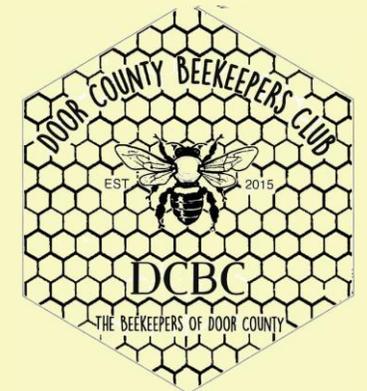
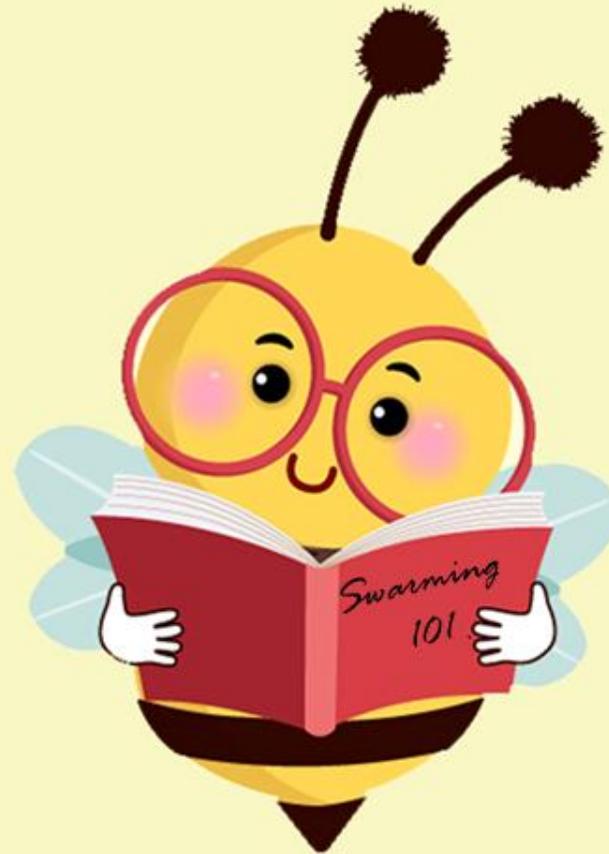


A Brief Discussion of Swarm Prevention and Control



Absconding or Swarming?

Absconding

- Complete Abandonment
- The entire colony departs leaving comb, honey, pollen and brood behind
- Triggered by severe conditions
 - Varroa overload
 - Excessive disturbances
 - Vibrations/machinery
 - Animal harassment
 - Skunks, bears, ants, wasps
 - Thermal stress
 - Wax moths
 - Small hive beetles
 - Pesticide exposure
 - Poor health, weak colony
 - Unsuitable conditions

Swarming

- Normal Reproduction
- A portion of the hive remains functional
- Retains the resources to continue

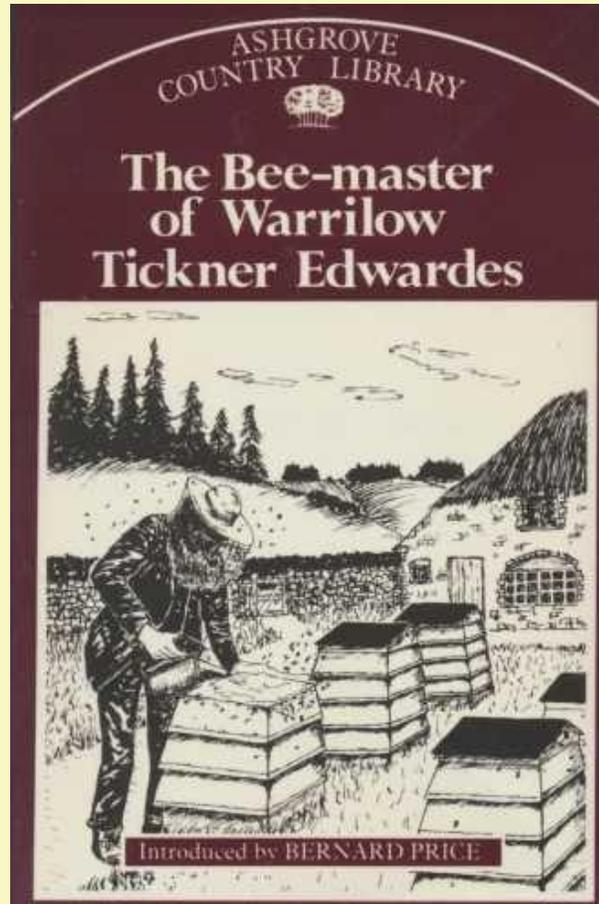


Honeybee Colony Economics

- In order to survive the colony needs:
 - Nurse bee
 - Care for the brood
 - Produce Royal Jelly for brood, queen and foragers
 - Workers to forage for pollen and nectar
 - Honey processors
 - Drones to fertilize virgin queens
 - Colony reproduction—creating the next generations
- How does the colony “know” how to allocate the right proportion of workers to each critical task and yet quickly readjusted when a honeyflow starts or ends? Randy Oliver 2010

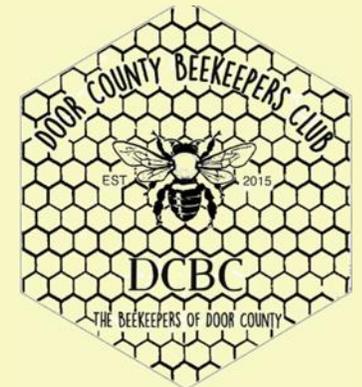


Without swarming there would be no honeybees



- “The bees have their definite plan for life, perfected through countless ages, and nothing you can do will ever turn them from it.
- You can delay their work, or you can even thwart it altogether, but no one has ever succeeded in changing a single principle in bee-life.
- And so the best bee-master is always the one who most exactly obeys the orders from the hive”—

Ticknor Edwards, 1920



Unmanaged Colony Swarming

- Most strong colonies will attempt to swarm every year
- Consists of the queen and a majority of flying bees
 - Find a safe location
 - Create new comb
 - Rear brood
 - Collect sufficient stores to get through the winter
 - That's a tall order
 - Only about 23% of swarms survive the winter
- To maintain a stable population feral colonies need to swarm at least twice a year



Residual Colony After Swarming

- The colony left behind has about an 80% chance of survival
 - Possess drawn comb, nutritional stores, eggs and larvae
 - Require a new queen (20% failure rate)
 - 85% of the Varroa mites are still in the hive
 - Likely to swarm again the following year
- Without swarming there would be no honeybees
- But swarming is a loss of extremely valuable resources



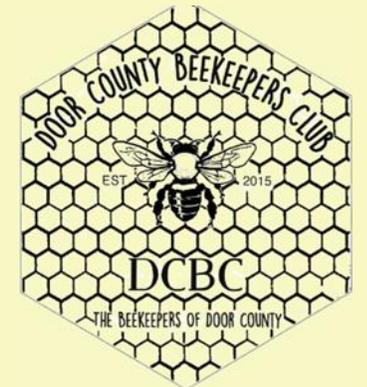
Two Versions of Swarming Activity

- **Colony Reproduction**

- Natural process in spring
- Creates next generation

- **Colony Congestion**

- Management problem
- Happens any time
- Most common during spring buildup and honey flows



Superorganism Reproduction

- **Spring Swarming**
 - Queen produces offspring
 - Keeps the colony alive but can't create another colony
 - **Swarming is Necessary**
 - Ensures survival of feral honeybees
 - Not wanted in managed colonies
 - Replaces colonies that are lost
 - Creates the next “generation”
 - The behavior is hardwired, an instinctive drive
 - **But Swarming is dangerous**
 - Usually only the strongest and healthiest hives swarm
 - The swarm is at its most vulnerable position



