
Considerations	May negatively impact queen health; wear latex gloves; perform resistance test and/or monitor mite levels following use to confirm control effectiveness. (See Bibliography & Resources for information on resistance testing.)

Essential Oils

Apiguard®	
Name	Apiguard® or Thymovar® (Canada)
Active Ingredient	Thymol (essential oil)
Formulation	Gel (individual hive dosage or bulk tub)
Mode of Action	Fumigant
Treatment Time/ Use Frequency	Twice at 2 week intervals (remove or spread remaining gel over frame top bars at end of 4th week)
Time of Year	**Population Increase:** Only if colonies will not be supered within 6 weeks **Population Peak:** Only if bees are not storing honey & not during pollination rental if temps are elevated **Population Decrease:** Post-honey harvest or approaching dormancy
Effectiveness	74 to 95% (more effective with warmer temperatures)
BIP Results	26 to 31% fewer overwintering colony losses with use in 4 consecutive survey years
Conditions for Use	Temperatures >59°F and <105°F (15 to 40°C)
Restrictions	Do Not use when colonies are supered for honey.
Advantages	Naturally derived; easy to use with container or tub.
Disadvantages	May reduce queen egg-laying activity; may increase adult and young larvae mortality; works best under warmer temps; may cause bees to beard in hot weather; human skin irritant.
Considerations	Effectiveness reduced for light mite infestations; requires closed screen bottom board; do not feed sugar syrup during treatment; consider using spacer rim above brood nest for individual gel trays.

Api Life Var®	
Name	Api Life Var®
Active Ingredient	Thymol + camphor, menthol and eucalyptol oil (essential oils)
Formulation	Tablet: divide into ¼ strips, place on top of brood box at corners
Mode of Action	Fumigant
Treatment Time/ Use Frequency	2 or 3X for 7-10 days each (leave 3rd treatment in for 12 days); Repeat or combine with another treatment if heavy mite numbers.
Time of Year	**Population Increase:** Less effective but better during early season buildup or low mite numbers; **Population Peak:** If honey supers are not present **Population Decrease:** After nectar flow, with temperature considerations
Effectiveness	70 to 90%
BIP Results	24.5 to 40% fewer overwintering colony losses with use in 4 consecutive survey years
Conditions for Use	Use between 65 to 85°F (18-30°C); ineffective below 45°F (8°C).
Restrictions	Do not use more than 2x/year; do not use when colonies are supered for honey; wait one month before harvesting honey following removal of strips
Advantages	Naturally derived.
Disadvantages	Temperature considerations: may run bees out of hive if temperature is 80°F or above; increase in bee adult irritability; honey taste tainting.
Considerations	Wear gloves; high temps may cause bees to exit hives and/or adult/brood deaths; may melt plastic hive parts; not available in CA or HI.

Mite-Away Quick Strips®	
Name	Mite-Away Quick Strips® (MAQS®)
Active Ingredient	Formic acid (organic acid)
Formulation	MAQS®: legal formulation-impregnated biodegradable strip
Mode of Action	Fumigant
Treatment Time/ Use Frequency	Treatment time 7 days, not necessary to remove strips.
Time of Year	**Population Increase/Population Peak:** Unique chemical that can be used while honey supers present **Population Decrease:** Following harvest if not too warm
Effectiveness	61 to 98% under temperature limitations; if too warm (>95°F) less effective
BIP Results	16 to 31% fewer overwintering colony losses with use in four consecutive survey years.
Conditions for Use	Full dose (1 sachet, 2 strips) or ½ dose (single strip) per a single or double brood-chamber of standard Langstroth equipment or equivalent hive with a colony cluster covering a minimum of 6 frames. Note, when using a 1/2 dose, a second, single strip treatment is recommended. Use when outside day temperature 50-92° F (10-33°C).
Restrictions	Excessive temperature above 92°F (33°C) can cause brood mortality and bee absconding
Advantages	Natural product; OK to use while bees storing honey; able to kill mites under cappings.
Disadvantages	Potential for bee brood mortality and queen losses.
Considerations	Use acid resistant gloves and protective clothing. Although no longer required; Caution, it is recommended to use a respirator and eye goggles when handling this material; post "72-hour restricted" re-entry signs in apiary; leave screen bottom board (if used) open and add empty hive body or spacer frame above brood chamber; may see bee bearding first couple of days; use permitted during nectar flow.

Oxalic Acid	
Name	Oxalic Acid
Active Ingredient	Oxalic acid dihydrate (organic acid)
Formulation	Sugar syrup drip with syringe or applicator, also fumigation. NOTE: mist application approved for caged (package) bee use.
Mode of Action	Contact
Treatment Time/ Use Frequency	Treatment at application; Use no more than 2x/year.
Time of Year	**Population Decrease:** Late when brood rearing reduced **Dormant Phase:** When brood not present
Effectiveness	82 to 99% when brood not present
BIP Results	37 to 41% fewer overwintering colony losses with use in 2 consecutive survey years.
Conditions for Use	5mL between each frame; max. 50mL per colony; 1.0 g per brood chamber of Oxalic acid; fumigation per label directions.
Restrictions	Recently approved for legal status in US; Permitted in Canada.
Advantages	Cleanses bee adults of mites during broodless periods.
Disadvantages	Corrosive; Liquid application may chill adult cluster.
Considerations	Legalized in U.S. in spring 2015 http://www3.epa.gov/pesticides/chem_search/ppls/091266-00001-20150310.pdf

HopGuard® II	
Name	HopGuard® II
Active Ingredient	Potassium salt (16%) of hops beta acids
Formulation	Folded cardboard strips
Mode of Action	Contact
Treatment Time/ Use Frequency	1 strip per 5 frames of bees, 4 week treatment; Max use 3x per year (6 strips)
Time of Year	**Dormant Phase:** Suggested use when brood not present or brood reduced. Decrease during Pollination phase.
Effectiveness	Not clear, little beekeeper experience to date. Registrant suggests that it is most effective when used during the pre-pollination period (before sealed brood), mid-summer, and at the onset of winter brood development.
BIP Results	10% fewer overwintering colony losses with use in one survey year.
Conditions for Use	Perhaps during little capped brood phase.
Restrictions	Not legal in all states; Section 18 registration. Check with your state Department of Agriculture to see if it is approved in your state.
Advantages	Natural compound; can be used during honey storage.
Disadvantages	Strips are "messy" to use; Use disposable gloves; check effectiveness of mite control following treatment. As an emergency exemption use, any adverse effects should be promptly reported to your State Department of Agriculture.
Considerations	New material only available 2 years and formulation changed in second year; little data or experience reported with product use.

