

Be Included. Be Involved. **Bee Informed.**

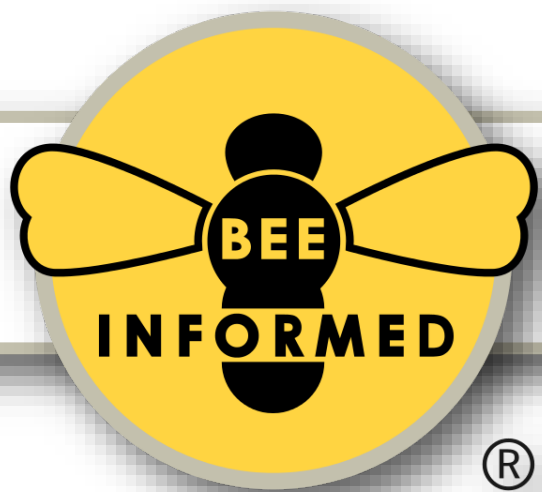


Honey bees Pests and Diseases

Nathalie Steinhauer, PhD
UMD Entomology
02/16/2021

Questions?

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Be Included. Be Involved. **Bee Informed.**

beeinformed.org

®



[bee-informed-partnership-inc](https://www.linkedin.com/company/bee-informed-partnership-inc)



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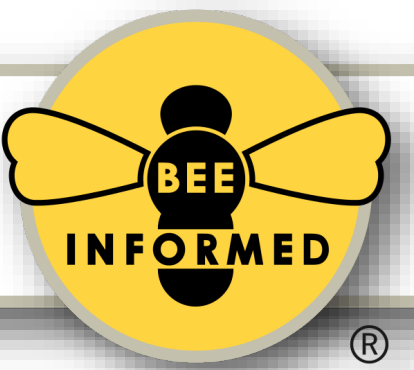
[BeeInformedPartnershipPlus](https://www.youtube.com/BeeInformedPartnershipPlus)



[beeinformedinfo](https://twitter.com/beeinformedinfo)

Visit beeinformed.org/support

Text "Give" to 301-234-8334



- **Improve colony health**
- **Support beekeepers**
- **Largest US repository for colony health data**
- **Bridge between science and industry**

Tech Transfer
Team



IT Tools



Sentinel Apiary
Program



Field Trials



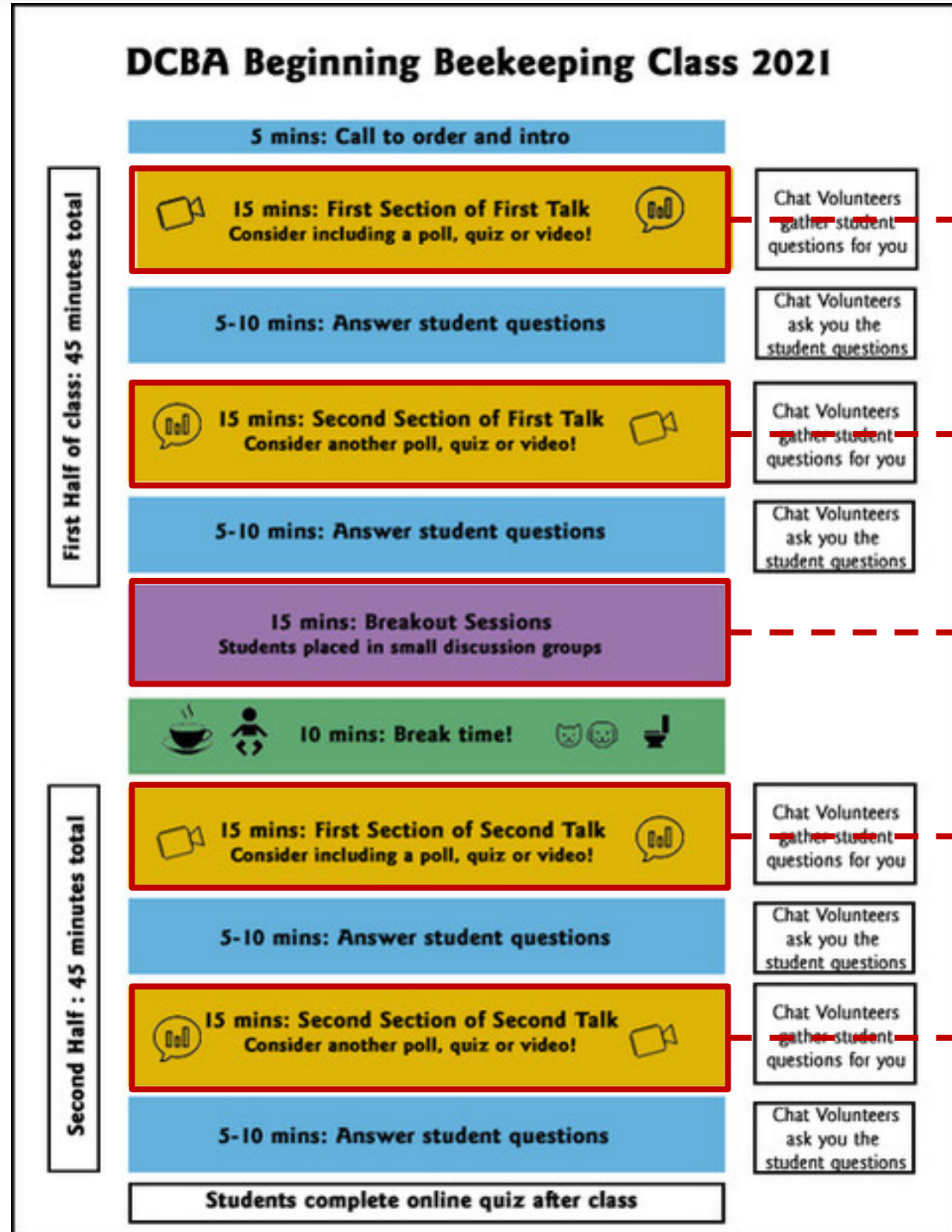
Loss &
Management
Survey



Emergency
Response Kits



Content



Honey bees overall health;
“Most wanted” list

Varroa (and viruses)