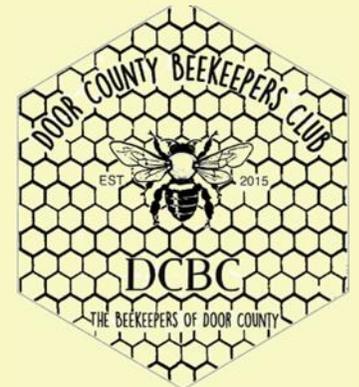
Colony Reproduction Swarms

- Begins in late spring to early summer
 - Depends on weather and location
 - Florida, California February or March
 - Midwest Late spring, early summer
 - Highly variable; based on daily weather conditions
 - Season to season variability
- Usually sometime during a 2-6 Week period
- Typically occurs a couple of weeks after abundant natural nectar and pollen resources, usually with the first nectar flow



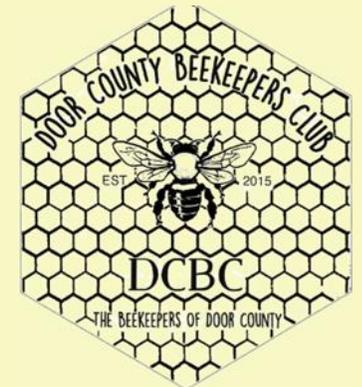
Conditions for Reproductive Swarming

- **Swarming is risky**
 - The colony needs to ensure conditions are right
 - The process is planned, not haphazard
 - Requirements
 - Mature drones available (emerged four weeks earlier)
 - Increased day length
 - Warm enough to survive a few days in exposed area
 - Night time above freezing temperature
 - Lots of pollen and nectar available in the landscape
 - Mild winds
 - Typically in the middle of the day
- **Success? Only about a quarter of the swarms survive the next winter**



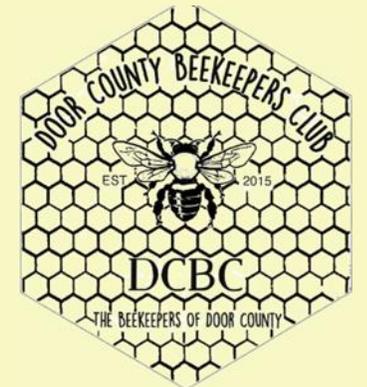
Colony Congestion Swarms

- There isn't enough room in the hive
 - Limited brood rearing
 - No place to store resources
 - Housing shortage
 - No room for the recently emerged workers
 - High levels of Vitellinogenin
 - Urge to do nurse duties, but limited brood
 - A bunch of teenagers with nothing to do is trouble!



Cues and conditions that promote swarming

- Crowding is a signal of swarming
 - Having a lot of bees and nutrients is good
 - But it can be too much of a good thing
 - Competition for space to raise brood and store food
 - The colony has all the resources it needs
 - Excess resources in the hive and the environment signals it's time to swarm



Cues and conditions that promote swarming

- **Crowding**
 - **Negative effects of hive maintenance**
 - **Dilutes Queen Mandibular Pheromone (QMP)**
 - Older queen has less pheromone production
 - QMP is spread by mouth from queen to nurse bees; they spread to other workers
 - Limited movement within hive impedes QMP distribution
 - Too many bodies for too little pheromone
 - **No place to store nectar and pollen**
 - Resources get backfilled in brood area
 - **Too many young bees, too little space**



Cues and conditions that promote swarming

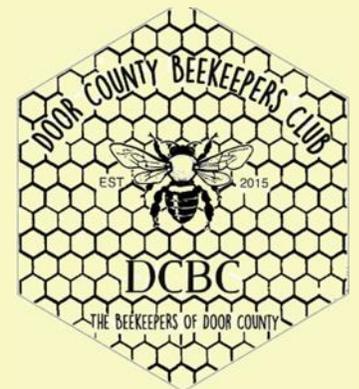


Wall-to-wall brood



Normal brood pattern

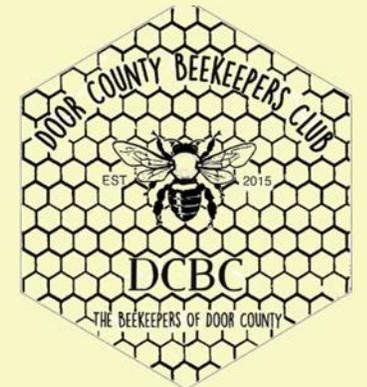
- **Wall-to-wall brood looks great!**
 - You are soon to have a lot of bees!
 - If all frames look like this you are soon to have too many bees!
 - This is a warning they may swarm



Cues and conditions that promote swarming



**Examining your hive
you see this...
It is not spotted brood!**



Cues and conditions that promote swarming

Backfilling of Brood Frames

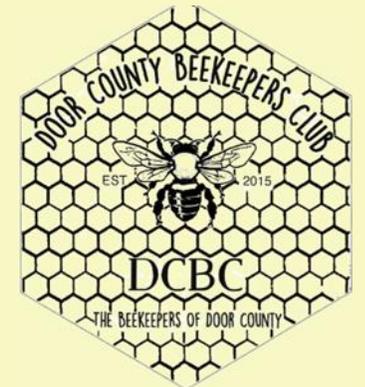
Foragers are bringing nectar to the hive

There is no open drawn comb above the brood chamber

Workers start storing it anywhere they find open cells

The workers have filled the brood box with food

There's no place to lay eggs



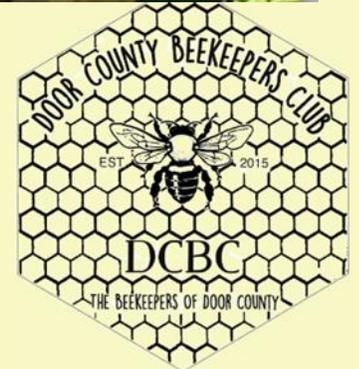
Note: Sometimes nucs are purchased that are already to swarm; tons of bees but no drawn frames

Bee's Check List for Swarming

- **Big hatch of young workers**
 - **Nurses have little to do**
 - **Few larva left needing care**
 - **No place to create comb**
 - **Become displaced**
 - **Hang out on lower frames and at the hive entrance**
 - **High Vitellogenin levels prevents maturing to foraging behaviors**



A frame loaded with lots of bees and bees hanging on the bottom means they are unemployed
May be heat related, but more likely they are waiting to swarm



Bee's Check List for Swarming

- Mature Drones in the apiary
- Queen has laid lots of eggs last few weeks
- Weather is mild --Temperature above 50 degrees
- Adequate pollen and nectar in the environment
- Lots of well nourished workers, fat bodies have huge Vitellogenin levels
- Colony prepares queen cups; queen lays eggs creating queen cells
- Nectar filling the brood chamber
 - Queen responds
 - Less space = decreased egg production
 - Nurse bees limit her feed = slims down to be able to fly
 - Queen Pheromone decreases

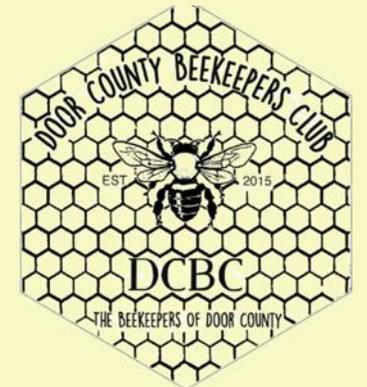


Bee's Check List for Swarming

- A final check of the weather
 - If conditions aren't favorable the swarm is delayed
 - Occasionally, the delay results in virgin queens emerging
- Worker bees gorge themselves with honey
- Workers in the swarm are about 7 days younger than those left behind
- The workers push the queen to the hive entrance
- Then 40-70% of the hive worker bees, the queen and a few drones all leave at once
- Workers in the swarm are about 7 days younger than those left behind
 - Healthier and delayed maturation
 - Better equipped to draw comb and nurse brood longer