Non-Chemical Controls

Screen Bottom Board	
Name	Screen Bottom Board
Technique	Bottom board with #8-mesh (1/8") screen surface
Formulation	Passive
Mode of Action	Falling mites drop out of colony through screen.
Treatment Time/ Use Frequency	Continuous, year-round
Time of Year	Year-round
Effectiveness	Perhaps up to 10% effective (in northern areas only)
BIP Results	Nationally no advantage in 4 consecutive survey years; however, in northern states a 12.4% reduction of loss was recorded in one survey year.
Conditions for Use	Replace hive bottom; leave space below for trash.
Restrictions	May attract scavengers beneath hive; may reduce brood rearing in lowest box during population increase (early spring).
Advantages	Low-tech and inexpensive; may be used with hive debris sticky board.
Disadvantages	Minimum to little control; may need to close hive bottom when fumigant Varroa control chemicals are used; may inhibit brood rearing in lower frames in spring with cool temperatures.
Considerations	Minimally to not effective; must be used with other controls; not reliable as single control technique; works best with good hive location (sunny site, good air drainage and hive ventilation with winter protection in northern locations).

Sanitation	
Name	Sanitation (bee biosecurity) comb management
Technique	Brood Comb Culling (replacement) + culling brood comb with high number of drone cells; basic hive sanitation; locating hives in sunny sites with good air drainage; Reducing bee adult drifting.
Formulation	Remove & replace brood frames every 3 to 5 years; remove brood frames with more than ⅓ of cells with drone-sized cells/brood
Mode of Action	Culling older brood frames & removing drone brood cells; remove dead-outs; store equipment inside or close stacks of equipment with drawn comb; place hives in sunny areas with good air drainage; space out colonies in apiary by adding distinguishing color, markings, or apiary landmarks to reduce drifting of adult bees; clean hive inspection equipment between hives.
Treatment Time/ Use Frequency	Continuous use beginning at apiary establishment. Move undesired frames to edge of box during active season, remove when broodless.
Time of Year	Population Increase and Population Decrease
Effectiveness	Unknown; considered to improve overall colony health
BIP Results	Beekeepers who replaced more than 50% of their comb in a given year lost more colonies than those beekeepers who did not replace any comb in all 4 survey years.
Conditions for Use	Negative effect if 5 or more combs removed at one time.
Restrictions	May reduce potential honey harvest; brood comb culling best performed under ideal comb drawing conditions (or replace with honey storage frames).
Advantages	May assist with improving overall colony health and performance.
Disadvantages	Culling costs in colony resources.
Considerations	Minimally to not effective if used without other controls; avoid movement of frames or bees between colonies except as specific management activity.

Drone Brood Removal	
Name	Drone Brood Removal (Drone Trapping)
Technique	Remove and destroy drone brood once capped.
Formulation	Use drone frames in brood chamber.
Mode of Action	Mites preferentially reproduce in drone brood; removal of capped drone cell selectively removes mites without harming adult bee population.
Treatment Time/ Use Frequency	Treatment at Population Increase and Peak Population. Remove drone brood at 28-day interval (before adult bees emerge).
Time of Year	Only when colonies rear drones (Population Increase and Peak Population)
Effectiveness	Not as effective as stand-alone treatment; effectiveness compounded by repeating 2 to 3x.
BIP Results	Nationally 11% fewer overwintering colony losses detected in 1 of 4 years; however, northern states saw 10 - 33% reductions in loss recorded by operations using this technique in 3 of 4 years.
Conditions for Use	Only applicable in Population Increase and Peak Population (when colonies actively rear drones).
Restrictions	Need to remove capped brood in timely manner.
Advantages	Inexpensive and effective.
Disadvantages	Time consuming management; may be minimally effective.
Considerations	Use colored drone comb or shallow frame in standard box (stimulating bees to build drone comb from bottom bar); cull drone cells built between brood boxes; to improve effectiveness, reduce drone brood on other brood combs to consolidate for easier removal.

Brood Interruption	
Name	Brood Interruption
Technique	Interruption of colony brood cycle
Formulation	Divide colony (can combine with requeening with hygienic stock); or cage queen for 1-2 weeks to disrupt egg-laying, thus interrupting brood rearing.
Mode of Action	Interrupt growth cycle of mite population.
Treatment Time/ Use Frequency	Treatment during Population Increase or Post-Population Peak (during nectar flow or post-harvest). Use once annually; may reduce harvest yield.
Time of Year	Population Increase, Peak Population or Post-harvest
Effectiveness	Little data; not a stand-alone treatment.
BIP Results	No information
Conditions for Use	Need a queen or queen cell for each division created.
Restrictions	Splitting and requeening splits difficult when there are few forage resources.
Advantages	Non-chemical and potentially effective It utilized with adult mite cleaning chemical control & subsequent introduction of hygienic/resistant stock.
Disadvantages	Requeening and/or holding original queen in cage not always successful; highly time consuming; need to purchase or raise queens to place queen in split.
Considerations	Effective but requires good beekeeping skills for season-long management (commercial beekeepers who split their colonies tend to retain the newer colonies better than non-split ones); may use brood interruption to create time with no capped brood cells & use treatment that is effective when there is no brood (oxalic acid or HopGuard® II); potential lower honey harvest or population growth due to delay in brood production.