Case scenarios

Other pests and diseases

Kevin Platte: regional insights



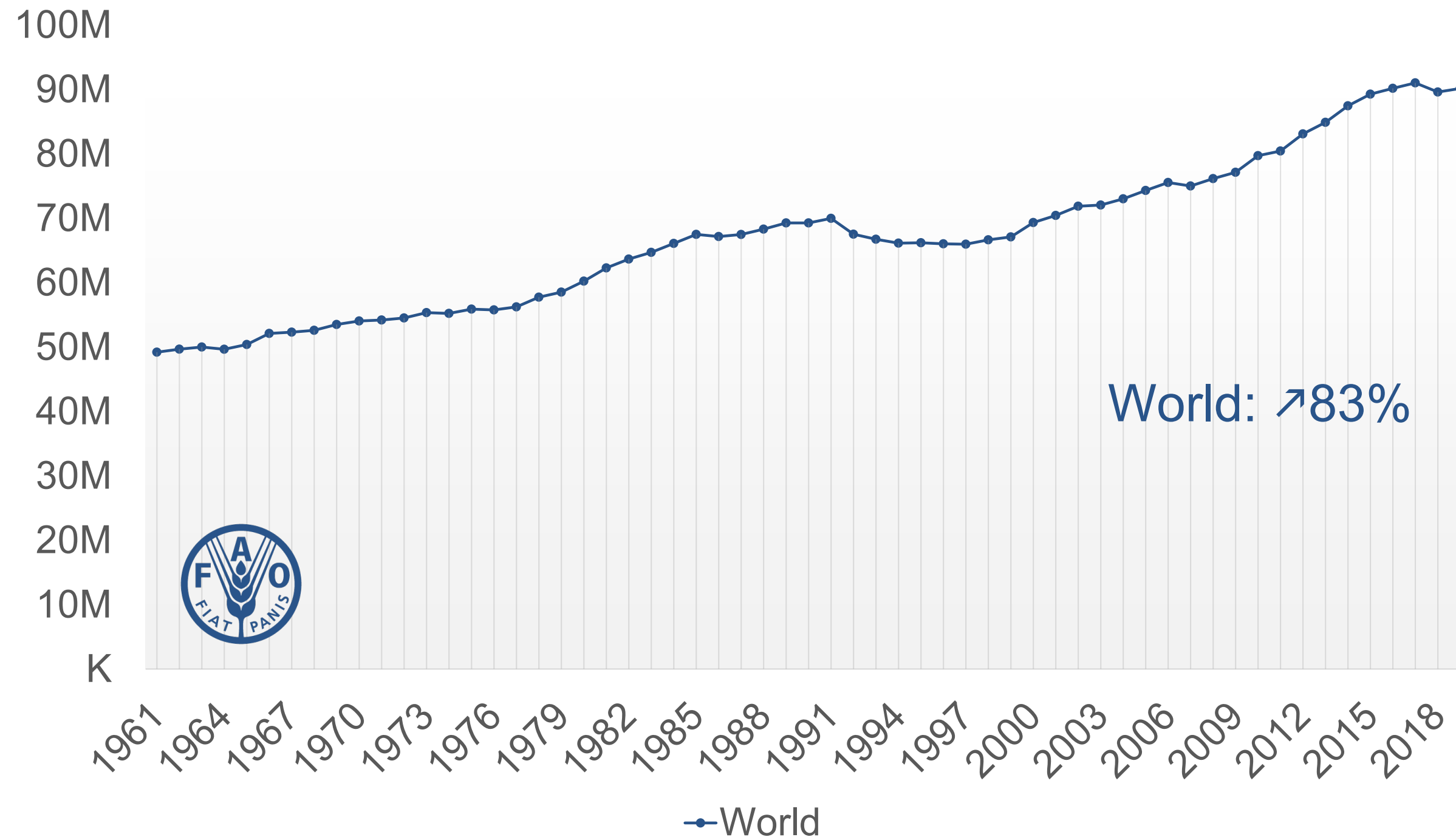
Which statement(s) is/are TRUE ?

1. The number of honey bee colonies in the world is decreasing
2. The number of honey bee colonies in the USA is decreasing
3. The mortality rates of colonies (loss rate) in the USA is increasing
4. The mortality rates of colonies (loss rate) in the USA is stable but high