The Swarm Happens in Minutes Not Much Will Stop It



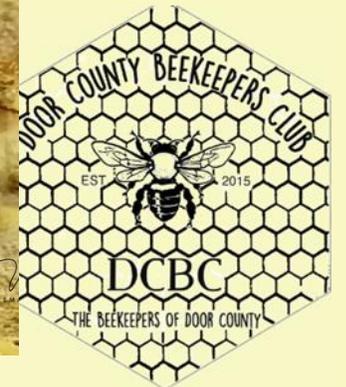
Swarm Activity

- Initially the swarm lands within 15 minutes
 - Usually somewhere nearby, e.g., 30 ft up in a tree next to the colony
 - They check to make sure the queen came along
 - Queen hormone keeps the hive together
- They stay there a short time, an hour or perhaps a day
- Scouts sent out look for a permanent home
 - Return & communicate the location with a dance
 - Prefer to relocate $\frac{1}{4}$ to a mile from original home
 - Can travel up to 6-10 miles
- If the weather has delayed swarming, virgin queens may be in the original swarm or a second swarm may follow shortly



How to Prevent Swarms

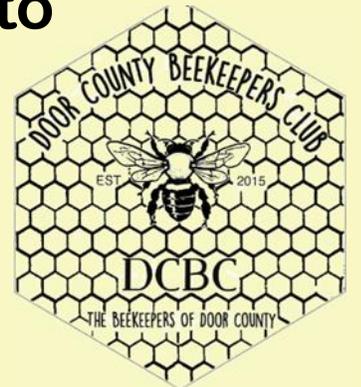
- Examine the hive
 - Is the colony is full of young bees?
 - Look different from older bees
 - Entire body is fuzzy
 - Wings have clean margins
 - Older bees have a bald thorax and tattered wing edges
- However, I don't think I'd notice this very easily



Preventing Swarms



- Examine the hive
 - Is the colony is full?
 - Wall-to-wall brood throughout the box
 - Signals lots of new bees coming
- Warning! They are going to swarm very soon!

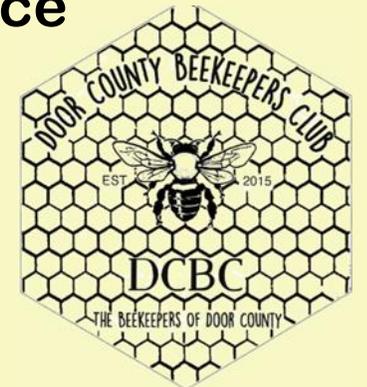


Preventing Swarms



Is there backfilling in the brood area?

- Are there combed frames available in the honey supers?
- When the brood frames are fully capped the brood hormone level drops, the pollen foragers stay in the hive, but the nectar keeps coming in with no place left to put it but in the brood chamber



Preventing Swarms

- **Bearding – Inspect the hive**
 - **Temperature Regulation**
 - **Bees outside decreases heat load inside**
 - **Poor ventilation**
 - **High humidity**
 - **Need to remove the water content of the honey**
- **Bees fan at the entrance to improve air flow**



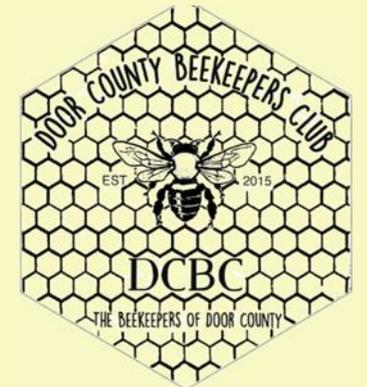
Preventing Swarms

- **Bearding—Hive Inspection**
 - **Overcrowding Management**
 - Creates additional space for storage and brood rearing
 - Worker bee on combed frame blocks four cells
 - You need to provide more usable space quickly
 - **Swarm Preparation**
 - Indication that the colony is preparing to swarm

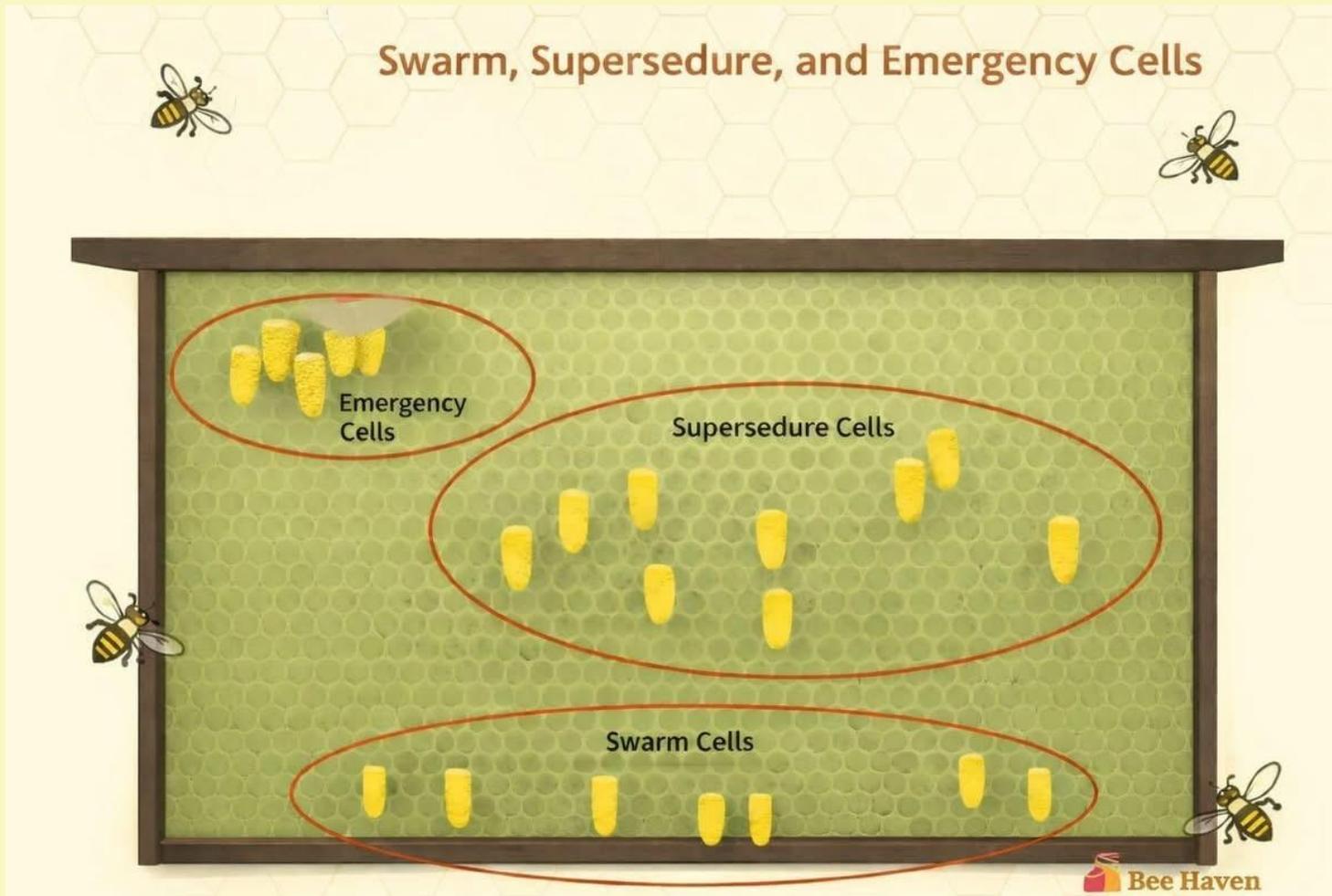


Preventing Swarms

- Look for Swarm Cells
 - Many large, well-formed evenly spaced cells
 - Usually found at the bottom of the frames
 - Indication of the colony's intention to swarm
- Can be seen by looking under the brood boxes
- Queen cups are normal in hive
 - Egg makes it a queen cell
 - Swarming is imminent