Requeening	
Name	Requeening (ideal with resistant stock)
Technique	Utilize bee stock with demonstrated hygienic or other mite reducing behaviors, if possible.
Formulation	Requeen using selected stock.
Mode of Action	Selected stock demonstrates slower mite growth.
Treatment Time/ Use Frequency	Treatment during Population Increase or Peak Population or post-honey harvest. Use annually.
Time of Year	**Population Increase:** As necessary **Peak Population:** Post honey harvest **Population Decrease:** Making of nucs
Effectiveness	Long-term solution to reduce need for chemical controls
BIP Results	Low survey responses. Use of locally selected bee stock resulted in 18 to 41% fewer overwintering losses in 3 consecutive survey years; Caucasian hybrid stock: 42% fewer losses; Buckfast hybrid stock: 92% fewer losses; Buckfast bees: 84% fewer losses; no statistically significant results for Varroa Sensitive Hygiene (VSH) or Minnesota (MN) Hygienic from 3 consecutive survey years.
Conditions for Use	Works best with proper queen introduction methods
Restrictions	Not always easy to introduce new queen into colony, especially when resources are not abundant.
Advantages	Stocks selected for mite resistance or tolerance may reduce chemical dependency.
Disadvantages	Cost of buying or rearing queens; requeening not always successful.
Considerations	Known stocks of some potential mite population reductions: Varroa Sensitive Hygiene (VSH), Russian bees, Carniolan bees (in northern locations), Minnesota Hygienic, improved Carniolan stock, Buckfast.

Powdered Sugar	
Name	Powdered Sugar
Technique	Icing sugar
Formulation	Dusting over and between frames of brood
Mode of Action	Contact
Treatment Time/ Use Frequency	Treat 1 to 2x per week. Use frequency is unknown, suggested use may eliminate emergence of new mites from brood cells.
Time of Year	**Population Increase:** Before extensive brood **Population Decrease:** Shortly before dormancy (when majority of mites are phoretic on adult bees)
Effectiveness	Minimal < 10%; Do Not rely upon. Check post treatment to determine effectiveness.
BIP Results	No reduction in overwintering loses from 4 consecutive survey years.
Conditions for Use	Need to use with open bottom or screen bottom board.
Restrictions	May harm open brood.
Advantages	None apparent, as method is minimally or not effective.
Disadvantages	NOT a stand-alone treatment; labor intensive.
Considerations	Generally not effective; do not rely upon. Check effectiveness post-treatment.

ABOUT THE HONEY BEE HEALTH COALITION

The Honey Bee Health Coalition was formed in 2014 as a cross-sector effort to promote collaborative solutions to honey bee health challenges. The diverse Coalition brings together beekeepers, growers, researchers, government agencies, agribusinesses, conservation groups, manufacturers and brands, and other key partners dedicated to improve the health of honey bees and other pollinators. The Coalition's mission is to collaboratively implement solutions that will help to achieve a healthy population of honey bees while also supporting healthy populations of native and managed pollinators in the context of productive agricultural systems and thriving ecosystems.

A major tenet and founding principle of the Coalition is the recognition that the current decline in overall honey bee health is a multi-factorial problem, and all stakeholders have a role to play in managing bee health issues. The Coalition is focusing on accelerating improvement of honey bee health in four key areas: forage and nutrition, hive management, crop pest management, and outreach, education and communications. As part of the hive management focus area, the Coalition has developed this "Tools for Varroa Management" Guide that beekeepers can use to help focus on more effectively controlling the Varroa mite in their hives.

For more information please visit at http://honeybeehealthcoalition.org/

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The views and opinions expressed in this document are those of the author and do not necessarily reflect those of the U.S. EPA, USDA, or the U.S. Government.

ADDITIONAL RESOURCES

General information

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Sampling for varroa tutorials

www.extension.umn.edu/honeybees

https://agdev.anr.udel.edu/maarec/educational-resources/powerpoints

Other Resources

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www.beeinformed.org/2011/09/test-for-varroa/

