



# Overwintering Honeybees

The Dynamics of Successfully Overwintering





## **INTRODUCTION – Kevin Inglin**

**10+ year hobbyist beekeeper - 18 hives**

**EAS Master Beekeeper**

**Past President – NWNJBA**

**Day Job > IT Manager for Web/Mobile Solutions**

**Bristol Myers Squibb**

**Beekeeping Podcaster**

# **Our Yard: Spring 2021**





# Image Credits

- ❑ This indicates that it is my photo
- ❑ This indicates that it is someone else's.
  - Credit, if possible, is given at the end in this format: SLIDE #XX:  
Rose Hive <http://www.rosebeehives.com/>





# About this Presentation

## □ This work was created by Kevin Inglin.

- *Except for where credited, images, artwork and shared concepts are my own.*
- *Only one stipulation if you please....*
  - I do not consent to any reposting this presentation or its message as your own.
    - No individual is authorized to take this content and repost it as your own work and when I find sites or others that do this, I will defend my ownership rights.
- *A copy of the presentation is available for you at [www.bkcorner.org](http://www.bkcorner.org)*
  - **Search for Presentations** at the site – it will come up in the list.



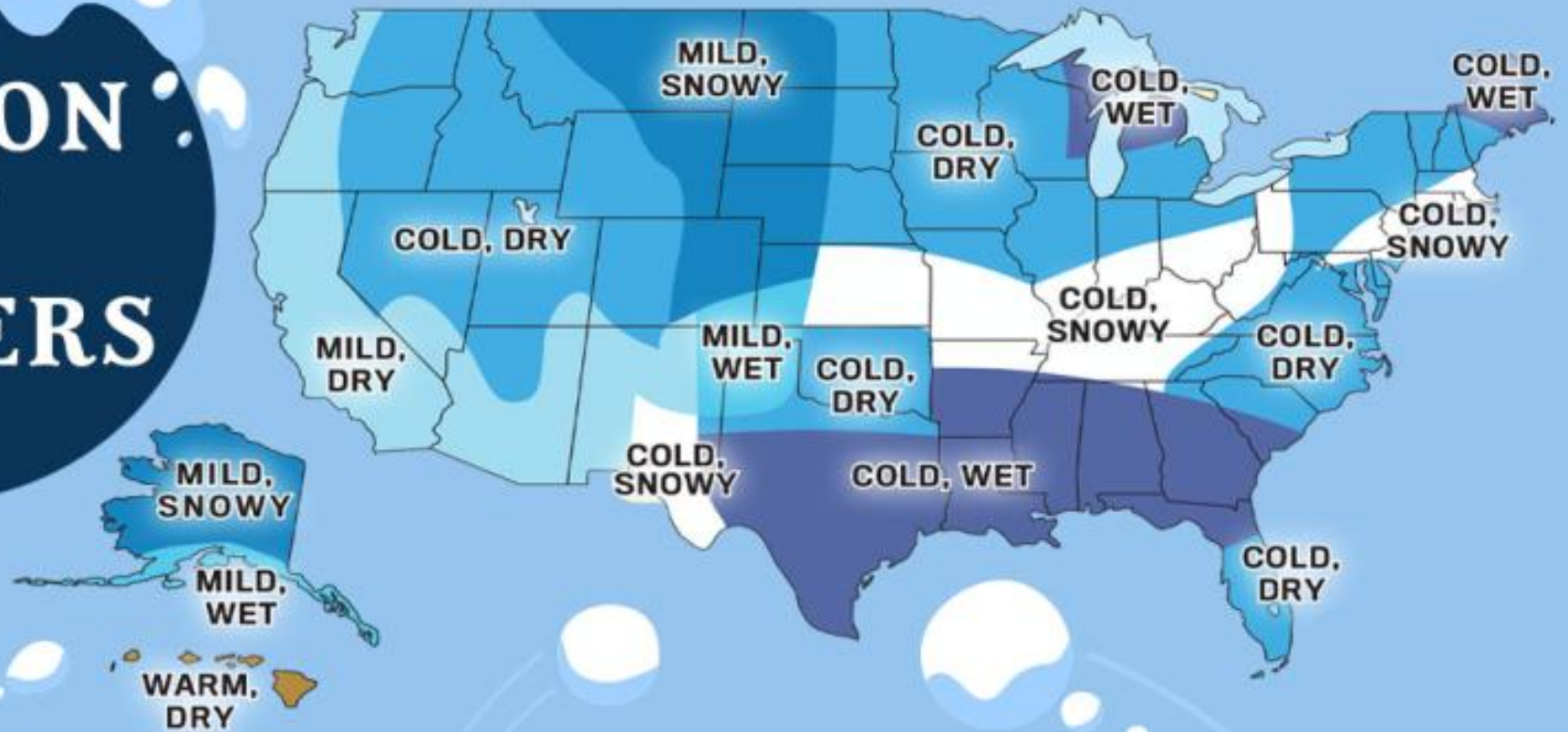
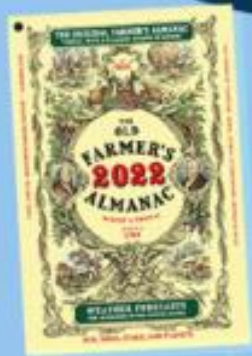


# Topic Groups

- ❑ **Introduction to Overwinter: Objectives**
- ❑ **The bees in winter**
- ❑ **Keys to Successful Overwintering**



# SEASON OF SHIVERS



# This Years Projection: Are you READY?





# Winterization

- ❑ When we cease day-to-day operations in the fall, we have 'winterized' our apiaries.

*Is there a proper way to do that?*

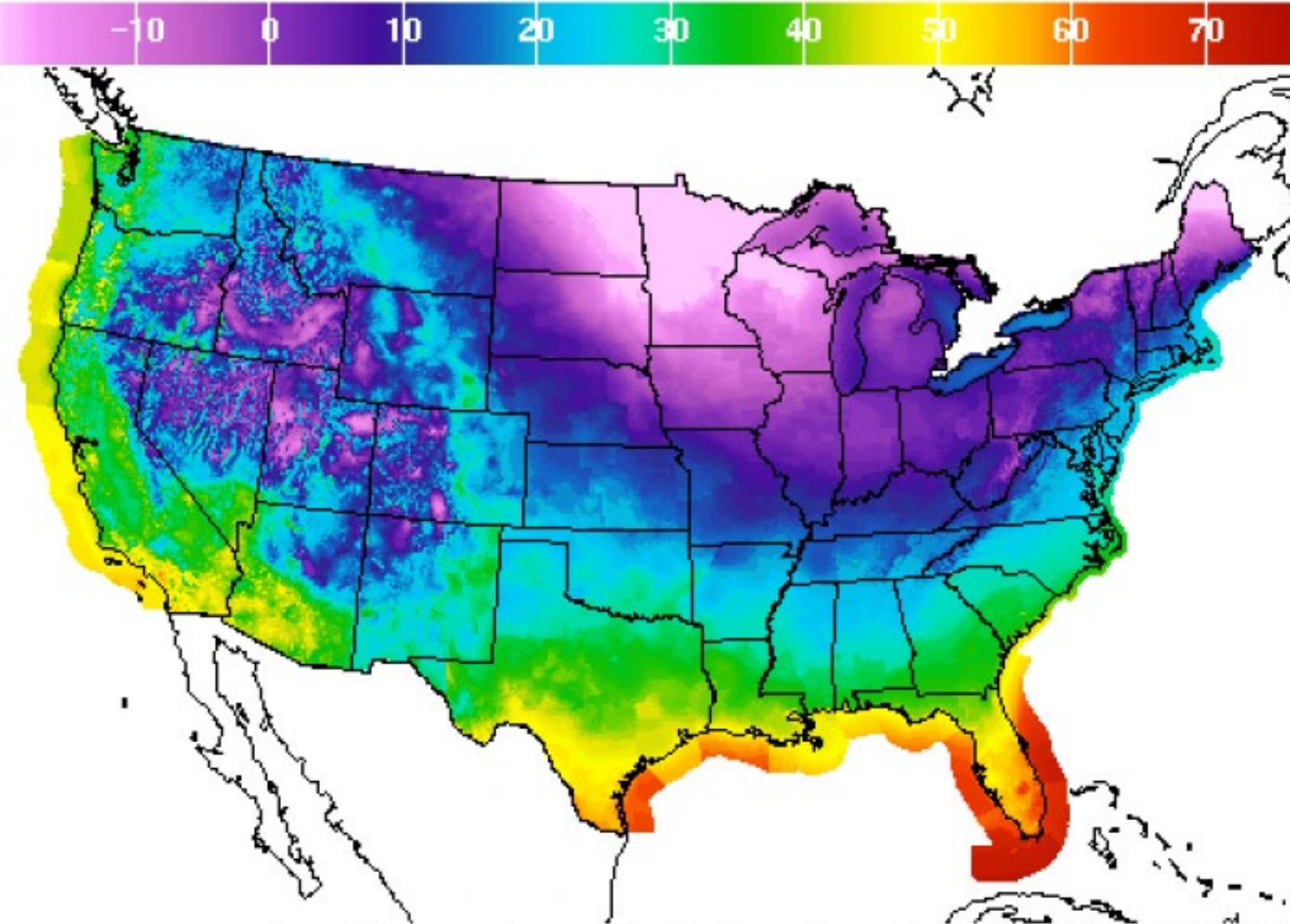
- ❑ In Beekeeping, to prepare is to:
  - *Know the weather*
  - *Follow the biology of the bees*

## Definition

**Winterize:** adapt or prepare something, for use in cold weather.







Low Temperature(F) Ending Tue Jan 22 2013 7AM EST  
(Tue Jan 22 2013 12Z)

National Digital Forecast Database

20z issuance Graphic created-Jan 21 3:07PM EST



# To prepare for winter...

## Alberta Clipper Weather Pattern

- *Common polar air mass movement during the U.S. Winter*

## Weather history for Omaha, Nebraska

Average temperature

January

33 / 14 °F | C

Record temps

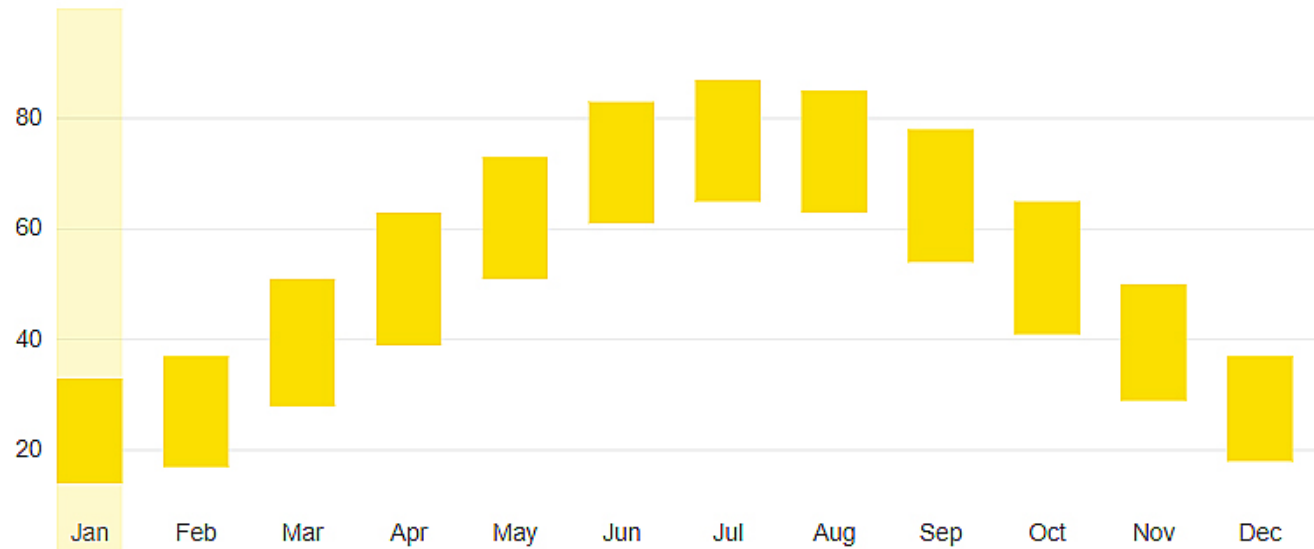
64° / -18° F

Avg rainfall

0.85 in

Snow

14 days



Temperature

Rain

Snow

## Weather Ranges

❑ SEPT: 78/54°

❑ OCT: 65/41°

❑ NOV: 50/29°

❑ DEC: 37/18°

❑ JAN: 33/14°

❑ FEB: 37/17°

❑ MAR: 51/28°

❑ APR: 63/39°

❑ MAR: 73/51°



# Too small to stay warm

## ❑ Individual bees cannot survive

- *A bee, by its body shape, has extensive of exterior surfaces.*
  - Exterior surfaces result in heat exchange.
  - Insects with large external surface areas lose a lot of heat and would require a tremendous amount of energy to stay warm.
    - ❑ While they have hair, it is not enough. They would require fur for an individual

## ❑ Compensation Mechanism

- *They compensate by clustering together to create a single unit super organism*

## Bees in Winter

### ❑ Bees on the Cluster

- *At 50° Bees will gather*
- *At ~45° Bees will cluster*

45°

### ❑ Ranges Vary Year-on-Year

- *Sometimes cold weather comes early*
- *Sometimes it comes late*
- *Same with spring; sometimes it warms up early or it stays cold longer into the season*

**Bees will likely Cluster together in these months**

❑ SEPT: 78/54°

❑ OCT: 65/41°

❑ NOV: 50/29°

❑ DEC: 37/18°

❑ JAN: 33/14°

❑ FEB: 37/17°

❑ MAR: 51/28°






❑ APR: 63/39°

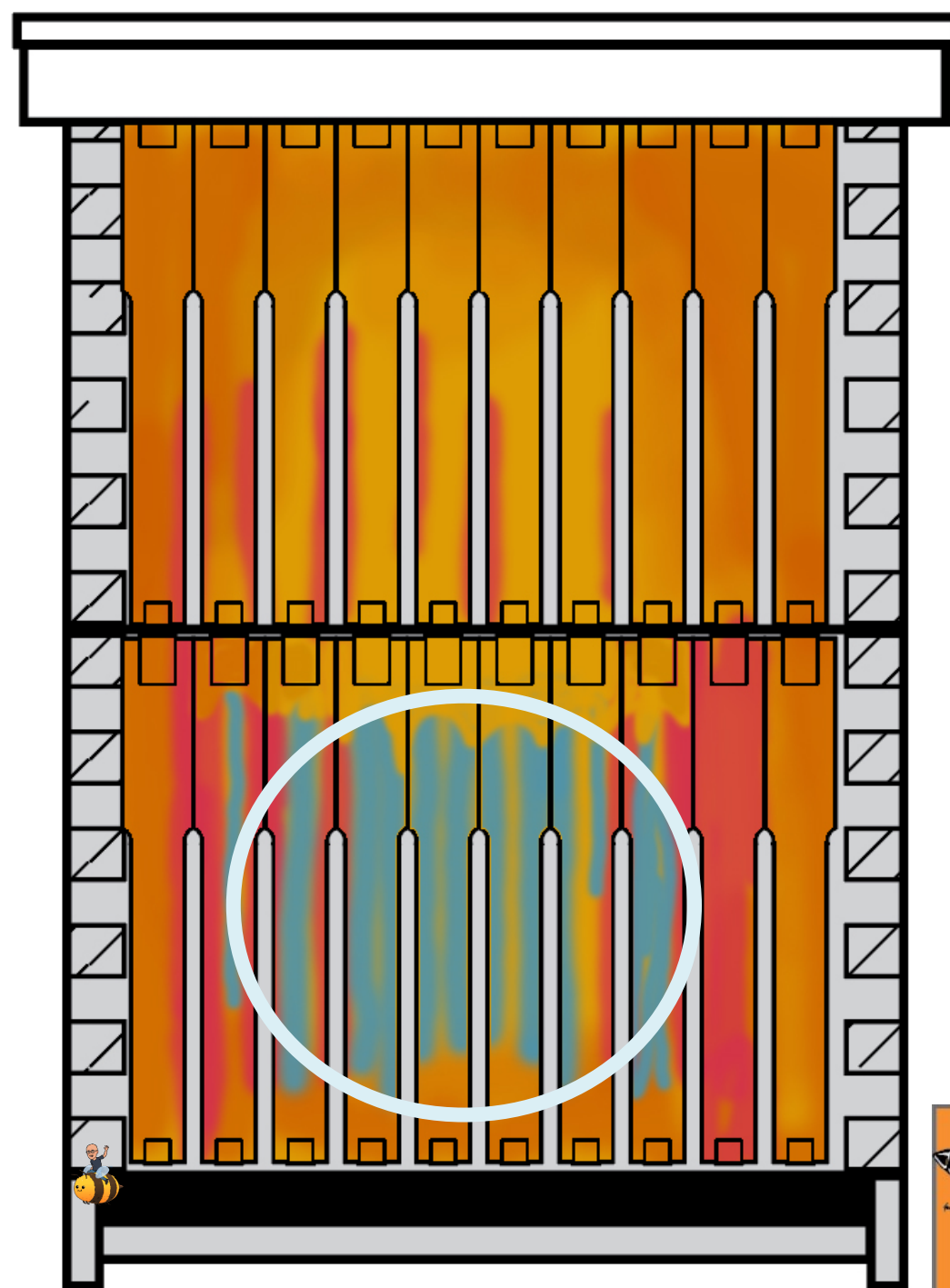
❑ MAR: 73/51°





## Late Fall Arrangement

-  ☐ **Brood in the center bottom**
-  ☐ **Pollen in and alongside**
  -  *Possibly some in the top frames*
-  ☐ **Honey left and right**
-  ☐ **Honey above**



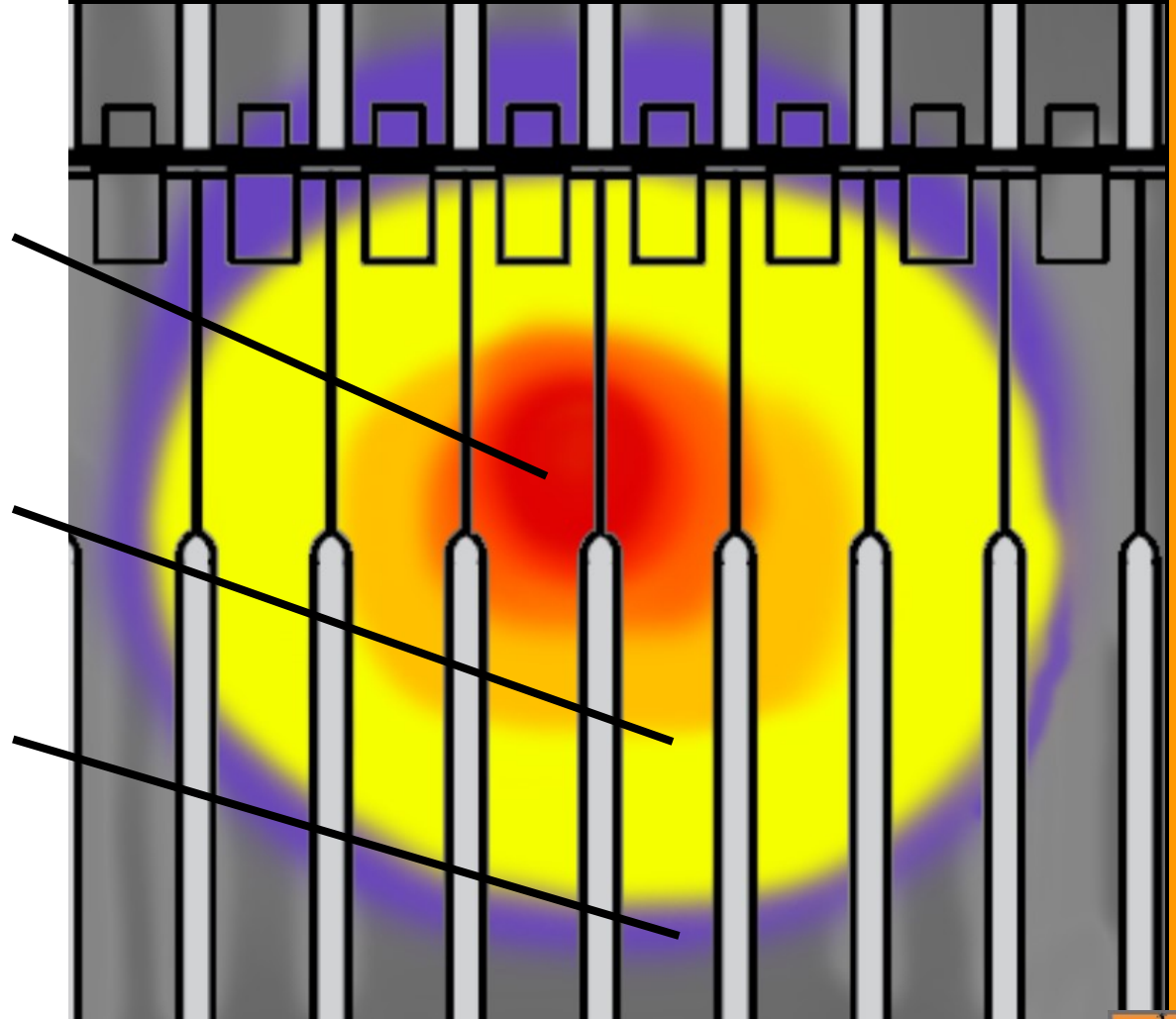
# The cluster

**Brood Nest - 90 to 95°**

Queen, Nurse and Heater Bees

**Core Bees - 65 to 85°**

**Mantle Bees - 50 to 65°**

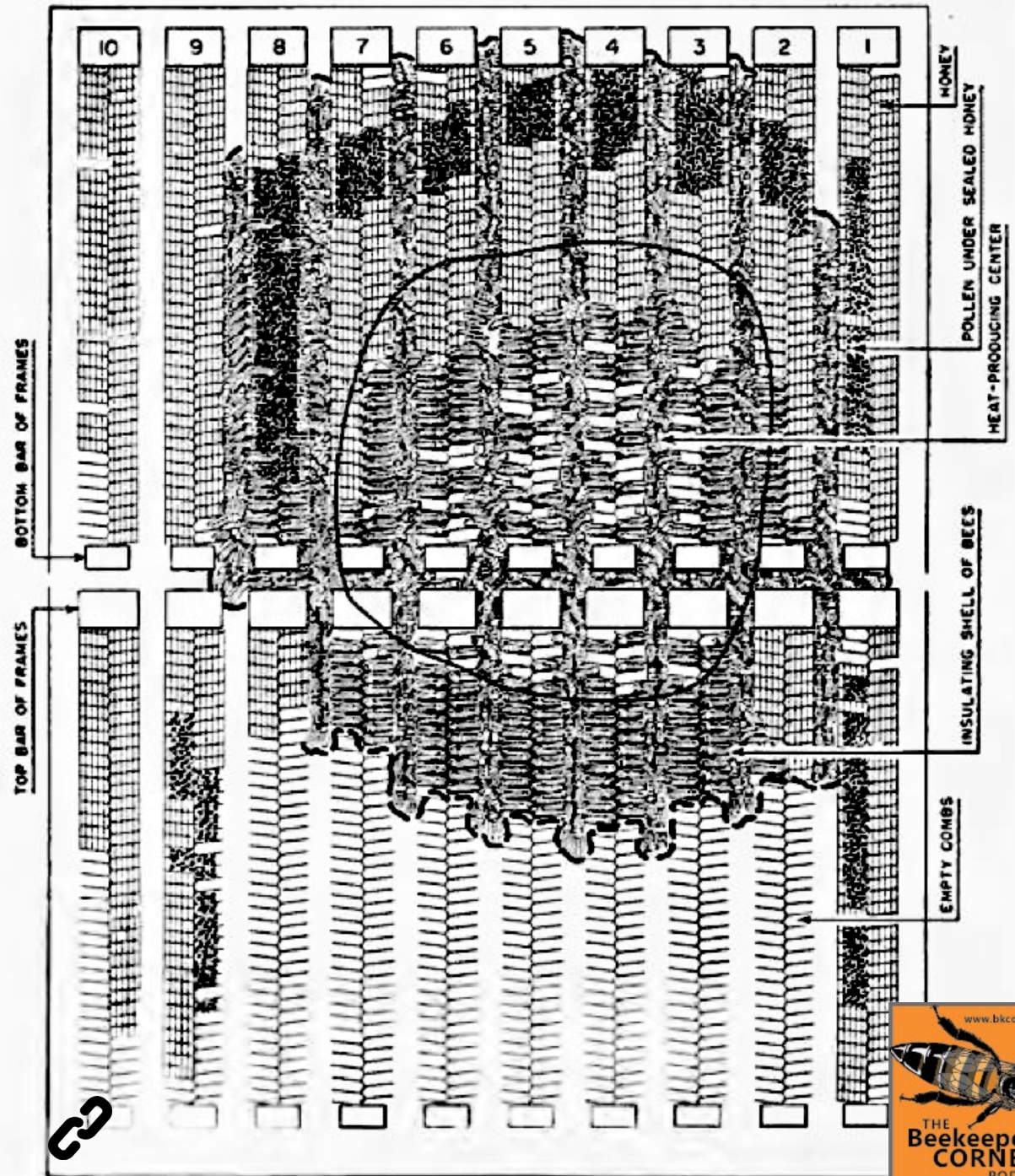




# Cluster Render

## □ Use of Cells

- *The visual here demonstrates how the bees occupy the space*
  - Bees occupy empty cells
  - They gather together in the gaps
  - In the center they can move around
  - At the shell they form a tighter outer barrier as a tactic to reserve heat radiating off the bees





# A picture is worth...

❑ A thousand words

## Cluster formation

- Note: **Do not do this;** this is *extremely detrimental to a cluster.*
  - Disturbing a large, tight cluster can result in extreme stress to the colony, and sometimes sudden death. (Randy Oliver Comment)



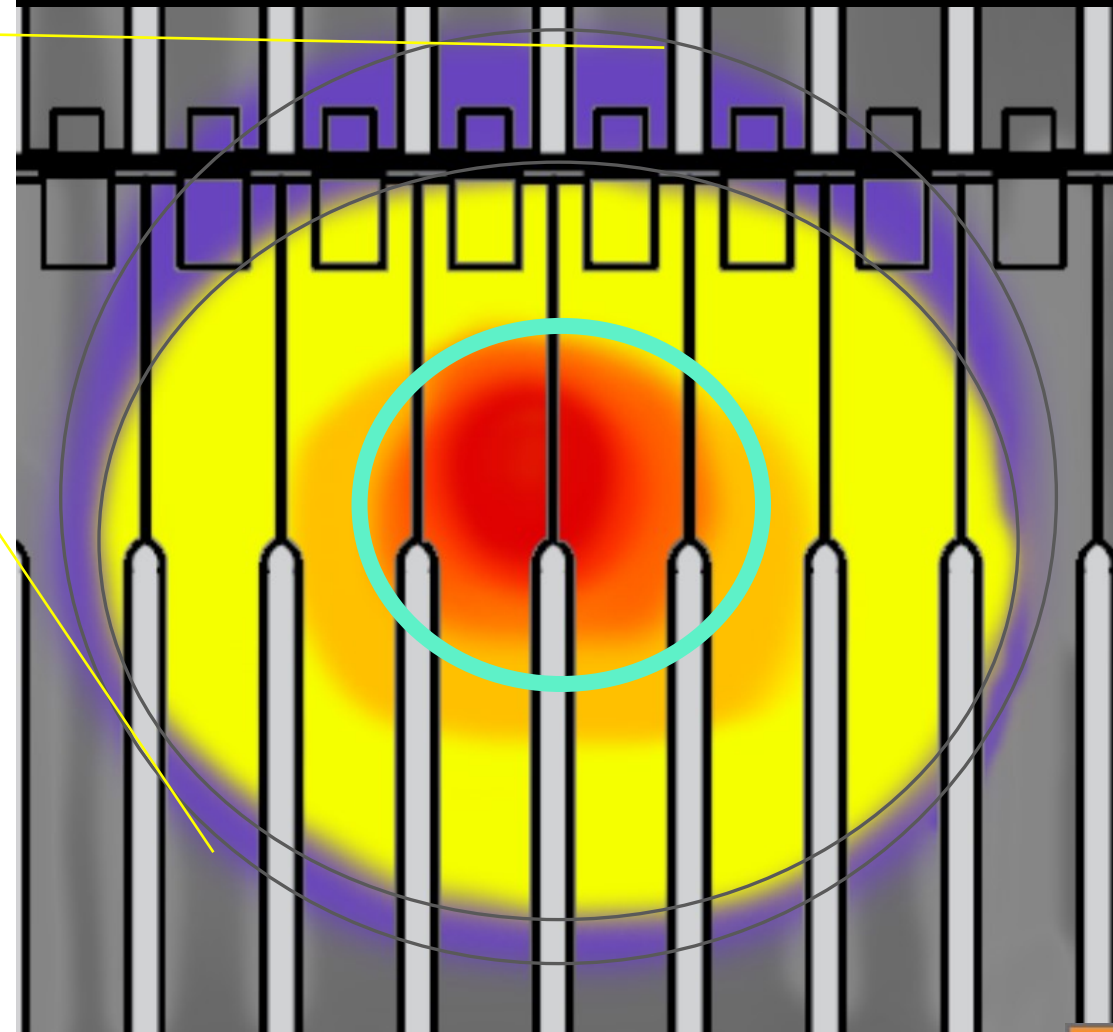
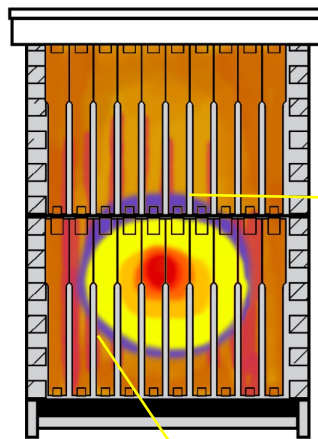
Photo Credit Randy Oliver



# The cluster

## □ Nest

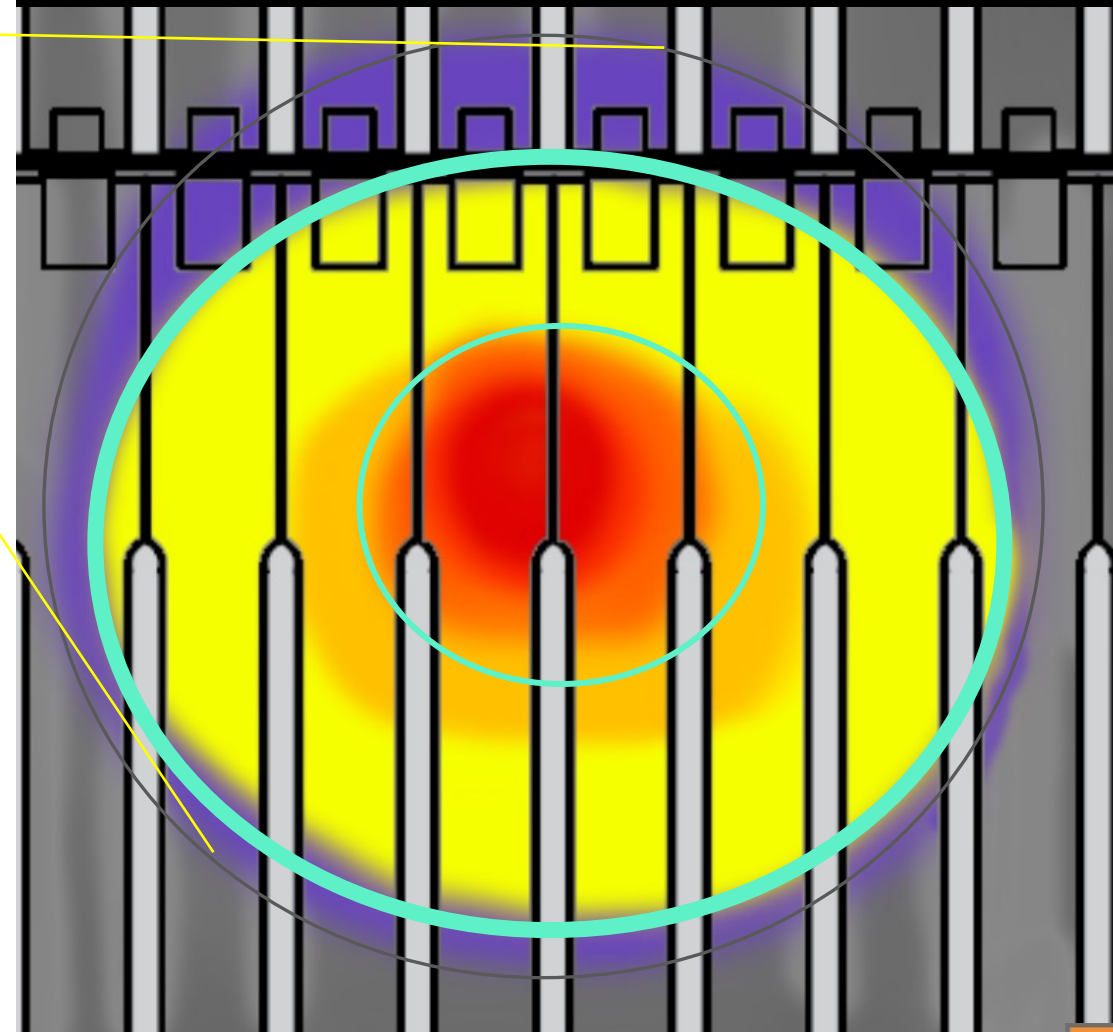
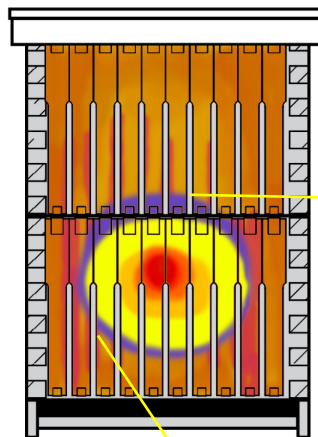
- *Nest includes the queen and the Nurse bees, as well as brood*
  - They will maintain a small space for brood rearing through part of winter
- *In the core, the queen will lay eggs and the nurse bees will care for the new bees*
  - Nest bees can move around as necessary