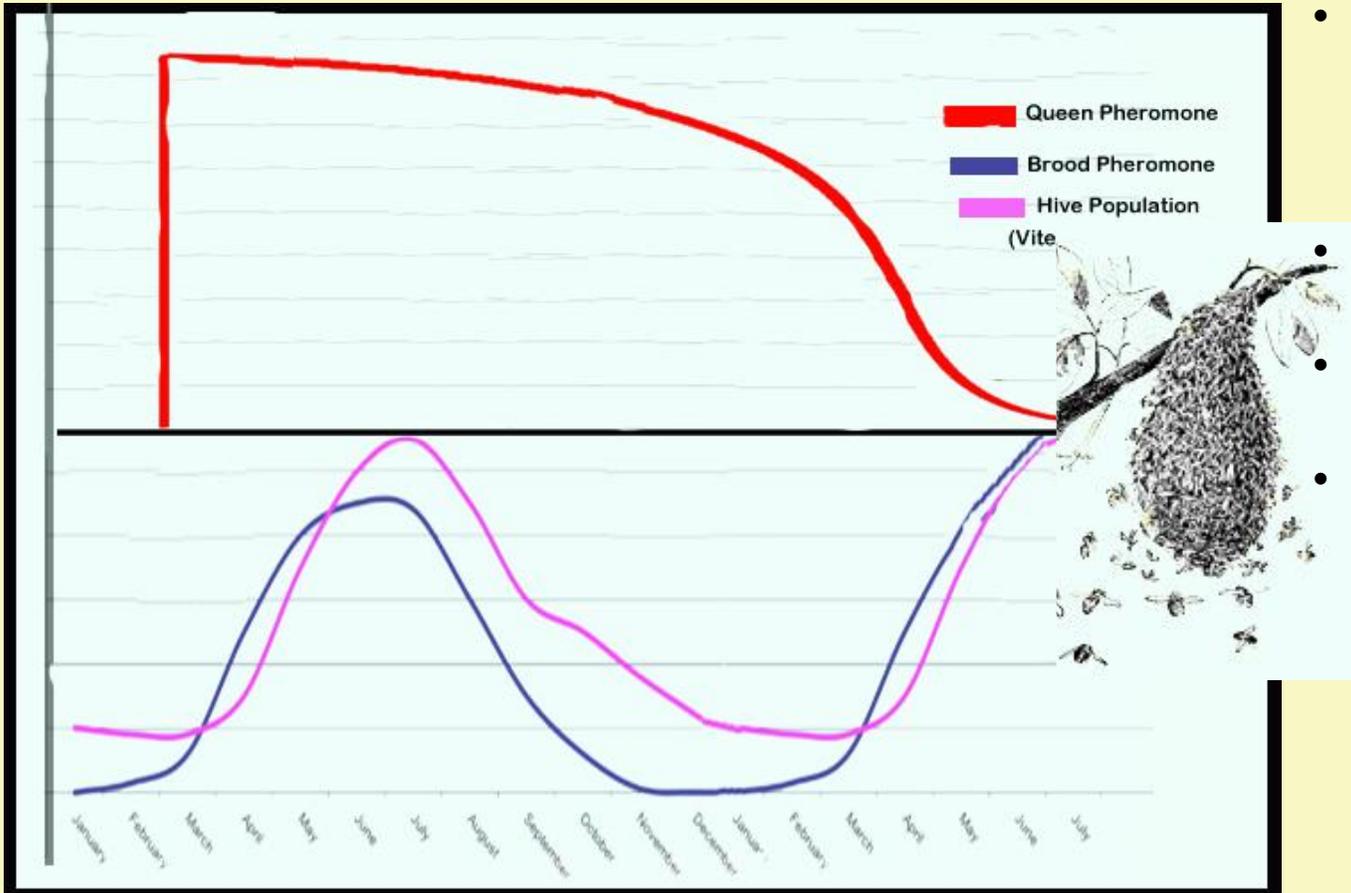
Swarm, Supersedure, and Emergency Cells



Swarm Cells are more frequently found near the bottom of the foundation or the frame
They are more ordered and well constructed than emergency cells



Inevitable Swarm Situation



- Old Queen = decreased pheromones
 - Tarsal hormone not spread
 - ↑ Queen cell production
 - ↑ Motivation to swarm
- Brood chamber full
 - High Brood Pheromone levels
- Lots of New Bees
 - High Vitellogenin levels
- Crowded
 - Workers can't transmit QMP
 - Back filling
 - No room for egg laying
 - Pollen foragers stay in hive



Actions to Prevent Swarming



Prevent Springtime Reproduction Swarms

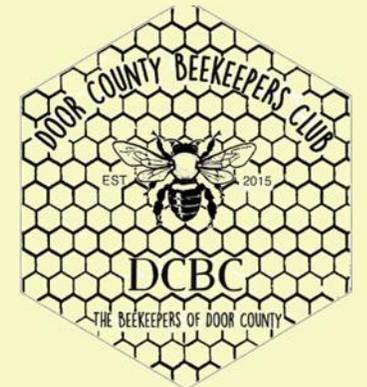
- **Over Wintered Hives**
 - Start early in season to mitigate crowding
 - Put supers with drawn comb on top of hive
 - The cluster is in the top boxes
 - The bees usually won't go back to the lower boxes
- **Do reversals**
 - If you don't have drawn comb, do a reversal
 - Take any unoccupied boxes from the bottom
 - Place them on top of all occupied boxes
 - Don't separate the cluster

Spring Colony Reversal



Preventing Both types of Swarming

- Prevent Backfilling
 - Add supers with drawn comb
 - Don't use undrawn foundation
 - It's useless for immediate storage
 - It's only a place to work; to draw comb
 - It very labor and resource intensive process; a lot of time and nectar
 - Too late; you need places to store now, not two or three weeks from now
 - Adding sugar supplement at the right time usually prevents backfilling

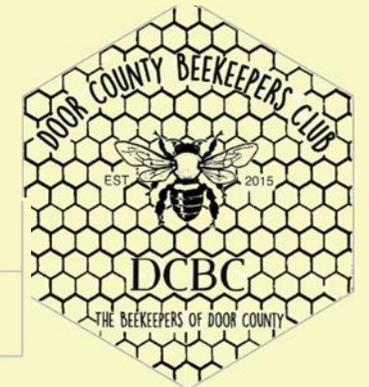


Prevent Swarm Triggers

- Prevent Backfilling
 - Adding sugar supplement earlier gives the workers time to make combed foundation
- Checkboard is an option
 - Use drawn comb in honey supers only, not in brood area
 - Fairly labor intensive
 - Disturbing to the hive



2 nd super	Full	Empty								
1 st super	Empty	Full								



Prevent Swarm Triggers

- Prevent crowding
 - Move wall-to-wall brood frames
- Build up weaker colonies
 - Move drawn out frames from weaker colonies to strong ones
- Make one (or more) splits depending on resources
- Make a nuc with a mated queen or a queen cell



Swarm Traps

- Prepositioned for potential capture
- Wooden bait hives
 - 5-6 frames;
 - 1 frame of drawn comb to provide hive scent
 - Add a few drops of lemongrass oil to mimic queen pheromones
 - At least 50-100 ft from bee yard
 - Partially shaded areas
 - Along the edge of woods or fence rows
 - High visibility (not hidden behind leaves and branches)
 - 10-15 feet off the ground
 - Slight preference for south facing



Swarm Traps

- Check traps every 3-4 days during swarm season
 - Look for bees visiting the box, usually scouts
 - Swarm may arrive within a day or two
 - Bees carrying pollen means the swarm has moved in
- Transfer swarm to permanent hive within 24 hours to prevent absconding
 - Collect the trap at nightfall after all the foragers have returned