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Screen Bottom board

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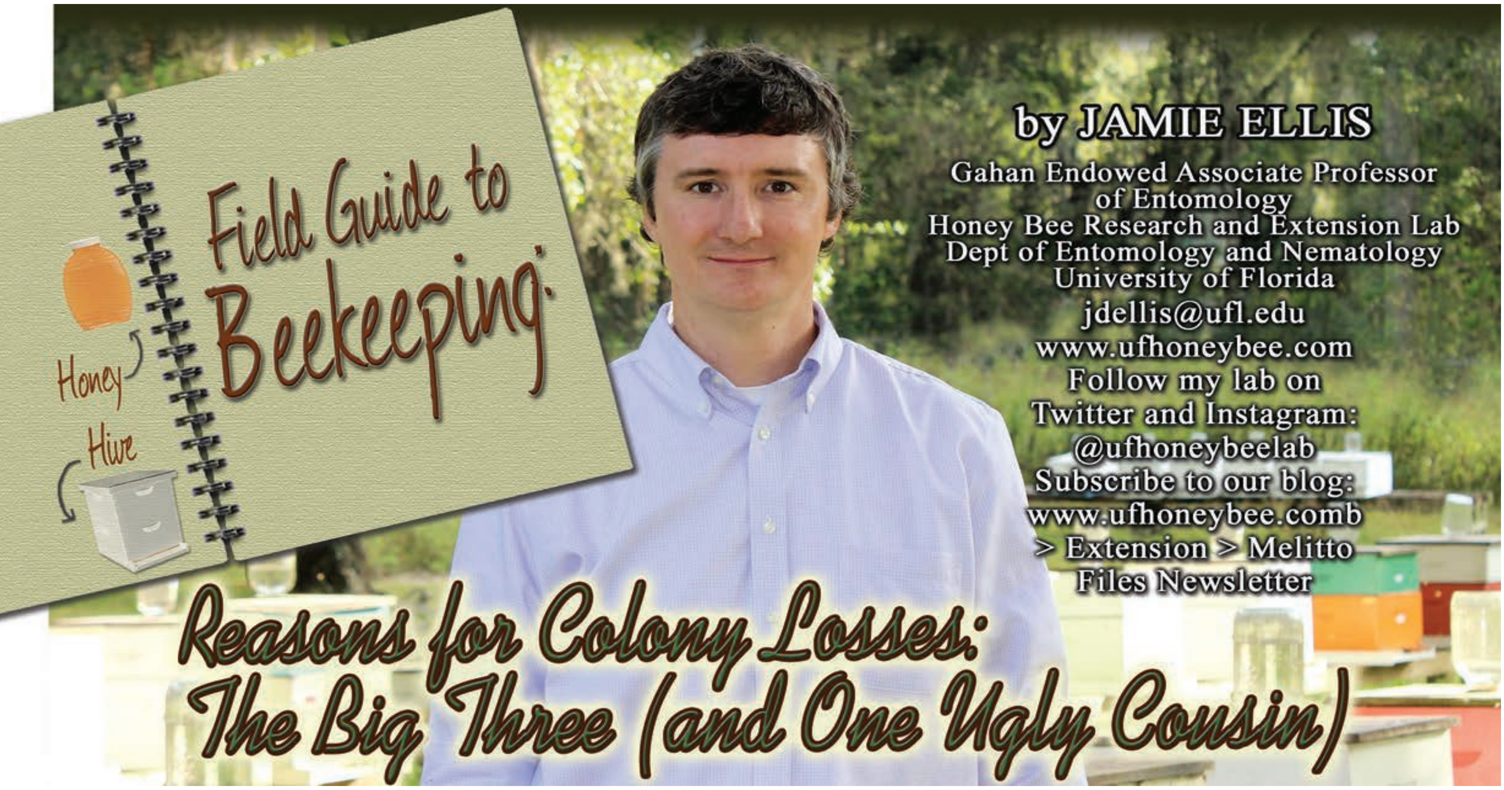

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Reasons for Colony Losses: The Big Three (and One Ugly Cousin)

There are a number of stressors that impact honey bees and their colonies. In fact, I wrote a two-article series about the stressors bees face and included 32 biotic (Ellis 2016a) and 31 other stressors (Ellis 2016b) of honey bee colonies. That means there are at least 63 stressors that can affect your bees! Coupled with this, bees have been dying at alarming rates since 2006, at a national yearly average of around 30%. Herein lies a fundamental problem for many beekeepers. Bees seem to be dying left and right and up and down. What are we to do? How can we keep bees alive at all considering the huge number of stressors they face? How can we make sense of all the noise? How do we know what matters most?

Enter the Bee Informed Partnership (**https://beeinformed.org/**), or BIP for short. I do not have time in this article to share all that BIP does for beekeepers (and they do a lot). What I do want to highlight in this article is that BIP publishes yearly colony loss reports (**https://beeinformed.org/results-categories/winter-loss/**). These loss reports tell us our average winter, summer, and yearly loss rates for managed colonies in the U.S. They break these loss rates down by state, thus allowing you to see how your loss rates compare to those of other beekeepers in your state. One of the things I most appreciate about the loss reports is that they list what the nation's beekeepers say are the key stressors that are responsible for killing most of their hives in a given year (BIP calls this "self-reported causes of losses"). In other words, BIP reports tell you what you should be worried most about as a beekeeper.

This is interesting. While there are many things that can affect your bees, most of the stressors I note in my articles (Ellis 2016a,b) will never be a problem for the average colony. Thus, it behooves the beekeeper to narrow down the long list of stressors to a much smaller, manageable list of things that they should address in their colonies. The BIP loss reports do this for you. BIP and its team of staff dedicated to helping beekeepers send out yearly questionnaires asking beekeepers how many colonies they had at a certain point in the year, how many they have now, and what the causes of their losses were. Using this information, they develop a table or figure of self-reported losses that one can use to rank, even if superficially, the causes of colony losses. Admittedly, these data are generated from surveys and surveys have their problems. However, I think these data are reliable because they seem to match the situation seen in the field.

If I understand the data correctly, one can rank a given cause of losses relative to other ones based on the number of beekeepers reporting that cause. That said, there might be some beekeeper bias in the data. For example, imagine an instance where many more hobbyist beekeepers take the survey than do commercial beekeepers. If many/most hobbyists think wax moths kill their colonies, "wax moths" will move to the top of the list just because most beekeepers voted for them. This can be a problem if the commercial beekeepers completing the survey managed many times more bees than did the hobbyists completing the survey because their causes of colony losses are underrepresented.

I have spent some time digesting the self-reported causes of colony loss data reported in the BIP surveys and have noticed that some interesting trends have emerged. For example, the top five stressors reported by beekeepers of all three levels tends to remain constant, though the order of these stressors varies from year to year. For example, *Varroa* always seem to be in the top five, but they may be five one year and second the next. On average, over the last decade, the top five self-reported causes of colony losses have been, in no particular order:

- -*Varroa*,
- -bad weather,
- -starvation,
- -weak in fall, and
- -poor queens (sometimes reported as queen failure).

Oher causes of losses have moved into and out of the top five periodically. These include CCD, pesticides, *Nosema*, etc. I want to stress that *many* things weaken and kill honey bee colonies. However, the five I list above are the ones that keep rising to the top year after year, suggesting that they are a chronic problem for bee colonies.