# The cluster

## □ Interior bees

- *Interior bees are a combination of spare bees and heater bees*
  - The interior bees also cluster together body to body
  - They will go inside cells and radiate heat into the wax
- *Given the warmth, interior bees can also move around to sustain operations inside the cluster*

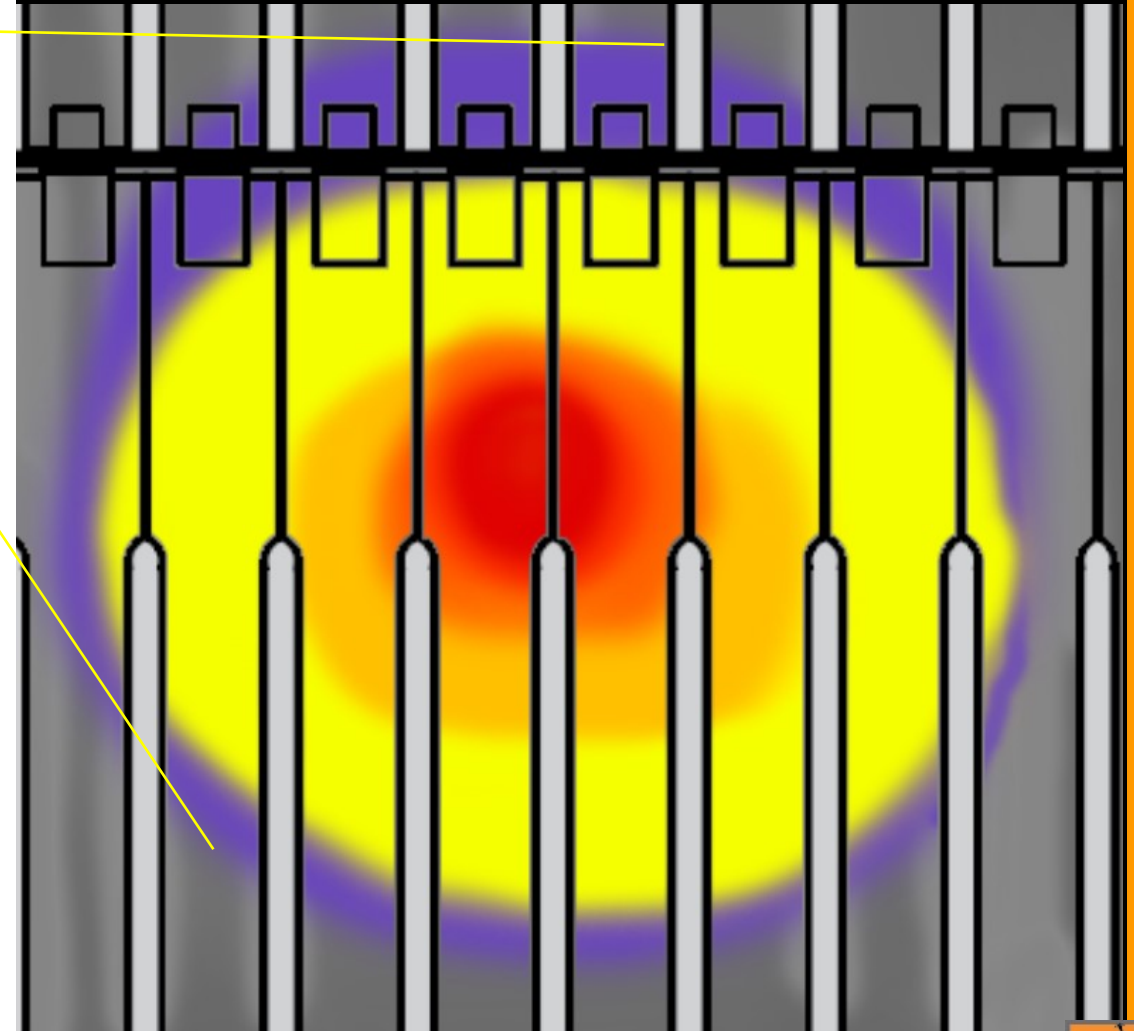
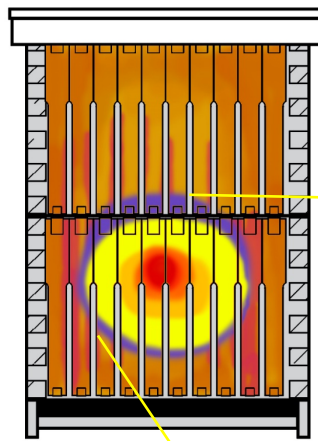




# The cluster

## ❑ Outer Shell

- *The outer bees are tight to each other and/or in the cells tight.*
  - The outer shell are bees that are head in, body to body

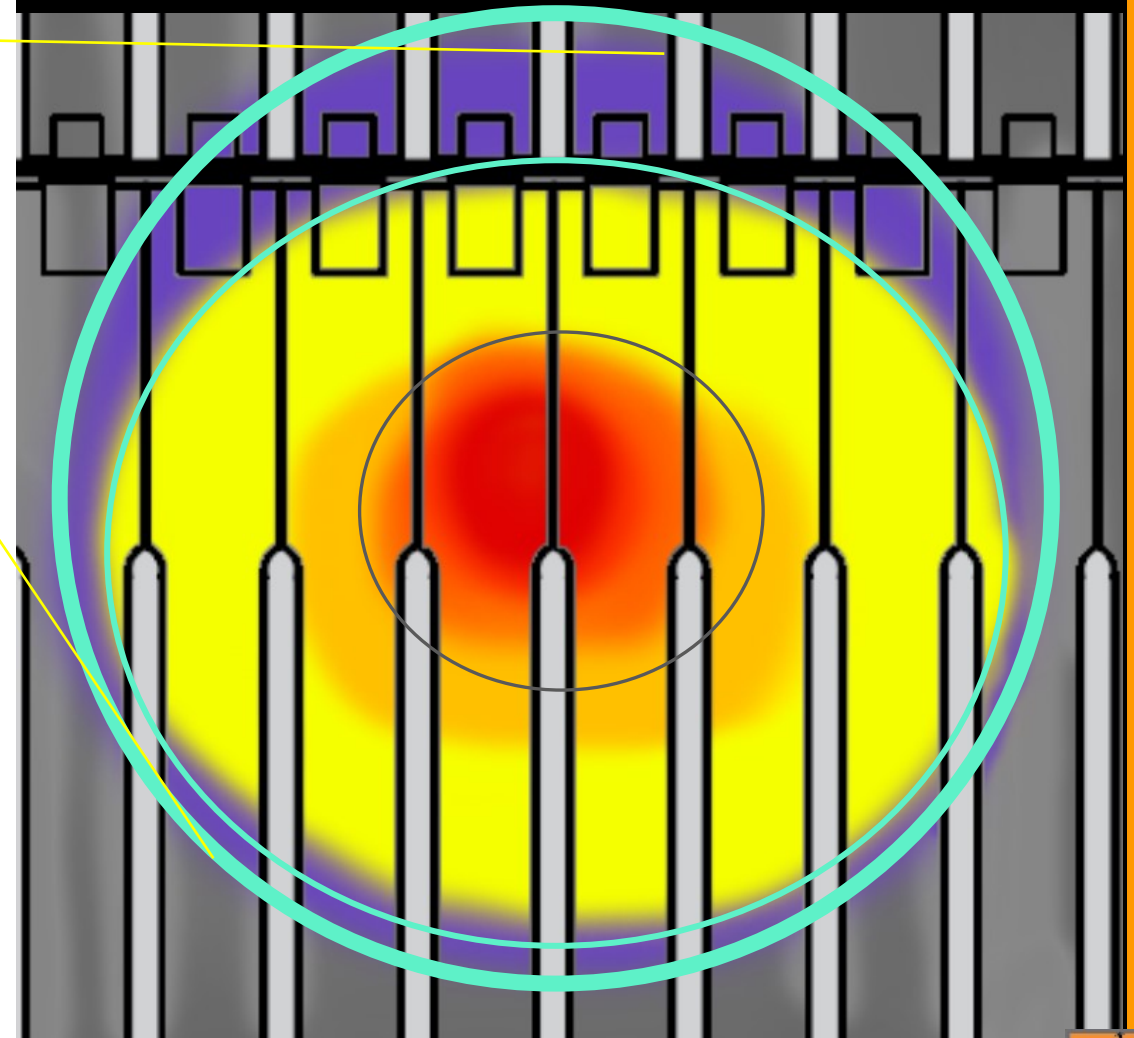
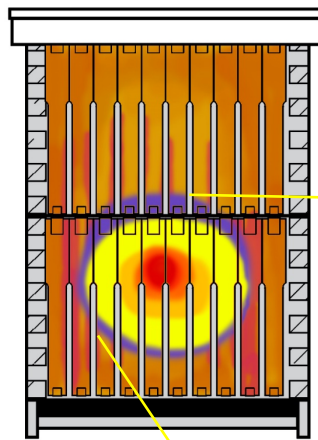


# The cluster

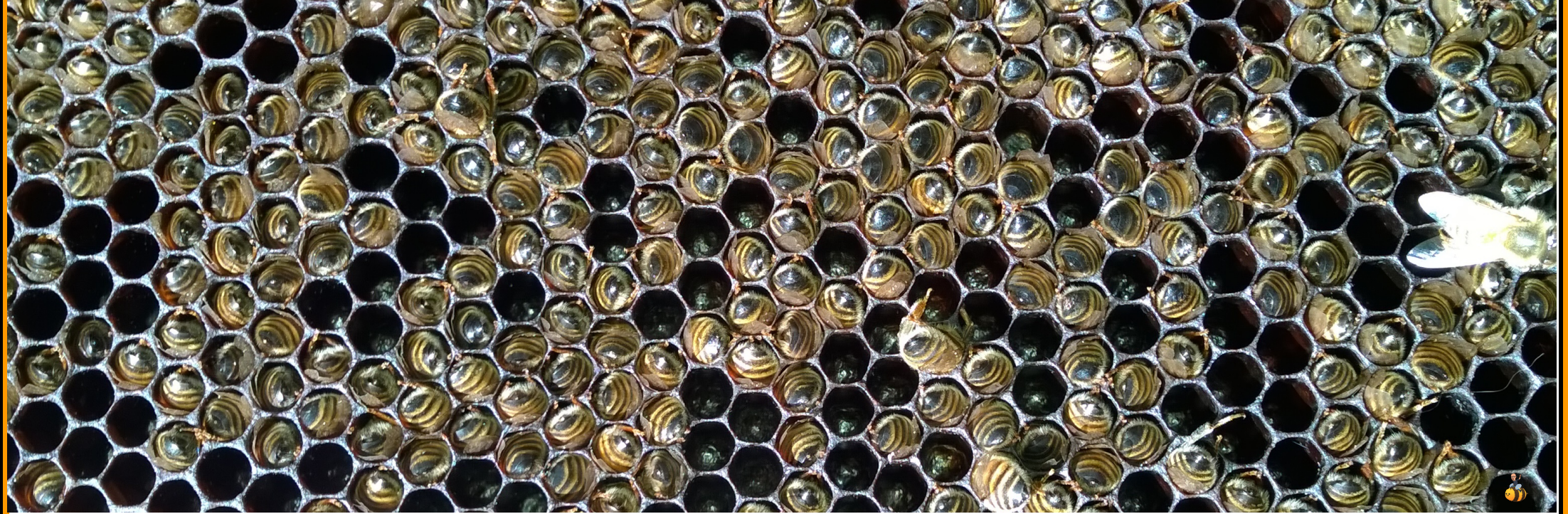
## □ Outer Shell

- *The bees on the shell are thicker on the top*
  - Dr. Farrar's sketches of cluster cross sections in Wisconsin winters show nearly twice the thickness of the insulating band at the top.
- *In doing so they do more to keep the heat from escaping the mass*

Landmark USDA  
Study Data







## Bees in cells

### ❑ Visualizing how they might look...

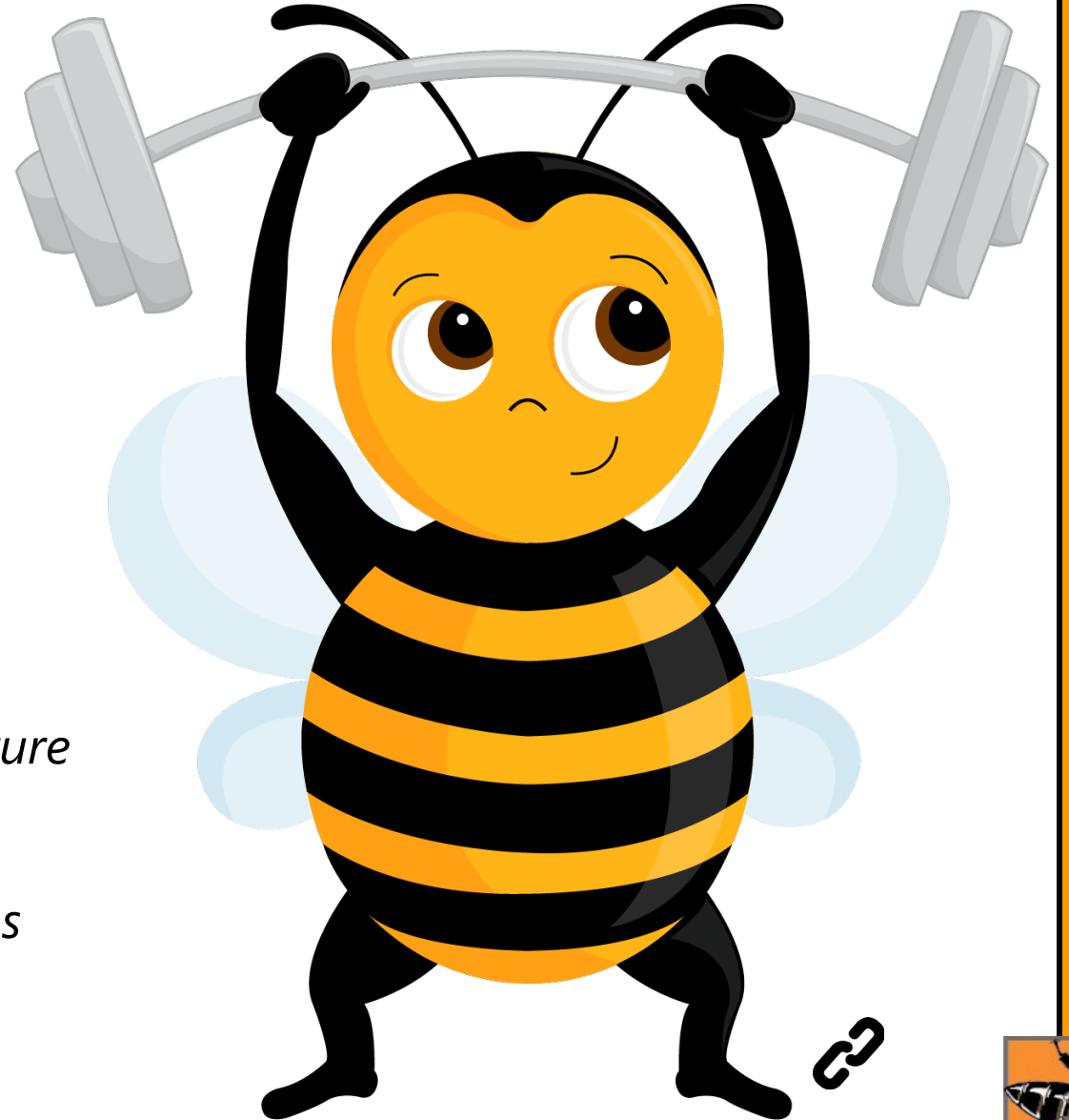
- *This is unfortunately a shot of a 'dead out' after starvation.*
- *It does however give a sense of how the warm bees might go into the cells and radiate heat to the comb and each other in times of clustering.*



# ‘Bee Aerobics’

## □ How do bees generate heat?

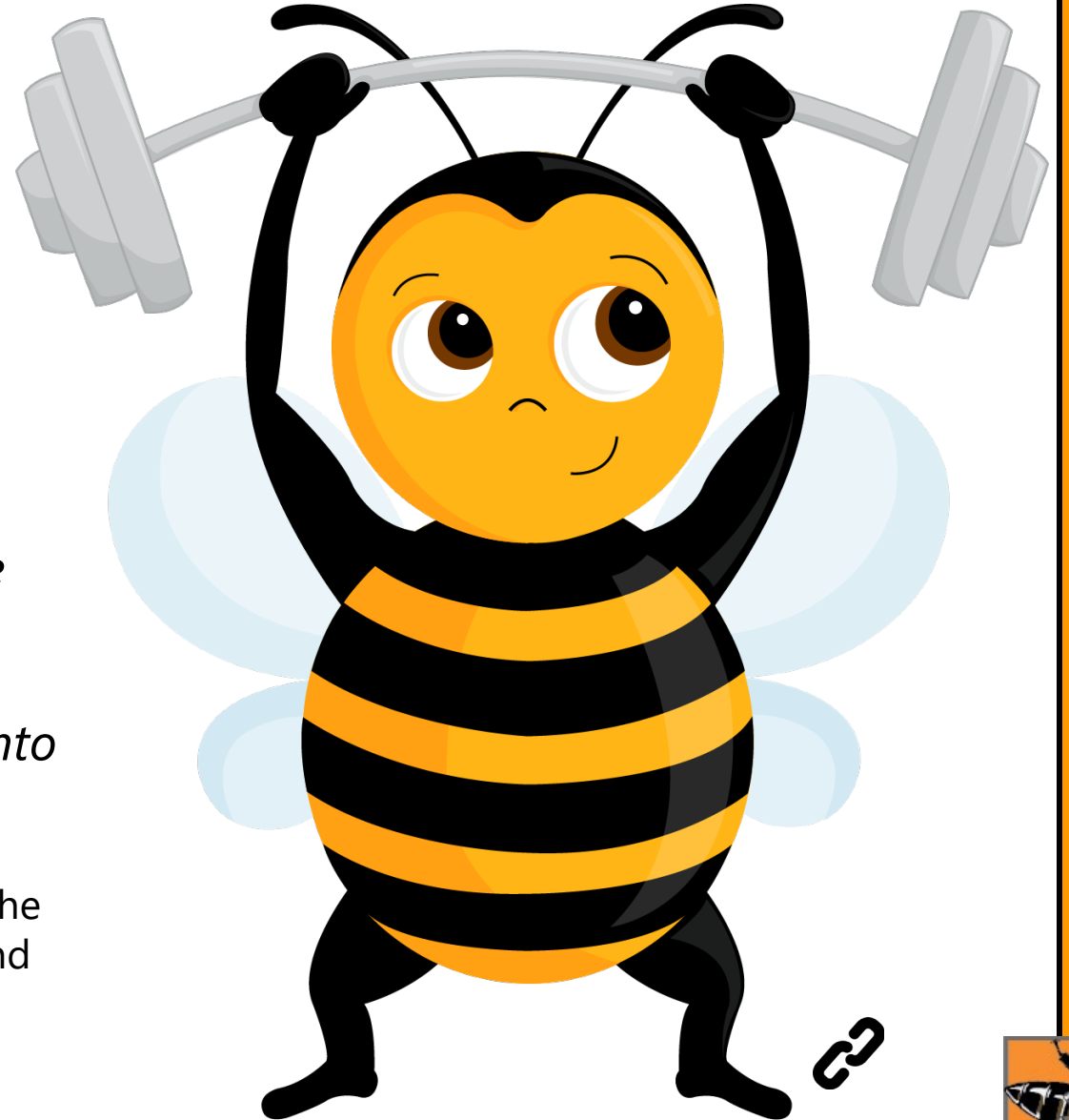
- *Through their flight muscles*
  - (Kind of like our shoulders)
- *They can relax part of the musculature that connects to the wing*
- *They are flapping their wings, minus the flapping*



# 'Bee Aerobics'

## □ How do bees generate heat?

- *Like us, when they move the muscle group, they heat up*
- *This heat radiates off the bee and into the mass*
  - While we are enjoying the holidays, the bees are out generating heat 24x7 and dreaming of spring



# Heater Bees and Shell Bees

## ❑ Heated through movement and circulation

- *As noted, heat is generated at the thorax*
- *The narrow passage of the waist, coupled with the fact that the circulator system of the bee pushes fluid forward, means the front half of the bee is heated.*
  - There is virtually no heat made at the back of the bee – the abdomen

## ❑ Shell Bees

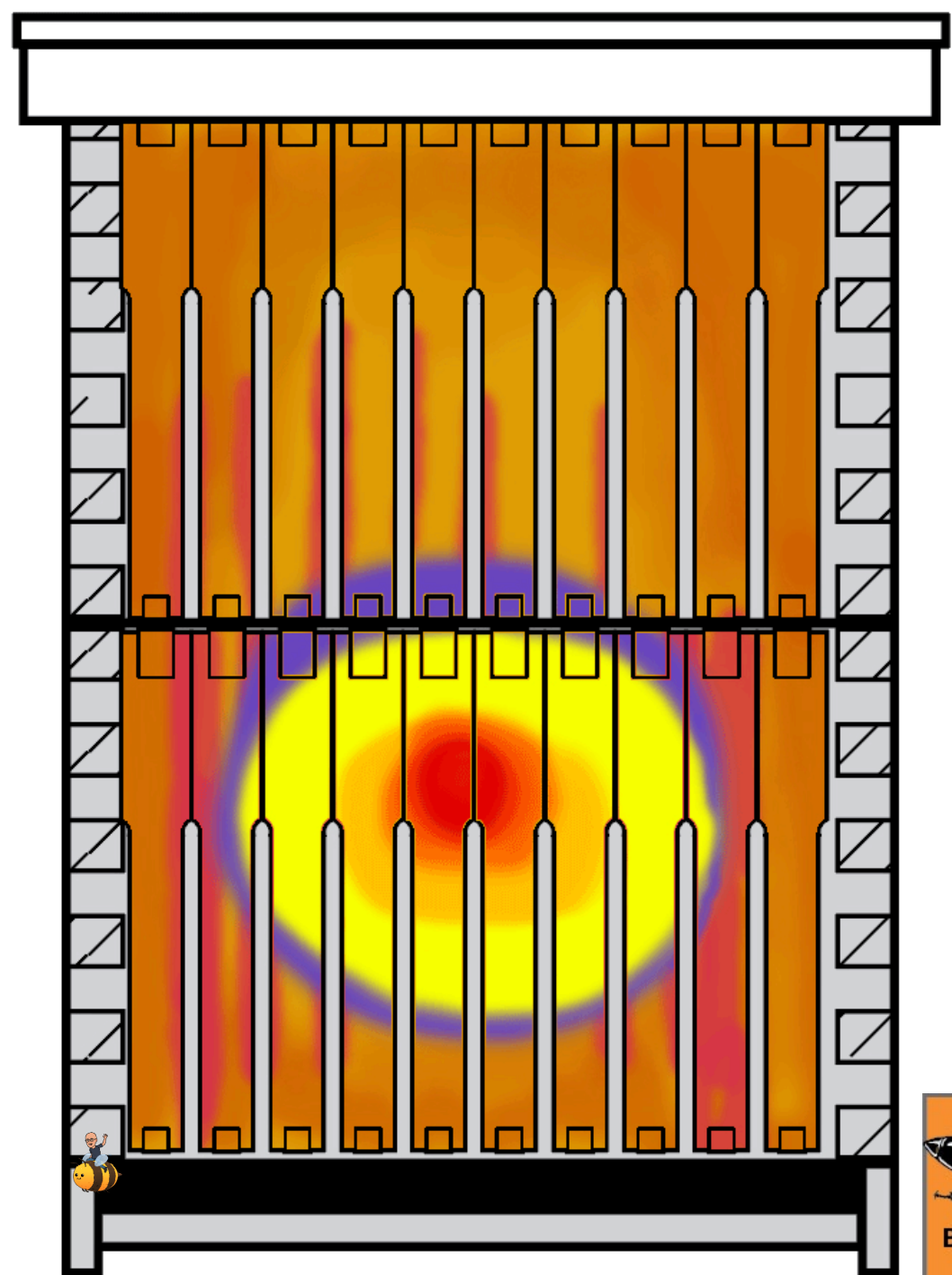
- *Shell bees face inward, tail out.*
- *Any heat generated from the center mass is trapped by the downy hairs that cover the body when the cluster together in the shell.*



# The Progression

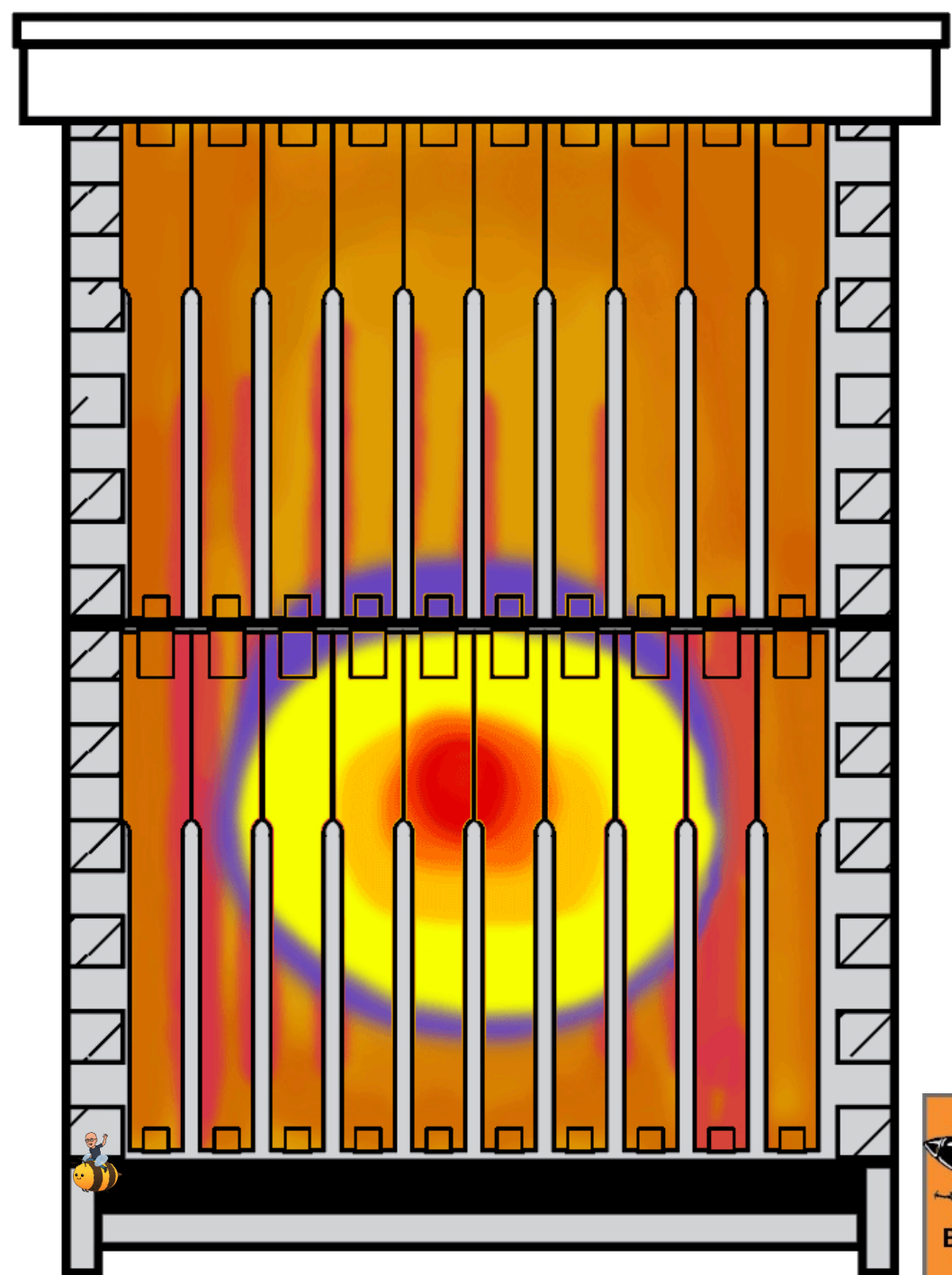
*One imagined example*

- ❑ **Cluster in the bottom**
- ❑ **Move left and right**
- ❑ **Then steadily upward**
  - *Brood production slows*
  - *Then they cease brood production altogether*
  - *Return to brood production*