Methods to Prevent Swarming

1. Regular Hive Inspections to catch overcrowding
2. Create adequate space with supers (70-80% filled)
3. Spring inspections every week when temperatures reach 55° F
4. Summer—monitor for swarms, overcrowding, queen cells
5. Requeen every 1-2 years
6. Split Colonies
7. Balance Resources Between Colonies
8. Set Up Swarm Traps



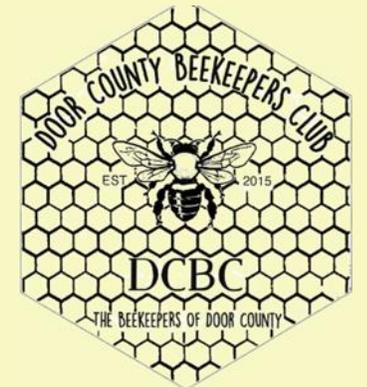
Not Recommended Alternative Methods

- Clipping the Queen's wings
 - Pushed out of the hive she can't fly and may fall to the ground
 - Swarm may notice she is missing and return to the hive
 - Queen may not make it back into the hive
 - Queen might climb a nearby bush and attract the swarm but she is vulnerable
 - Workers may kill a queen that can't fly and attempt to raise a new one
- If no adjustments made to the hive
 - Queen excluder on front entrance
 - Queen can't get out and swarm leaves without her
 - Destroying Queen cells
 - Workers will only make more or possibly swarm without any possibility to requeen the parent hive
 - Caging the Queen
 - Just delays the swarm



Are Swarms Safe?

- The workers are full of honey
 - Their stinger is less operational
 - Young bee can't sting yet (age <21 days)
 - Swarm focus
 - protect the queen
 - find a new home
 - Become irritable if food is scarce
 - Reach into the middle of the swarm to feel the heat
 - Wear a veil; facial stings hurt

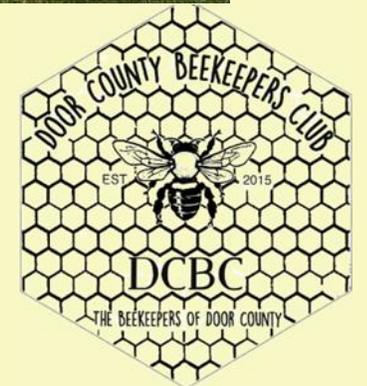


Swarm Activity

- Sometimes swarms form on the ground
- We've capture two this way
- This one had been along a garden fence for over 24 hours
- It was the end of June
- We captured it and overwintered it

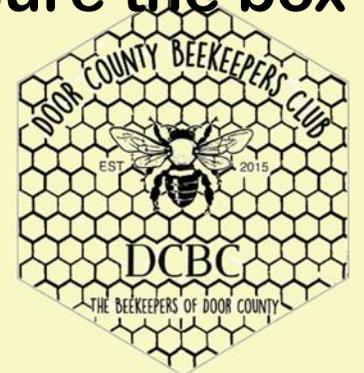


A swarm in May is worth a load of hay
A swarm in June is worth a silver spoon
A swarm in July isn't worth a fly



Capturing a Swarm

- **Every Swarm Capture is Unique**
 - **Location**
 - On the ground
 - In a bush
 - Up a tree
 - Hanging on a mailbox
 - Inside a building
- **Equipment**
 - Protective clothing
 - Suitable box
 - Attractant
 - Brush, Dust Pan
 - Ladder
 - Spray Bottle of Sugar Syrup
 - Netting or cloth to secure the box
 - Be resourceful

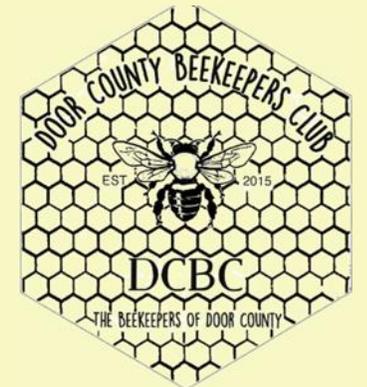


Capturing a Swarm

- **Stay Calm, Move Slowly**
- **Priority—Capture the Queen**
 - **Place her in the box, the rest will follow**
- **Secondary Methods**
 - **Shake Branch While Collecting the Bees in a Box**
 - **Cut Branch and Place it in the Box**
 - **Place Box next to a Swarm on the Ground,**
 - **Encourage movement with Gentle Brushing**
- **Once Most Bees are Collected (and remain in the box)**
 - **Close box with small opening to allow stragglers to enter**
 - **Wait until early evening to move the box to allow scouts and foragers to enter box**