I will omit two of the causes of colony losses from the list of five. The first I will omit is "weather." Weather, from year-to-year, shows up in the top five, but it is the one stressor about which we can do nothing. Weather can have a very broad impact. The weather that affects bees in Florida is different from that which affects bees in Germany. Weather effects on colonies range from extreme cold to extreme heat. It includes flooding, wind, tornadoes, hurricanes, drought, humidity and even more. Nevertheless, I cannot tell a beekeeper how to control weather in their colonies. It is not manageable. Consequently, I will omit it from further discussion.

Next, I will eliminate "weak in fall" as something to discuss in this article. This condition appears in the top five almost every year. My problem with it is that "weak in fall" is not a stressor of honey bees. It is the result of other stressors (mites, starvation, weather, etc.). You cannot apply a treatment for "weak in fall" and you have to remedy it by addressing other problems. Thus, it is not a true stressor itself, leading me to omit it also from further discussion.

That leaves what I call "the big three": *Varroa*, starvation, and poor queens. Many other stressors affect bees and will affect *your* bees periodically. However, *Varroa*, starvation, and poor queens *will* affect nearly *every* colony at some point. This alone makes them something that every beekeeper must recognize and have the management skillset to address. Make no mistake, if you keep bees long enough, some, perhaps all, of your colonies battle the big three. You need to be ready.

1) Varroa – *Varroa* (Figure 1) is a mite that many feel is the number one threat to honey bee colonies globally. *Varroa* reproduces on immature bees and can transmit pathogens to these bees while the bees are developing. Increasingly, research is showing that the *Varroa* and its pathogen complex are significantly nastier than either is alone. A close look at the title of this article will show that I also intend to talk about "an ugly cousin." Well, the *Varroa* pathogen complex is that ugly cousin. The pathogens that *Varroa* transmit are underrepresented in the loss reports. The research data show, though, that the two work in tandem to take down even the healthiest of colonies. How does this work? *Varroa* carry pathogens that they transmit to young bees, pathogens such as Deformed Wing Virus (DWV – Figure 2). These pathogens can cause problems for the bees as they age, if the pathogens do not kill the bees outright while they are developing.

It is important you know that *Varroa* are ubiquitous and they will kill your bees. Beekeepers keeping bees before *Varroa* arrived in this U.S. talk about "the good old days" when they did not have to manage *Varroa* and when colonies just survived. Once *Varroa* arrived, beekeepers had to begin managing their bees heavily. Today, failing to address *Varroa* means that you will have no bees at all. That is a truth worth memorizing.

The excessive colony losses that have dominated our discussions the last decade have given rise to meetings galore, to "save the bees" groups left and right, to initiatives, congressional hearings, and to increased funding for bee research and education, all among other things. One of the groups born from the bee loss chaos was the Honey Bee Health Coalition (HBHC, **http://honeybeehealthcoalition.org/**). This group has published fantastic information on controlling *Varroa* (**http://honeybeehealthcoalition.org/varroa/**). I think the pdf entitled

Figure 1. An adult female Varroa. Photograph: University of Florida.

Tools for Varroa Management is an indispensable guide that every beekeeper should read and then read again for good measure. The HBHC developed a video series to accompany the pdf. You can find the videos here: **http://honeybeehealthcoalition.org/varroa/#videos**. This document and video series influenced the discussion of *Varroa* that follows.

Your bees will die if you do not address *Varroa* in your colonies (see the HBHC video entitled *Will Varroa kill my bees?*). Consequently, you *must* monitor for *Varroa* in your colonies. One of the great things about the HBHC *Varroa* management guide is that it includes a table (reproduced in this article as Table 1, with all credit going to the HBHC for its development) that notes the *Varroa* populations that are damaging to your colonies (the "thresholds"). In the table, the HBHC tells you what percent mite infestation (i.e. number of *Varroa* per

Figure 2. An adult bee infected with Deformed Wing Virus.

Table 1: Treatment thresholds by phase; (%=Number of mites/100 adult bees).

*This table is reproduced in its entirety from the Honey Bee Health Coalition's *Tools for Varroa Management* guide. I credit the Honey Bee Health Coalition for the information contained herein.

Colony Phase	Acceptable - Further control not needed	Caution - Control may be warranted	Danger – Control promptly
Dormant with brood	<1%	1-2%	>2%
Dormant without brood	<1%	<2-3%	>3%
Population Increase	<1%	<2-3%	>3%
Peak Population	<2%	<3-5%	>5%
Population decrease	<2%	<2-3%	>3%

Acceptable: Current mite populations are not an immediate threat.

Caution: Mite population is reaching levels that may soon cause damage; non-chemical control might be employed while chemical control may be needed within a month; continue to sample and be prepared to intervene.

Danger: Colony loss is likely unless the beekeeper controls *Varroa* immediately.

100 adult bees) demands instant control depending on what phase your colony is in at any given time. Thus, you know exactly what levels are damaging depending on your colony conditions. To summarize Table 1, having less than one mite per 100 bees is acceptable. Typically, having 2 – 3 mites per 100 bees suggests you may need to apply a control. Having three or more mites per 100 bees usually means that you must apply a control promptly or you risk losing your bees. At levels of 5 or more mites per 100 bees, your bees are dead and they have yet to realize it.

The HBHC guide tells you exactly how to determine your colony *Varroa* levels using soap washes, powdered sugar shakes, and/or alcohol washes. I will not go into the details here given that the guide does such a great job. I will only say that you absolutely should monitor your colonies. The HBHC guide recommends that you monitor them at least four times per year. My general recommendation is to do it monthly during the active season, starting when the bees are coming out of winter and continuing until the colony becomes dormant.