The number of honey bee colonies in the world is decreasing = **FALSE**



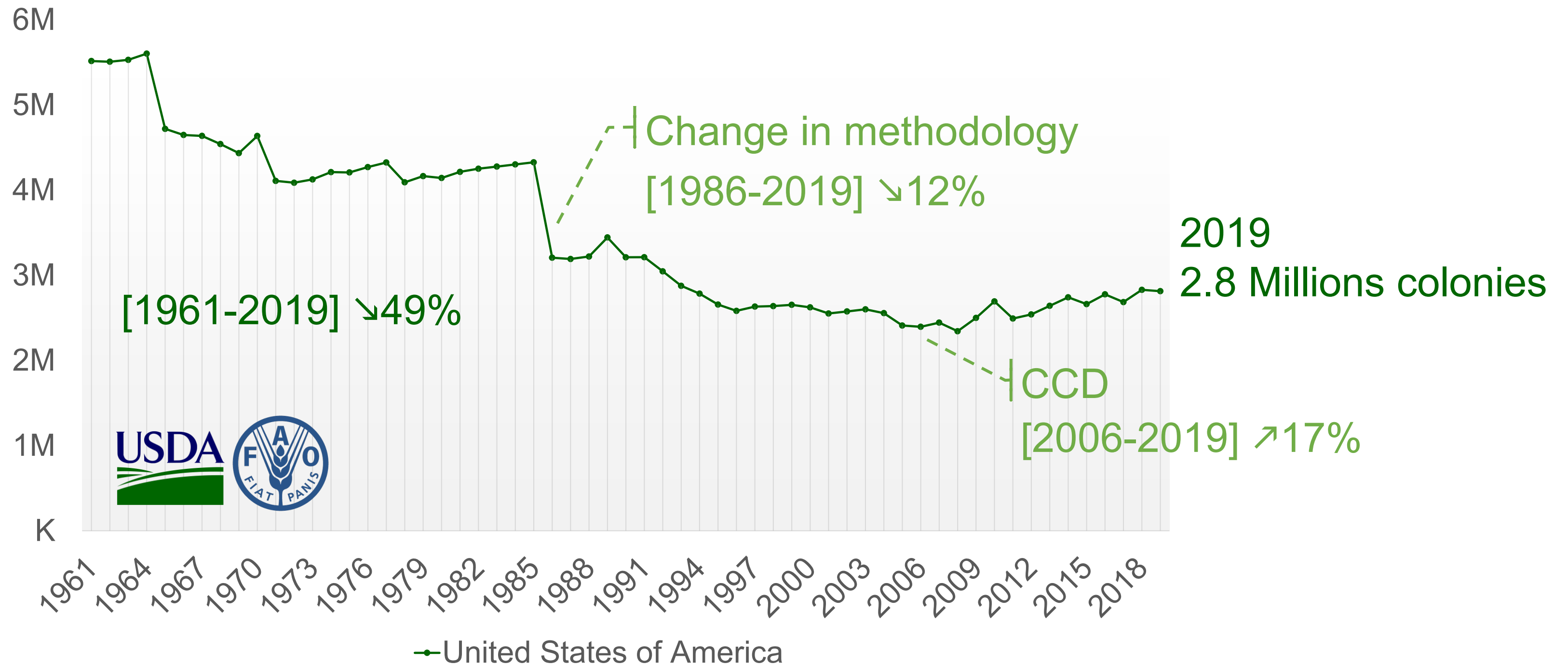
Beehives (source: FAO)



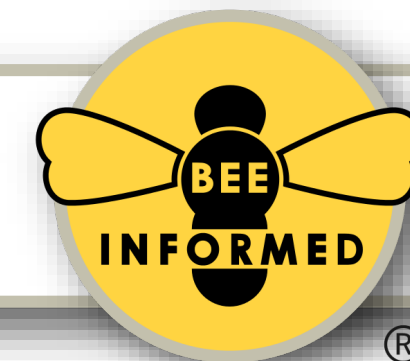
The number of honey bee colonies in the USA is decreasing = TRUE-ish?



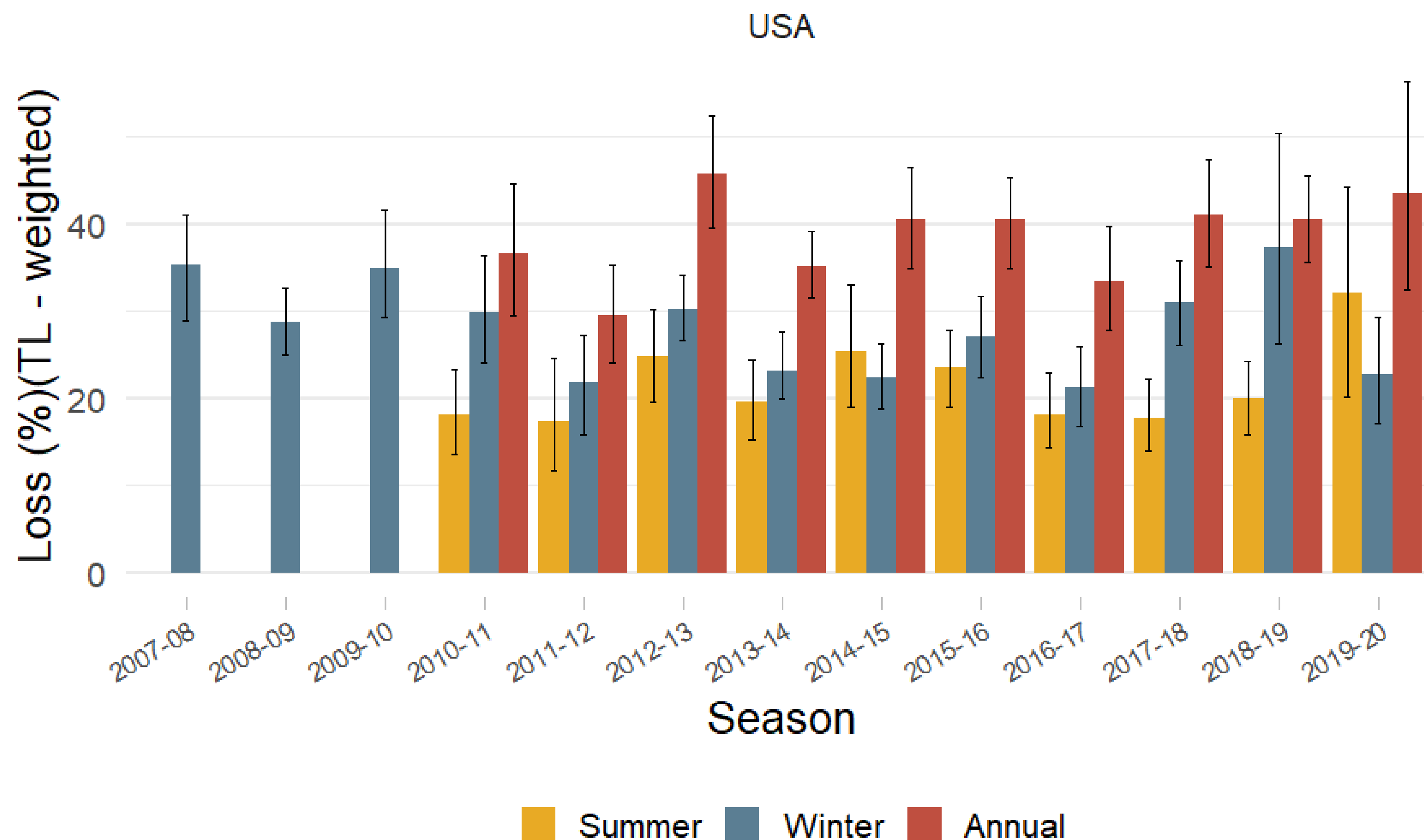
Beehives (source: FAO)