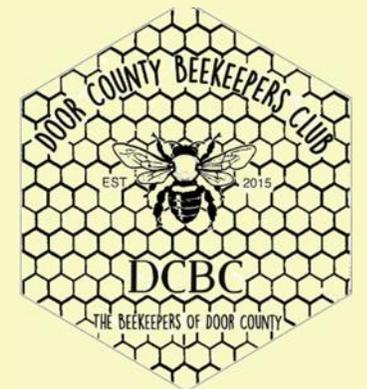
Adventures in Capturing Swarms



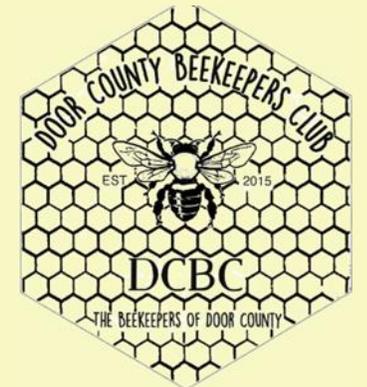
Adventures in Capturing Swarms



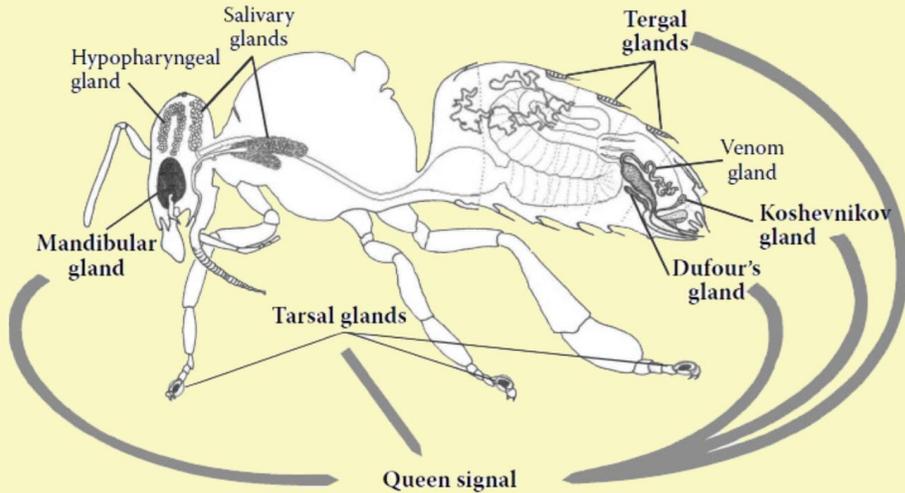
Adventures in Capturing Swarms



Adventures in Capturing Swarms



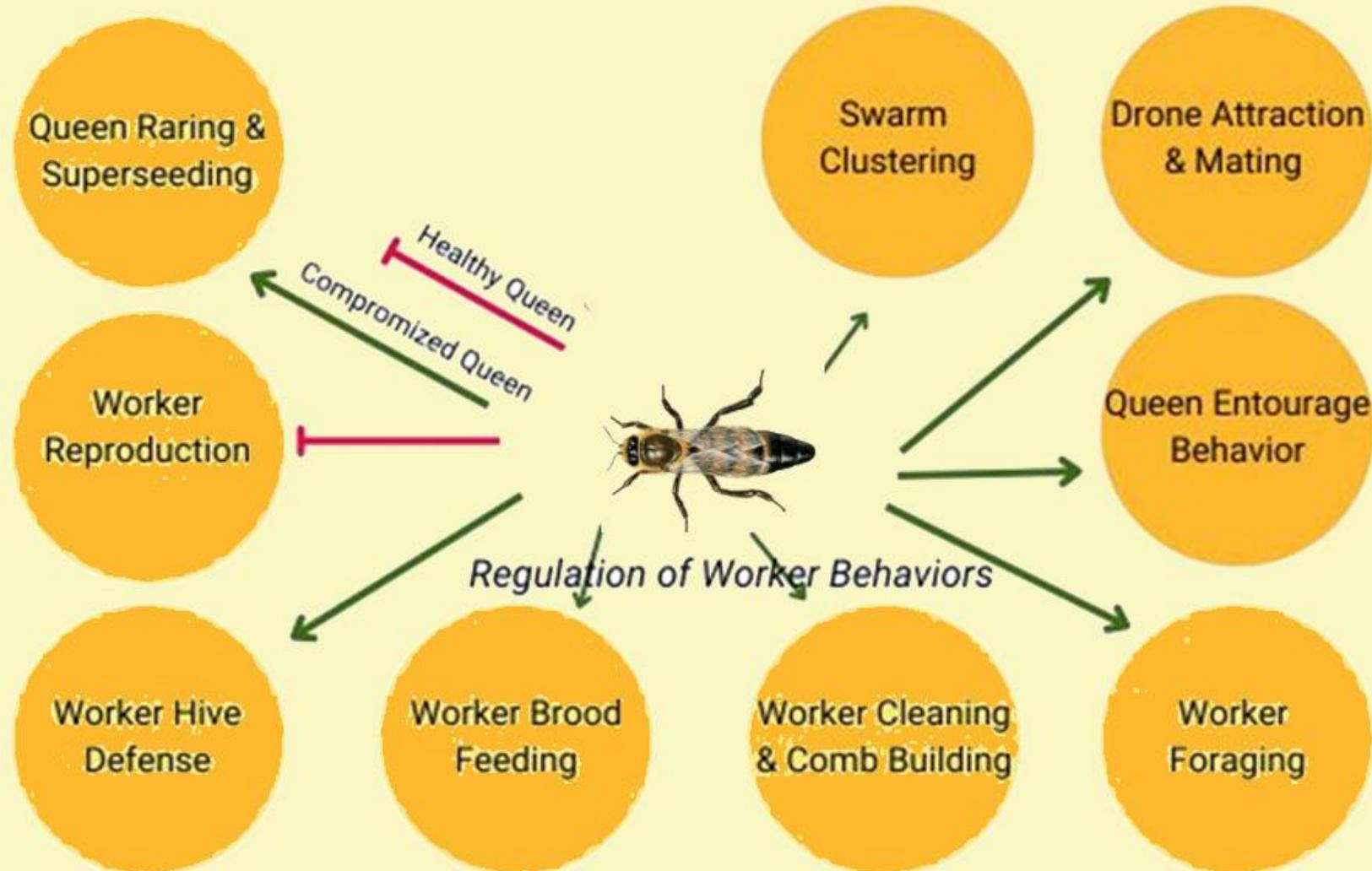
“Queen Signal”- A Complex Blend of Pheromones



- Mandibular Gland (Queen Mandibular Pheromone)
 - Attracts attendant nurse bees
 - Inhibits worker ovary development
 - Keeps swarm together during swarming
 - Attractant for drones when mating
- Tarsal Gland (Tarsal Gland Pheromone)
 - Distributed by walking on the comb
 - Inhibits queen cell construction
 - Less motivation to swarm

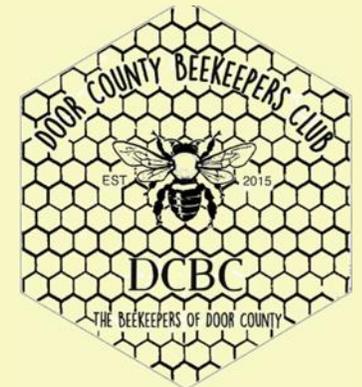
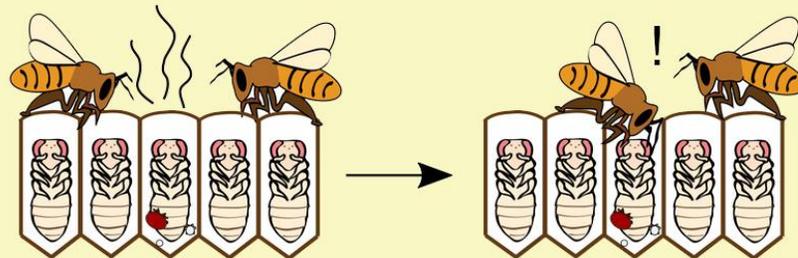


Queen Signal Controls



Brood Controls on Hive

- Larvae produce pheromones
 - Young larvae produce more than the old
 - Stimulates nurse bees to feed the larvae
 - The need for food prompts foragers to gather pollen
 - Inhibits development of worker ovaries
 - Prevents laying workers
 - Allows nurse bees to discriminate between healthy and diseased brood
 - Hygienic behavior prevents disease spread

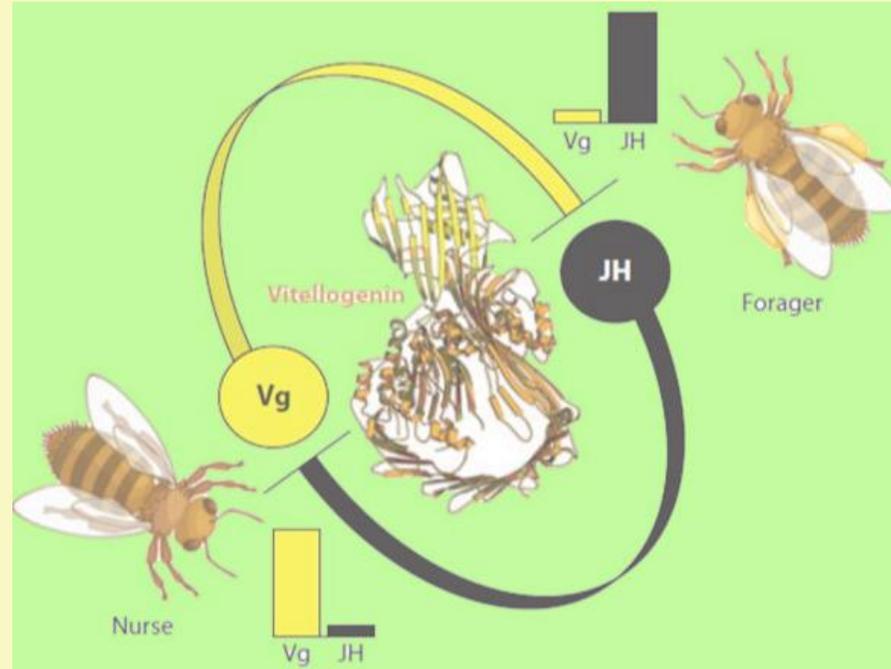


Worker Bee Determinants

Nurse Bees

↑ Vitellinogenin

- Brood care
- Comb building
- Food processing



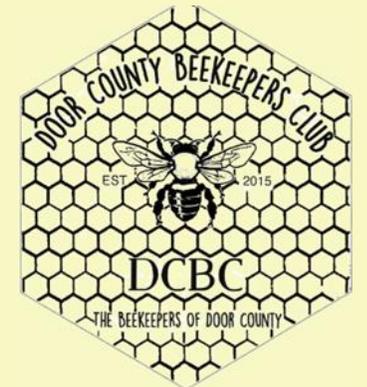
Forager Bees

↑ Juvenile Hormone

- Foraging
- Colony Defense

Two to three weeks after emerging Vg synthesis declines, juvenile hormone increase stimulates foraging behavior