The final thing I want you to know about *Varroa* is that you must control their populations once you reach the appropriate threshold. I know that this point is the most sensitive of all *Varroa* topics. There are three viewpoints on this issue. There are those who will use conventional methods (usually, this means the approved miticides) to address *Varroa*. Others would not consider putting a miticide in their colonies if every bee in the nest had three *Varroa* on them. The third group of people is the group confused by the rhetoric spouted by members of the other two groups (the "I will use miticides" group and the "I will not use miticides" group). This is not an article on *Varroa* control. However, I will make a few simple statements regarding my feelings on this topic. (1) It is possible, with tremendous amounts of work, to keep thriving, productive colonies with little chemical intervention against *Varroa*. It requires diligent monitoring of colonies at all times and an all-out blitz of non-chemical *Varroa* control measures integrated to reduce *Varroa* populations (resistant stock, drone brood trapping, bottom screens, etc.). Even if it is possible to do this, it is a lot of work given that you have to monitor regularly and most of the non-chemical control approaches are labor intensive. (2) It *is* ok to use chemical miticides to address *Varroa*. I understand the anti-pesticide movement afoot in the world today. However, when used according to label, miticides do their job with minimal to no impact on bees. The problem with miticides is that rampant misuse has led to the development of miticide-resistant *Varroa*. There are only a few active ingredients that continue to work against *Varroa* today. The HBHC guide goes into significant detail about each *Varroa* control option, including their efficacies, proper use, and pros/cons of using them, etc. (3) *Varroa* cause significantly more damage to bees than the control options available to use against them (with the caveat that you follow the labels closely). It is sad to see colonies sick and dying because the beekeeper believed that not using a given treatment was healthier for the bees than killing the *Varroa* with the treatment. *Varroa* kill bees. You should kill *Varroa.*

What should you do about *Varroa*'s ugly cousin (the *Varroa*-associated pathogens)? The answer is not clear. It would be easy to say, as most do, "control the vector (*Varroa*) and you will control the pathogen." I have heard that said, and have said it myself, a thousand times. However, I do not think it is that simple. Furthermore, we have no antiviral drugs for bees. I know that some may be forthcoming, but this could take years and we do not know what their efficacies will be, if they are efficacious at all. My real reason for mentioning the ugly cousin is to reinforce the idea that you cannot separate the two. It is important to know that *Varroa* are in your colonies and they are carrying some nasty things with them.

To summarize the *Varroa* issue: (1) monitor your colonies and (2) treat your colonies when they exceed the damage thresholds. Remember, beekeepers consistently list *Varroa* as one of the "big three". Please, control your *Varroa*. When you are done, control them again. Your bees will thank you for it (because they will be alive to thank you).

2) Starvation – Of all the big three, this is the one that frustrates me the most. It shows up in reports in different ways. The BIP reports usually list it as "starvation," but I like to use the phrase "nutritional management" which, of course, includes starvation, but also includes a lack of quality food in the environment for the bees. The reason starvation frustrates me so much is because it is the easiest of the big three to address. When your bees need food, feed them. It is as simple as that…or is it? [Quick disclaimer: When I say "food" from this point forward, I mean "honey" even if honey is not bee food.]

Bees starve for two reasons. First, they have no food in the nest. Second, nothing is available in the environment that can compensate for this lack of food in the nest. Starvation can occur at any time of the year. It often occurs while the bees are coming out of winter. Perhaps they had an unusually long winter and did not store enough honey to last the entire winter. Maybe there are no major nectar flows available in an area, leaving the bees unable to collect enough to keep up with the needs of a growing colony. For most beekeepers, however, colonies starve in/around winter. Consequently, the astute beekeeper has to know going into winter if their colonies have enough stored honey to survive winter. I want to stress, starvation can happen at any time. Thus, a beekeeper should always

Figure 3. Hoisting a colony from behind to determine how much food it has. ***Photograph: University of Florida.***

be able to recognize when their colonies need food and how to feed them.

To my knowledge, there is no up-to-date U.S. guide to honey bee nutrition, including starvation and general nutrition management, like that the HBHC produced for *Varroa*. There is, however, an Australian guide to bee nutrition. Its name, rather humorously, is *Fat Bees Skinny Bees* (Somerville, 2005 — **https://rirdc.infoservices.com.au/items/05-054)**. It is a great document. In fact, I like it so much that I feel that something like this needs to be developed for U.S. beekeepers (I am looking at you Honey Bee Health Coalition.☺) That said, I think it contains information that can be of value to beekeepers in the U.S. and around the world.

How do you know when your bees need food? The simplest way is to hoist your colony with one hand from the bottom box (Figure 3). I usually try to do this from behind the colony. Grasp the handle on the lowermost box and try to rock it forward, off its stand, with one hand. Colonies that need honey are easy to rock forward, thus signaling that they need to be fed. Colonies that are hard to lift with one hand generally have enough honey, with no further action required.

Figure 4. A colony fed sugar syrup via a jar feeder on top of the hive. ***Photograph: University of Florida.***

What should you feed bees? There are two options for supplying sugar to a colony. First, you can feed bees sugar water or sugar patties (some beekeepers call the latter "fondant" or "sugar cakes"). Both of these rely on the use of granulated sugar that is either dissolved in water and fed as a syrup or mixed into a cake. The second option is to feed bees corn syrup. Most people just feed whichever is cheapest at the time. How should you feed bees? It is up to you (Figure 4). This is one of those "there is more than one way to skin a cat" situations. At the end of the day, it is less important how you feed your bees than it is to feed your bees if they need it.

You must monitor and feed your bees when necessary. Be prepared to do it. There is no shame in giving bees food. People like to say that feeding bees is not natural. Neither is keeping and managing bees. Given that we are managing a wild creature in a domestic setting, there are times we need to intercede to give them the best chance of survival. Please, do not let starvation end up being a reason your bees die. I look forward to the day we have a guide to honey bee nutrition. Until then, just remember: "hoist" and "feed when light".

3) Poor queens – Nearly every year, poor queens (sometimes called "queen failure") seem to make it into the BIP's top five reported causes of colony losses. Queens (Figure 5) can be poor or fail for a number of reasons. These include, but certainly are not limited to:

-shortened lifespan
-low or reduced egg output
-poor selection, leading to unproductive offspring who may be prone to illness
-infertility
-unsuccessful mating flight (never mated due to inclement weather, did not mate with enough drones, etc.),
-drone layer (only lays infertile eggs), and
-has a spotty pattern (Figure 6 – uneven distribution of randomly aged brood, many cells in brood nest containing no brood).