# The Progression

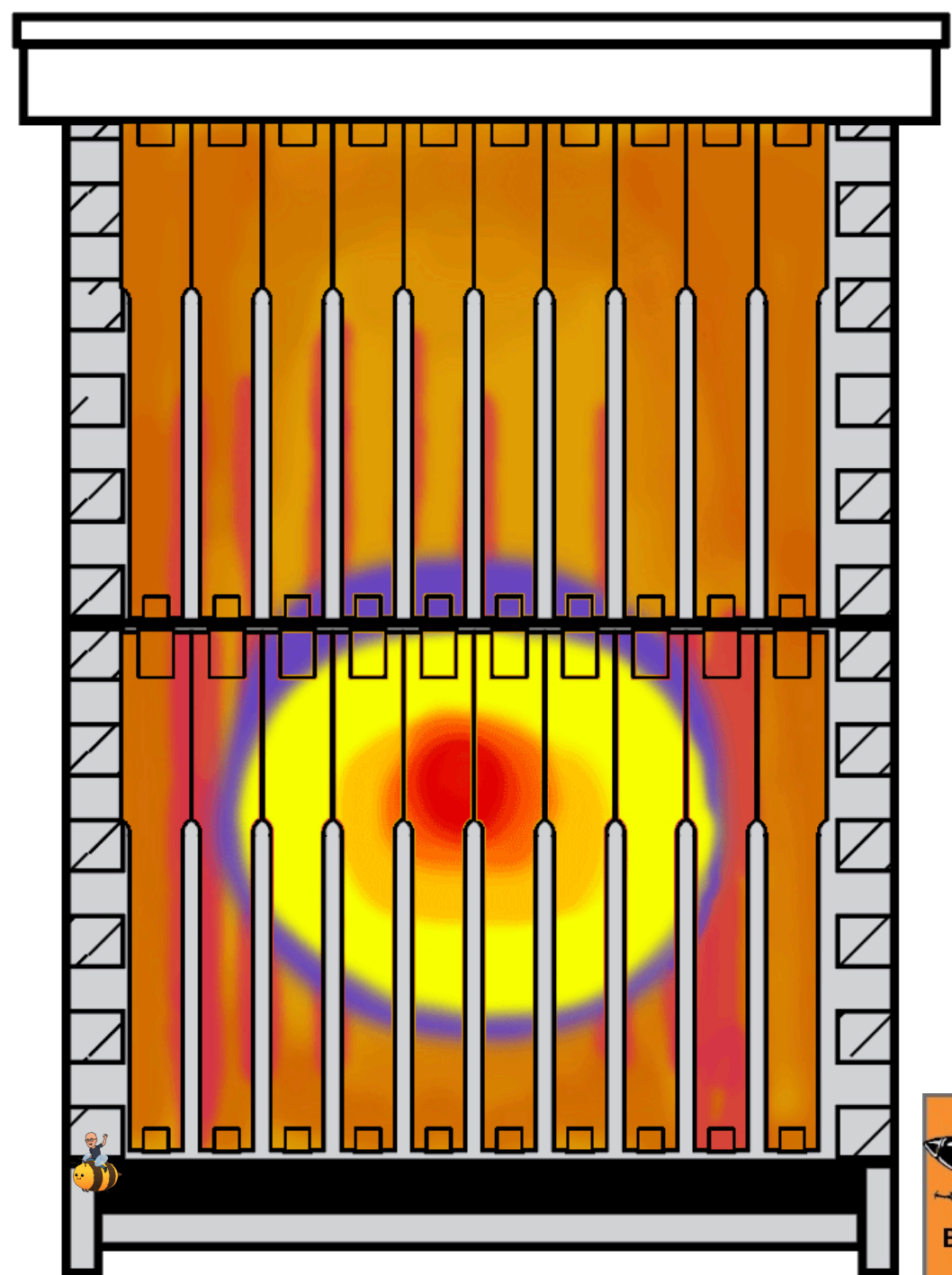
- ❑ **This animation is for an active winter**
  - *Some hives will not go through this extensive movement*
  - *Some will stay in the bottom nest*



# The Progression

## ❑ Colder Winters

- *Some will stay in the bottom nest*
  - They stay under the dome
- *Late Winter*
  - Fully in the bottom box, or mostly in the bottom box, after winter
- *Subsistence through colder months via a Torpor State*

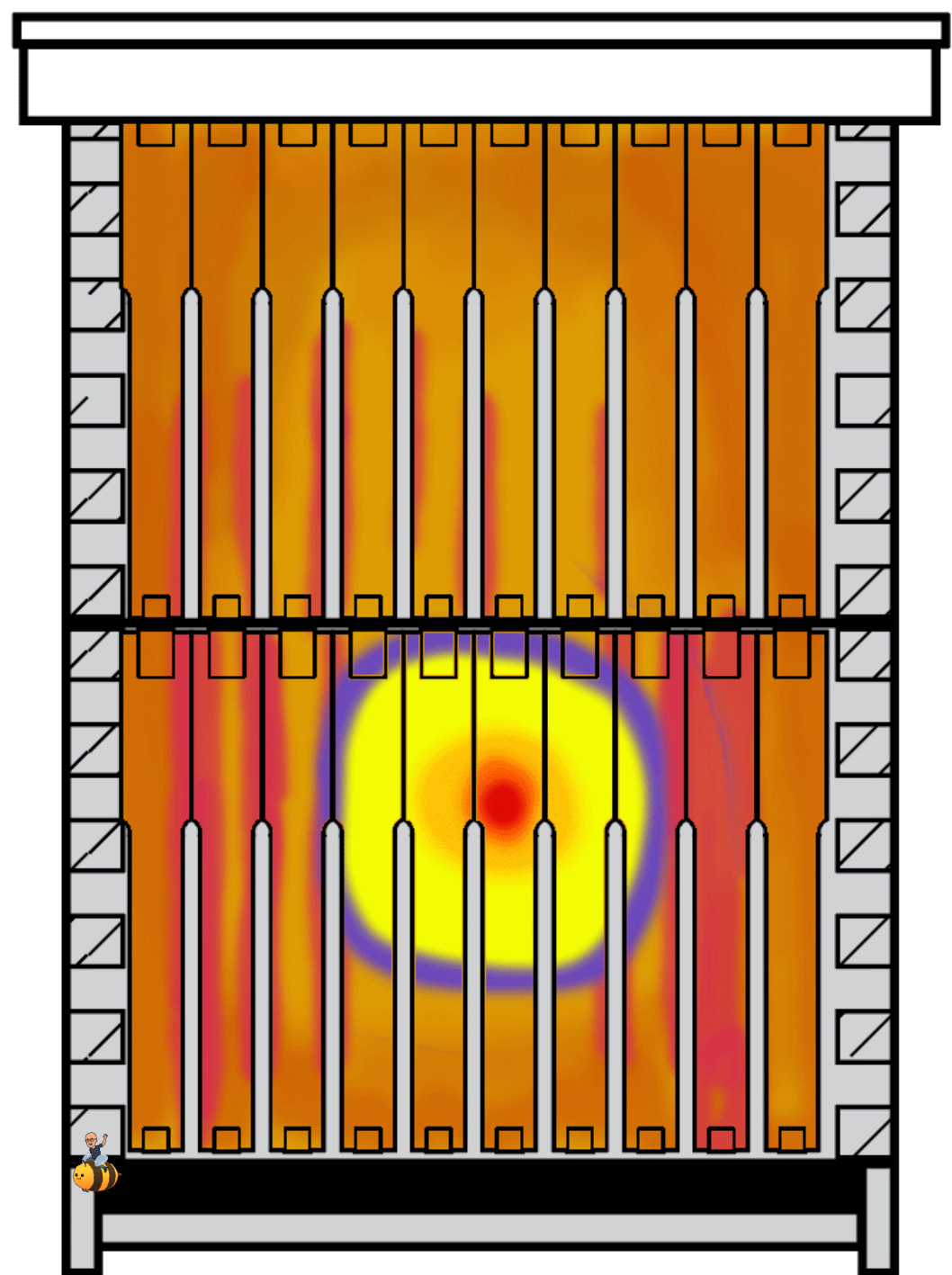




# Stretch to food

## ❑ Reaching for food

- *Sometimes colonies change the shape of the cluster to reach for food.*
  - The colony will make short-term shifts to food or space
  - The likely objective of moving resources into the clustering area.



# Active vs. Inactive Winters

## ❑ Some winters are milder

- *Bees will attempt to operate if temps get to 40° and above*
  - Good for cleansing flights.
  - Bad for wasteful, fruitless foraging (some pollen)
- *If below 40° consistently (assuming a flight day periodically)*
  - The bees will go into a **torpor** state
  - Many of the cluster will slow down, and get into a quiescent state
  - They will **subsist** off of their internal stores

### *Definition*

**Torpor:** a state of physical or mental inactivity; lethargy.

### *Definition*

**Subsist:** maintain or support oneself, especially at a minimal level.

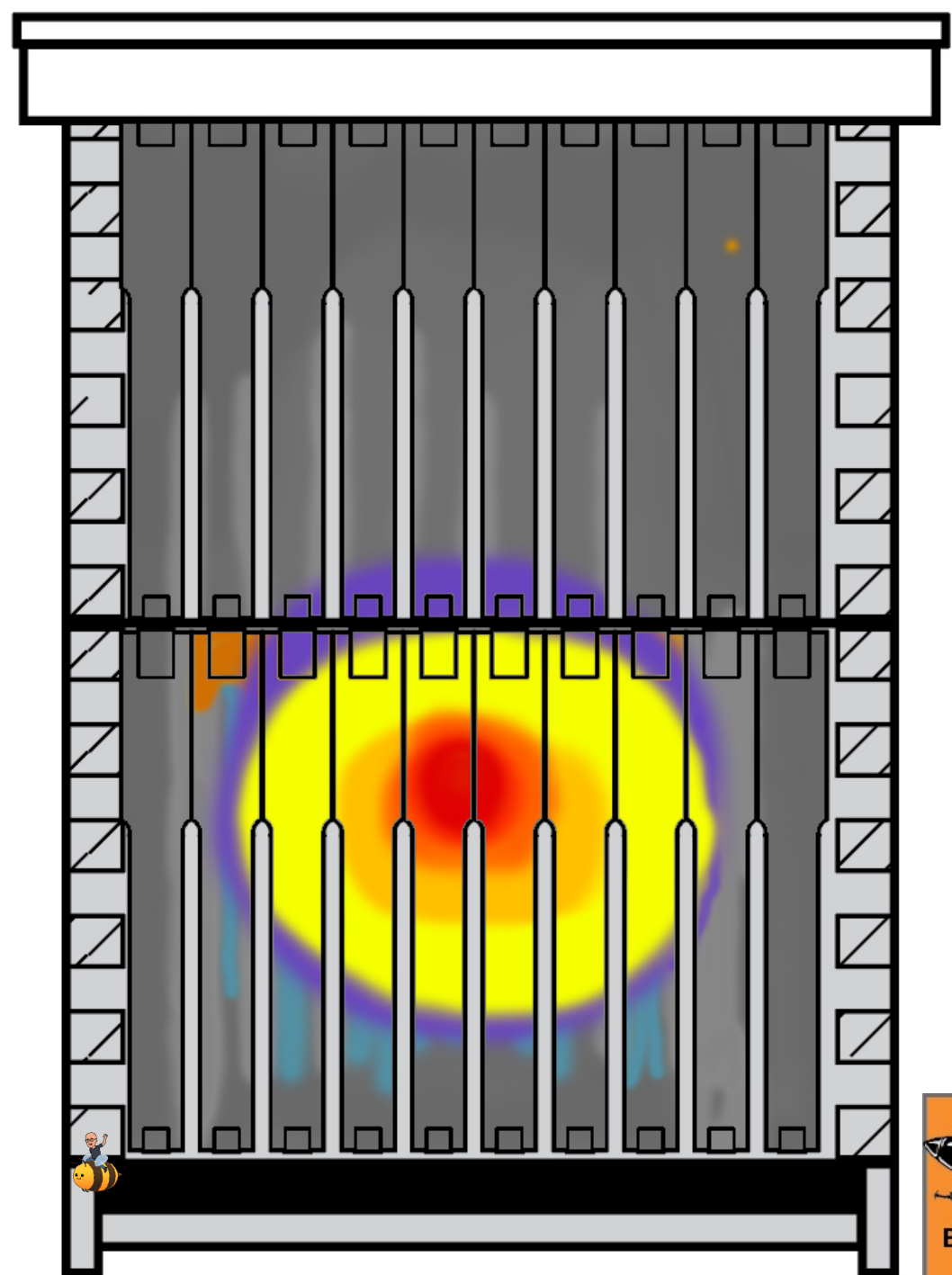


# Interior Warmth

## ❑ Heat Dynamics

- *Brood rearing temperature in the center*
- *Heater bees in the middle*
- *Tightly clustered bees form the shell*

## ❑ The hive interior is not heated (Gray Tones)

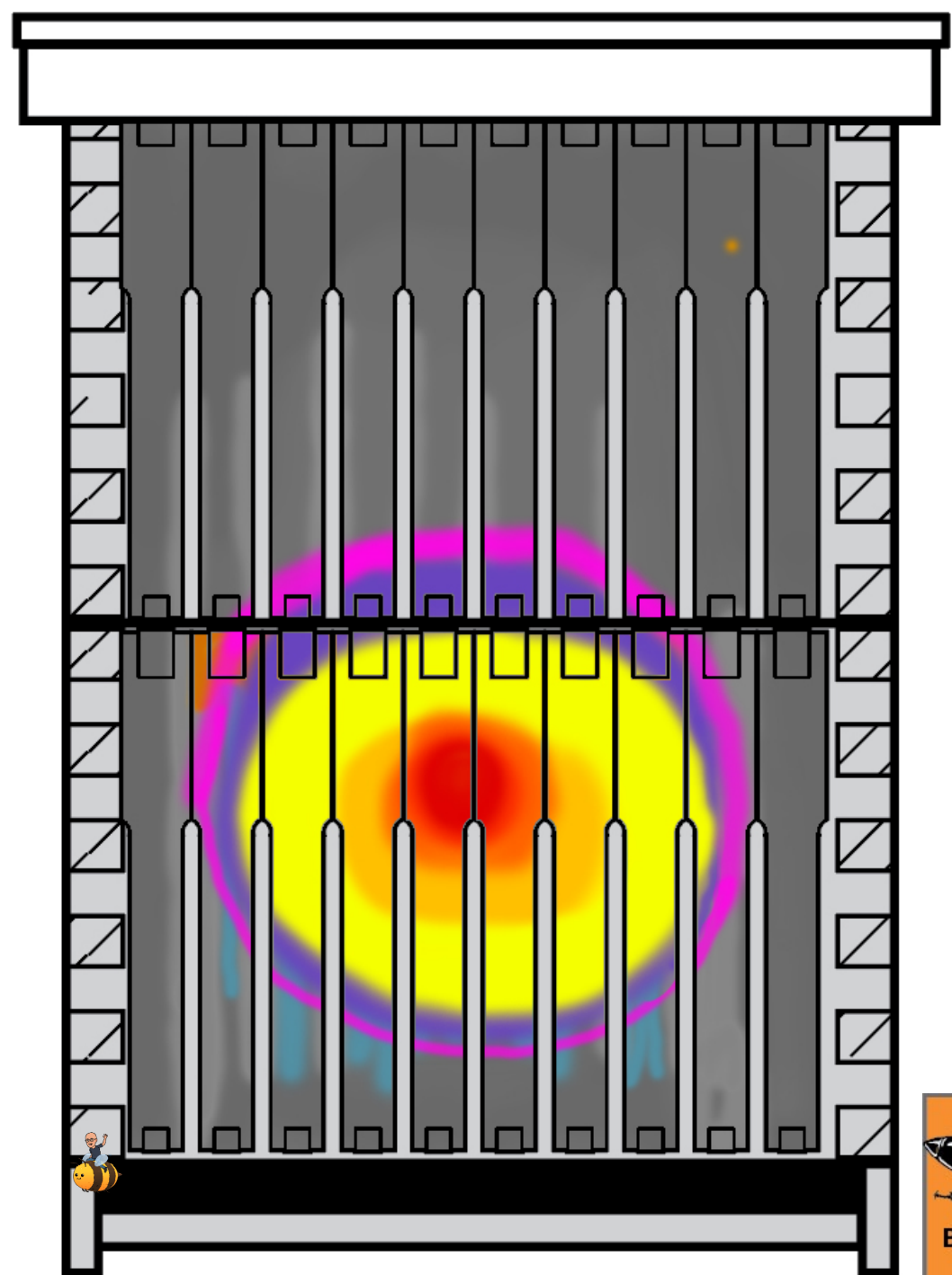




# Warmth Envelope

## ❑ Surrounding Air

- *Heat radiates off the cluster*
- *This warms some of the air around the cluster*
- *But mostly the interior hive temperature is only a few degrees warmer than the outside air*
  - Some warmed air will collect at the top of the hive, as we will see later.



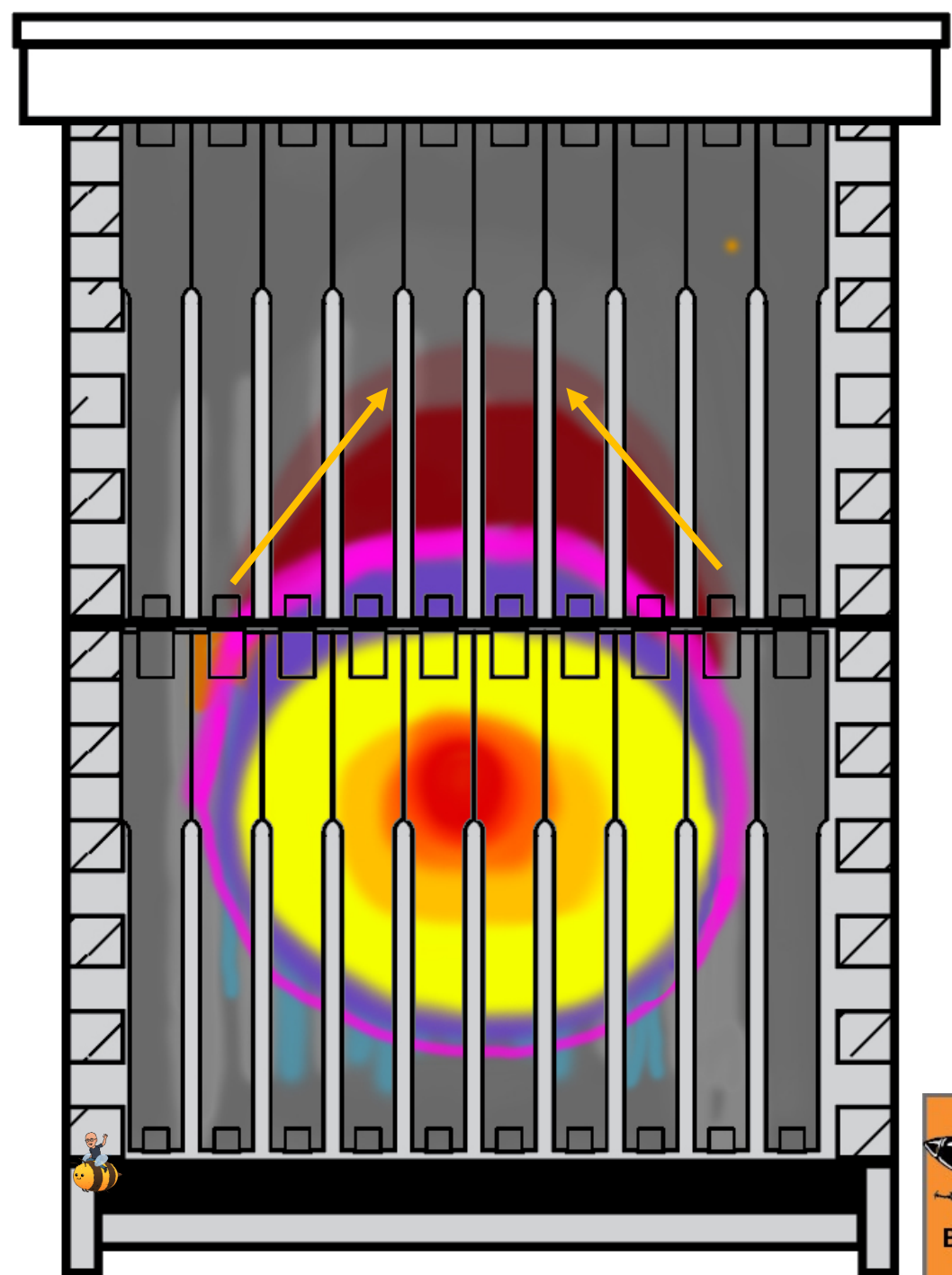
# Heat Rising

## ❑ Rising Over the Cluster

- *Heat will come up and over the cluster – heat rises*
- *It will center itself over the cluster*
  - Much like a fire comes together to form a pillar.



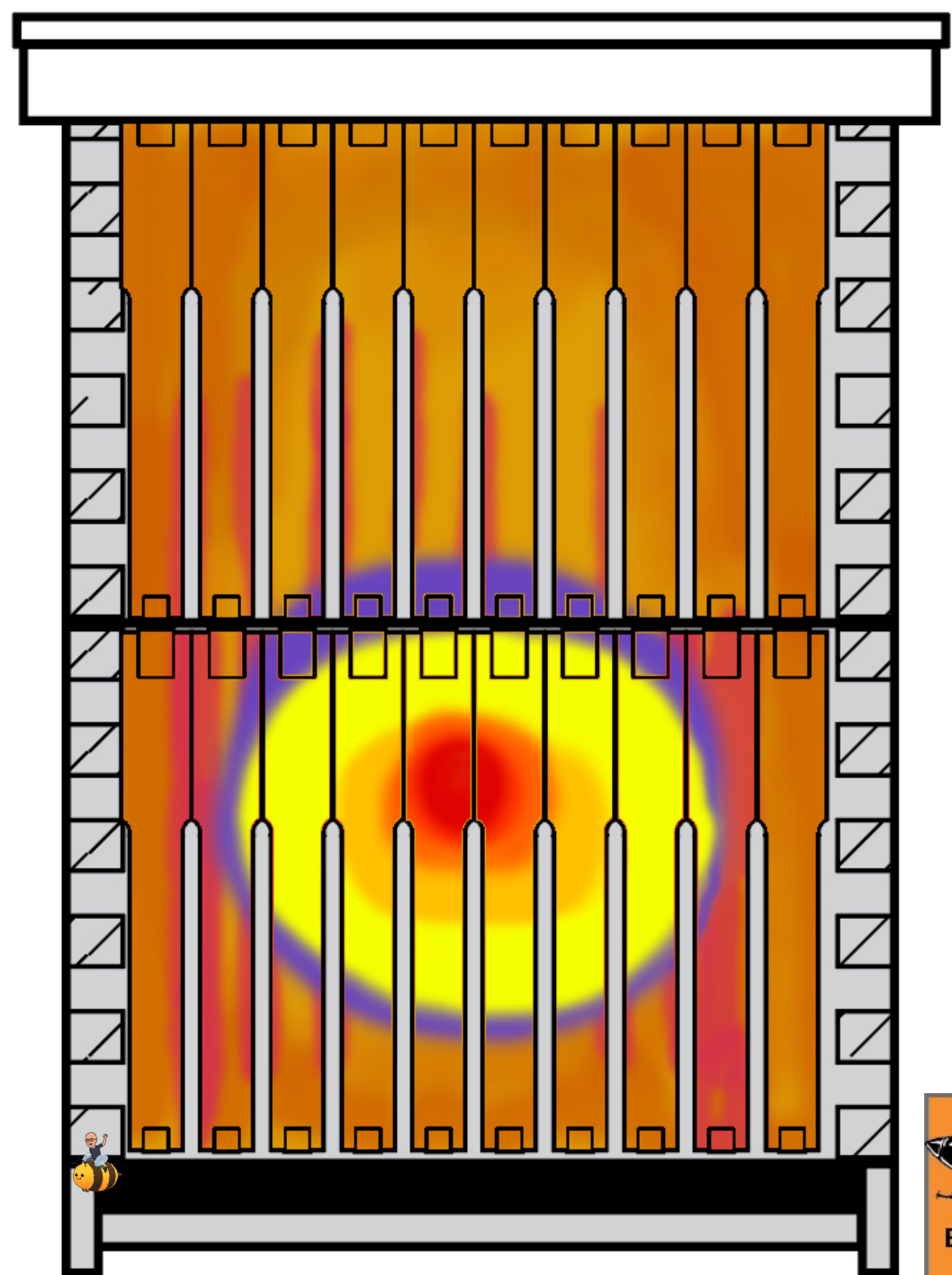
**Scientists say:** Heat rising near the outside edges of a heat source will fold inward and concentrate toward the center of the mass.



# Progression 1

## ❑ Bees cluster Between 45 and 50°F

- *They come together and form a mass*
- *The bees on the outside form a tight body-to-body outer layer*
- *They will consume the food underneath and within reach of the cluster*

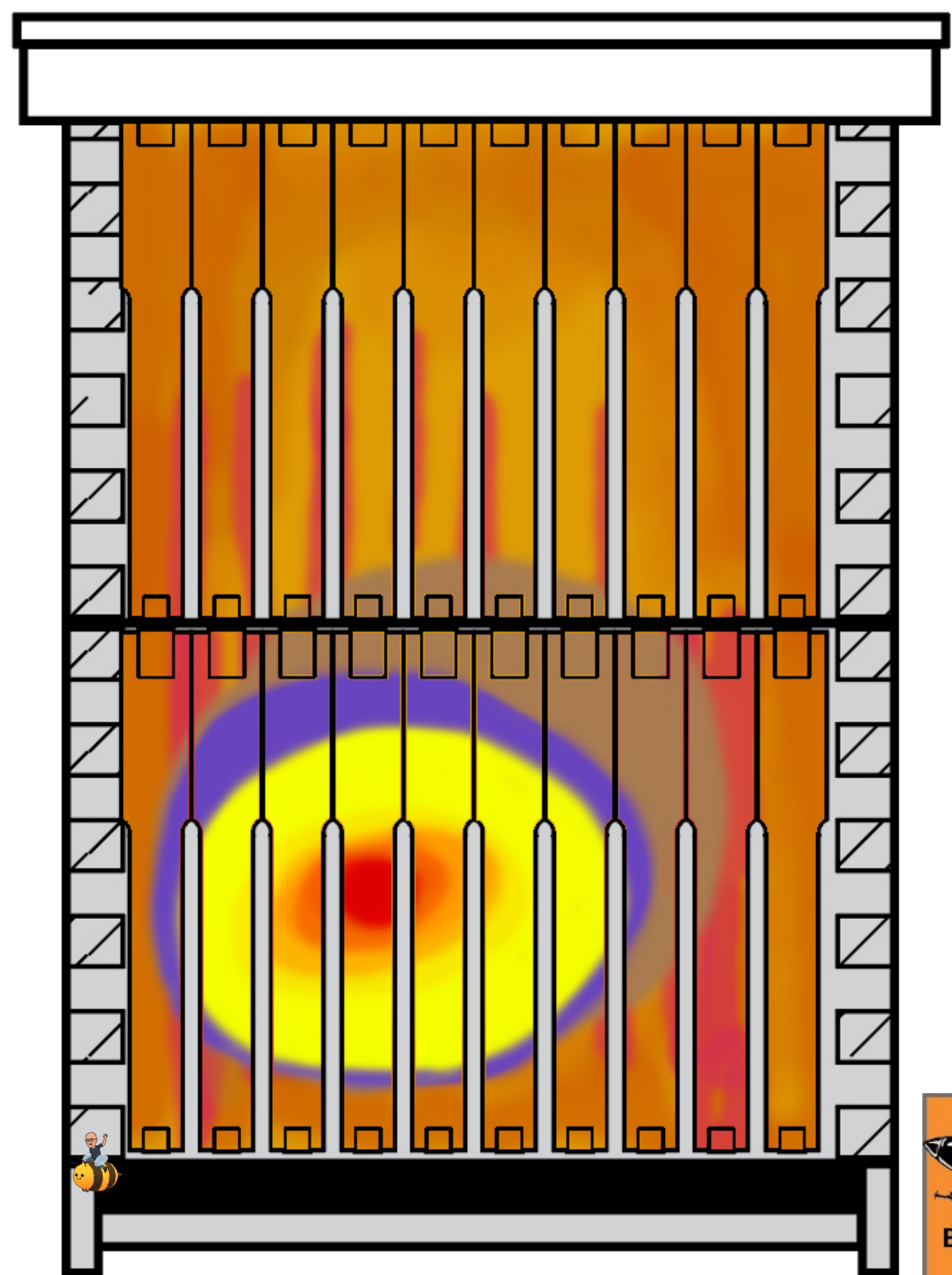




## Progression 2

### ❑ Movement

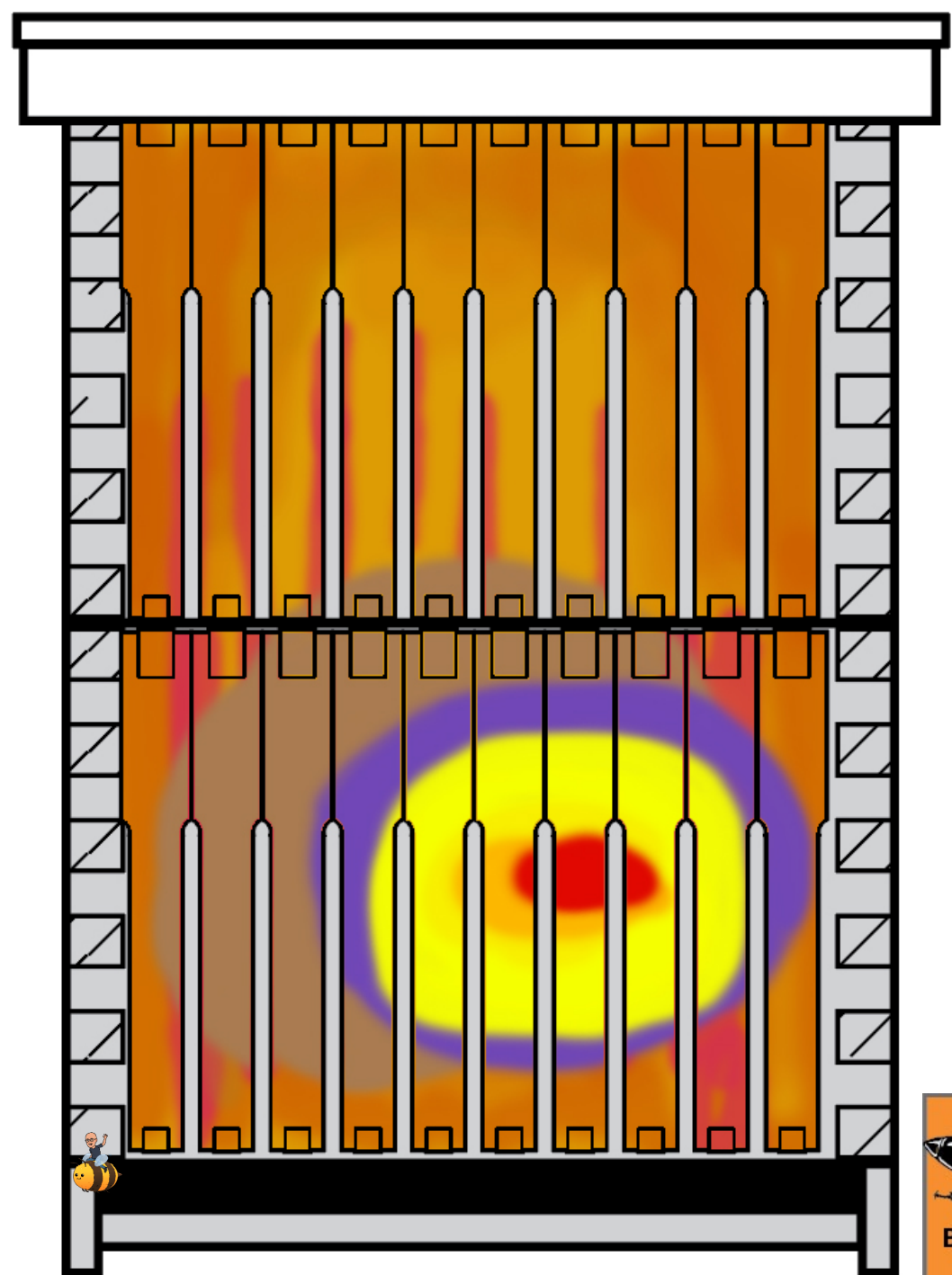
- *As the bees move through early winter they will have to move to food*
- *In this example, as suggested earlier, the cluster has moved left to the food stores.*



# Progression 3

## □ Movement

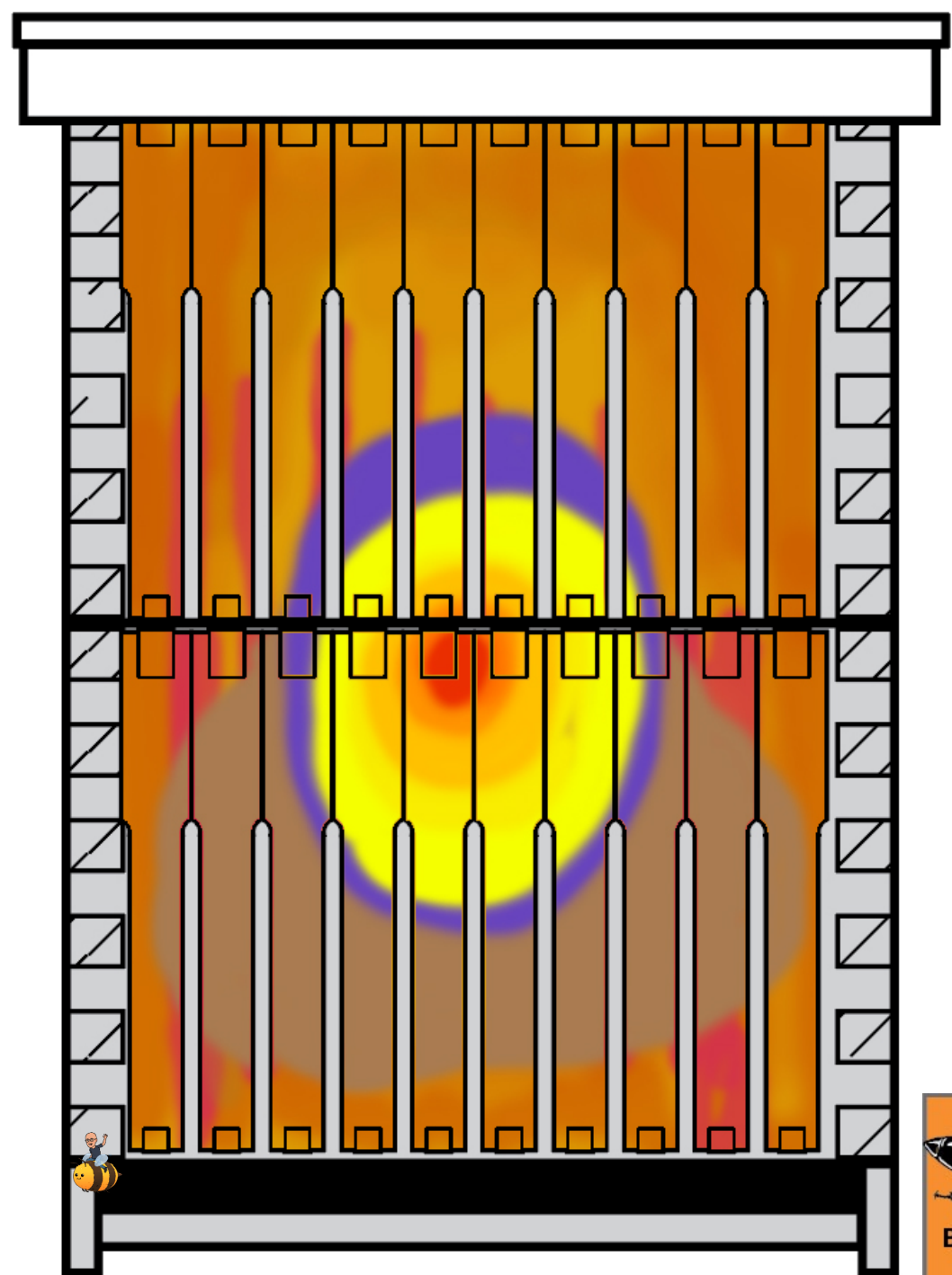
- *Conventionally it is said that they will move right and left before going up.*
- *Here the cluster has moved over to the right side for the food stores.*



# Progression 4

## ❑ Pushing UP

- *Mid Winter they may use up what is in the bottom and start to move up*
- *Here they are aided by the heat coming off the cluster*
  - The heat may afford some warmth to the honey dome above.
  - Which allows them to process and consume it.