When no brood, pollen foragers stay in the hive adding to crowding

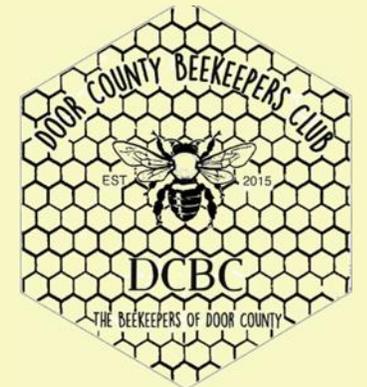
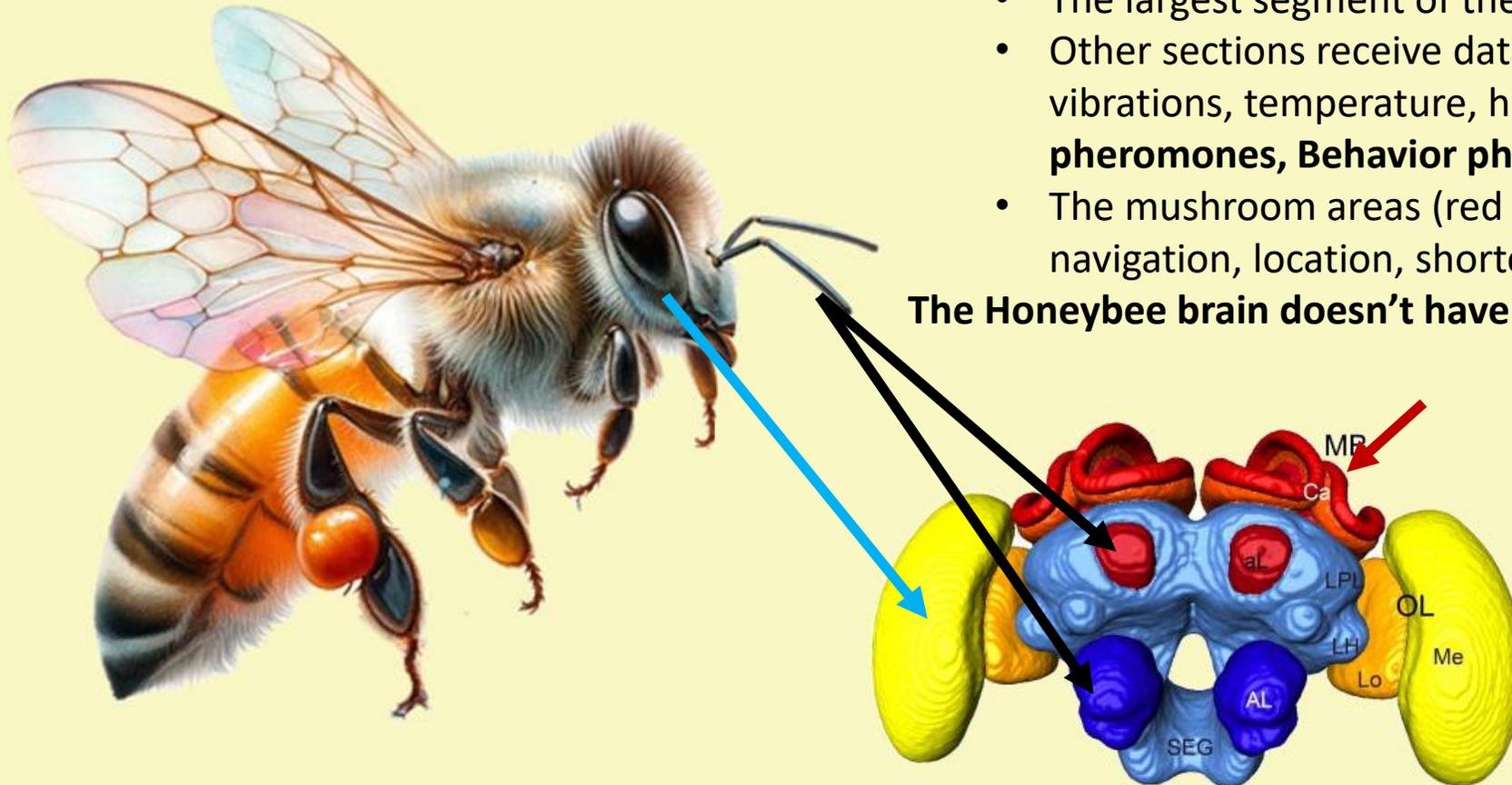


Honeybee Brain and Cognition

Honeybee brain weighs about the same as a grain of table salt
It contains a million neurons; humans have 86,000 times as many

- The largest segment of the brain receives vision
- Other sections receive data from the antennae about smell, taste, vibrations, temperature, humidity, wind speed, **Queen pheromones, Behavior pheromones**, alarm pheromones
- The mushroom areas (red arrow) help with cognitive functions, navigation, location, shortest route, type of flower, etc.

The Honeybee brain doesn't have the capacity to control hive dynamics!



Worker Bee Determinants

Vitellogenin (Vg)

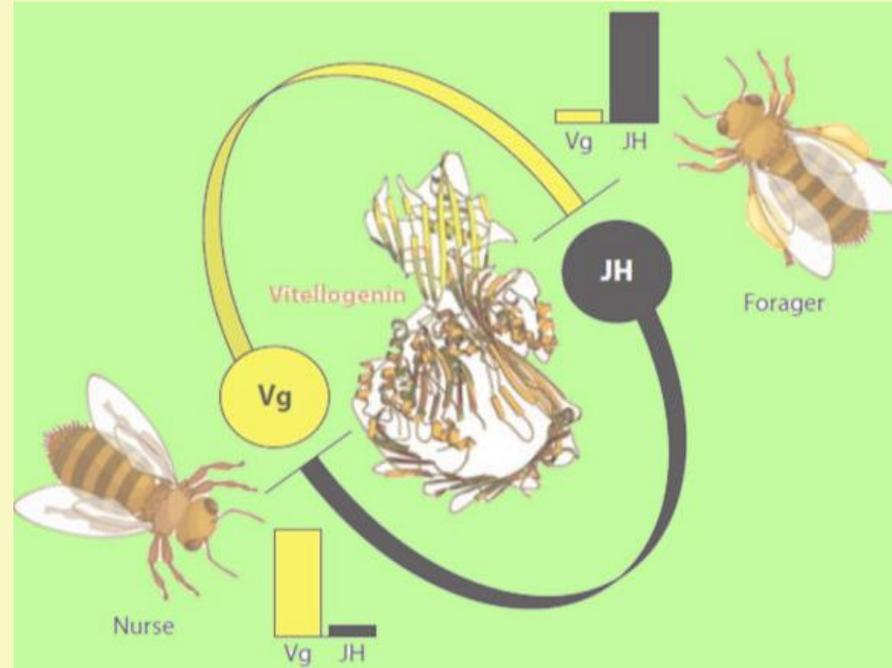
- individual longevity
- indicator of colony health and nutritional status
- Inhibits effects of Juvenile Hormone (JH) transition to foraging

Nurse bees feed larvae Vg in the royal jelly

Higher titers early prime bees for pollen collection

Low titers prime bees for nectar
Enhanced resources leads to rapid increase in young workers and Vg levels

Higher levels of Vg found in swarming colonies, delayed maturation (important for swarming success), well fed, stress resistant, Vg stores provide nutrients



Two to three weeks after emerging Vg synthesis declines, juvenile hormone increase stimulates foraging behavior

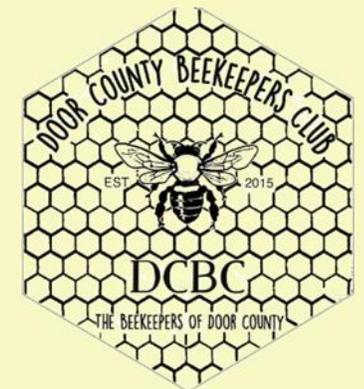
Foragers curtail their activities just prior to swarming
Reduction in foraging activities leads to an excess of foragers within the hive.