The mortality rates of colonies (loss rate) in the USA is stable but high



Bootstrap mean and 95% CI (n-out-of-n, 1000 rep)



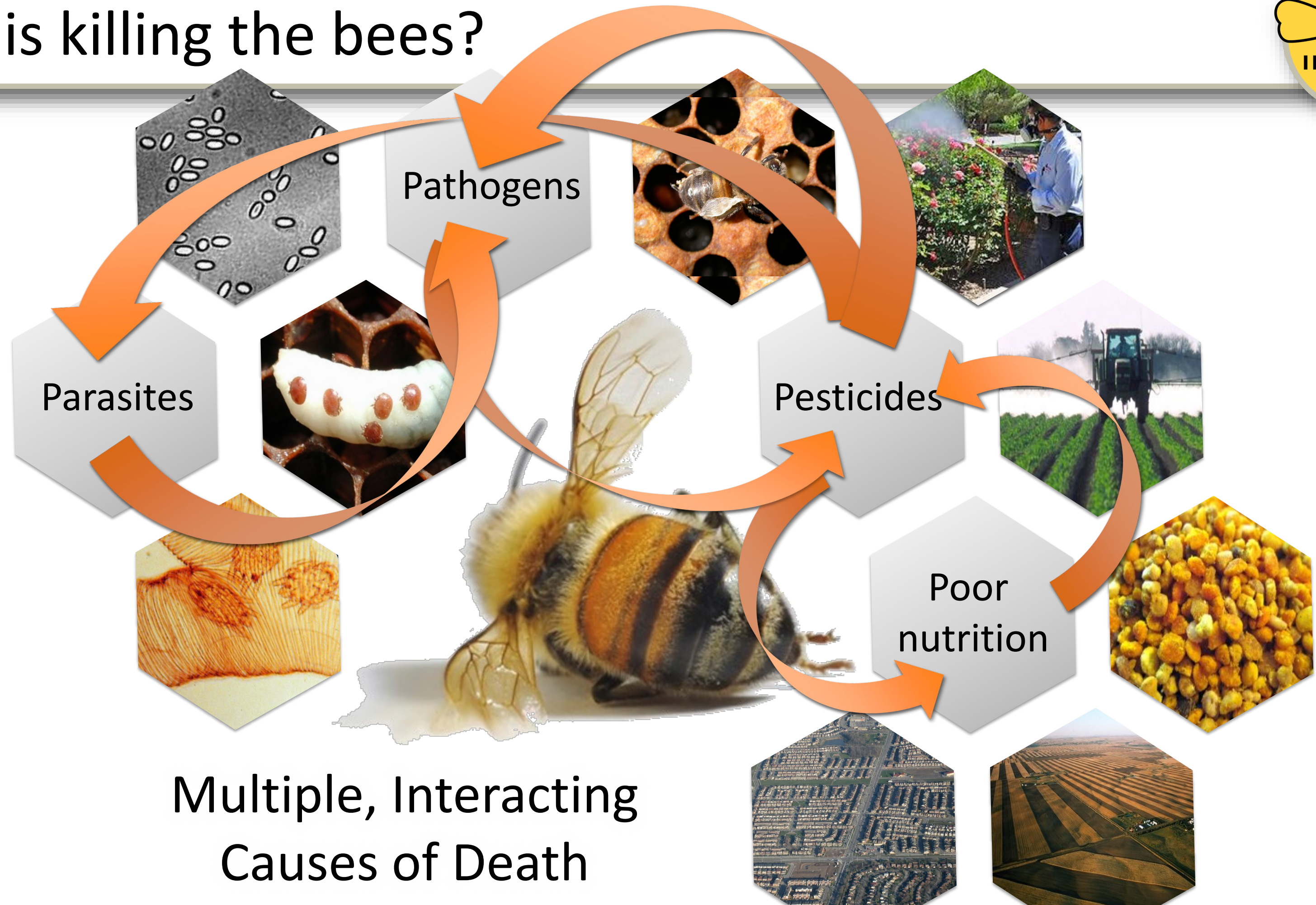
All years:

~ 30% Winter Loss

~ 40% Annual Loss

All results on
research.beeinformed.org/loss-map/

What is killing the bees?