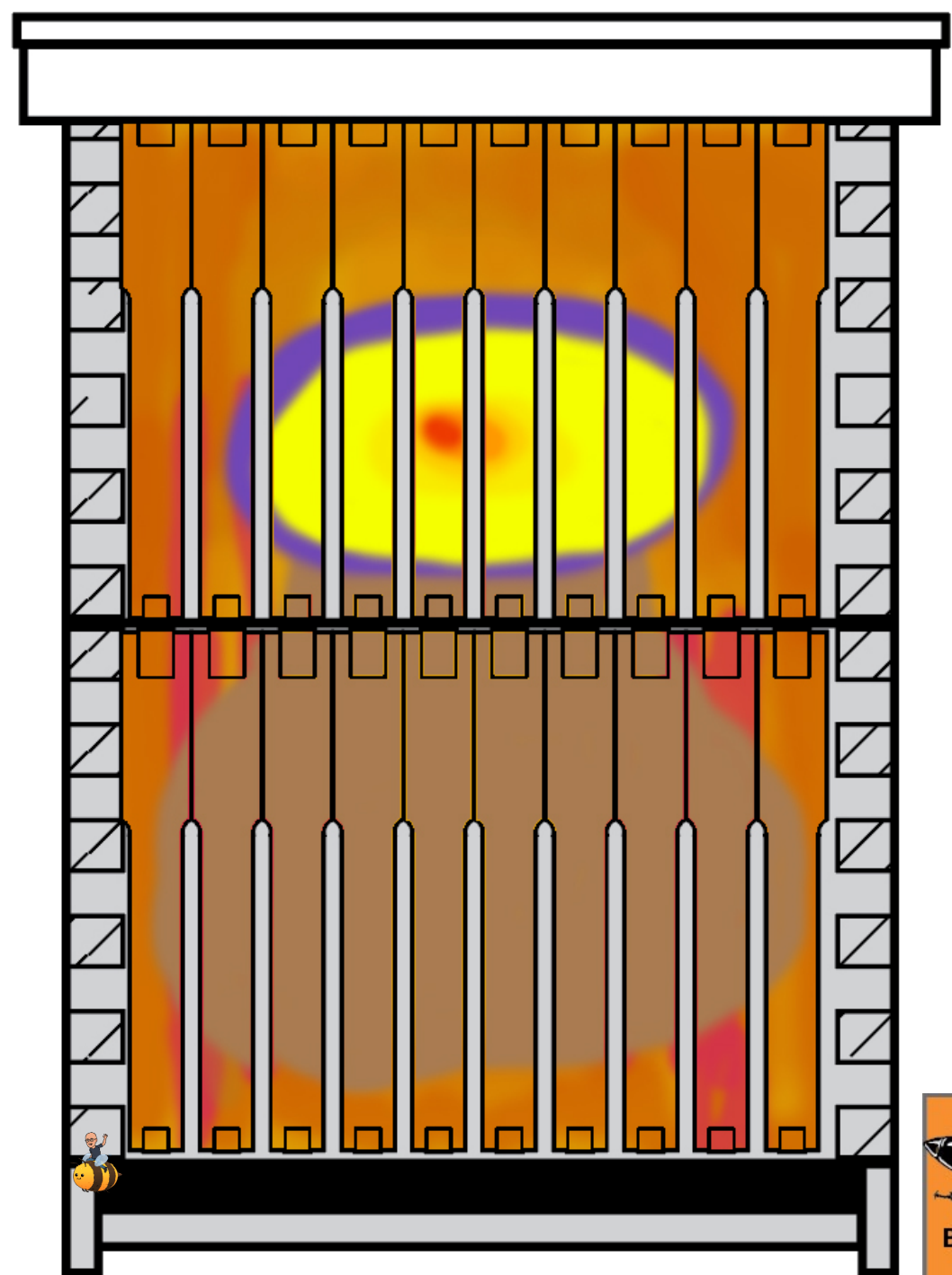




# Progression 5

## □ Top Box

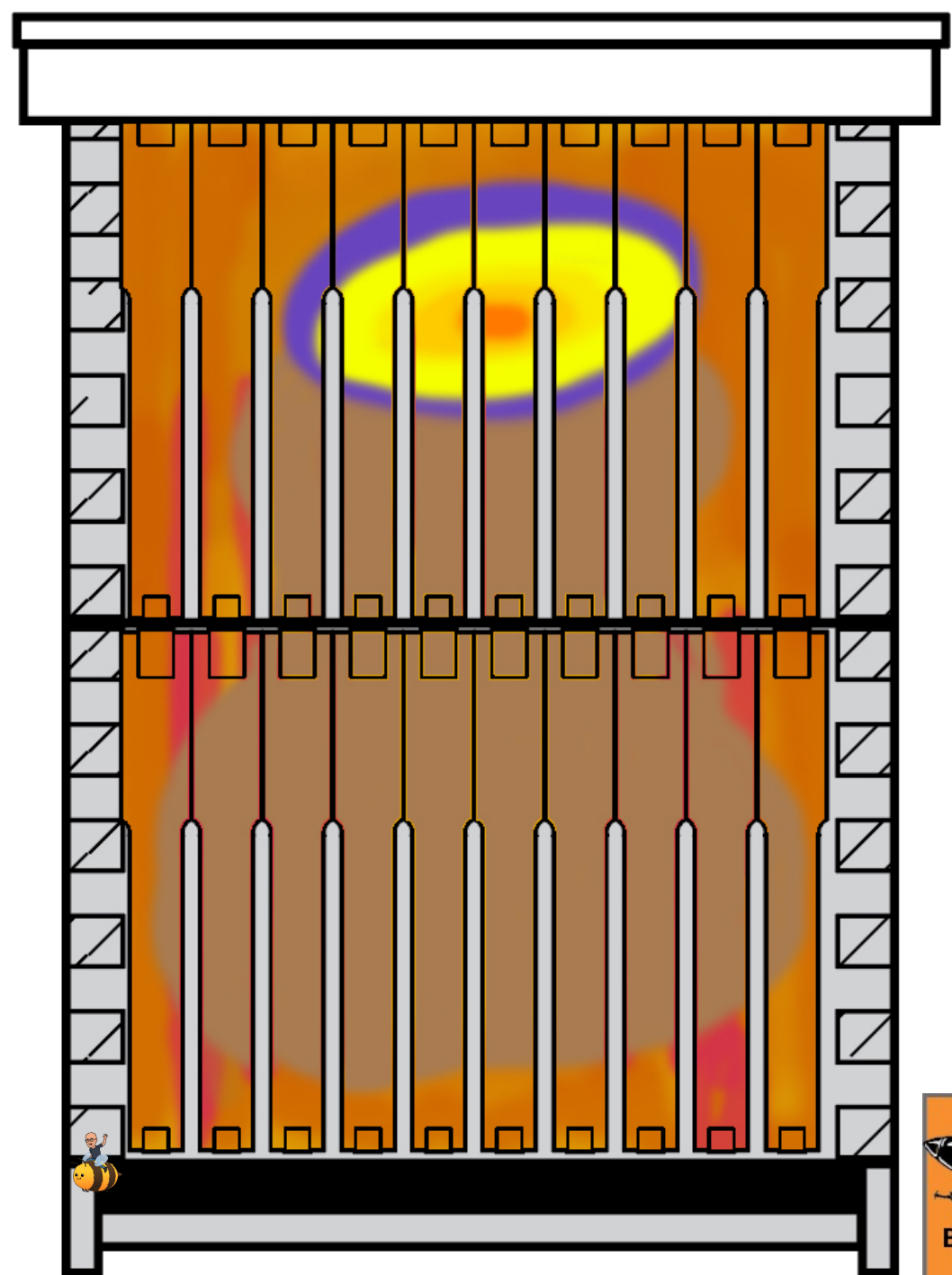
- *In an active winter the bees may consume more stores*
  - Here they have moved fully into the honey and pollen reserves in the top box.
- *Note the brood rearing cessation*
  - It is suggested that the queen will likely stop laying eggs at the coldest point of winter



# Progression 6

## ❑ Cluster Shrinkage

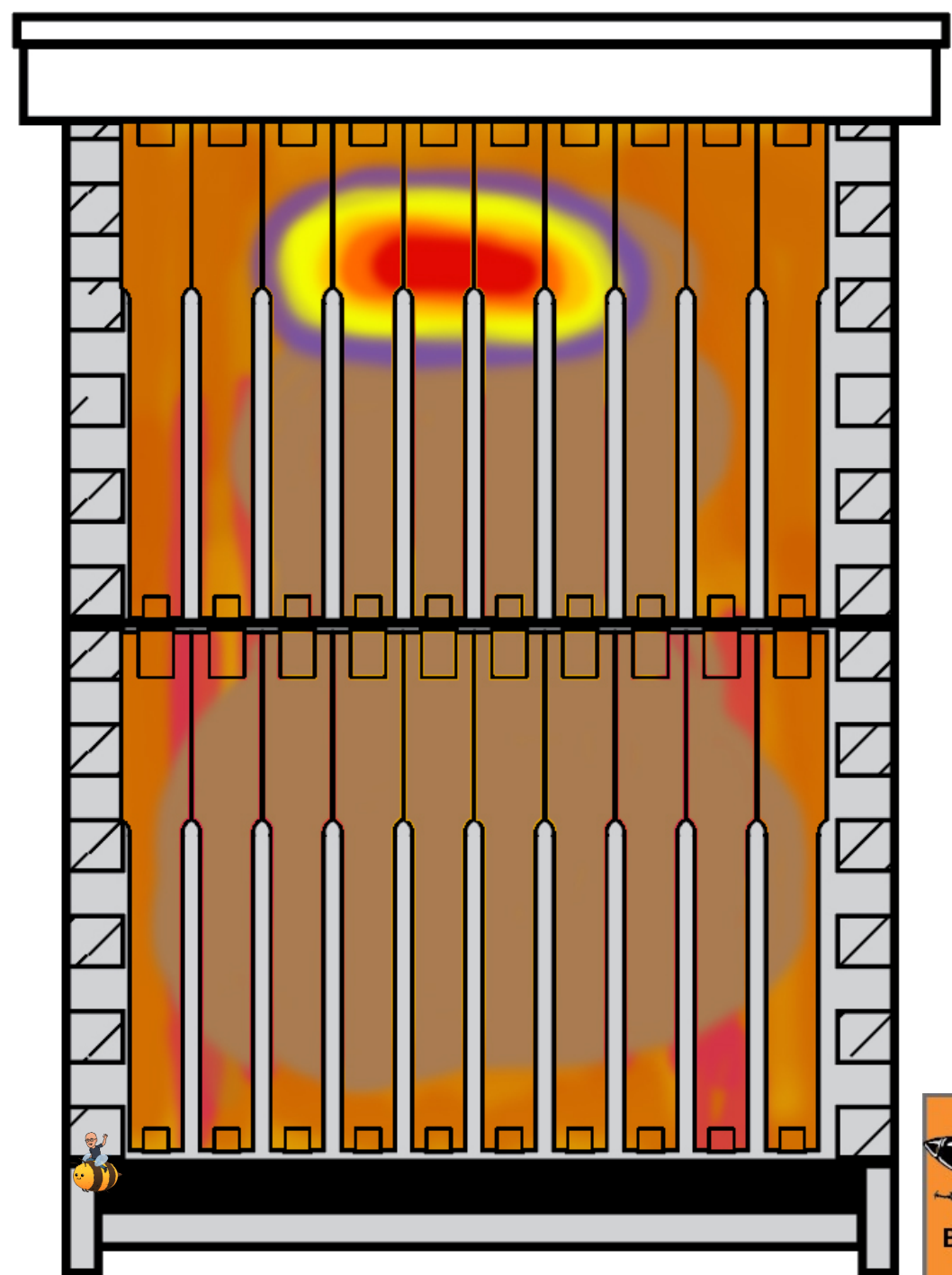
- *Late December and the cluster is holding on until spring*
  - Day after day attrition takes place and the colony is down in numbers from the fall
  - The oldest bees die off
  - The brood reared during winter compensates some
  - It is likely that the colony will only lose bees from here on out until brood rearing continues in earnest



# Progression 7

## ❑ Restart

- *Somewhere in January the colony will kick in and start brood rearing again*
  - Small increments to begin with
  - Full on once the early forage and weather cooperates
- *Early forage and reserves will be consumed while the workforce grows*

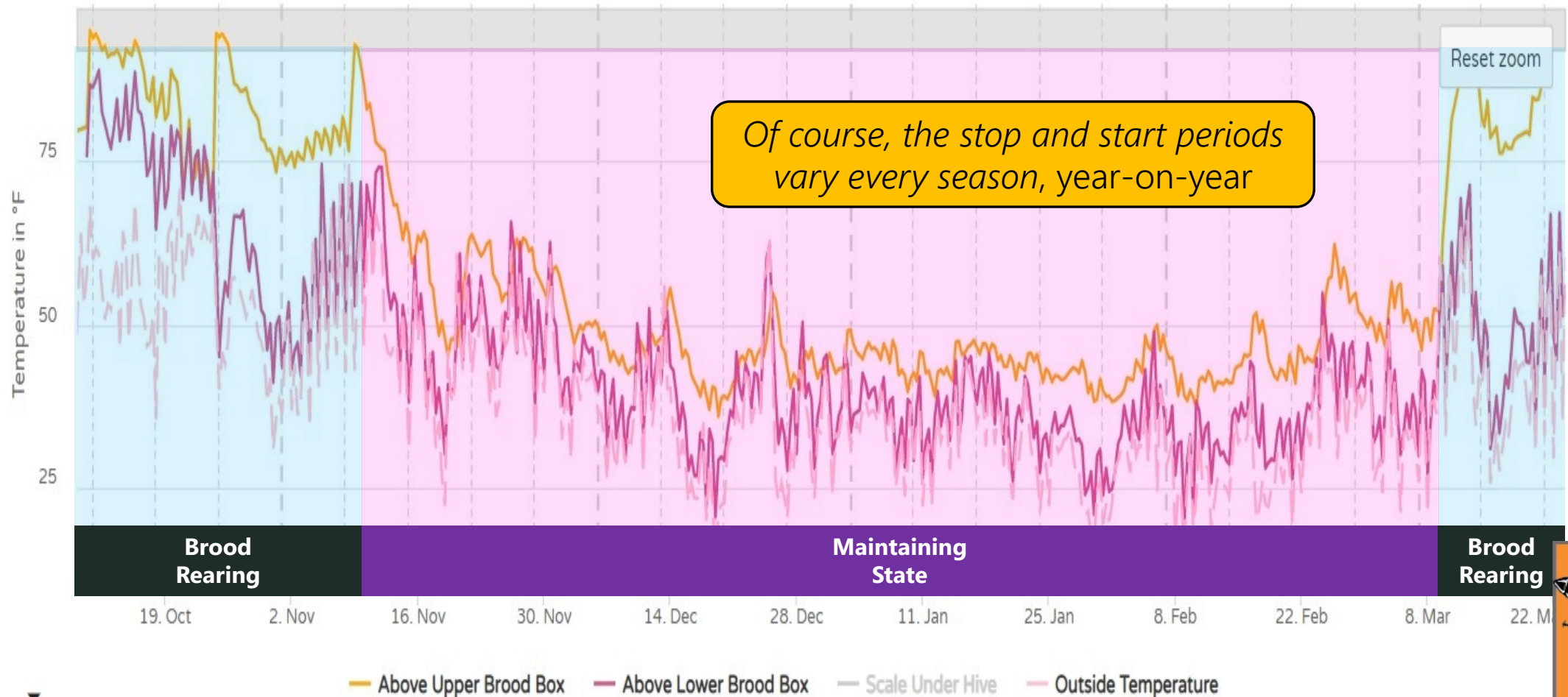




# Brood Rearing / Torpor / Brood Rearing

## ❑ This chart shows when they ceased and continued

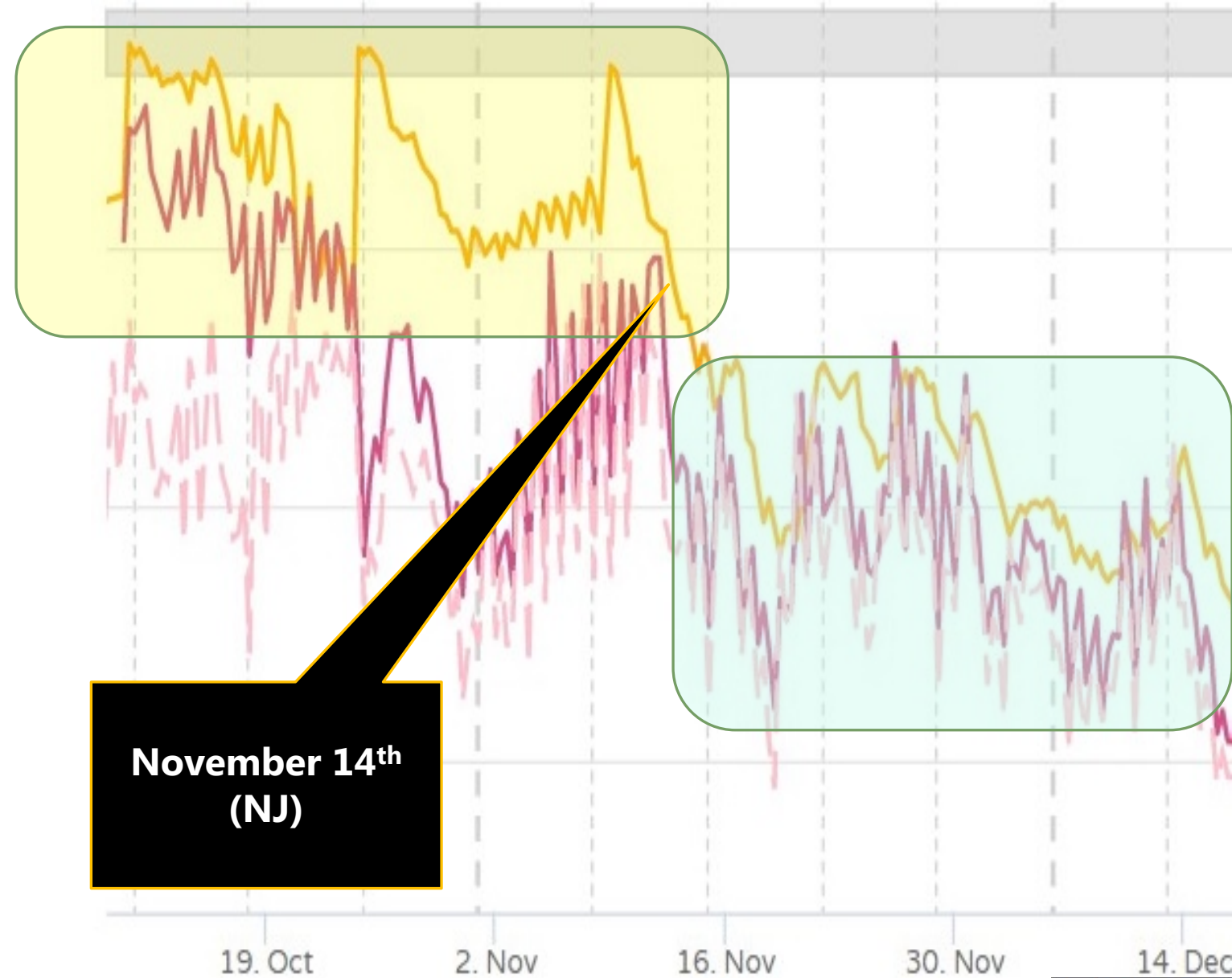
- *These sensors are not representative of the heat inside the cluster, but it does show the heat generation adjacent to the cluster*



# Fall Shut Down

## □ For this hive

- *On November 14<sup>th</sup> they stopped conventional brood rearing*
- *The temperature got below the threshold to operate normally, and they formed a cluster*



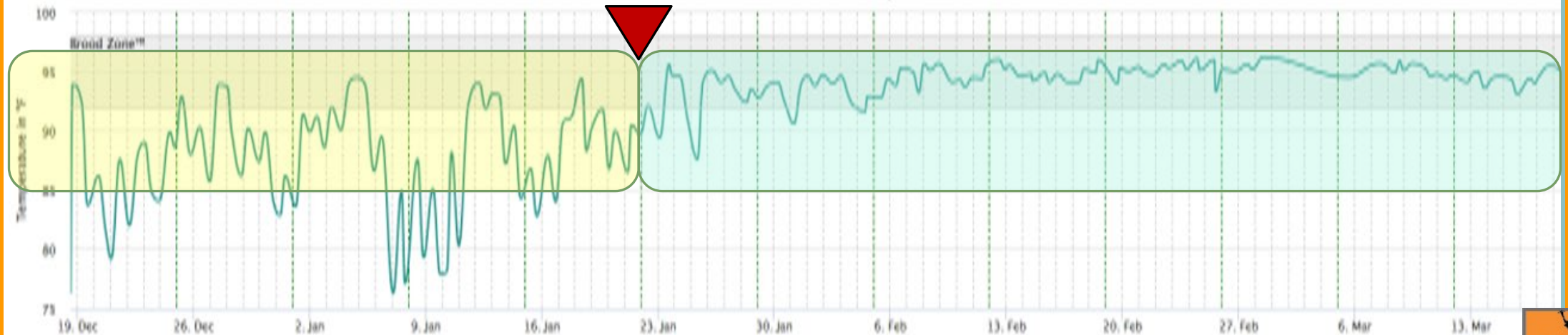
# Spring Ramp Up

## ❑ For this hive

- *On January 23<sup>rd</sup> this colony resumed conventional brood rearing*
- *The temperature returned to the threshold to operate normally, and they broke cluster*

Cluster populations continued to decrease during December and reached a minimum around mid-January, when they started to increase as brood emerged. [Thermology / Owens]

This is a normal condition throughout North America. [Ferrar]

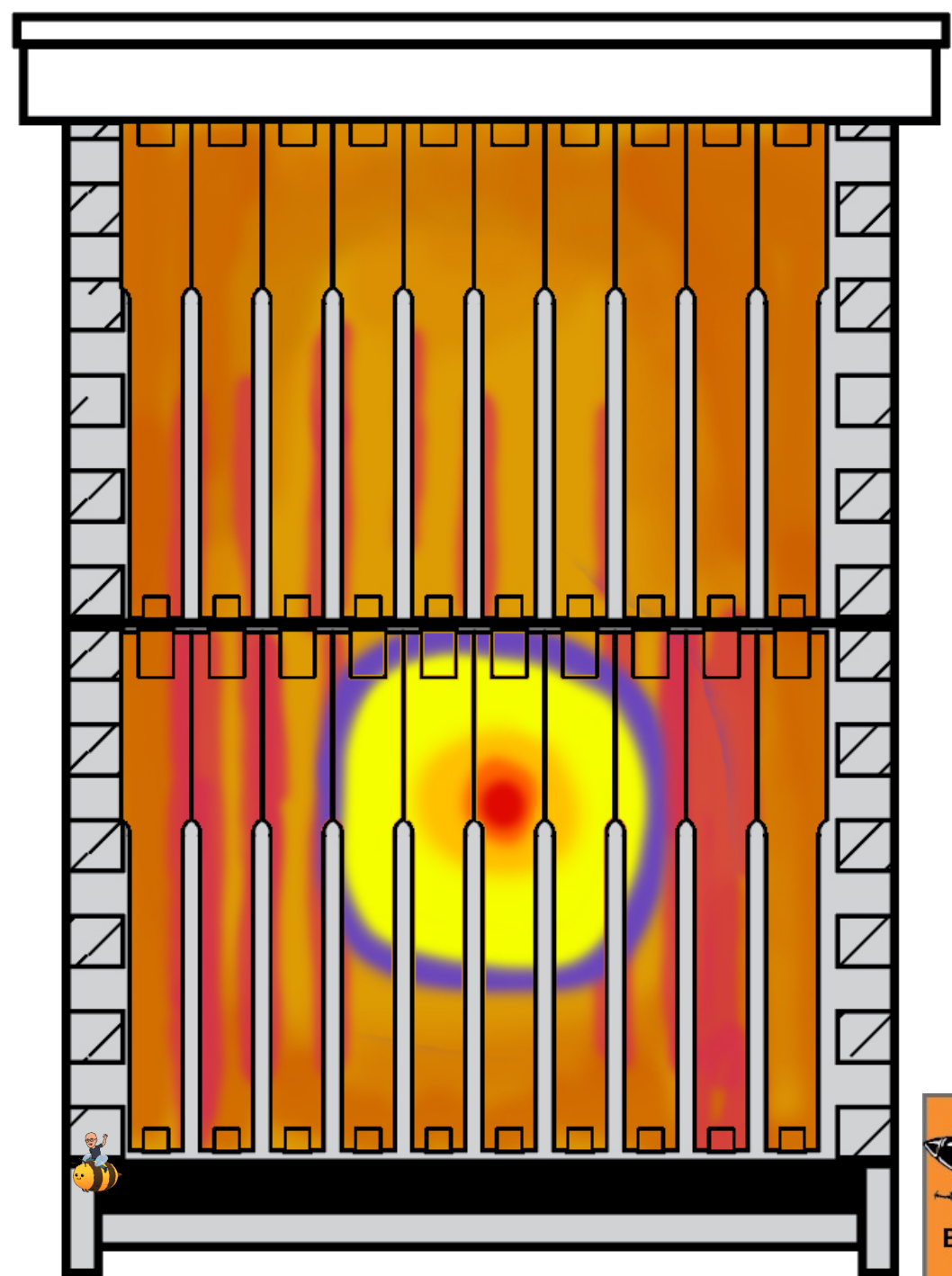




# Progression 1

## ❑ The Fate of a Small Cluster

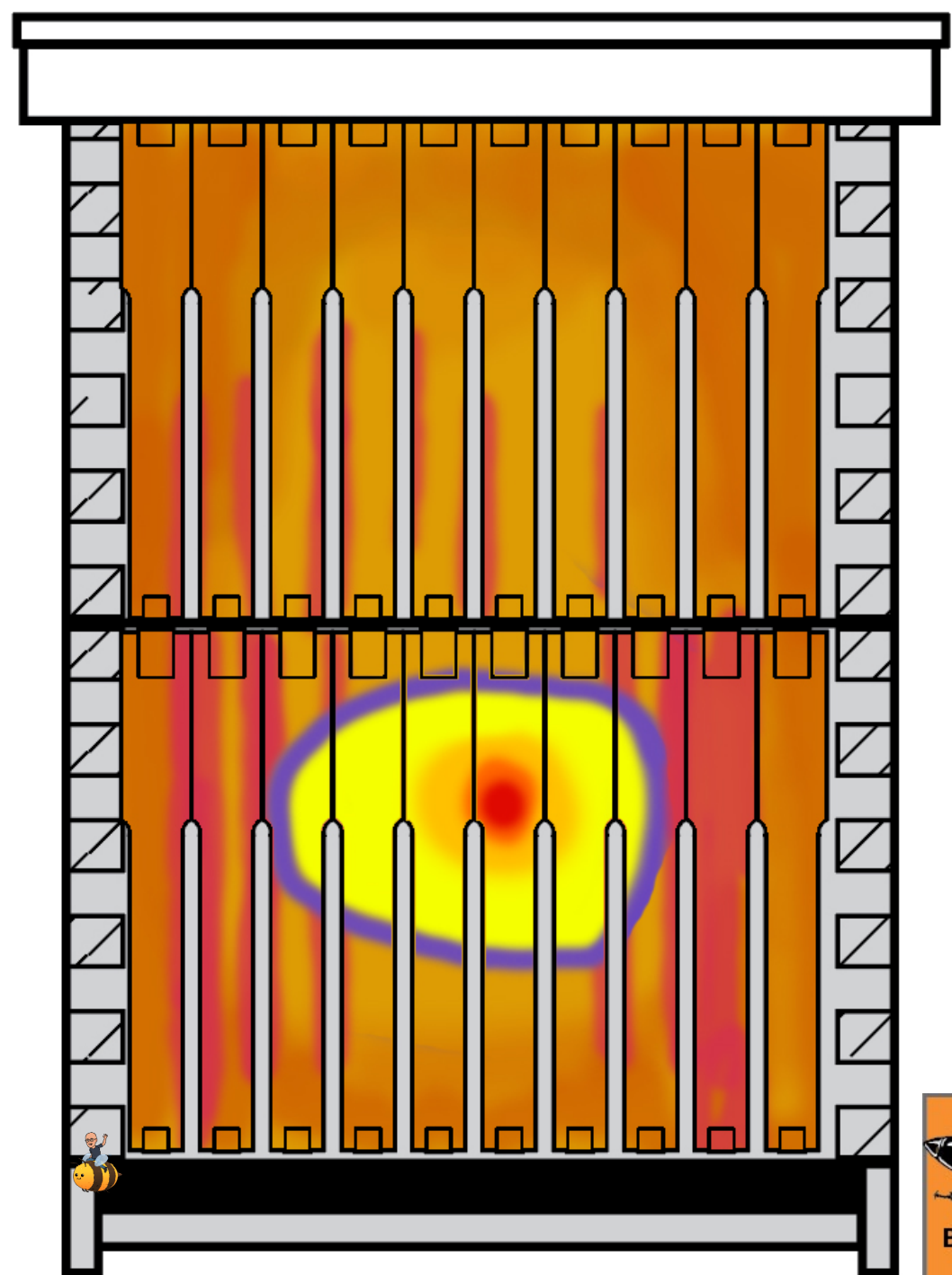
- *Small clusters can get by for a period of time*