Nurse bees ↑Vg

- Brood care
- Comb building
- Food processing

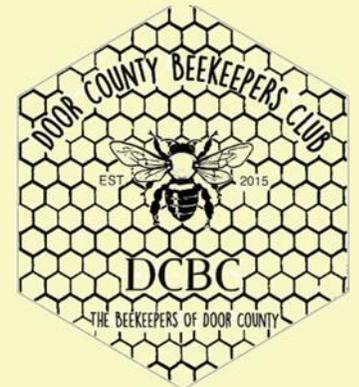
Foragers ↑JH

- Foraging
- Colony Defense



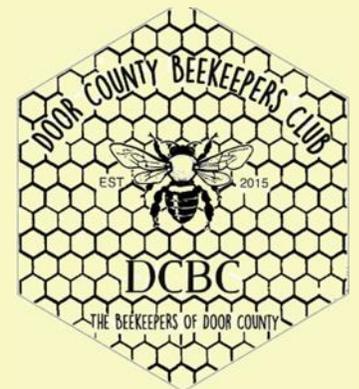
I can't smell the pheromone or measure the hormone levels....what can I do?

- **Swarm prevention--strategies to delay or stop the colony from initiating events that lead to swarming**
- **Swarm control--strategies are direct interventions that are used to prevent the loss of a swarm**
- **One major driver of swarming is the need to reproduce**
- **Bees also swarm if their environment is unable to accommodate colony expansion**
- **Expect that strong, healthy, populous colonies will try to swarm on an annual basis**
- **The hive needs to be examined regularly!**



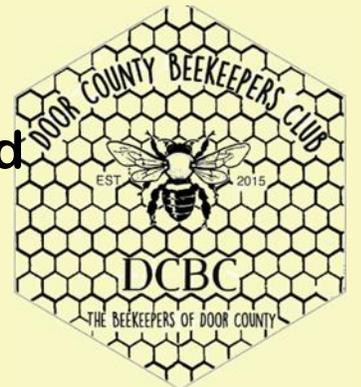
Who or What Controls Hive Operations?

- **Visual signals can't be effective**
 - The hive is dark inside
 - Young bees are phototactic, they move away from light
- **Auditory signals could provide some communication**
 - When irritated the bees produce louder and more aggressive buzzing
 - Unable to communicate direction of multiple tasks
- **Touch -- Vibratory**
 - Dance communicates distance and direction to resources
- **Taste**
 - Sensed through the antenna and probably a lesser factor
- **Smell is the major controlling sensation (mostly)**



Smell (better discussed as pheromones)

- **Pheromones are chemical signals that regulate behavior, communication, and physiology (not all are odors)**
 - **Nasanov Pheromone marks foraging locations, attracts other bees**
 - **Alarm pheromones released with sting, triggers more stings and defensive behaviors (Banana scent)**
 - **Drone Pheromone attracts other drones to mating sites**
 - **Dufour's gland pheromone secreted by the queen when egg laying**
 - **Egg marking pheromone also demarks queen laid eggs**
 - **Others— wax gland and comb, tergite gland, rectal gland**
 - **Tarsal Footprint pheromone left by bees as they walk**
 - **Brood Pheromones from developing larvae stimulates workers to feed larva**
 - **QUEEN MANDIBULAR PHEROMONE—MOST IMPORTANT**

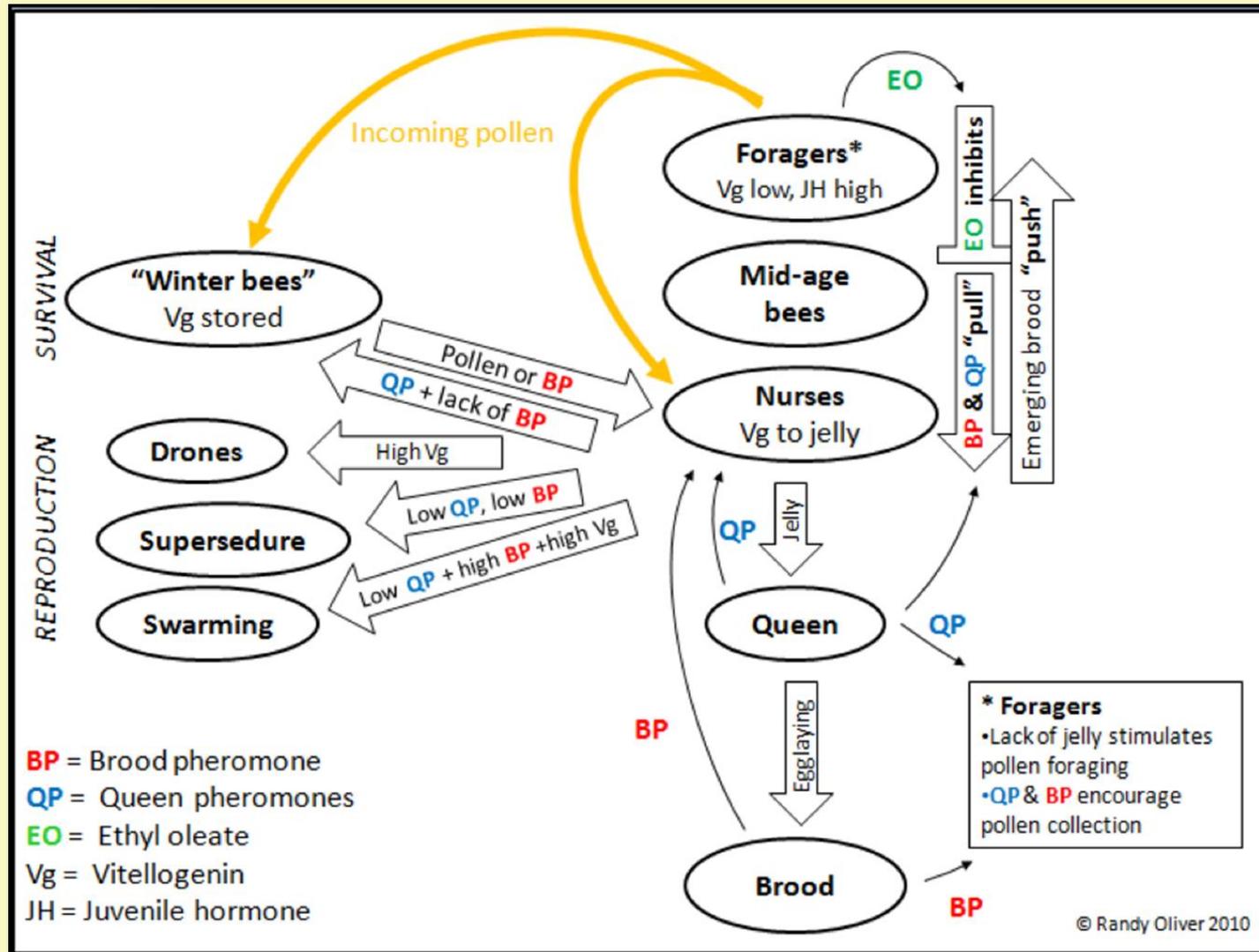


Queen Mandibular Pheromone

- The queen's attractiveness varies depending on her age and mating status.
- Workers are not attracted to virgin queens
- This changes when the queen is fertilized and starts to lay eggs
- This attractiveness further increases if the queen mated with multiple drones
- Workers highest attraction to queens aged between 5 days and 18 months
- If the pheromone decreases, or is absent, the worker bees will begin feeding larvae Royal Jelly within 24 hours in order to produce a new queen for the hive



Pheromones and Hormones Control Colony



- Low level of Queen Pheromones
- High levels of brood pheromone from the larva
- High levels of Vitellogenin from all the young bees