Many beekeepers say that queens are not living long enough or that they are not of sufficient quality (not producing enough, high quality offspring). To be honest, the topic of poor queens is the most difficult of the big three to discuss. It seems to be more of a moving target. After all, your definition of a poor queen may vary from my definition. There are no good queen management guides available today and one seems sorely needed (another job for the HBHC or other industrious group.☺)

Despite the difficulties associated with addressing this topic, there are some general comments about poor queens that I can make. First, the demand for bees has never been greater. Those selling packages, nucs, and queens are having a hard time keeping up with the demand for these items. Thus, there can be little motivation to invest in the time and labor it takes to produce quality queens when the demand to produce many queens is so high (a focus on quantity often comes at the expense of a focus on quality).

Second, the science of breeding bees is straightforward intellectually, but the practice of breeding queens is expensive, time consuming and laborious. It is possible to breed beneficial traits into bees. However, it is a lot of work to do. Furthermore, the mating habits of queens and drones makes it difficult to maintain a stock, given that queens leave their hives and mate with multiple drones that are not under your selection. I think about it this way. You may have the world's most perfect daughter, perfect in every way. However, you have a hard time controlling who she brings home – do you not? Queens are the same way. You can invest a lot of time in their selection, but it is difficult to control the source of drones with which they mate. Of course, you could own an island, or be an expert in instrumental insemination. Yet, the former is not an option for most of us and the latter requires special instrumentation and skills.

Third, no one knows quite what to look for when a queen is "poor". I provided at the beginning of my discussion of this topic a list of qualities that many believe poor queens have. However, I have managed very productive colonies headed by queens exhibiting one or more of these qualities. Knowing your bees are starving or that they are succumbing to *Varroa* is easier than knowing your colony has a failing queen. For example, you generally find out that the queen was producing unproductive offspring *after* the production season has passed. By then, it is too late!

What can one do to remedy the poor queen issue and reduce the number of colonies lost to poor queens? I list some recommendations below.

A – Requeen your colonies yearly. Young queens often are more productive (lay more eggs) than are older ones. You possibly can forgo this recommendation if your old queen remains a prolific egg producer and if is her offspring are productive.

B – Requeen your colony if you notice any problem with your queen. Many new beekeepers are so happy that their colony has a queen at all that they are willing to put up with an inferior queen for the comfort of knowing they have one. However, this is not a good way to manage bees. Replace unproductive queens or queens suspected of being poor in any way.

C – Requeen your colony if it exhibits any undesirable traits. For example, requeen defensive colonies. Replace queens from chalkbrood-infested colonies, or, for that matter, colonies that have recurring issues with other pathogens. This, after all, is a sign that the queen's stock is susceptible to these issues.

D – Purchase and use queens from reputable breeders. Ask other beekeepers who they would recommend or try a few queens from different sources and decide for yourself.

Figure 5. A queen surrounded by her retinue of workers. ***Photograph: Mike Bentley.***

E – Purchase and use queens selected for *Varroa* tolerance or resistance traits. I wrote an article about the queen stocks available in the U.S. (Ellis, 2015). Decide on which of those you would like to try and contact the producer of that stock for advice on which breeders to use as your source of queens. For example, I would contact the USDA Bee Lab in Baton Rouge if I wanted to find a queen breeder who produces VSH (*Varroa* Sensitive Hygiene) queens.

F – Contrary to what you hear, do not rear your own queens if you have five or fewer colonies or if the density of feral bee colonies (those living in the wild) is low. Many people, me included, believe that inbreeding is one of the main reasons queens produce spotty brood patterns. The chances of producing inbred queens has an inverse relationship to the number of colonies you have (i.e. the chance goes up as the number of colonies you have goes down).

G – Take classes, attend workshops, and read books related to rearing queens if you plan to produce your own. You can start by reading this good overview: Büchler et al. 2013 (***http://www.tandfonline.com/doi/abs/10.3896/IBRA.1.52.1.07***). It pays to invest time and energy into being educated on this topic given that queen quality is a significant contributor to colony losses.

Generally speaking, you need to learn to spot queen problems and work quickly to remedy them.

Conclusion

Will all of your colonies survive if you control *Varroa*, ensure your bees have enough food, and your queens are always good? Of course not. Plenty of other things

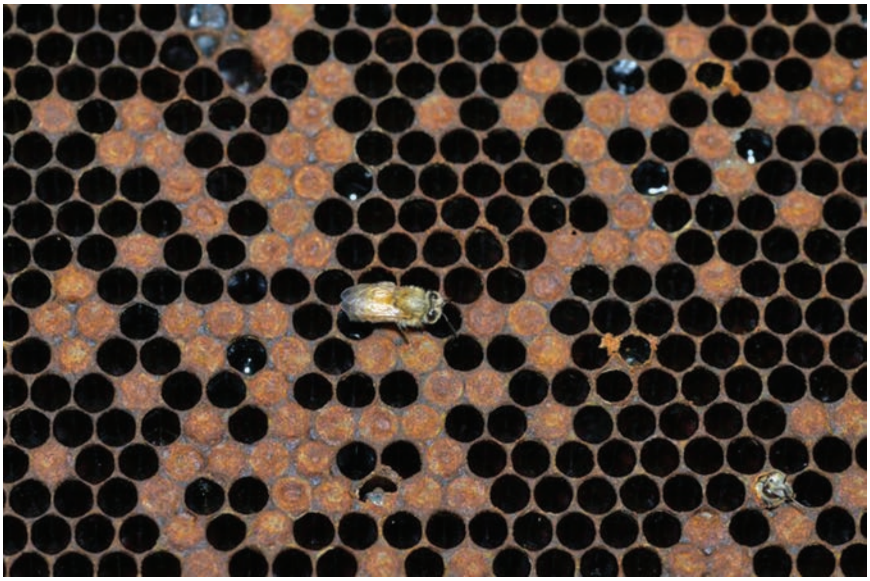

Figure 6. A spotty brood pattern. ***Photograph: University of Florida.***

kill bees. However, *Varroa* (and their ugly cousins), the threat of starvation, and poor queens will plague your colonies nearly every year. It is essential that you know the threat posed by each, recognize when a colony is suffering from one of the three, and know how to help colonies when they are under attack by one of the big three. Proper management of *Varroa*, starvation, and poor queens will reduce your colony loss rates significantly.