## Progression 2

### ❑ Small Cluster

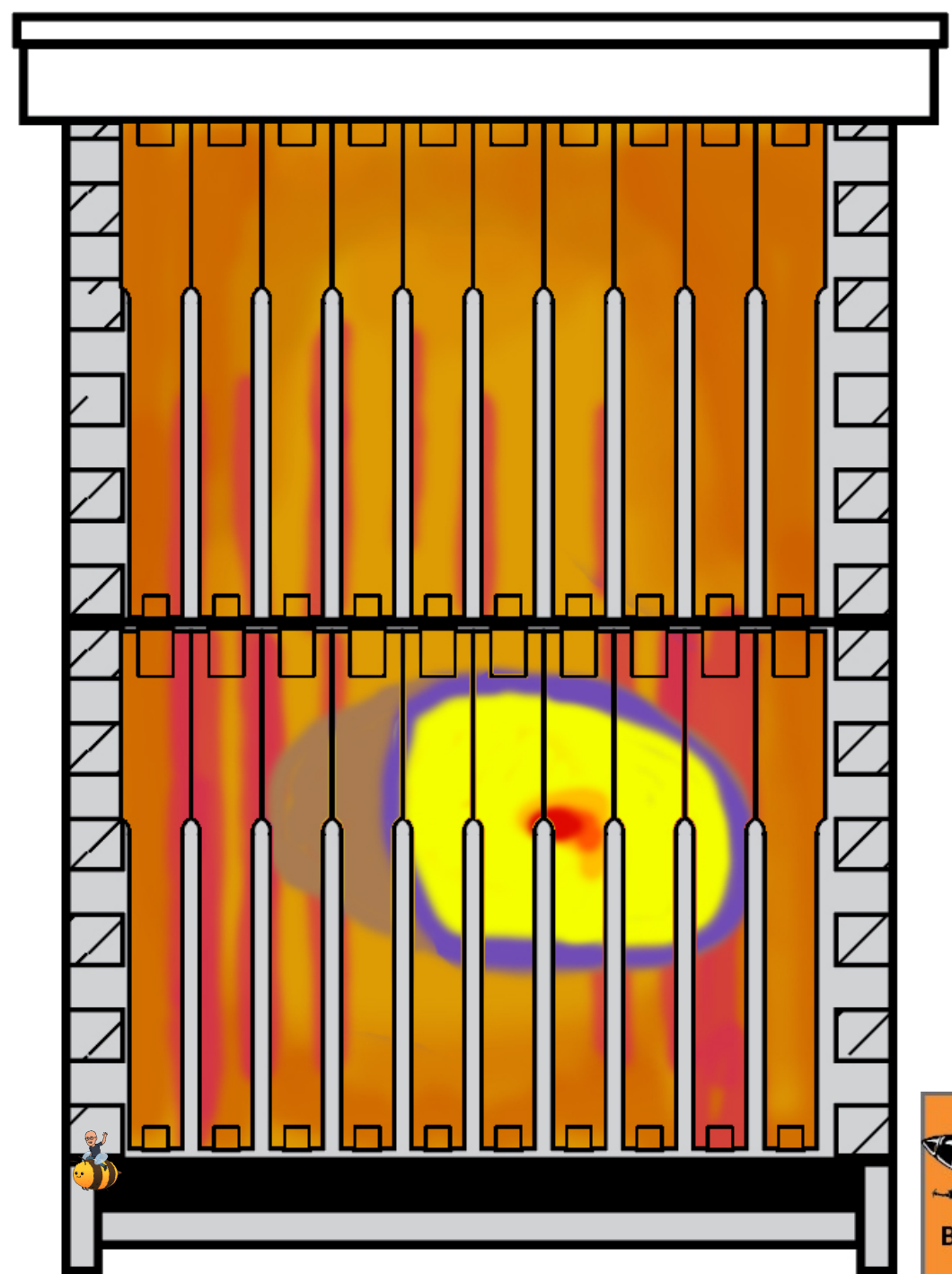
- *Like big clusters, they can move side to side when it is not terribly cold*
- *Small clusters covering only the depth a frame or two can move only under very mild temperatures.*



## Progression 3

### ❑ Small Cluster

- *They might get by, and move left and right.*

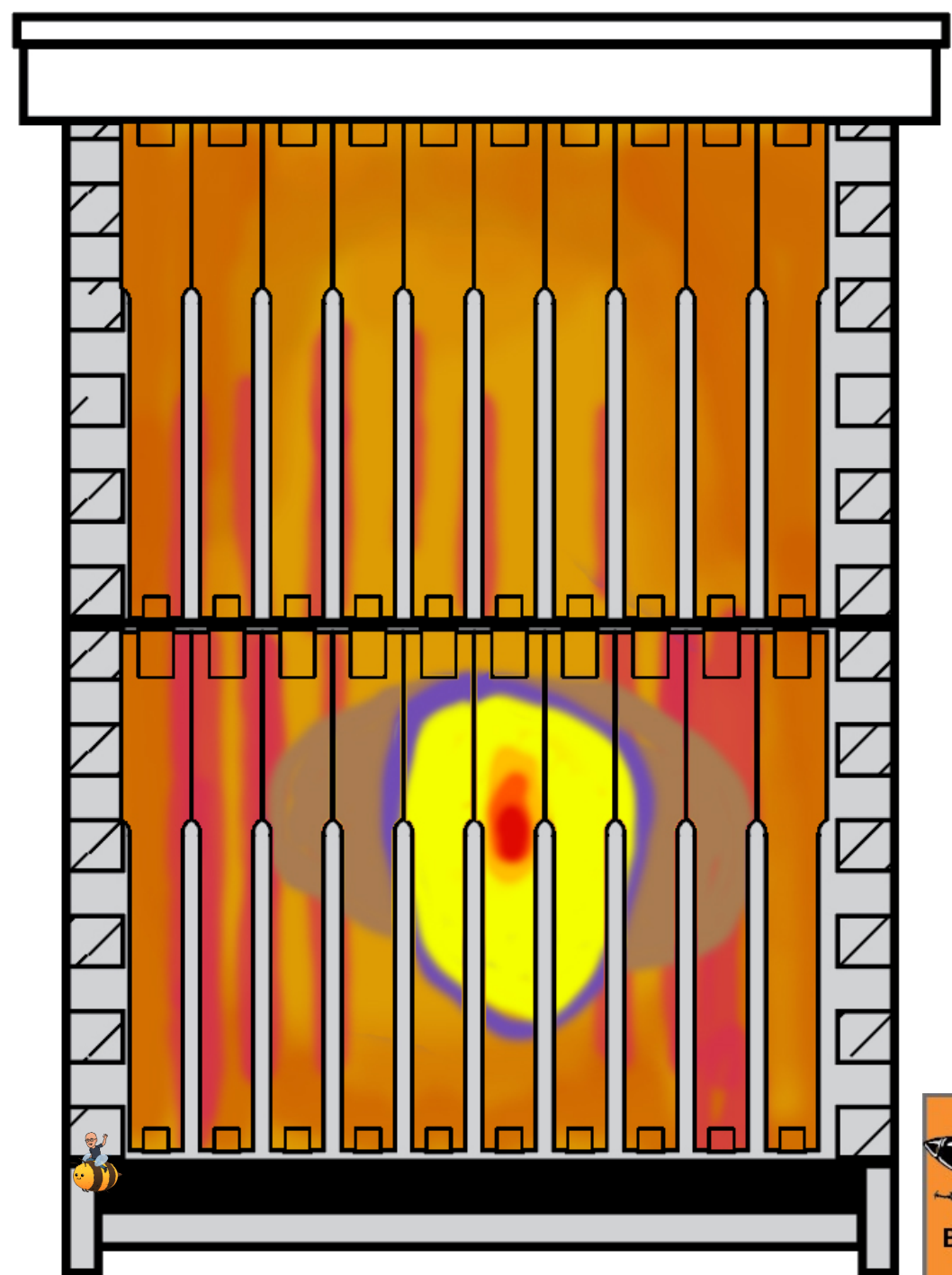




## Progression 4

### ❑ Small Cluster

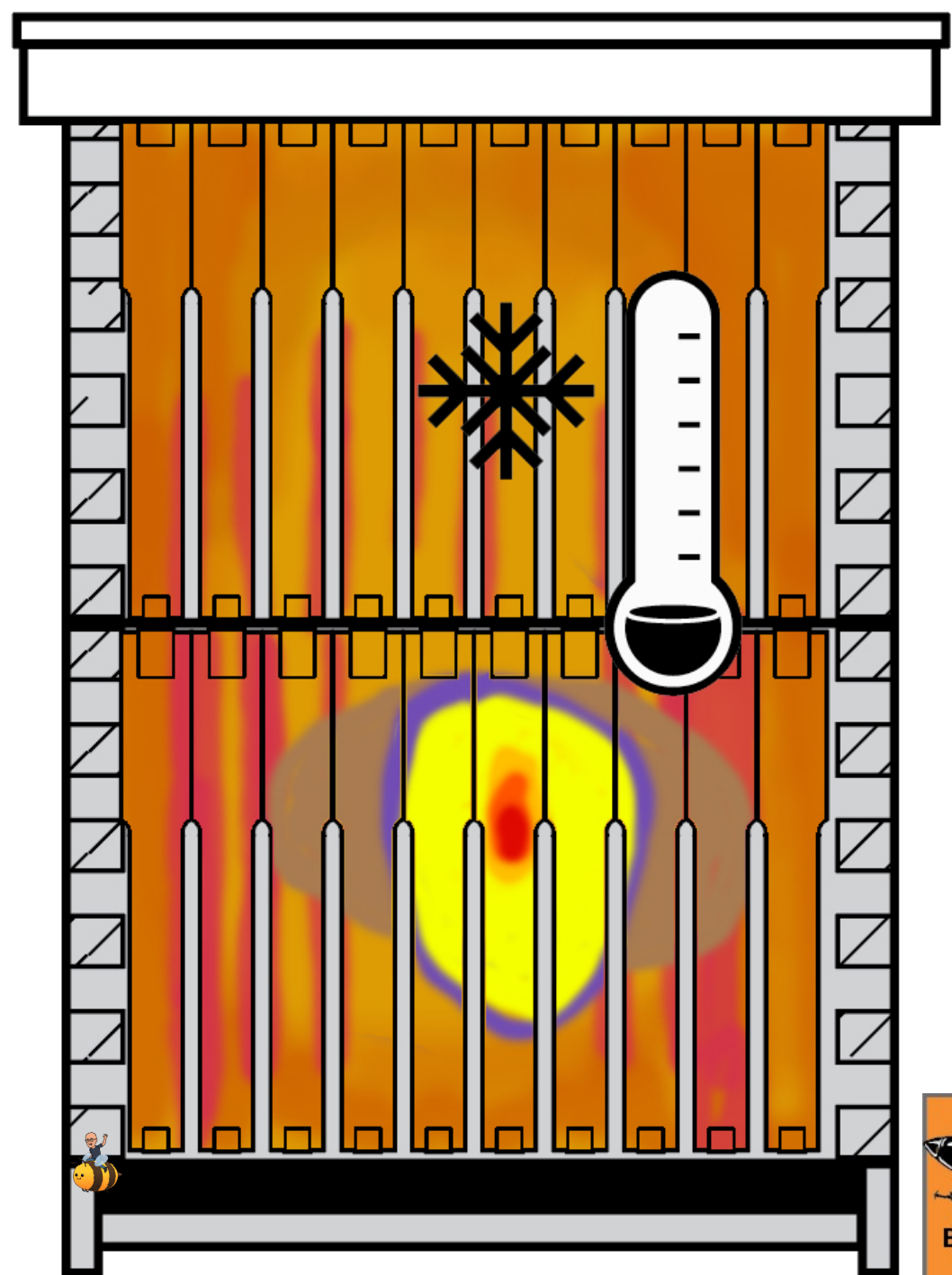
- *Sooner or later though, they cannot, stretch, or reach for resources.*
- *Resources within reach are consumed.*



## Progression 4

### ❑ Small Cluster

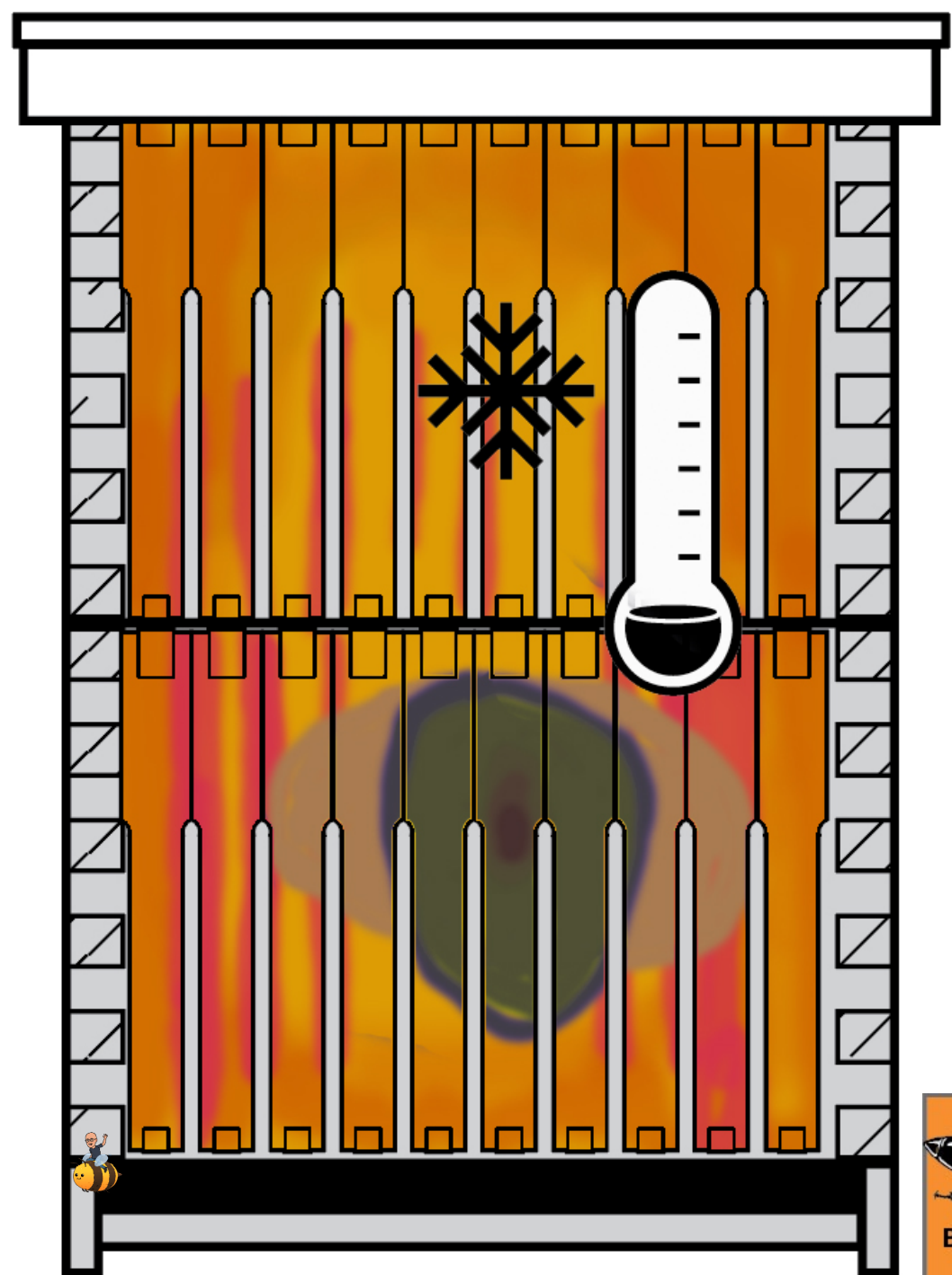
- *They are restrained from moving away from any brood that is underway.*
- *A cold period comes, and they simply cannot move.*



## Progression 4

### ❑ Small Cluster

- *Without food, and subsequent brood they will perish*
- *They will sometimes starve with food just inches away.*
- *If the body temperature of a bee falls to 42° it loses the power of motion and will drop.*
  - To maintain life, the temperature of the shell bees cannot go below 43°F.





# Disease Dead Out

## ❑ Hives Sick, and Under Stress

- *If a colony is not healthy going into fall. They may have enough bees but it is a false sense.*
- *The sick bees do not make it through winter. They dwindle.*
- *Dead bees fall off and the colony perishes mid-winter.*





# Demise of strong hives

## ❑ Big (*Supreme*) Hives

- *They are good at making bees and honey*
- *They are also varroa mite factories*
  - IMO, these mite building machines are hard to fix through treating
  - The mites overwhelm the large population
  - Through winter they bees die off because the larger population is mite impacted



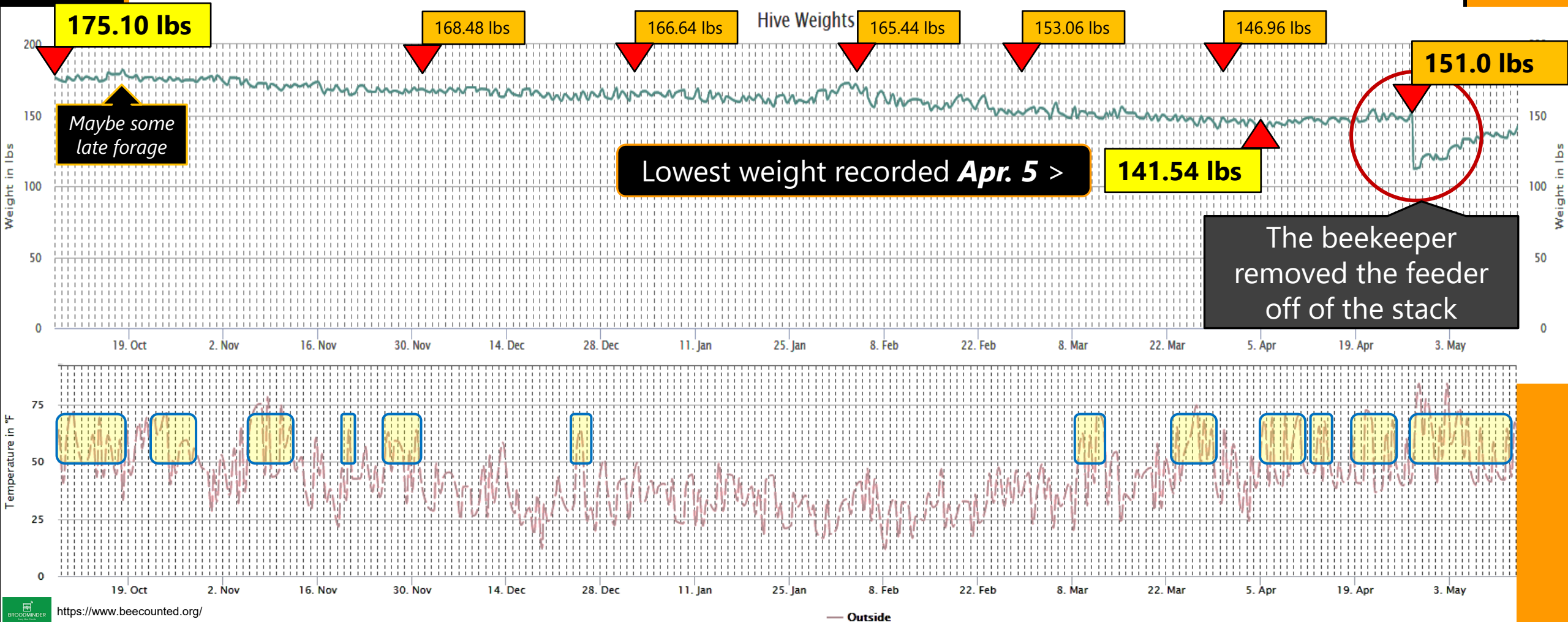
Lately, I have taken to breaking large hives up, and I do not allow them to become so big



Have you heard?

*My Best Colony has Died!*

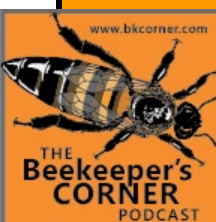
# How much do bees eat? [NJ Example]



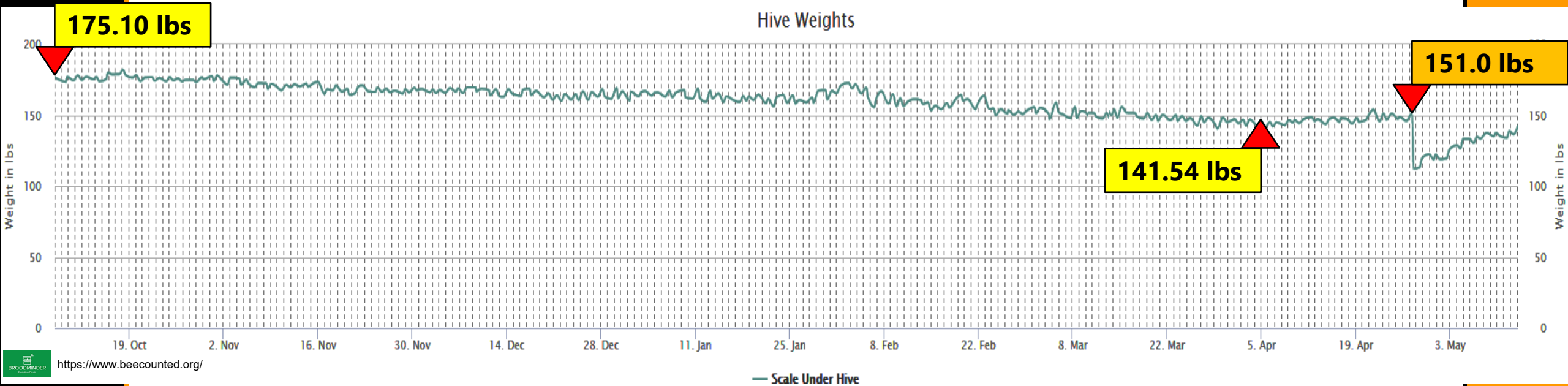
## ❑ Hive into winter

- Two deep hive, with a top feeder OVER the inner cover (for storage)

■ **Flight Days**



# How much do bees eat? [NJ Example]

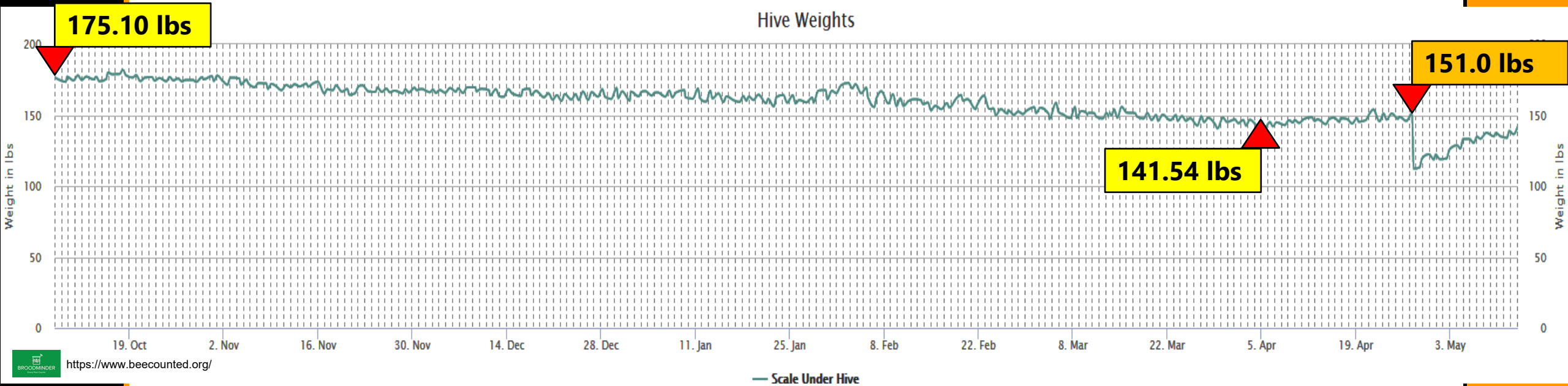


## □ Weight Loss

- Primary loss is two things > Food consumed, and bees that perish
- **Math:** October 8<sup>th</sup> to April 5<sup>th</sup>: 25 Weeks (179 days)
  - **34-pound** weight loss **over 25 weeks**
  - That equates to **1.36 pounds a week**.



# How much do bees eat? [NJ Example]



## □ 1 to 1 ½ pounds a week consumption/loss

- *We have been measuring this year on year.*
- *Mild winter or harsh winter; the consumption rate does not vary as much. It is generally a little over 1 pound a week.*
  - This loss goes from late fall (clustering) until early forage

# Overwintering Success Basics

## Successful Overwintering is a “Combo Package”

### ❑ It is a mix of conditions and practices

- *Proper colony development*
- *A quantity of healthy, adapted, quality bees*
- *Operating in a sound location with suitable nutrition*
- *Appropriate Stewardship **on a proper timeline***

# Let's start with what they need

We will also talk about what they don't need and few other points

- ❑ Quality Queen
- ❑ Adapted Healthy Bees
- ❑ Quantity of Bees
- ❑ Water
- ❑ Propolis
- ❑ Quality Comb
- ❑ Reserves of Pollen, Nectar (early) and Honey, Water, Propolis
- ❑ Proper Cavity Space
- ❑ Suitable Location
- ❑ Pest Protection Measures







# COMPONENTS to OVERWINTERING



# Quality YOUNG Adapted Queens

- ❑ **A young well mated queen...**
  - *Will be able to lay the quantity of bees to get to spring*
  - *Will give off great pheromones*
  - *Will provide larger colonies going into winter*





# Young queens are helpful for overwinter

## □ Why?

- *Young queens of the current year will lay eggs (and more of them) later into the fall than old queens.*
- *Older queens do not lay as vigorously throughout the season*
  - Net, net of this is higher ratio of older population in the workforce going into winter.
  - Older bees do not have as much vigor to survive and work.



# Old Queen Populations

## □ They can deceive you

- *When this situation occurs, the population size may look adequate in late fall*
- *However, as winter progresses, the population may shrink faster than winter brood-rearing can compensate.*
- *This could be so bad as to lead to a colony loss.*  
[Ferrar]



# Locally Adapted Bees

## ❑ Acclimated to the climate

- *It stands to reason that bees that are suitable for colder climates will do better in cold conditions*
- *The common recommendation is to source bees that are survivors for the local conditions*
  - At minimum, say with a package, they were started early in the season and can acclimatize to the area as best as possible.
  - It is established that southern bees, reared in warm climates, simply do not overwinter well if they did not start with some genetics that would help them compensate



# Locally Adapted Bees - Genetics

## ❑ Certain races of bees are...

- *Selected because they came from cold climates*
- *Exhibit traits that coincide with the weather*
  - Fly in colder weather... Use less resources... Hold a tighter cluster...Manage food stores more efficiently

## ❑ When it comes to genetics

- *Due diligence, but know that there are no magic pills*
  - Most bees are mutts and IMO locally sourced stock is better than genetics

# Last word on Genetics

## ❑ Sure, ok...

- *It is beyond most normal beekeeper to seek out true genetics in the marketplace.*

Italian	Carniolian	Russian	German	Buckfast	Caucasian
overwinter with large population, thus require large food supply for winter; can starve if food stores are exhausted	fly in cooler weather, overwinter in smaller clusters, efficient users of winter food stores, good choice for colder climates	overwinter well with small stores	well-adapted to cold, damp climates	require less than Italians, but more than Carniolans	maintain good overwintering stores

### Source bees from your region

Support your local beekeepers putting in the work to rear locally adapted bees that overwinter

Unless you are buying from someone who is breeding pure stock, most bees sold are really not fully the race they are advertised

# Quantity of Bees in the hive

## ❑ More is Generally Better

With the caveat that resources need to match the size of the cluster

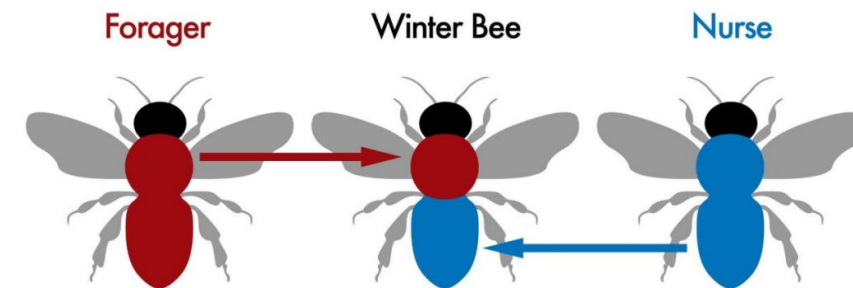
*A larger colony will:*

- Have more of a workforce seek out resources in the late summer, and further into the fall
- Can run brood rearing if they need to build more bees
- Can ramp up earlier in the spring and be better equipped to deal with fluctuations coming out of winter
- Have more bees to spare to attrition; this equates to more bees to do the jobs required and less stress overall on the populous
- As demonstrated earlier, bigger clusters can generate required heat and can move around to resources





# Winter bees are different



## □ They are a different phenotype

- *You will find that the winter bee can be thought of as a mix of a nurse and forager*

- Winter bees resemble nurse bees in **fat body tissues**
- Winter bees resemble forager bees in **flight muscle tissues**.

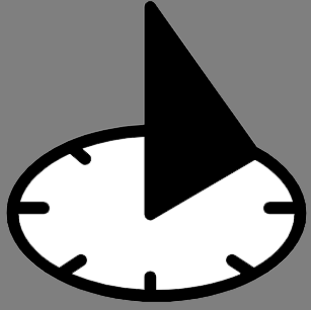
The hypothesis is that winter bees are using tissue-specific genetic toolkits

- It is a bit of a mix-and-match molecular and physiological traits strategy for adapting to winter conditions in temperate environments

### *Definition*

**Phenotype:**  
observable traits  
or characteristics.

Can be appearance  
or physical traits –  
driven by genes  
and environmental  
factors



summer solstice  
June 20<sup>th</sup>, 2021

# Winter Bees

- **Winter bees start in summer**
  - What you do in spring and summer impacts survivability for winter
  - Winter bees are thought to start on the journey to switch over after the summer solstice
- **Months, not weeks**
  - Fair weather bees live for weeks
  - Winter bees have to persist for months
    - *And they are doing hard work in generating heat for the colony during the duration – which means they have to be healthy*

# Winter Bees

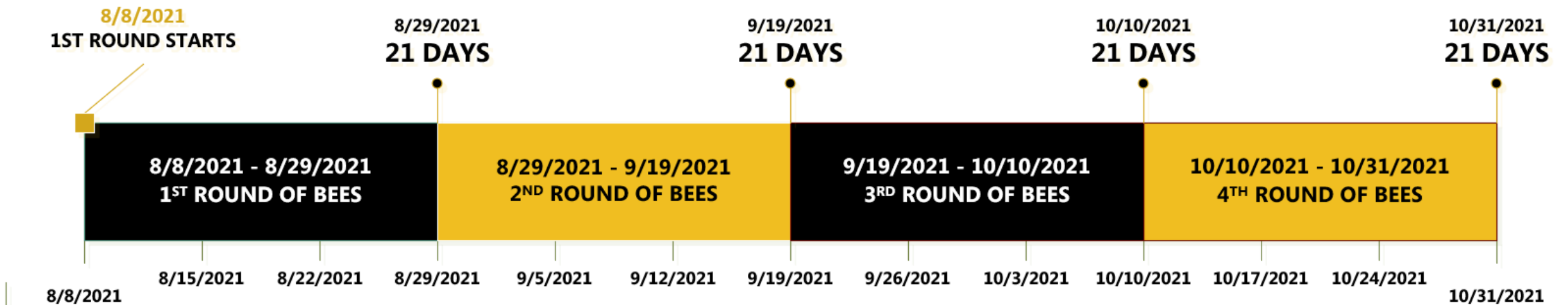
First frosts are possible in late August for northern Nebraska.

Most of Nebraska, first frost is as early as mid September

A late first frost has occurred as late as mid November.