Multiple, Interacting
Causes of Death

Pests and Parasites:



Varroa mites



Tracheal mites



Tropilaelaps mites



Wax moths

More prevalent in
1980's
Rare at present

Opportunistic
parasites

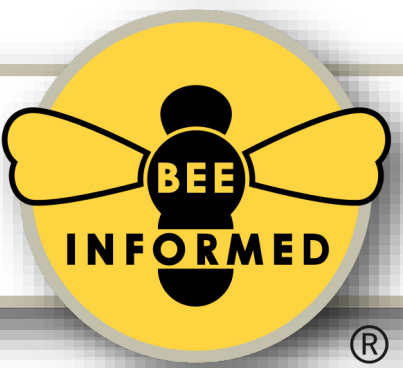


Small hive beetles

Not currently
present in the US
(monitoring)

Opportunistic
parasites

Pathogens:



Bacteria

AFB

EFB

Highly contagious
Very damaging
But rare

Becoming more
prevalent!



Fungi

Nosema

Chalkbrood

Ascosphaera

Stonebrood

Aspergillus

High prevalence
Lower impact?
Env. factors



Viruses

(*) Associated with *Varroa*

ABPV (*)

BQCV

CBPV (*)

DWV (*)

IAPV (*)

KBV (*)

LSV (*)

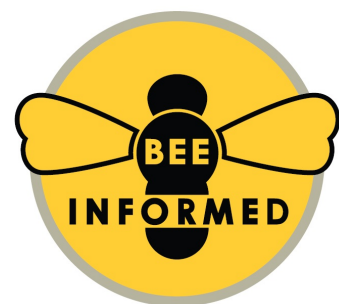
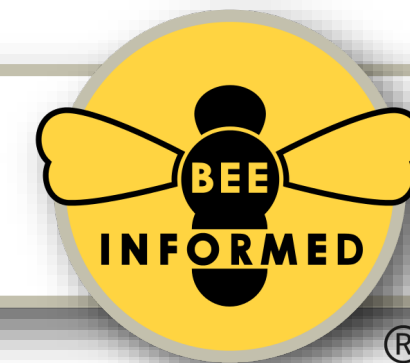
SBPV (*)

SBV

...



2020 webinars recordings

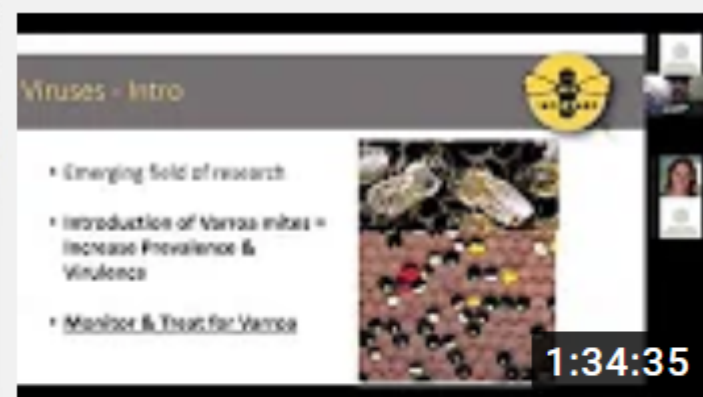


Bee Informed Partnership



Honey Bee Brood Diseases

462 views • 7 months ago



Identification of Adult Honey Bee Diseases

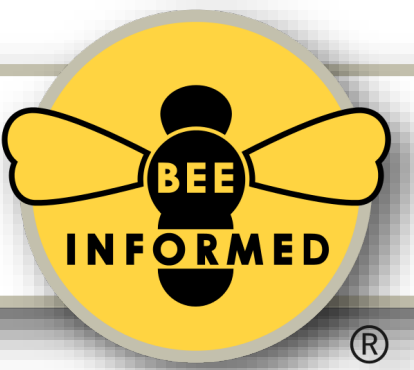
623 views • 6 months ago



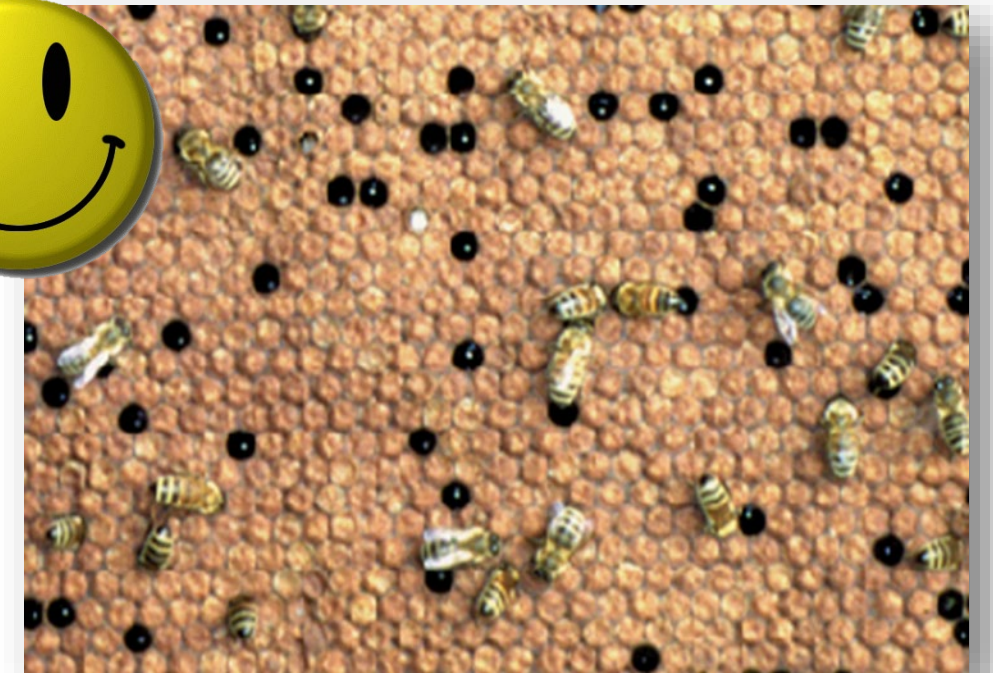
Voracious Varroa

927 views • 6 months ago

Recognize a healthy hive



- Population size
- Activity level (hive entrance, behavior...)
- Frame
- Brood pattern
- Brood
- Worker
- ...