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A Year in the Life of a Beekeeper

Learning Objectives for this Lesson

After completing this lesson, you should be able to:

1. Recognize seasonal trends in honey bee colony needs throughout the year in Florida including:
   a. Nectar and honey flows
   b. Pest cycles
   c. Swarming
   d. Brood build up
2. Identify the regular actions required of a beekeeper to maintain quality honey bee colonies.

Overview

Colony faces challenges for growth based on season

- Spring, summer, fall, winter

Spring is the busiest time for beekeepers!

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Early Spring

Colonies are coming out of winter and their populations will grow rapidly.

This is the best time to start new colony from packages.

Overwintering colonies should be prepared for the spring nectar flow. Preparation includes:

- Supplemental feeding
- Pest control (nosema, tracheal mites, varroa)

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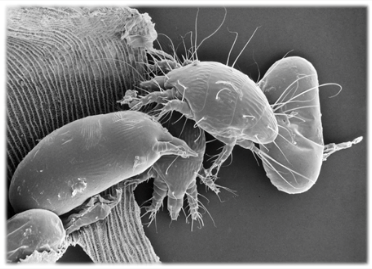
Early Spring



Pest trends follow colony growth trends

Early control can mitigate potential problems later in the year.

Some pest and diseases to look for early in the year include:

- Nosema
- Tracheal Mites
- American and European Foulbroods
- Small Hive Beetles
- Varroa Mites

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Early Spring

Large colonies will begin to swarm as the nectar flow approaches.

Preventing swarms keeps your bees in your hives.

Swarm control is necessary if you want to maximize honey production!

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Mid-Spring

The major nectar flow begins in mid-spring in most areas.

Inspect your hives weekly (swarm control, disease/pests, etc.).

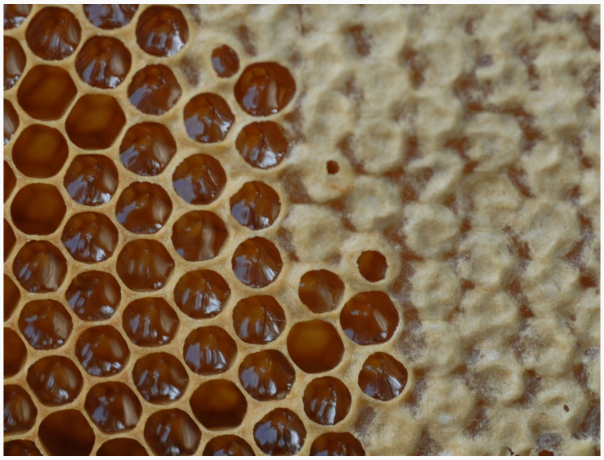
Supers should be added to hives to increase space to store honey.

Continue splitting colonies or controlling for swarms.

Mid-Spring

Supers should be placed on colonies just prior to the start of the nectar flow.

When to Remove Supers



Uncapped honey

Capped honey

Supers should be removed when honey is ~¾ capped.

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Late Spring

Honey production typically peaks in late spring.

Continue to control swarming.

Monitor for diseases/pests.

Remove empty supers and harvest full supers as needed.

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Early Summer

Most major nectar flows end. Colonies need to cap remaining uncapped honey.

Remove full supers and begin to process honey.

Leave one super on hives to provide food to the bees during the following months or feed bees.

Monitor for pests/diseases, especially varroa, the foulbroods, and small hive beetles. Treat if necessary.

Mid-to-Late Summer

In most areas nectar production has almost completely stopped.

Pest levels can dramatically increase, especially varroa and small hive beetles.

Mid-to-Late Summer

It gets hot!

Bees should have an adequate water source or they will forage for water elsewhere!

Food stores should be monitored and colonies fed if necessary.

Reduce entrances and take other measures to prevent robbing

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Fall

Disease and pest control (small hive beetles, varroa, tracheal mites, nosema)

Feed colonies that do not have food.

Some areas have a moderate nectar flow.

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Winter

Diseases/pests should be under control by early winter.

Hive activity will decrease greatly.

The queen usually stops laying eggs until spring.

The hive does not need to be opened as frequently as in the Spring

Colonies begin to cluster at temperatures <60º F.

Winter

Hive "hoists" can be performed every 3-4 weeks to make sure bees have enough honey.

Feed if needed.

Frames of honey and pollen should be placed around the bee cluster or within easy reach.

Queen excluders should be removed from supers to allow cluster to move to food sources.

Winter

It is not too early to make plans for next season!

Place orders for queens, packages, and/or nucs.

Locate spring forage sites.

Build and repair equipment.

Review – Nectar Flows

Major nectar flow occurs in the Spring

Exact timing varies depending on flora near your apiary

Minor nectar flow in Fall in many areas in Florida

Management point: Critical to monitor food stores during summer and winter

Management point: Important to harvest excess honey

Review – Colony Growth

Colony growth coincides with nectar flows

Most growth occurs in Spring!

Management point: Monitor growth closely to manage swarming

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Review - Pests

Pest populations grow quickly when the colony grows.

Management point: Monitor pests and expect to treat early spring and fall.

Management point: Follow treatment instructions on the label.

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Any Questions?