## ■ 4-Cycles (of 21 days)

- In NJ our first frost can come as early as Nov 1.
  - *Some years it is Nov 1, other years it might be Thanksgiving*
  - *Since we cannot tell, we plan for Halloween (Oct 31)*
  - *By Halloween, we want our bees are fat and happy*
    - And we want all of our honey ripened and pollen stores flush throughout the comb.
- We want a cycle of 4 generations of *CLEAN* Bees to overwinter, and that starts August 8<sup>th</sup>.







# *Complete* Treatments before winter bees

## □ July & August for Clean Bees

- *The 4 generations of bees will be well served if varroa impacts are mitigated **prior** to August 8<sup>th</sup>*
- *Treating bees prior cleans things up; Otherwise*
  - Bees are wounded from Varroa Mite punctures
  - Bees are sick and virus laden, which will not bode well for rearing new workers post August 8<sup>th</sup>
  - The colony will be stressed and varroa impacted colonies are not healthy which means the workforce for **winter gathering is compromised**.

# Stores: Nectar and Honey

## □ Nectar and Honey

- The bees will begin the overwinter journey with a mix.
  - Presumably nectar should be ripened or capped outside of the broodnest
- *Wet (Nectar) under the brood nest is ok; the bees will consume this and use the space that frees up for the cluster*
- *Wet outside of the broodnest is undesirable*
  - Do not feed too late into the season as the bees will not be able to ripen it and it will create moisture conditions in the hive.

# Stores: Pollen and Bee Bread



## □ Pollen & Bee Bread

- Adequate stores of fresh pollen in the fall and bee bread for overwintering are required
  - The colony should collect enough pollen, and make enough bee bread, to hold the bees over until spring
  - Pollen is necessary to raise brood during winter, and especially in spring
  - Typically, in the fall, the bees will meter the pollen required – more on this later when we cover feeding.

### Bee Bread:

A mixture of pollen with some nectar and/or honey.

The source of protein for overwintering workers and larvae.

Workers add extra secretions and micro-organisms which inoculates the bee bread. This helps to break it down so it releases amino acids and other nutrients from the pollen.






# Stores: Water and Propolis



## □ Water

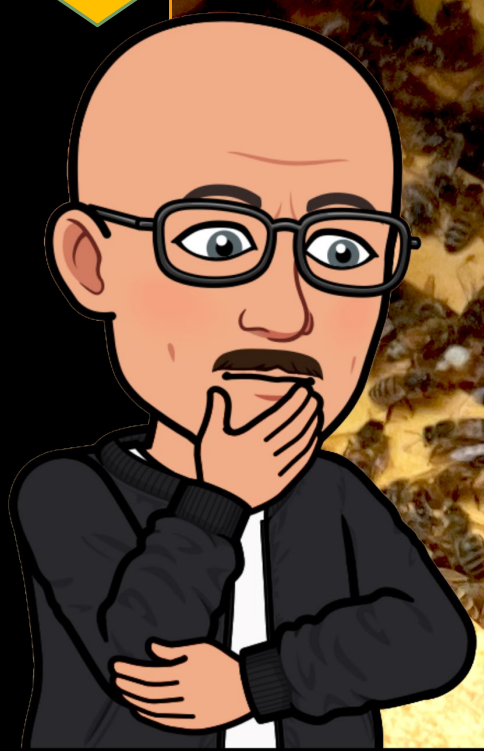
- *Water is supplied by the bees up until clustering*
  - Post clustering some water is absorbed into woodenware (frames) and comb.
  - It will be given off and absorbed when environmental conditions ebb and flow
-  Moisture, in the form of water, is given off with honey consumption

## □ Propolis

- *The bees will collect propolis up until clustering*
- *The uses for winterization are common – sealing, coating, closing*



What do  
you think of  
this comb?





# Honeycomb

## ❑ Comb is important

- *Clean, quality comb;*  
***it deserves more attention***
  - Clean, in that it is not that old, and it is not laden with nasties
  - Quality, in that it is well formed > all the way from frame 1 to frame 10
  - Speaking of 10 frames; Running 9 frames in your brood box?
    - ❑ This is 10% less comb for the bees to use.
    - ❑ Does it matter; hard to say, but it sure seems like it would factor.





# Rotate old comb out of service

## ❑ Move it to the fringes

- *Move old comb, malformed comb, comb not built out to the outside during the bee season.*
  - If you cannot get them to build comb to replace it, move it to 1 and 10 in the bottom box. When the bees move up, that comb will be the first to cull in the spring.
- *Better yet, focus on getting good comb built in the spring.*
  - **Idea:** Put a full-size box for a **honey deep**. After harvest you have 10 frames of perfect comb to fix any comb problems in your operation.
  - Suffer for working with the weight, **but** treasure the clean well formed comb.

# Frame Game 2020

I went through 95% of all of my frames

Broken and/or loose frames were repaired or discarded

All Plastic went in the bin

Frames from as far back as 1995!

**Maria Kondo and I were on the same wavelength**

Thank you for your service. Thank you for your service....





# Plastic vs. Wax

## ❑ Does plastic foundation affect overwintering?

- *We know the bees use wax to store and radiate heat*
  - What happens with plastic in cold conditions? Do not have the answer to this but I suspect that wax would likely perform better. Looking for an answer on this

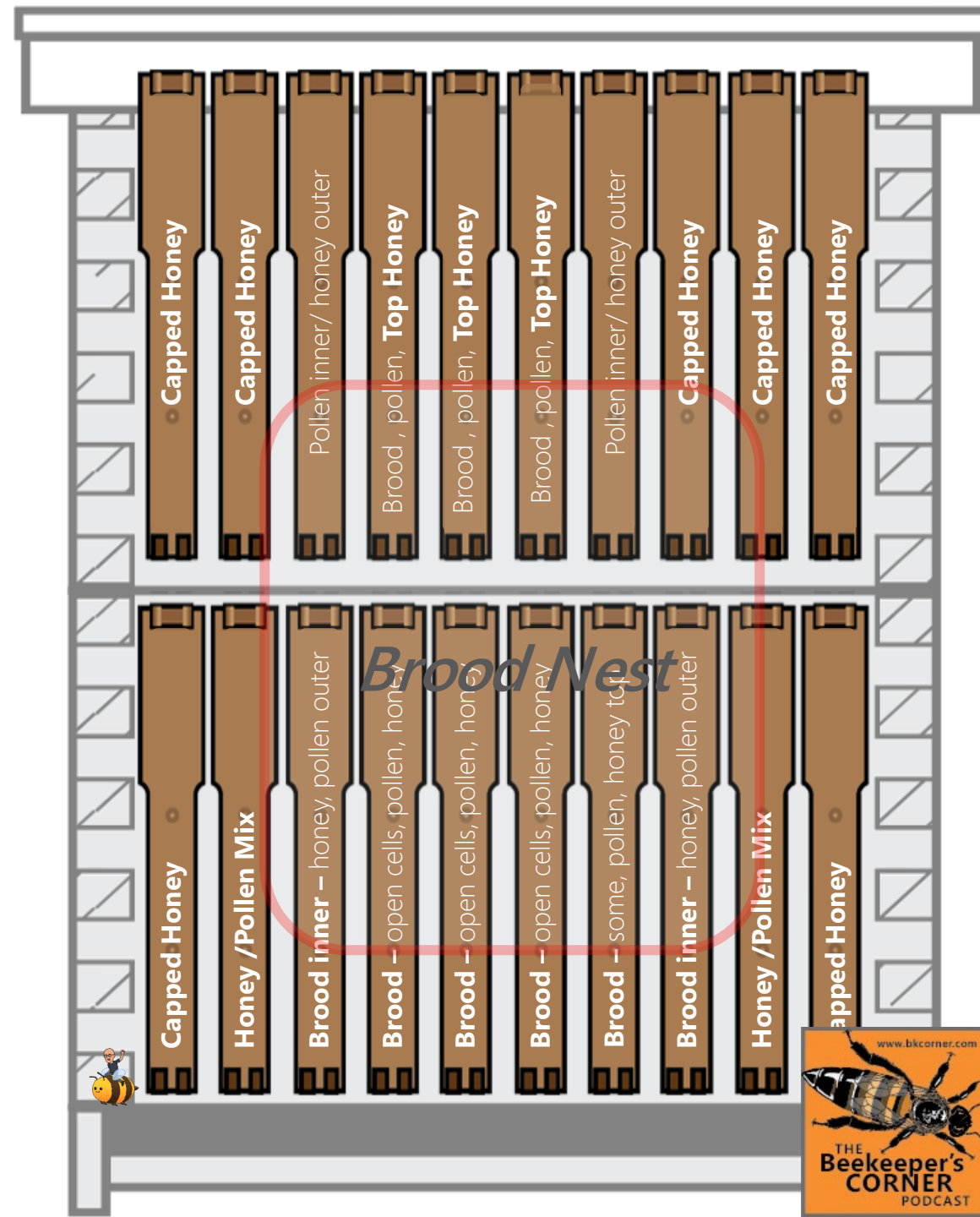
## ❑ Bottom Line: **Poor comb is undesirable**

- *If it is not built out; If gaps in the margins; If undrawn Foundation*
- *These are that are detrimental to overwintering and require attention*

# Cavity Size into winter

## ❑ Layout in late fall

- *Ideally, the bees would be clustered in a convention setup in the bottom box. Overhead and to the sides would be stores.*
- *Excess stores are not going to be used and increase space – remove.*

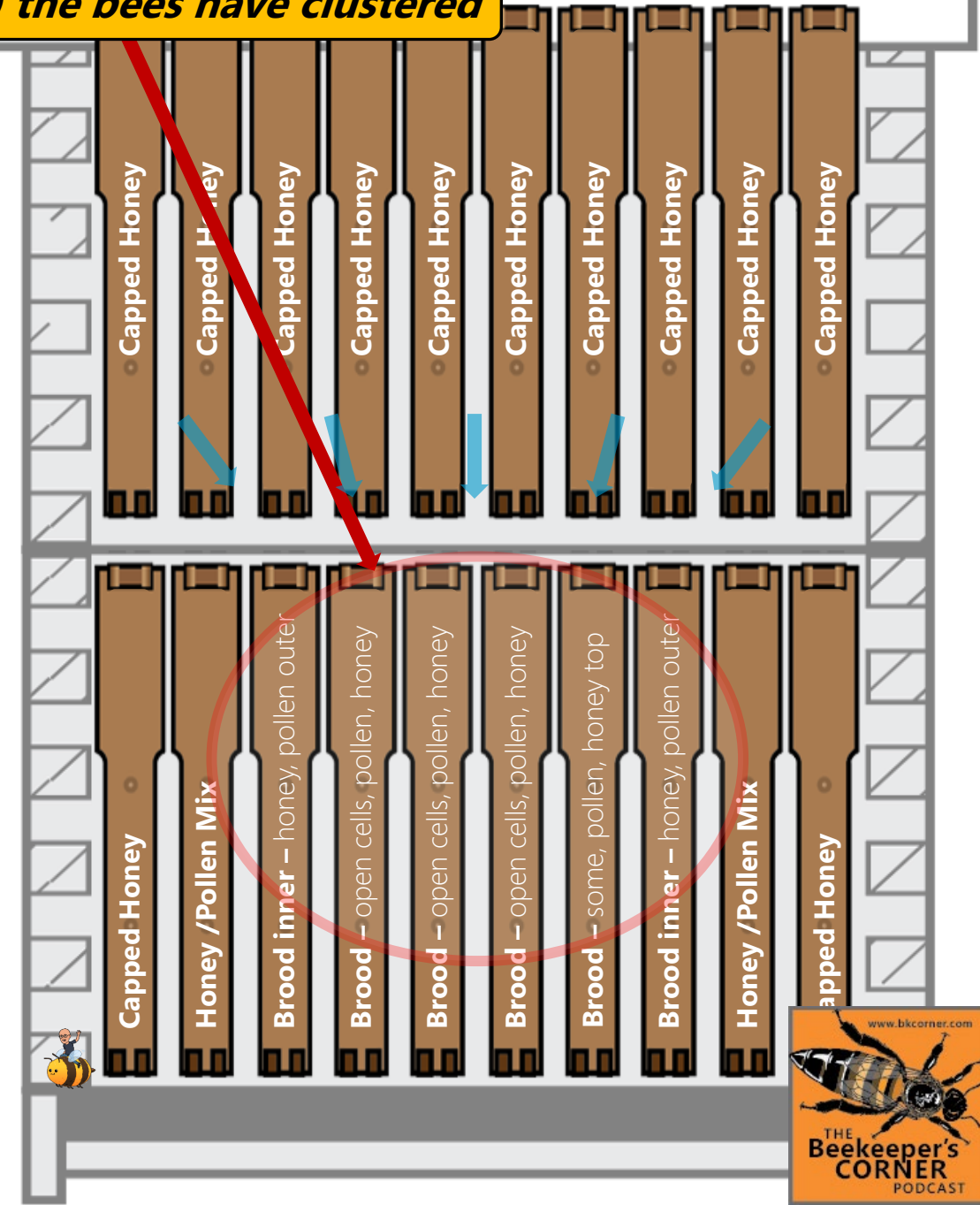


*In this stage(Example) the bees have clustered*

# Hypothetical Unicorn

## ❑ If you could lay out a perfect colony for winter

- *Brood in the bottom –with resources to work arranged in and around*
  - Surrounded by resources left and right
- *Plenty of food above*
  - Even if they ate through much of what is above, they would still have enough resource reserves to be comfortable for spring



# Should you re-arrange for Fall?

## ❑ Resources scattered in the fall are problematic

- *The natural progression of fall flow and/or fall feeding results in honey stored in the upper chamber.*
- *Ideally this drive bees down into the lower box – naturally.*





**Bees Backfilling brood in the top  
Box. This forces the queen down.**





# Should you re-arrange for Fall?

Taken things into consideration, *YES*, rearranging in the fall is not a bad concept

## ❑ Resources scattered in the fall are problematic

- *The natural progression of fall flow and/or fall feeding results in honey stored in the upper chamber.*
- *Ideally this drive bees down into the lower box – naturally.*
  - A problem presents when both hive bodies contain scattered brood, honey, and pollen. Scattered comb usage is okay in warm weather, but undesirable when the bees get on the cluster.
  - The bees will form a cluster no matter what when the weather gets cold.
  - If it is haphazard, The outcomes might mean trouble for outlying areas that are not organized; Abandoned brood, pollen in the wrong place, etc.

# Giving Credit, Where Credit is Due

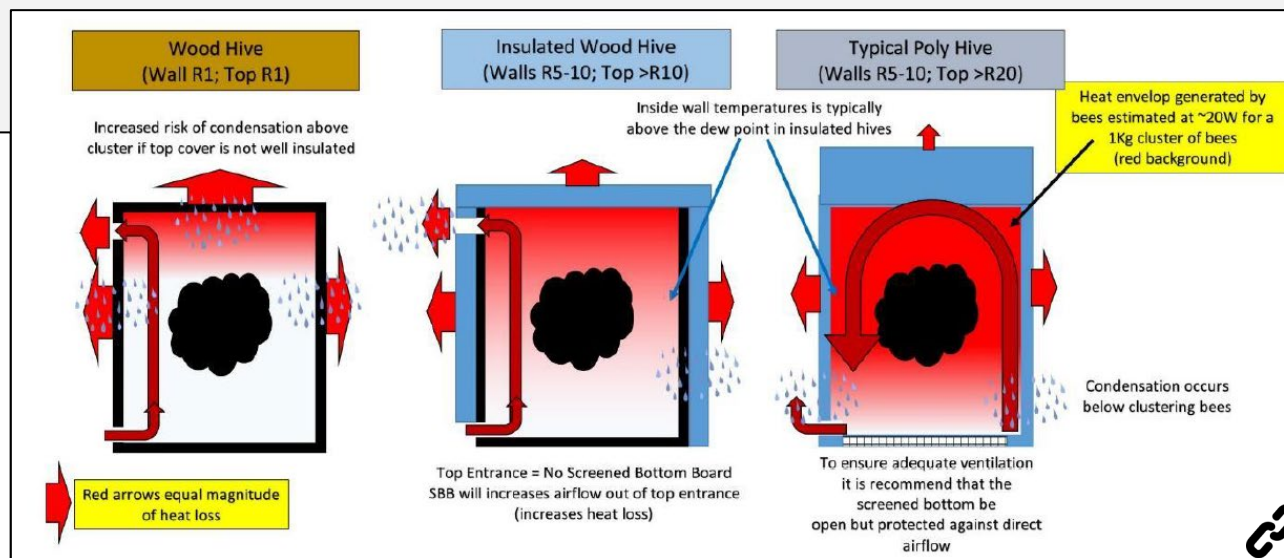
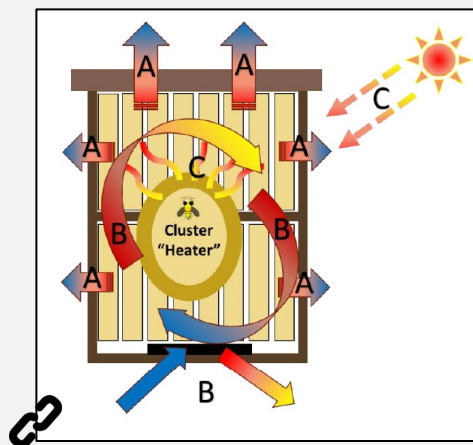
## ❑ Disclaimer: I am not a specialist in thermodynamics

- *I have read all that I can from a good number of resources; it has long been a passion of mine*
- *For this next section I am going to share new work from **Etienne Tardif**.*
  - Etienne has done the most recent, and interesting work, in this area.
  - I have taken Etienne's Ideas and re-rendered his concepts with my artwork
  - Make no mistake, this work is Etienne's **and he deserves all of the credit for the heavy lift. I am not claiming it to be my own.**

I created my own versions of some of his renders so I could step through the concepts....

*—but the basis of much of the information is Etienne's work*

## Etienne Tardif: Wintering in the Yukon



## Referral: Etienne Tardif

Wintering Hive Management and Seasonal Bee Nutrition for the Serious Hobbyist

### ❑ Western Apiculture Society Presentation

- *This was a 2020 Mini-Conference*
- *Etienne presented his concepts in this 45-minute session*



**<https://youtu.be/Fbb3R9h1Eno>**



**[NorthOf60Beekeeping.com](http://NorthOf60Beekeeping.com)**



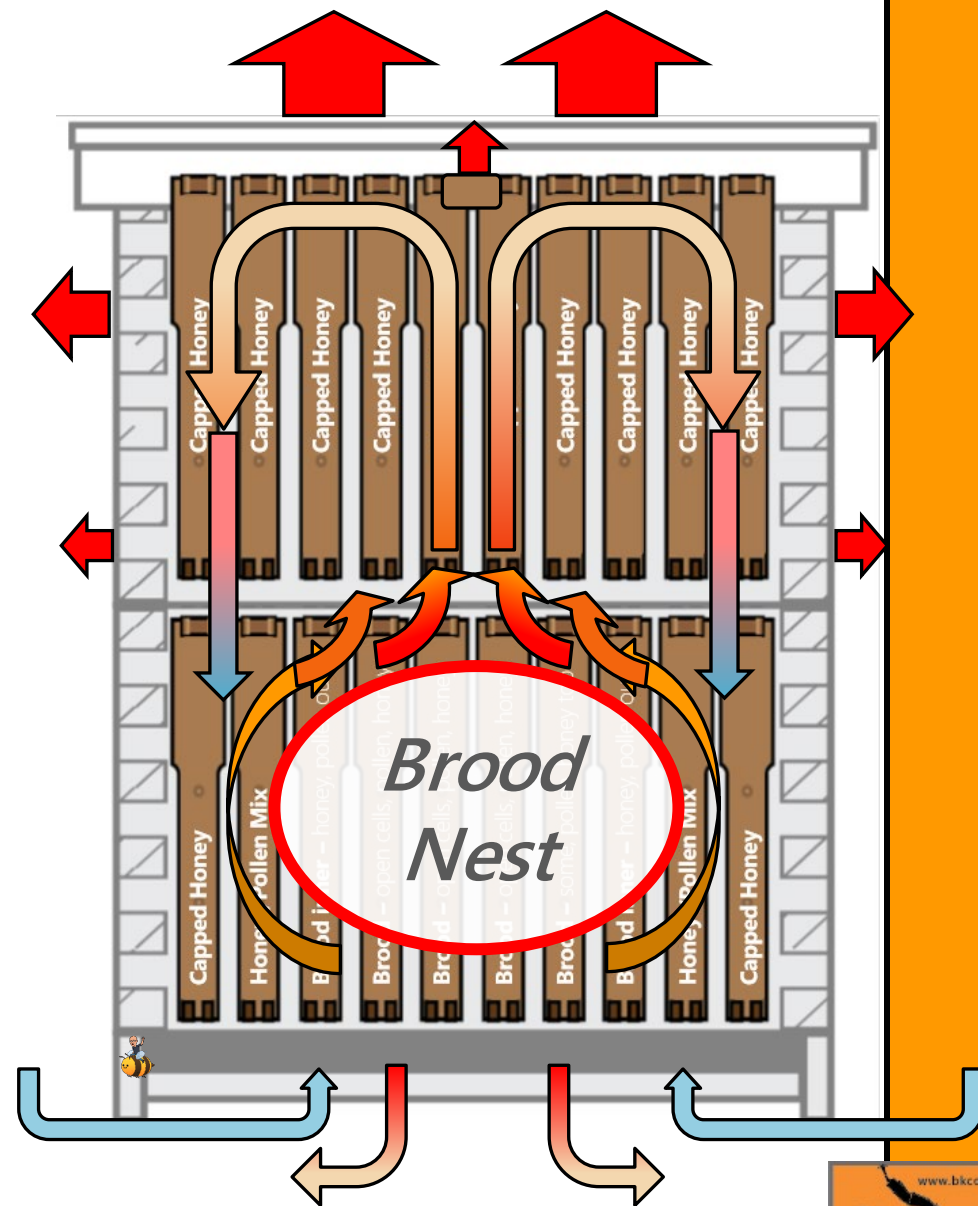
# Thermodynamics

## ❑ Conduction and Convection

- *Air comes in the entrance, hot air rises*
  - **Convection:** Heat rises, collects, circulates and subsequently dissipates
    - ❑ As it is doing so, it provides some utility for the colony in that it might warm what it is passing through
  - Through **conduction**, Heat also dissipates out through the hive walls and roof

### Definition

**Conduction:**  
the process by which heat is directly transmitted through a substance when there is a difference of temperature

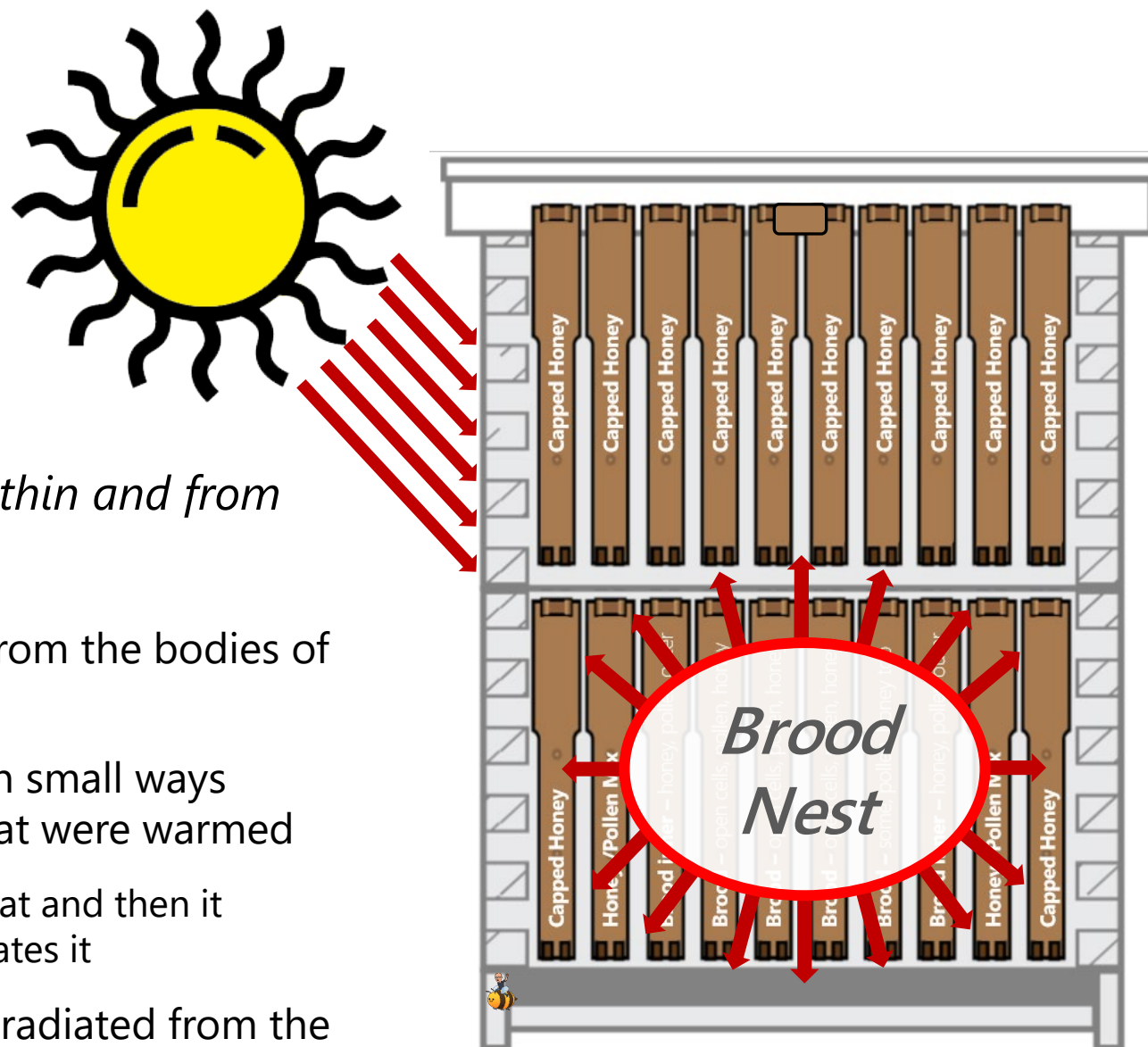


# Thermodynamics

## ❑ Radiation

- *Radiation occurs within and from outside of the hive.*

- Heat will radiate from the bodies of the bees
- Heat will radiate in small ways through things that were warmed
  - ❑ Honey absorbs heat and then it subsequently radiates it
- Of course, heat is radiated from the sun to, and into the hive



### Definition

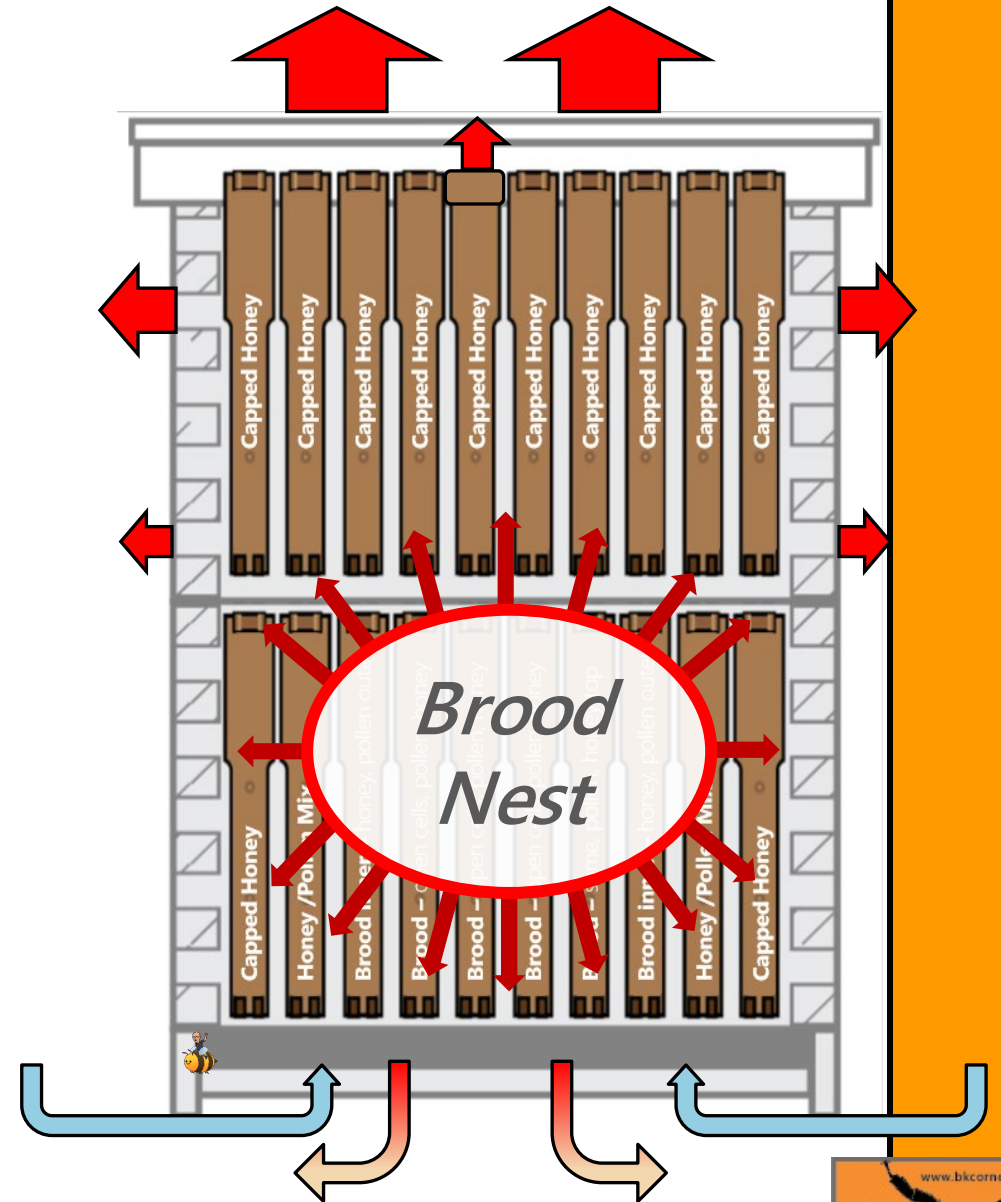
#### **Radiation:**

the emission of energy as electromagnetic waves or as moving subatomic particles

# Heat Exchange

## ❑ Roof and sides

- *The main exchange is UP*
  - Typical heat loss is **15% more through the roof** than the sides
- *Ventilation*
  - Heat loss is also a result of how much ventilation.
  - More ventilation results in more exchange and therefore loss of residual heat.
  - Close the bottom boards, close down the entrances, and reduce ventilation at the top of the hive.
    - ❑ Some say, close the top of the hive down altogether! *This is a subject onto itself.* Read Derek Mitchell, Etienne Tardif, John Gaut, William Hesbach, and others.