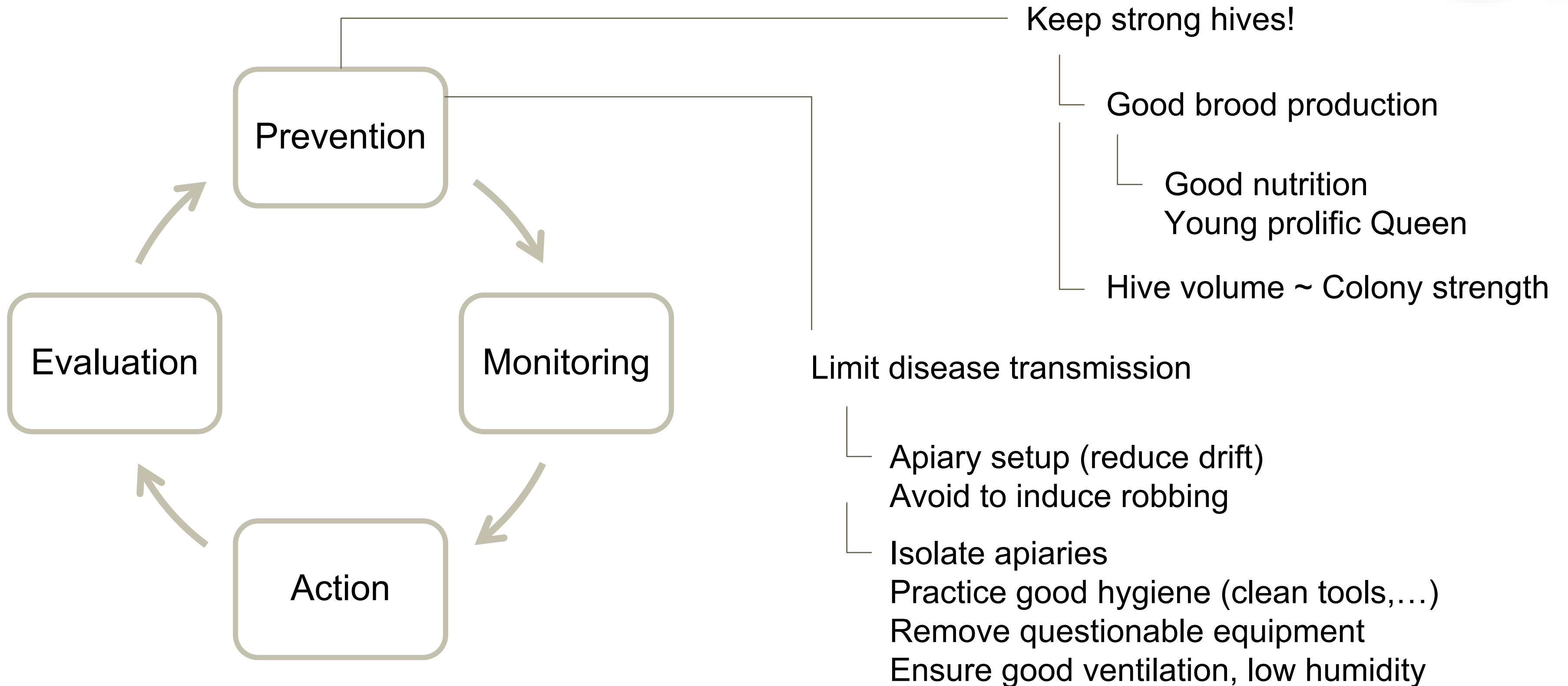
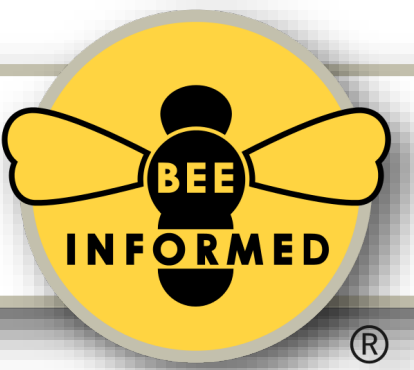
Practice common sense hygiene