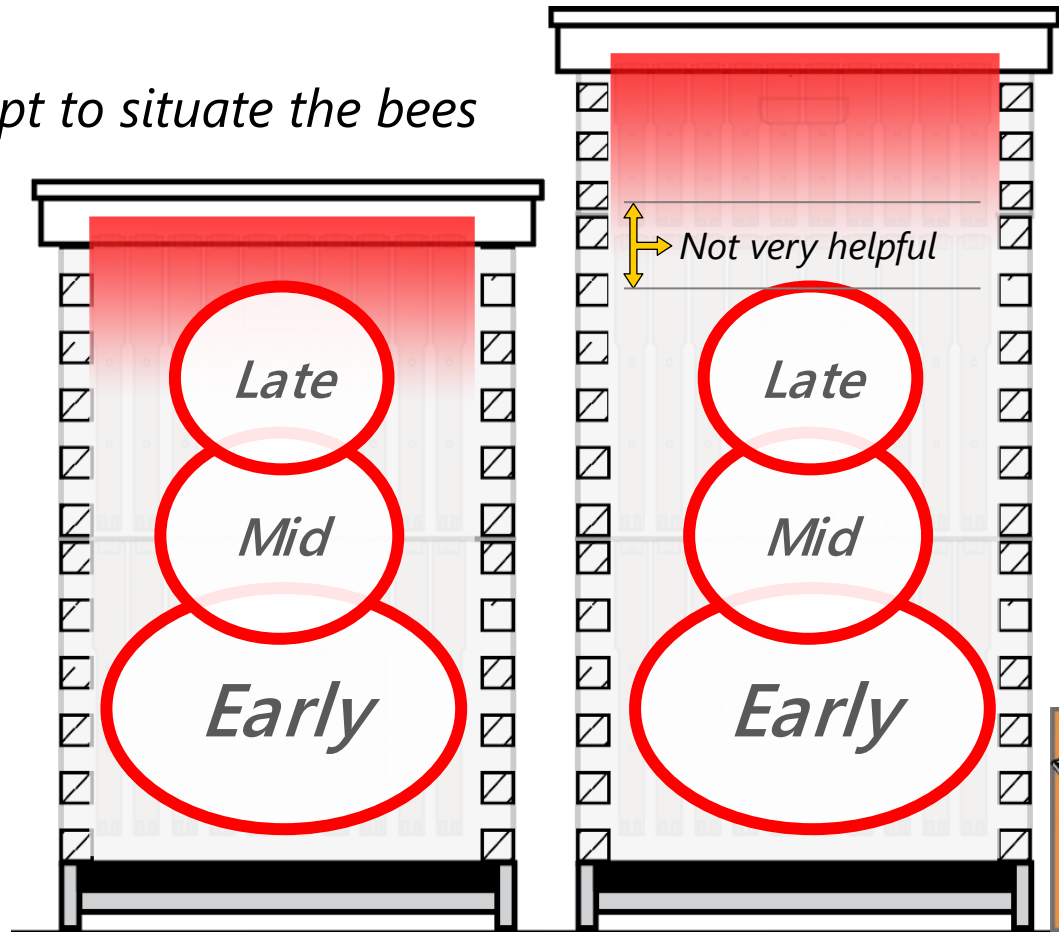
# Why no honey supers in winter

## ❑ Compact

- *The reason for compaction is in attempt to situate the bees in residual collected warmth*
- *As stated earlier, heat rises*
  - Heat rises, collects, circulates and in time dissipates. Late, smaller clusters, benefit.
  - Residual heat does provide some utility for the colony; it warms the honey dome and comb; Especially late in winter
- *Two deeps, prepped well; no real need for the honey held in the honey super*

**Winter Progression:** As temperatures goes down, the bees go up.

They move into any vestiges of collected heat in a compact hive.



# Right size

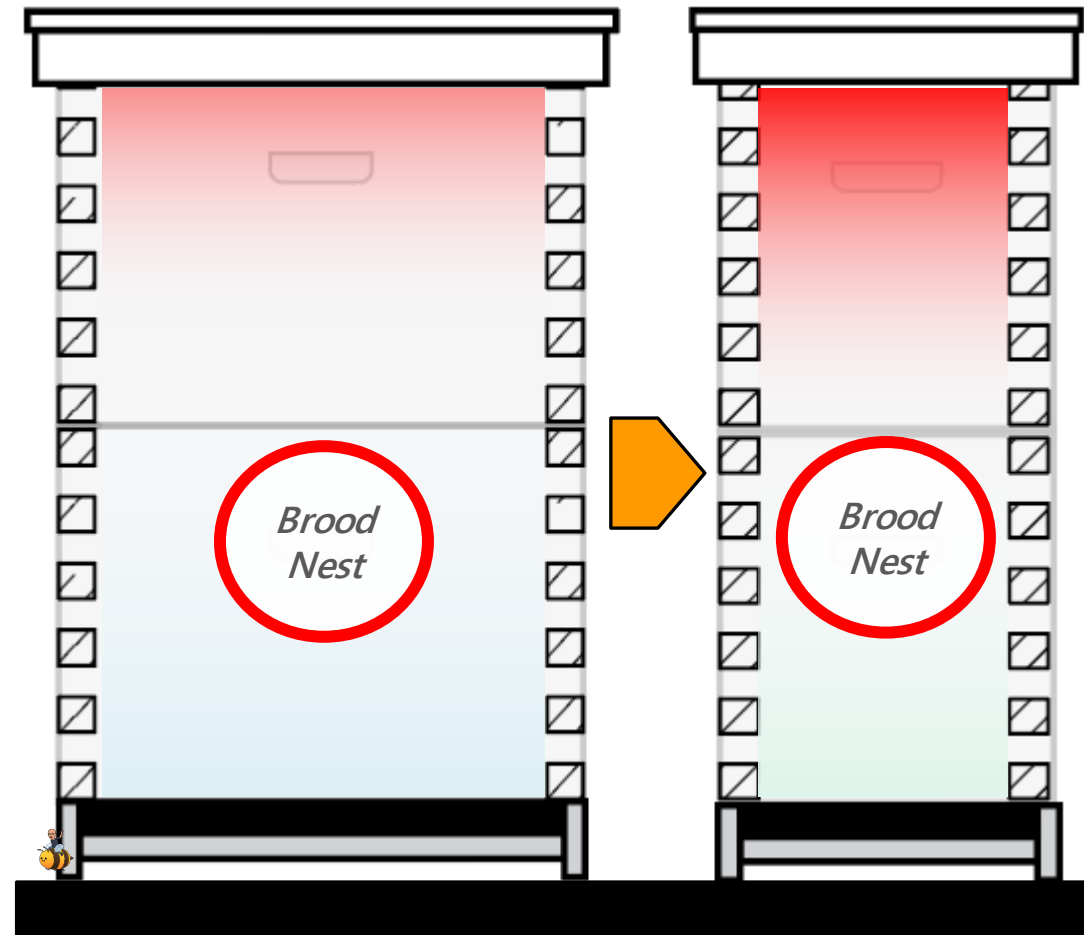
## Note:

Use common sense.

A colony that is too small should really be combined with another; *not* nursed along.

## ❑ Compact

- *If you have a small colony, move it to a smaller box.*
  - This gives them a chance to operate in a space that might hang on to more residual heat.
- *Options: Eight Frame, single brood box, Nucleus Equipment*
  - All reasonable options to downsize.



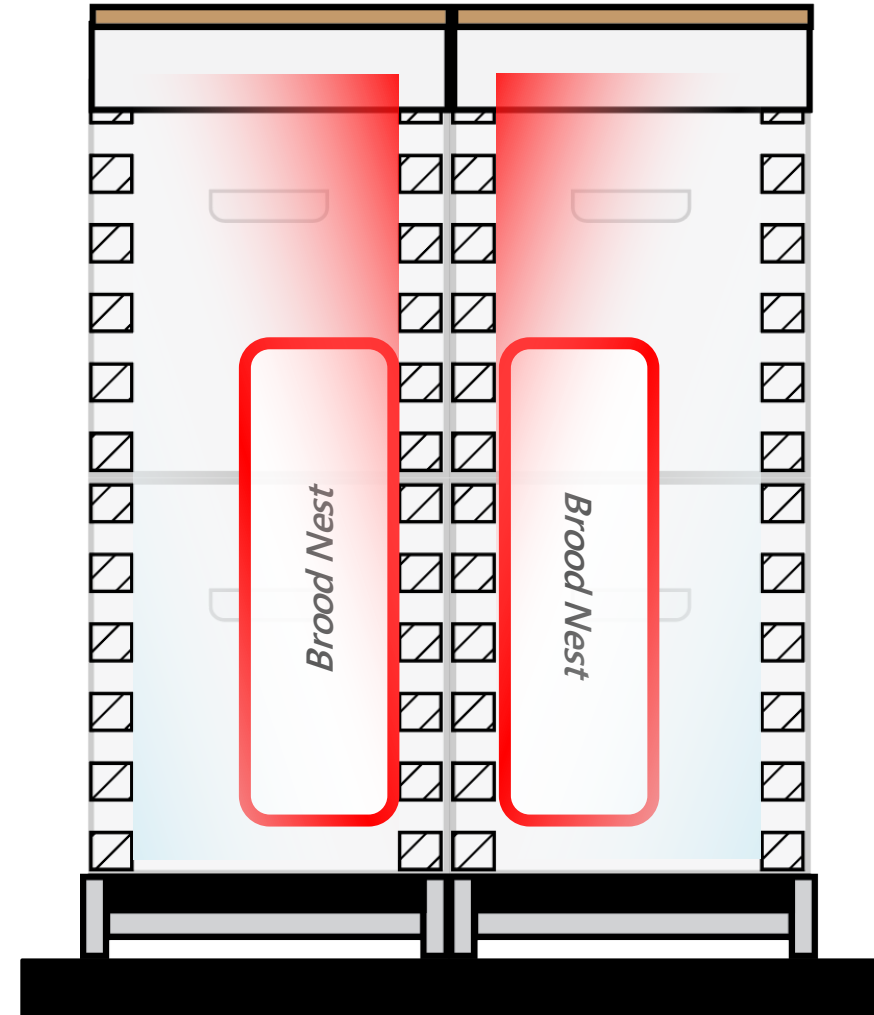
# Nuc Condo

## ❑ Side-by-Side

- *Consider pairing them up with other hives to share warmth; Nucs, single deeps, etc.*

## ❑ Not over top of each other

- *Note: In my experience, putting boxes over one another to share rising heat detracts from both hives.*
- *Would not consider that approach.*
  - Also, If one hive perishes it will impact the other







**A real life Nuc Condo.... *they do work***





# INSULATION

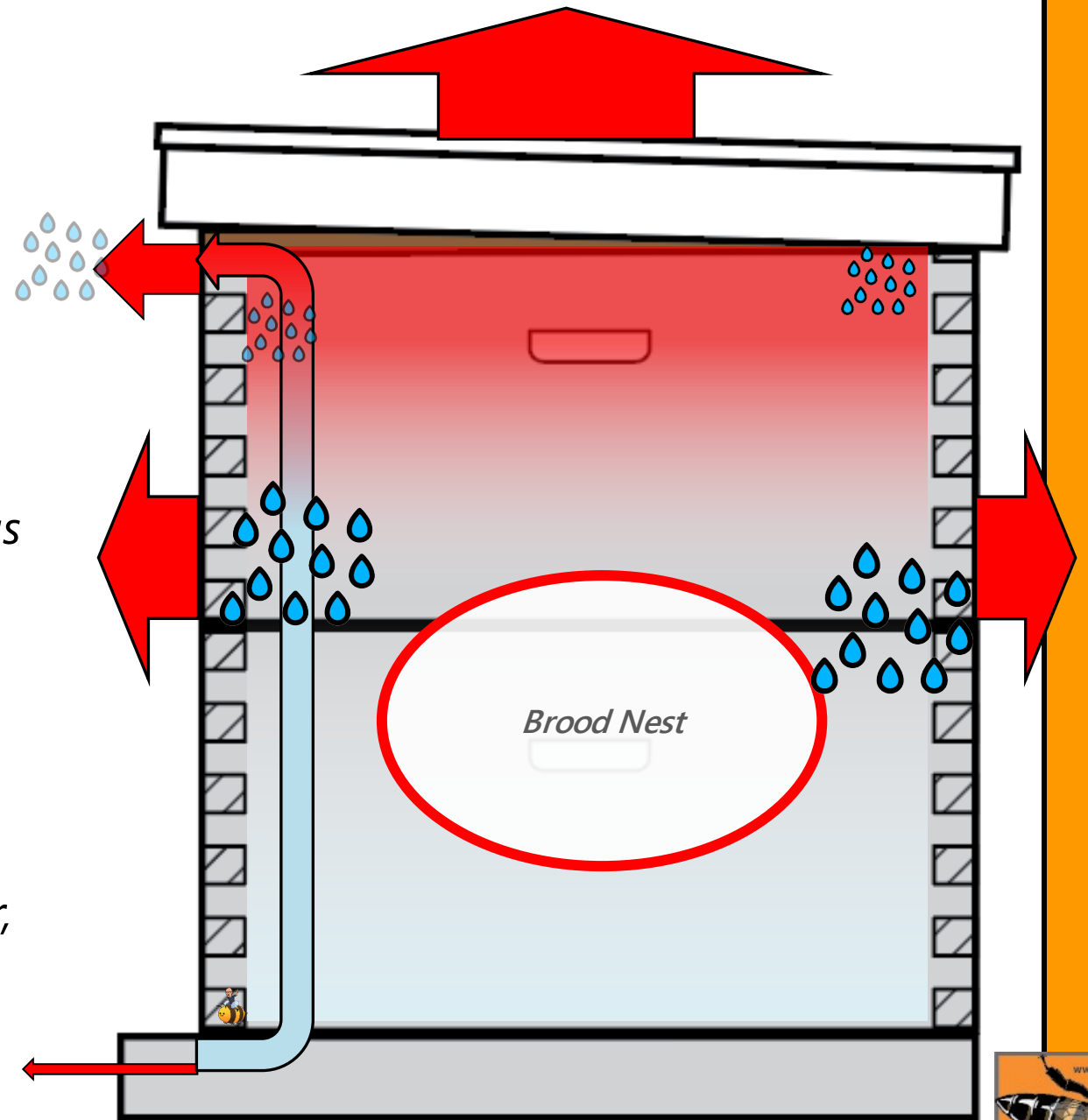
# Moisture and Heat Exchange

## ❑ Air Exchange/Heat loss

- *Air will exchange through openings*
- *Heat will transfer- through openings and woodenware*

## ❑ Moisture Formation

- *Where hot moist air meets cool air, water vapors will condense and turn to drops*

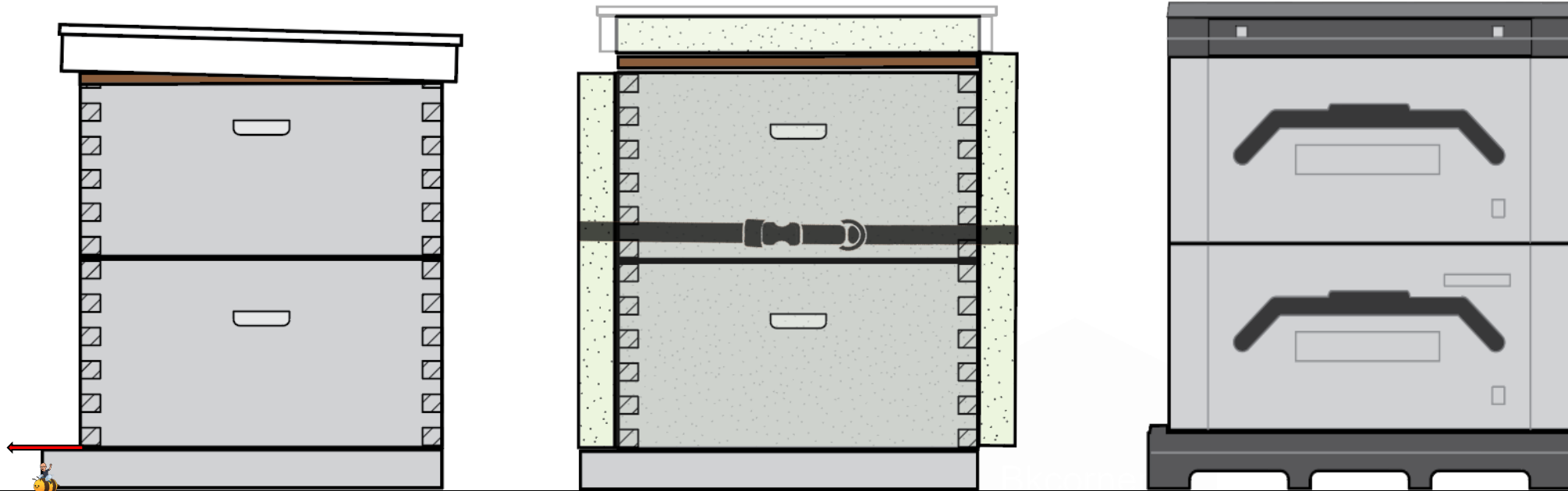




# Insulative Values Baseline

## ❑ R-Value

- *R-value is a measure of how well a material resists the conductive flow of heat.*



**Wood Hive**

Roof = R1

Wall = R1

**Insulated Hive**

Roof = >R10

Wall = R5-10

**Typical Poly Hive**

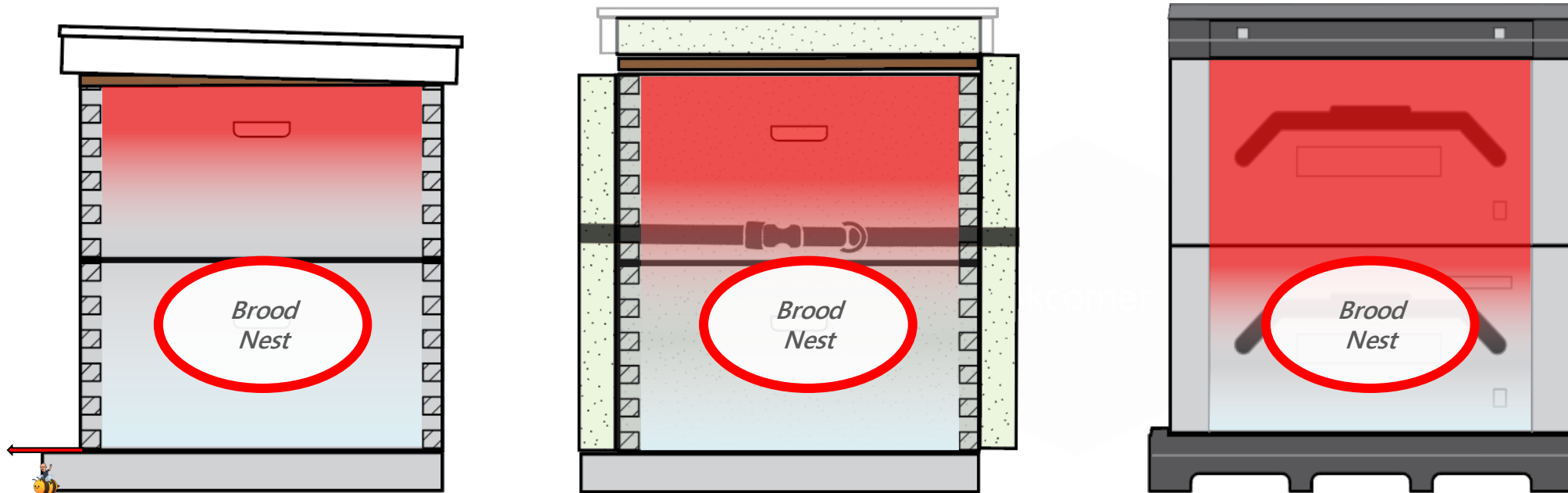
Roof = >R20

Wall = R5-10

# Comparative Heat Retention

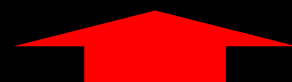
## ❑ Comparisons

- *Non insulated hives retain some heat, but obviously not as much as insulated*
  - Insulated hives will maintain more consistent temperatures
  - This is beneficial, especially in spring, when temperatures fluctuate up and down and bees move up as the season has progressed



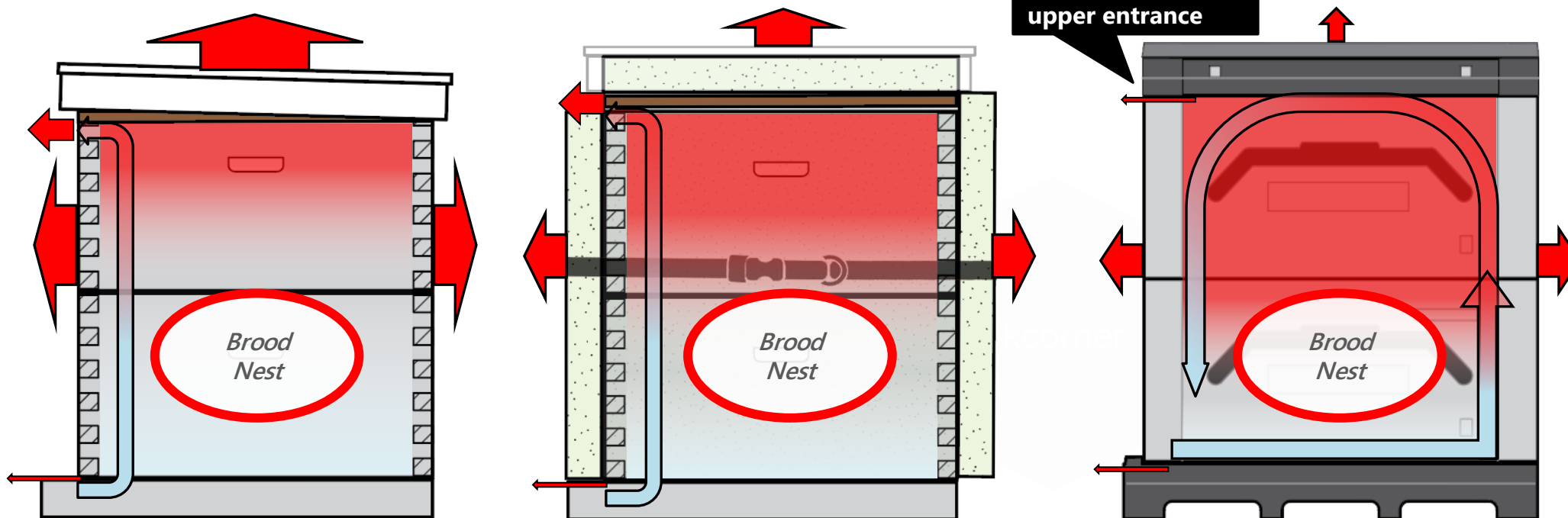
# Comparative Heat Loss

## ❑ Comparisons

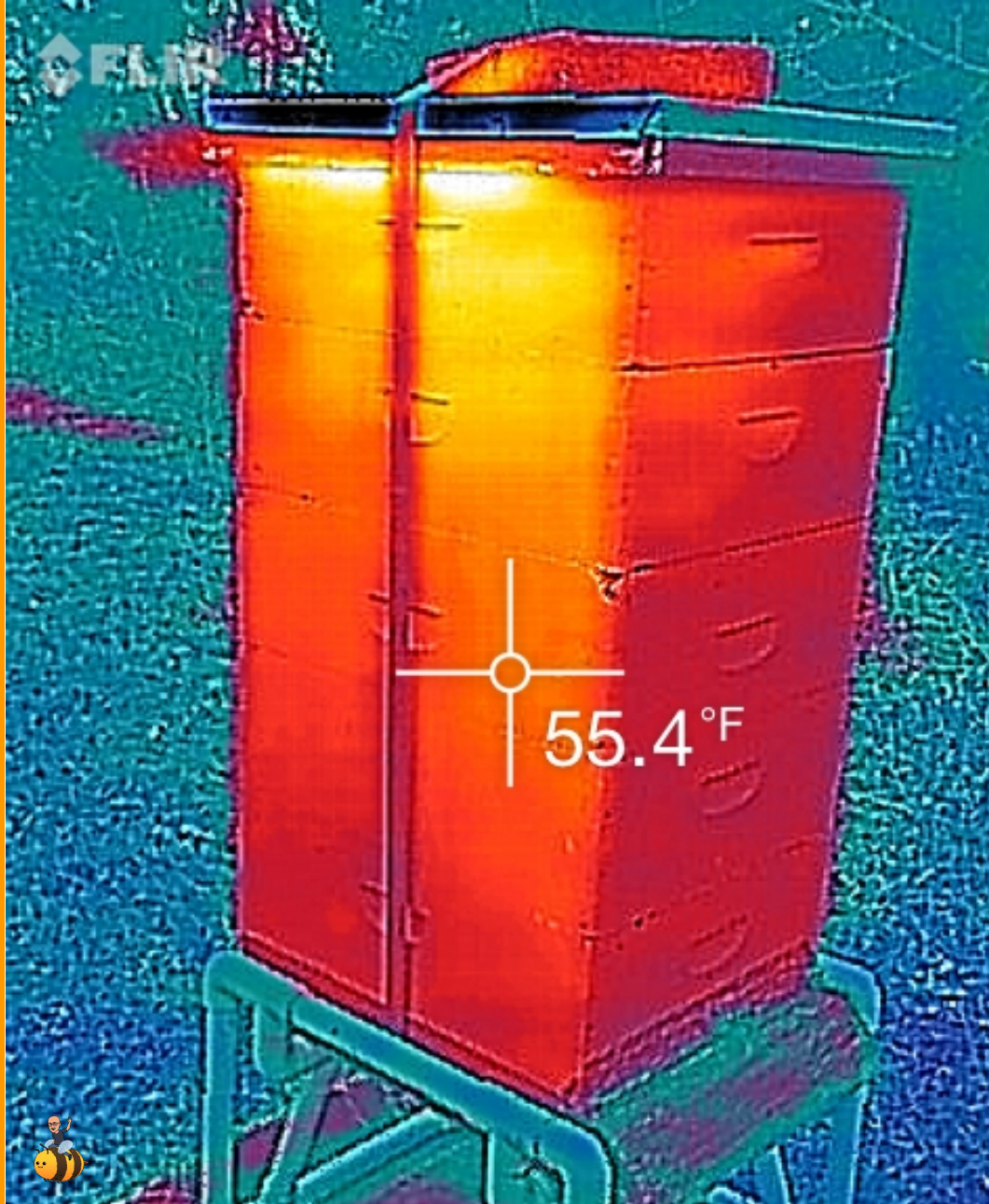


The bigger the arrow; the more heat lost

- *Non insulated hives retain some heat, but obviously not as much as insulated*
  - Insulation aids in keeping heat, but it needs to be said once more that the inside of the hive is not as warm as the cluster. It more like the ambient temperature plus any residual







**FLIR:** March timeframe.  
*The cluster size in both hives were fairly sizeable going into spring*

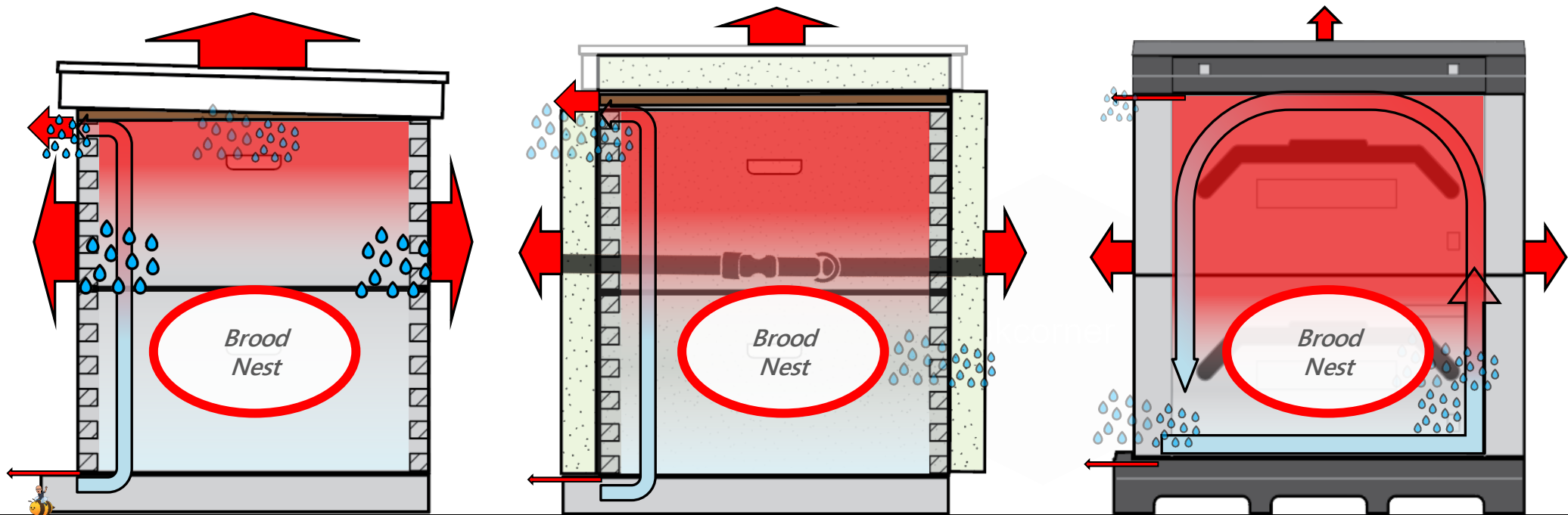
# Heat Dissipation: Wood vs. Poly



# Moisture & Condensation

## ❑ Condensation: Water forms where Hot turns to Cold

- *Vapor will turn to liquid as the temperature cools*
  - Inside wall temperatures are typically above the dew point in insulated hives.
  - Condensation occurs below clustering bees in insulated hives







Small Scale Winter Weight Loss Study  
Wood vs. Wrapped and Insulated Hives

**Doug & Tammy Horn-Potter Apiary**  
Lexington Kentucky Yard

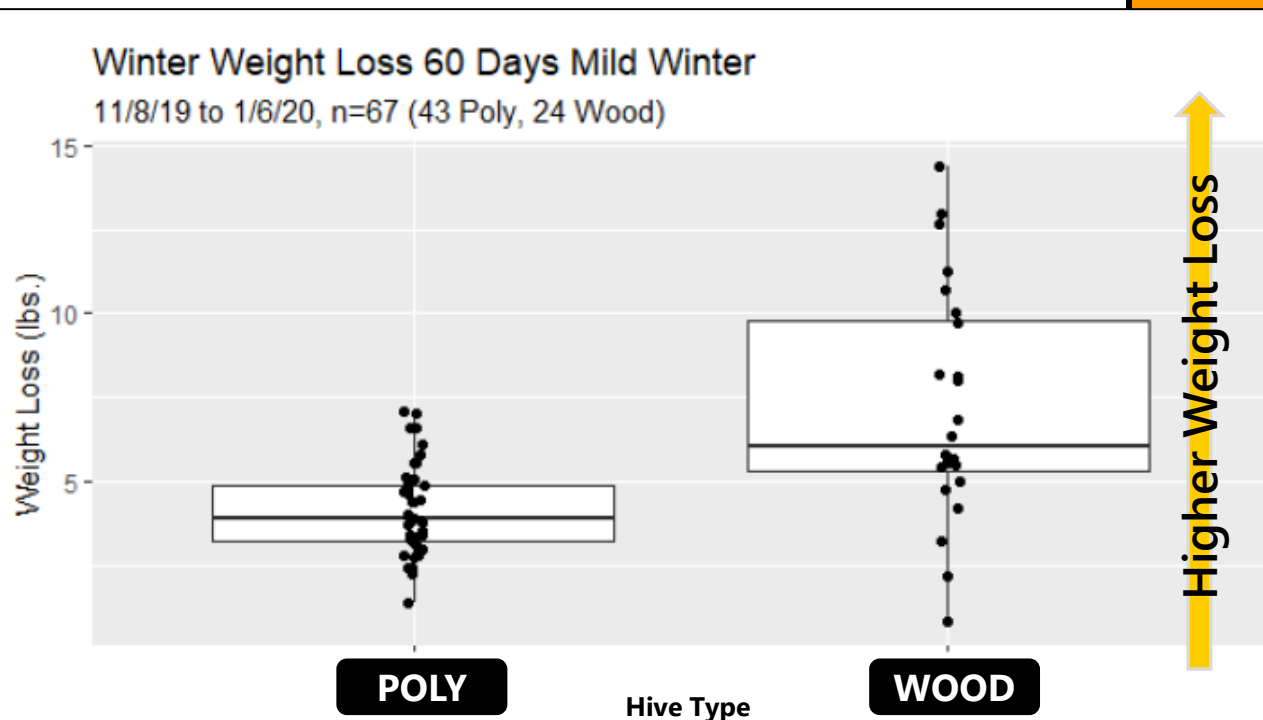
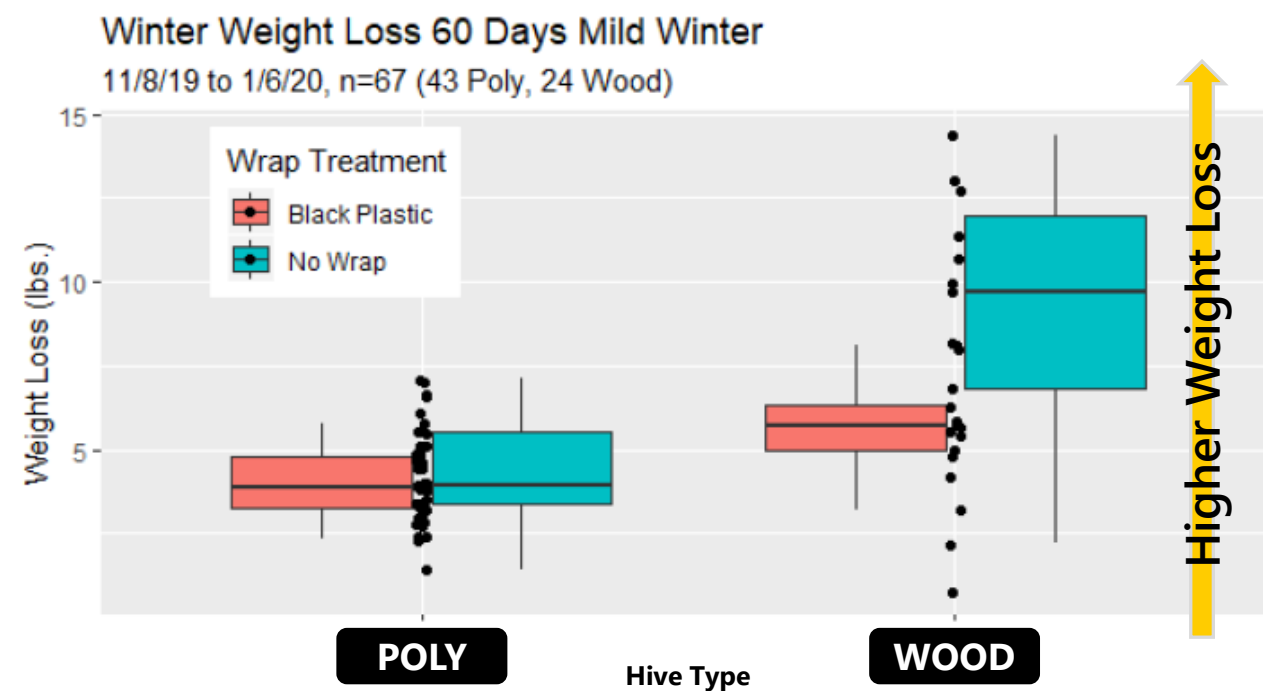


# Weight Loss

## ❑ Food consumption

- *The variations of food consumed were both less and more consistent in polystyrene hives*
- *Whether wrapped or not, **the wooden hives consumed more food.***

This is comparing the 6-frame deep poly (3 boxes high) to 8-frame medium wood (4-5 boxes high).



# Discussion: Do You Need to Insulate?

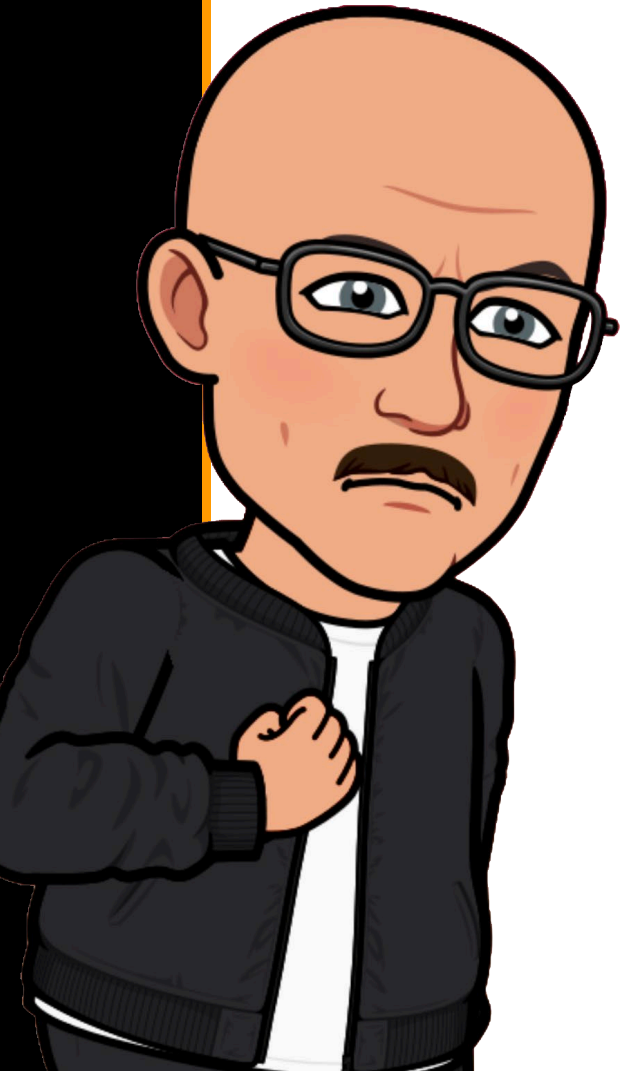
## ❑ Makes for an interesting discussion

- *Do you need to insulate? > Factually – No*

- The fact is hives survive winter in Canada without insulation.
- Some have a strong aversion to the cost and effort – and will defer the practice
- This means that the practical answer is – **No**, you really do not have to insulate.

- *Dabbling in Insulation?*

- We just reviewed some of the advantages – and what if you wanted to try?
- At minimum, it is simple to insulate the top of the hive.
- Putting insulation under the roof is simple, **and very beneficial**.



# Discussion: Is insulation worth it?

## ❑ Full (or Partial) Insulation Benefits

Research and real-world experience has taught us that

- *Reduction of heat loss*
- *Reduction of heat infiltration (Especially on cold & windy nights)*
- *Allows more ability for bees to move to resources*
- *Reduces the consumption of honey*
- *Aids in earlier build up*
  - Bees can take advantage of early forage by having a larger workforce





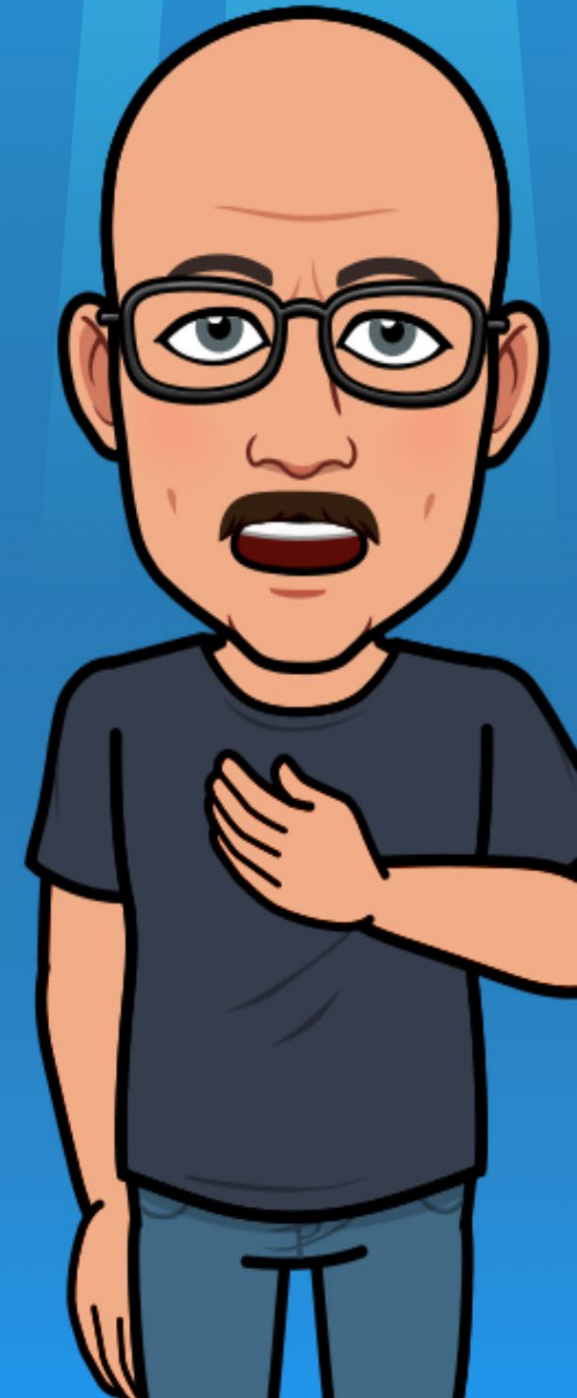
# Kevin Moment: My Personal Take

## ❑ Insulation

- *I like what insulating does based on experience, but it is a lot of work (And it costs money)*
- *At minimum, I have Insulation on the top of my Langs 24x7*
  - I find it beneficial for winter *and* summer

## ❑ Poly

- *I love these hives, and when I use them, I do not have to insulate*
- *Putting my money where my mouth is and have invested in 6, 8, and 10-Frame equipment.*
- *My 10F has been my best performer for the last 3 seasons*



# FOAM Choices



## ❑ XPS Foam

- *Most beekeepers that I know have settled on XPS foam*
  - Typically, these are panels sold at big box stores that are 2" thick
  - They are rigid, easy to cut, and provide an R-factor of R6 for each inch so they have more than enough insulation to do the job

### ***Consider storage***

When not in use, insulation takes up quite a bit of space.





# Insulation & Odds and Ends

## ❑ What about?

### ● ***Tar Paper or Wraps:*** *Sure why not.*

- *Tar Paper and Wraps perform better than one might think.*
- *I think it has a lot do with preventing wind penetration and escape*
- *Simplification > Tape the seams*
  - Simple painter's tape on seams will also benefit.





# Insulation & Odds and Ends

## ❑ What about?

### ● **Homasote:** *Meh.*

- Used for collecting and giving off moisture.
- I think they absorb outside moisture if they are exposed to the outside.
- Not for me; but there are some that swear by them



# Insulation & Odds and Ends

## ❑ What about?

- **Quilt Boxes:** *Tried them, didn't see the value.*
  - Didn't see evidence of moisture collection.
  - Like a honey box on top, they create space to collect in the box, up and away from the brood nest.
  - My hives did not thrive with them after 3 seasons.
  - Moved on; Progressed to top foam insulation covered earlier
- *While playing with this I also tested various differences with ventilation – Open vs. Closed*



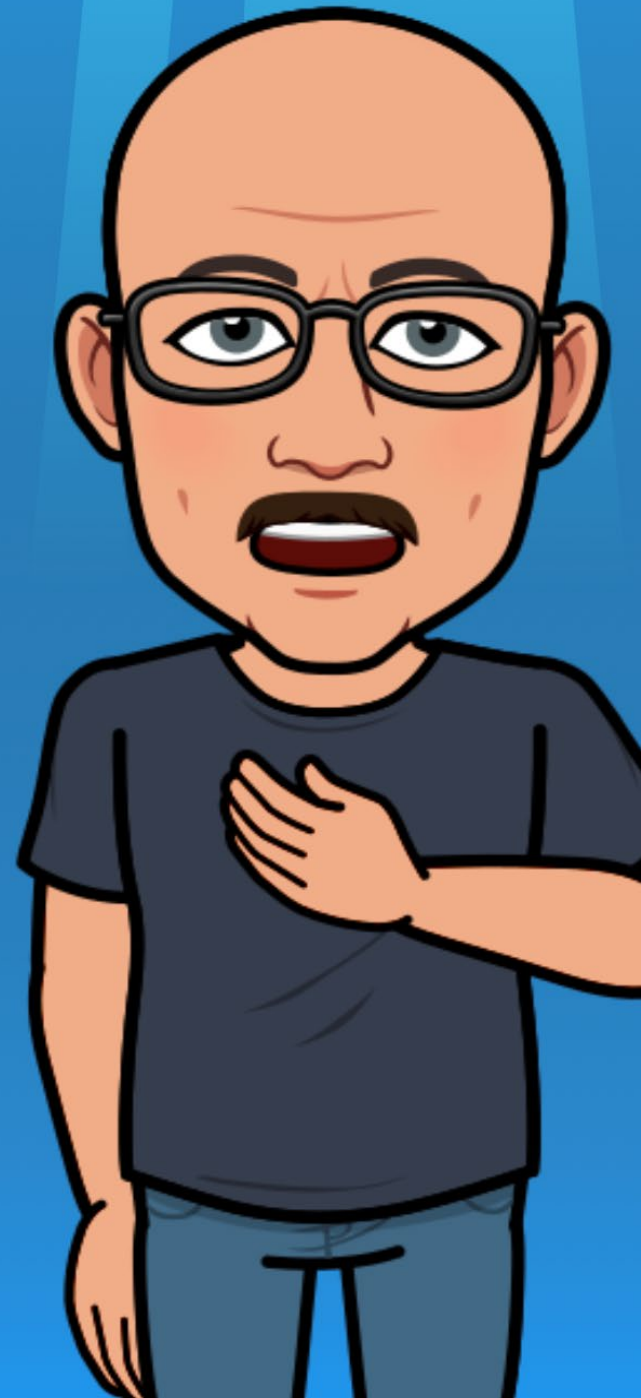
# Kevin Moment: Ventilation

## ❑ To Ventilate or not to Ventilate

- *Most debates stem from “Moisture kills bees, not cold”*
  - Some suggest that ventilation is the proper way to allow moisture to escape, and therefore is imperative
  - Others follow the bee tree model and that small entrances allow the bees to determine the moisture levels
- *What I believe...I like to emulate the bee tree model if possible*
  - I think moisture plays a role, and coupled with the belief that insulation helps to maintain more stability in temperature, I have joined the camp of moderate to low ventilation is best for my climate.
  - We close down our entrances and leave a small upper entrance via a notched inner cover (to the front to avoid chimney effect).
    - ❑ I have observed that - *even with a small upper entrance*, bees will propolize this closed which means they are choosing to close it off even further



Beekeeping  
is Local







# MANAGEMENT SUGGESTIONS

# Statistics\*: For those who need numbers

## ❑ Honey

- *60-80 pounds*
  - 40 to 45 pounds of honey in the uppermost hive body
  - 9 full deep frames equivalent

## ❑ Pollen

- *Several frames adjacent to the brood nest, and in the top box*
  - A minimum several frames of stored pollen, as noted in the earlier slide

## ❑ Bees

- *Ideally: 15 Frames of bees*
  - Equal to or greater than (15) Frames where bees cover the face of the frames.
- *Like to see a "2" or "3" scale\* (on the face of each side)*
  - "2" = 2/3rds of face covered
  - "3" = fully covered
- *Factoring Capped brood*
  - Lots of capped brood can be factored into the assessment

These values can be a guide for the colder northern U.S. States



\*Suggested Values sourced from the Mid-Atlantic Apicultural Research & Extension Consortium (MAAREC) Fall Management Fact Sheet



# Management: Winter Prep and Basics

## □ Dos and Don'ts

- *Avoid taking honey late.*
  - Bees will manage their honey reserves
  - When you take honey from them late, fall harvest for example, they cannot compensate.
  - Their forage pursuits are based on their perception of what they have.
  - If you take too much, they could be left short.



Please don't  
leave me short.



# Management: Winter Prep and Basics

## ❑ Feeding Sugar Solution

- *Feed if you have a shortage in summer*
  - Feed during the winter bee build out period if they need it.
    - ❑ Queens do not lay as many eggs if there is a shortage.
- *Avoid feeding the wrong ratio or too late*
  - It is customary to feed 2:1 sugar solution in fall.
  - Impacts of feeding the wrong ratio, or feeding for too long
    - ❑ If you feed 1:1, it could be too wet. It may also take too long to ripen.
    - ❑ Feed too late and they may not be able to ripen it all > Moisture problems, Mold, Fermentation, etc.

**Rule of thumb**  
**1:1 = FOOD**

*Bees often  
consume the  
lightweight syrup*

**2:1 = STORAGE**  
*Bees often use the  
heavier syrup for  
storage*



# Management: Winter Prep and Basics

## ❑ I Like 'Top Feeders'

- *I like top feeders in late summer and fall*
  - I use Iced Tea containers to fill my Mann Lake feeders.
  - Do not over fill, or you risk the workers backfilling the brood nest





# Bullets All Drones!

*It is sometimes customary to take a break after busy a busy spring.*

This is a reminder to maintain due diligence during summer for queen viability while queens can be sourced, and while there is time to recover.



## Inspect for Failing Queens

- You will want to discover this early if you stand a chance for replacement going into winter





# Management: Winter Prep and Basics



## ❑ Equalizing or Combining:

### ● *Combine weak with strong*

- Separate with newspaper & Smoke the bees.
- Consider feeding before combining
- Ideal to do it soon. You want to give time to acclimate and restructure before cold sets in

### ● *Equalizing*

- Take brood frames (no adult bees or queen) from large colonies and place in moderate colonies if they are behind.

# Management: Winter Prep and Basics

## ❑ Feeding Pollen



Personally, we do not feed any pollen subs.  
We have pollen availability during all seasons

### ● *Pollen as an indicator*

- There are different schools of thought about whether to feed in late summer/fall.
- Some believe the natural slowdown of pollen availability in fall moves the bees to take a winter posture. To switch to winter bees and to start winter preparations.
  - ❑ If you feed pollen, are you messing up the biology of the bees? – hard to say.

### ● *Pollen Substitute Patties (Pollen Subs)*

- Most places are not at a shortage of pollen during warmer months.
  - ❑ Trust but verify. If the colony does not have pollen stores upon inspection, **feed**

# Management: Winter Prep and Basics

## ❑ Feeding Pollen

*Pollen Volume Factors, it is an it depends*

- *Amount of brood that is being reared*
  - The amount of reserve pollen required in the fall depends on the abundance and time of bloom of the early spring sources of pollen.
- *Availability in the spring for your locale*
  - A colony needs pollen in the spring.
  - Where spring sources are not adequate or bloom occurs later than March, pollen supplement will need to be fed in early spring to bridge the shortage. [Ferrar]





# Management: Winter Prep and Basics

## ❑ Do not open hives prematurely

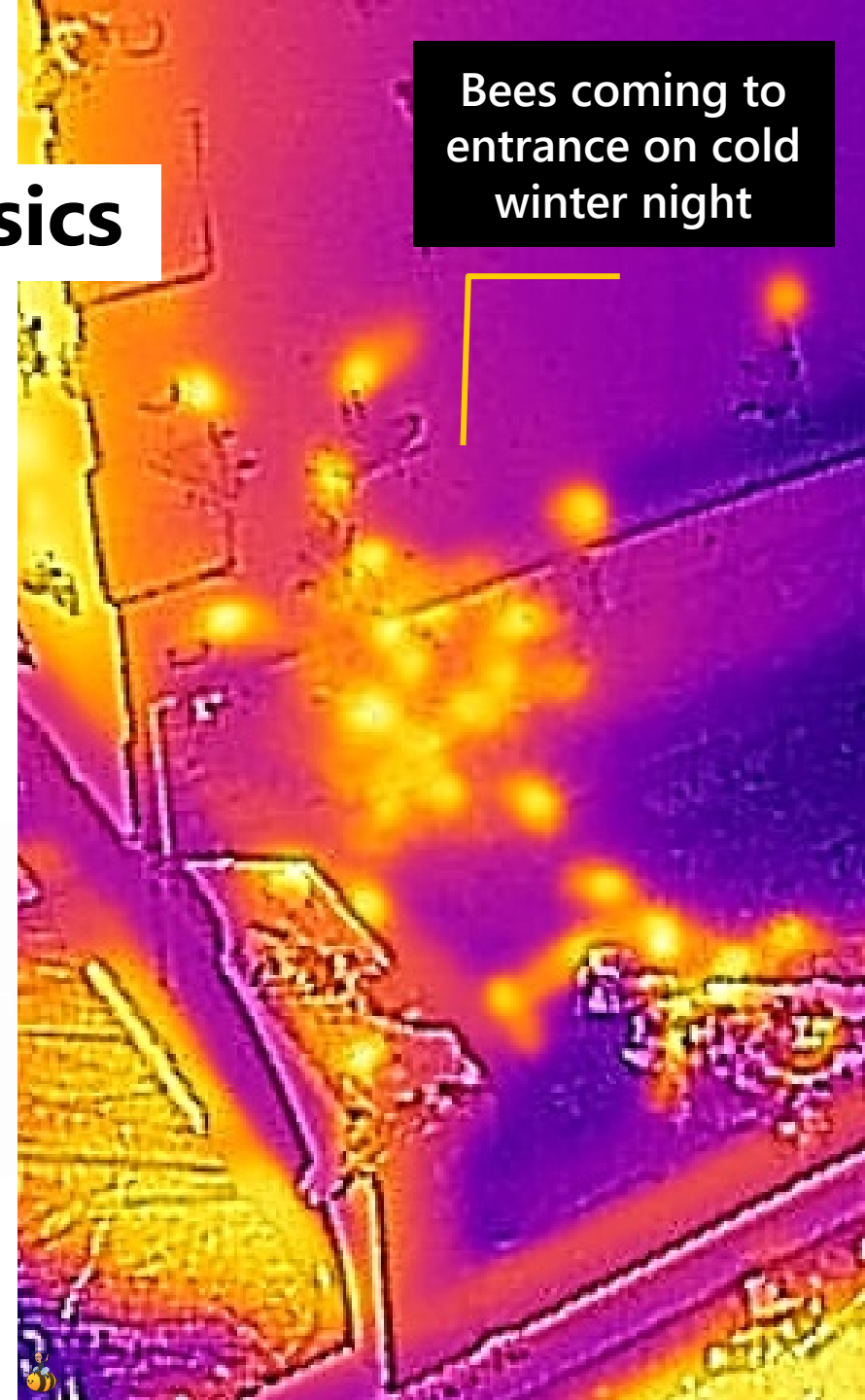
- *Breaking propolis seals is impactful to colonies*
  - In late fall, winter, and early spring, be done. The best offense is a good defense.
  - Avoid any reasons for you having to open your hives and breaking apart hive bodies.
  - If the bees have sealed things up with propolis, you are undoing their work.
  - They cannot break cluster to patch up what you have undone.
- *Be done with your management by first frost*
  - GOOD OFFENSE: If you do it well, they will not require any manipulations
  - Emergency feeding (fondant, etc.) is not something to do if you are prepped

# Management: Winter Prep and Basics

## ❑ Do not open hives prematurely

- *Do your best not to disturb hives in winter*
  - Bees will come to the entrance in defense of the hive.
  - Some perish when this occurs because they chill and do not make it back.
  - Not a fan of banging on hives to see if they are still alive.

Bees coming to entrance on cold winter night



# Management: Winter Prep and Basics

## □ Weekly Winter inspections

- *Look for cleansing flights on warm days*
- *Keep entrances closed, but **make sure they are not plugged***
  - Check that the hives are clear of debris, some air movement is required
  - Hives with closed entrances can suffocate – and **for that reason I always leave my hives with top entrances.**
    - Inner covers with a notch. The bees will close them if they want.
    - Does not seem to compromise ventilation, and is a good insurance policy



# Dead Cluster – Top Box



No top entrance, bottom entrance clogged



# Dead Cluster – Bottom Box



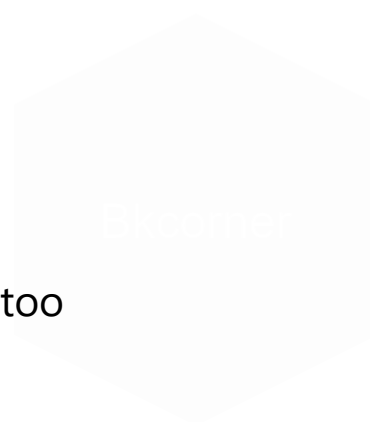
No top entrance, bottom entrance clogged



# Management: Winter Prep and Basics

## ❑ Consider a Windbreak

- *Protect from North and West*
  - Keep hives out of underbrush; underbrush promotes vermin coming to the hive
- *Options:*
  - Fence posts with a burlap wrap around
  - Windbreaks of corrugated plastic
  - Straw bales; again, be careful with this as it too promotes vermin coming to the hive





# Management: Winter Prep and Basics

## ❑ Entrance Reducers

- *Protect from Yellow Jackets and other predators*
  - Do this before they present themselves as a threat
- *Options:*
  - Traditional wooden cleats are just fine.
  - I prefer stamped metal ones; I close them down to the amount I desire with 3M Blue Painter's Tape.



Let it Snow,  
let it snow,  
let it snow

- **What about Snow?**
  - Clear entrance, or not...
    - *Keep in mind that hives in Vermont are under snow for months.*
    - *This does not cause problems, and some say is advantageous*
- **When it snows:**  
Take Winter Photos



# Management: Winter Prep and Basics

## ❑ Bear Fences

### ● *Protect from Bears*

- Keep the fence operational; keep it turned on
- Make sure it is baited with something so the bear is tempted to touch it with its snout
- Ensure that it stays clear from underbrush



# Management: Winter Prep and Basics

## ❑ Record Keeping

- *Try, Document, Assess, Synthesize*

- Obviously much of what was shared came from the wisdom of others
- However, I read things, **and then try them** (or develop them personally) to see what works.
  - ❑ As evidenced by our photos throughout
- One can forget more than can be remembered and one can be well served to keep good records.
- Build time in your process to keep notes

Hive Name:	Date:	Inspection Form#
Time of Day	Temp °	Hive ID/Yard
Weather	<input type="checkbox"/> Sunny   <input type="checkbox"/> Cloudy   <input type="checkbox"/> Partly Cloudy   <input type="checkbox"/> Light Rain   <input type="checkbox"/> Humid   <input type="checkbox"/> Dry	
Hive Type	<input type="checkbox"/> 10 Frame   <input type="checkbox"/> All Medium   <input type="checkbox"/> 8-Frame   <input type="checkbox"/> Nuc   <input type="checkbox"/> Top Bar   <input type="checkbox"/> Warre	
Configuration	Deep <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5   Medium <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5   Shallow <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2	Entrance Reduc
Bottom Board	<input type="checkbox"/> Solid   <input type="checkbox"/> Screened	Feeder? <input type="checkbox"/> NA   <input type="checkbox"/> Entrance   <input type="checkbox"/> Internal   <input type="checkbox"/> Top
INSPECTION OBSERVATIONS:		Type of Inspection: <input type="checkbox"/> External only   <input type="checkbox"/> Superficial
Reason for / Objective of the inspection.		
Observations	<input type="checkbox"/> NA   <input type="checkbox"/> Bearding   <input type="checkbox"/> Incoming Pollen	Mood <input type="checkbox"/> NA   <input type="checkbox"/> Calm   <input type="checkbox"/> Nerv
Brood Notes	<input type="checkbox"/> NA   <input type="checkbox"/> Ø   <input type="checkbox"/> Uniform   <input type="checkbox"/> Spotty   <input type="checkbox"/> BIAS (brood in all stages)   <input type="checkbox"/> Drone La	
Queen	<input type="checkbox"/> NA   <input type="checkbox"/> Y <input type="checkbox"/> N Queen Seen?   <input type="checkbox"/> Y <input type="checkbox"/> N Marked?   <input type="checkbox"/> Y <input type="checkbox"/> N Queen Cells?   <input type="checkbox"/> Y <input type="checkbox"/> N Capp	
Bees	Total Bees <input type="checkbox"/> Ø <input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> H   Eggs <input type="checkbox"/> Ø <input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> H   Larva <input type="checkbox"/> Ø <input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> H   Capped Brood	
Resources	<input type="checkbox"/> NA   Nectar <input type="checkbox"/> Ø <input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> H   Pollen <input type="checkbox"/> Ø <input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> H   Propolis <input type="checkbox"/> Ø <input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> H   Honey Fr	
Pests Present	<input type="checkbox"/> NA   <input type="checkbox"/> Ø   <input type="checkbox"/> Ants   <input type="checkbox"/> Mites/Frass   <input type="checkbox"/> Mice   <input type="checkbox"/> Wax Moths   <input type="checkbox"/> Beetles   <input type="checkbox"/>	
Hive Condition	<input type="checkbox"/> Normal   <input type="checkbox"/> Brace Comb   <input type="checkbox"/> Normal Odor   <input type="checkbox"/> Foul/Unusual Odor   <input type="checkbox"/> E	
ACTIONS TAKEN:		
Feeder in Use?	<input type="checkbox"/> Y <input type="checkbox"/> N	Type <input type="checkbox"/> NA   <input type="checkbox"/> Entrance   <input type="checkbox"/> Internal   <input type="checkbox"/> Top   <input type="checkbox"/> Zip Lock
Fed?	<input type="checkbox"/> Y <input type="checkbox"/> N	What? <input type="checkbox"/> NA   Syrup <input type="checkbox"/> 1:1 <input type="checkbox"/> 2:1   <input type="checkbox"/> Pollen   <input type="checkbox"/> Fondant/Dry Sugar
Boxes?	#Deeps <input type="checkbox"/> + <input type="checkbox"/> - <input type="checkbox"/> 1 <input type="checkbox"/> 2	#Mediums <input type="checkbox"/> + <input type="checkbox"/> - <input type="checkbox"/> 1 <input type="checkbox"/> 2 #Shallows <input type="checkbox"/> + <input type="checkbox"/> - <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> + <input type="checkbox"/> -
Other Equip	<input type="checkbox"/> Y <input type="checkbox"/> N	

# Questions

- ❑ **Note:** This presentation is available for download

<https://www.bkcorner.org>

- *Search for presentations, it will appear in the search results*

- ❑ **Kevin Inglin**

- [kevin@bkcorner.org](mailto:kevin@bkcorner.org)



# Image Credits

- ❑ Slide 06: Winter Weather [Link](#)
- [https://www.reddit.com/r/weather/comments/plp1q7/cold\\_winter\\_for\\_the\\_us\\_do\\_you\\_take\\_stock\\_in\\_the/](https://www.reddit.com/r/weather/comments/plp1q7/cold_winter_for_the_us_do_you_take_stock_in_the/)
- ❑ Slide 08: Alberta Clipper [Link](#)
- <https://www.almanac.com/winter-extended-forecast-farmers-almanac>
- ❑ Slide 14: B&W Cluster Illustration [Link](#)
- <https://www.beesource.com/threads/productive-management-of-honey-bee-colonies-support-material.365942/>
- ❑ Slide 15: Oliver: Cluster Formation [Link](#)
- <https://scientificbeekeeping.com/understanding-colony-buildup-and-decline-part-13a/>
- ❑ Slide x: Bee lifting weights [Link](#)
- <https://imgbin.com/png/XwmjsZGV/honey-bee-fitness-centre-exercise-physical-fitness-png>
- ❑ Slide 63: Tardiff: Bee Phenotypes
- *Wintering in the Yukon*
- ❑ Slide 66: Teutuls Panel Comic
- *Found on Facebook. Source undocumented.*
- ❑ Slide 78: Tardiff: Bee Phenotypes
- *Wintering in the Yukon*
- ❑ Slide 94: Doug/Tammy Horn Potter Hives
- *Shared with me personally from Doug Potter*
- ❑ Slide 95: Doug/Tammy Horn Potter Study Diagrams
- *Shared with me personally from Doug Potter*
- ❑ Slide 99: XPS Wrapped hives
- *John Gaut Presentation:*
- ❑ Slide 100: Slide Wrapped in Tarpaper [Link](#)
- *Foud on Pintrest*
- ❑ Slide 101: Homasote [Link](#)
- <https://thehoneyexchange.com/products/winter-insulating-homasote-board>
- ❑ Slide 108: Mann Lake Feeder [Link](#)
- <https://www.mannlakeltd.com/10-frame-top-feeder-with-super-painted>
- ❑ Slide 112: Pollen Feeder Barrel
- *Imaged shared with me personally from Tim Schuler*



# Resource Links to Learn More

- **THE THERMOLOGY OF WINTERING HONEY BEE COLONIES: USDA study**
  - <https://naldc.nal.usda.gov/download/CAT72345678/PDF>
  - <https://www.beesource.com/threads/the-thermology-of-wintering-honey-bee-colonies.365933>
- **NORTH OF 60 Beekeeping (Work from Etienne Tardiff)**
  - <https://www.northof60beekeeping.com>
- **[BEESOURCE] Walt Wright Articles** (several have insights on overwintering)
  - <https://www.beesource.com/threads/walt-wright.365657>
- **[BEE CULTURE] THERMAL EFFICIENCY: Derek Mitchell**
  - <https://www.beeculture.com/thermal-efficiency>
- **ScientificBeekeeping: Randy Oliver**
  - <https://scientificbeekeeping.com/understanding-colony-buildup-and-decline-part-13a/>
- **Colony Size Drives Honey Bees' Overwinter Survival**
  - <https://entomologytoday.org/2019/01/09/colony-size-drives-honey-bees-overwinter-survival>
- **[BEE CULTURE] WINTER MANAGEMENT: William Hesbach**
  - <https://www.beeculture.com/winter-management>