- Inspect !
- Monitor pests
- Use preventive care
- Stay informed



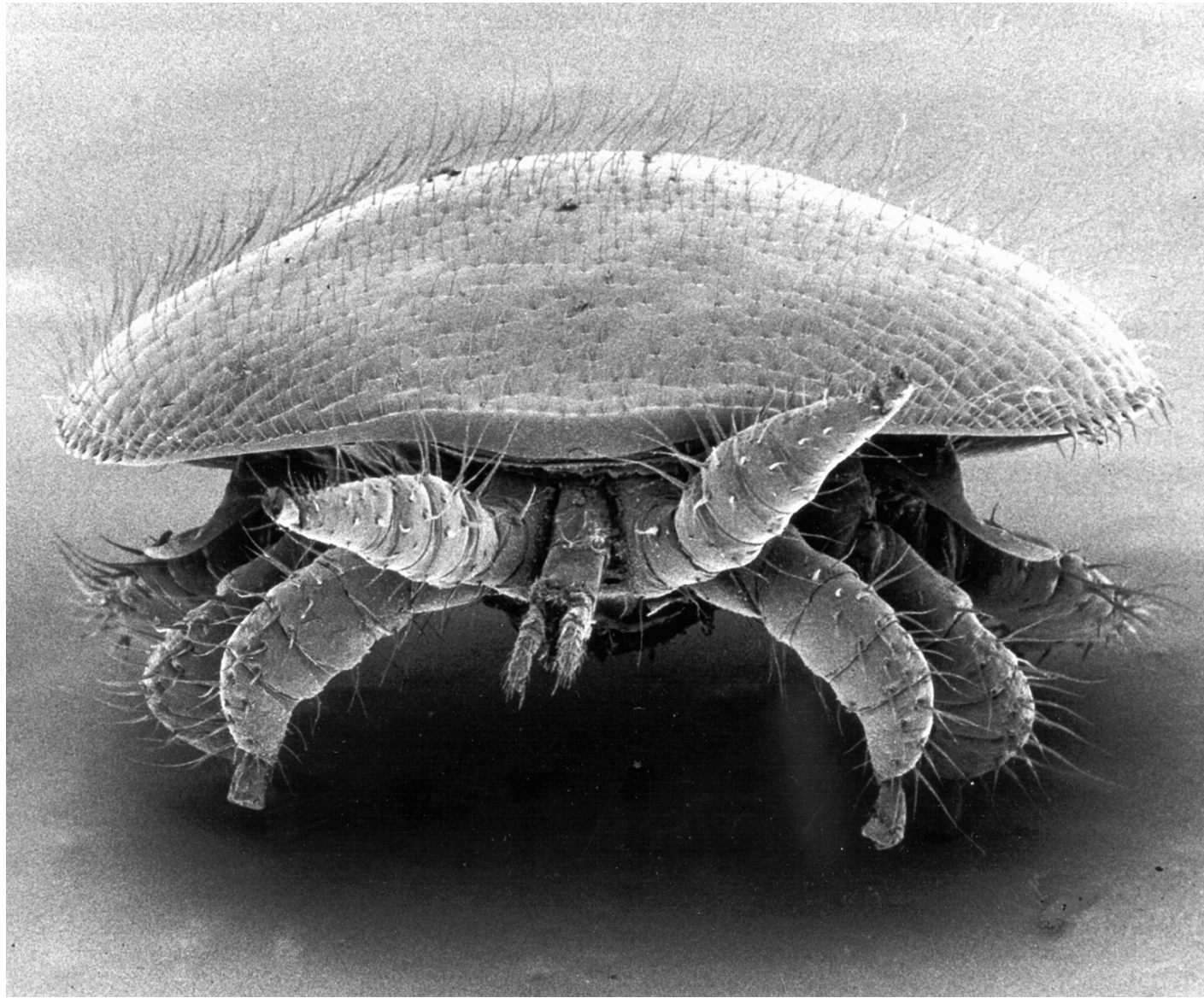
Pest Management



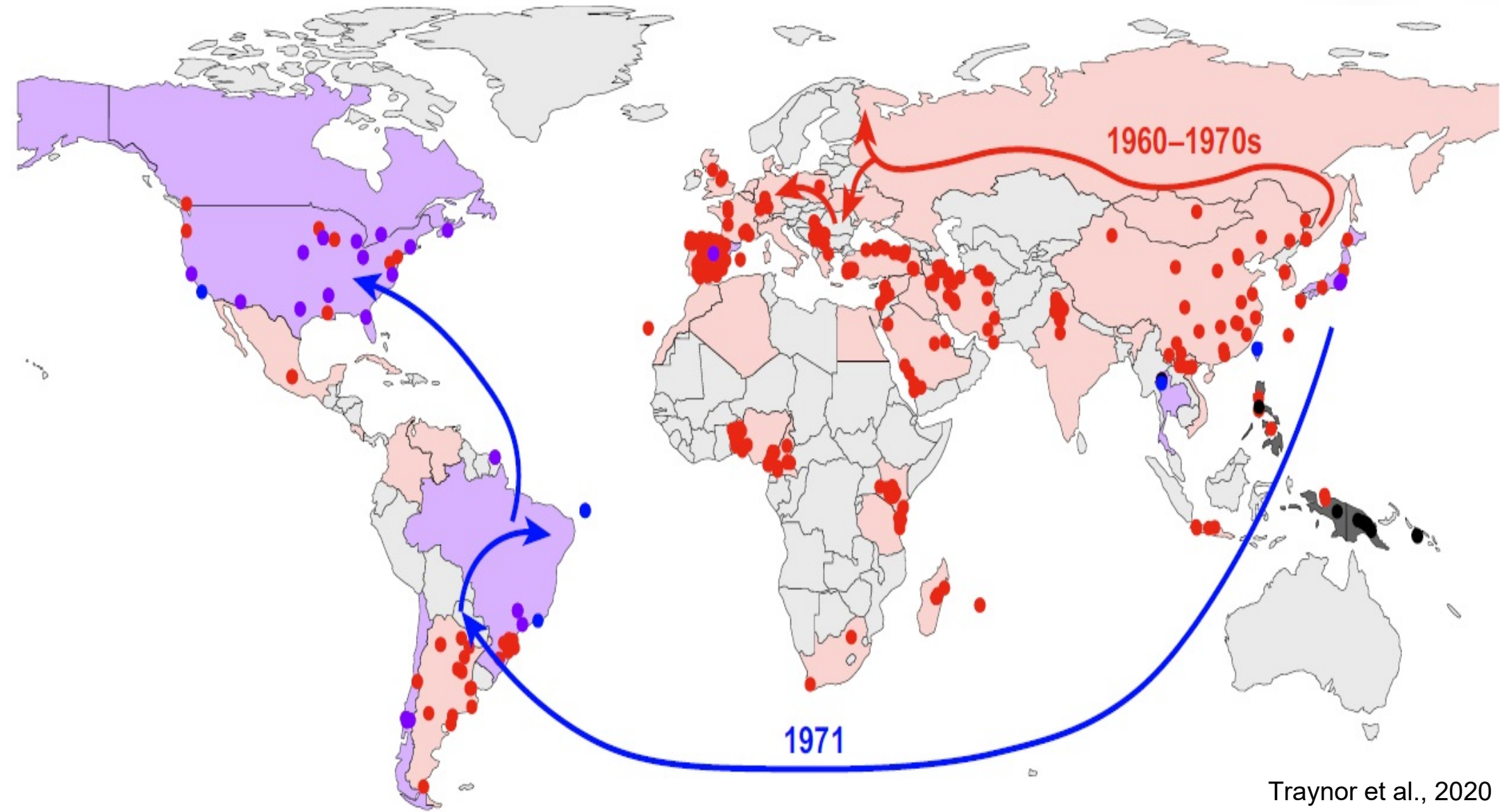
Varroa destructor



Varroa destructor



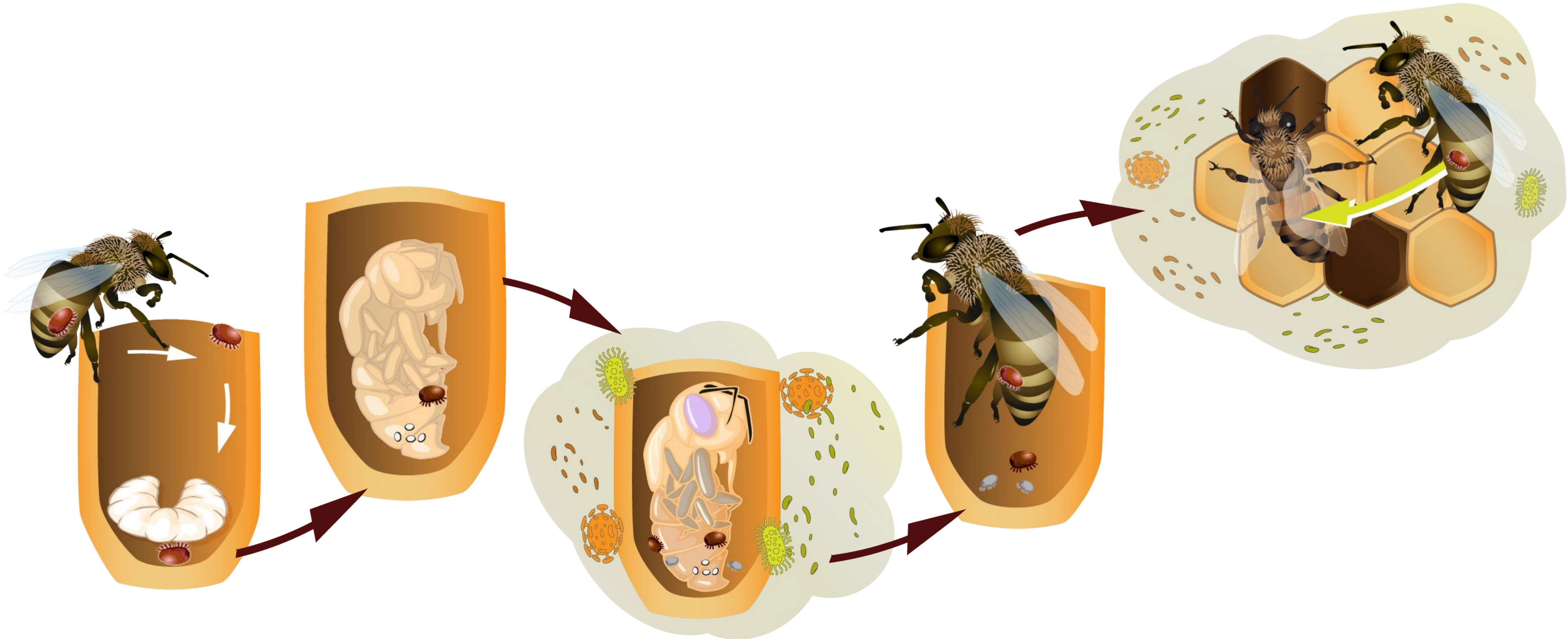
- Discovered in Indonesia 1904 on *Apis ceranae*
- Observed on *A. mellifera* brought to Asia in 1960s
- Arrived in Europe on *A. mellifera* in 1970s
- Arrived in USA 1987 (FL+WI)
- Spread throughout USA and Canada by early 1990s
- Currently present in all areas with *A. mellifera* except for Australia and few isolated islands



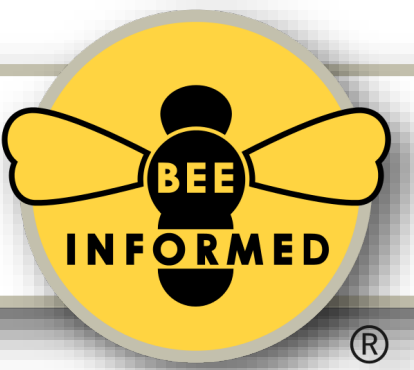
Traynor et al., 2020

Interactive map: <https://mikheyevlab.github.io/varroa-mtDNA-world-distrib/>

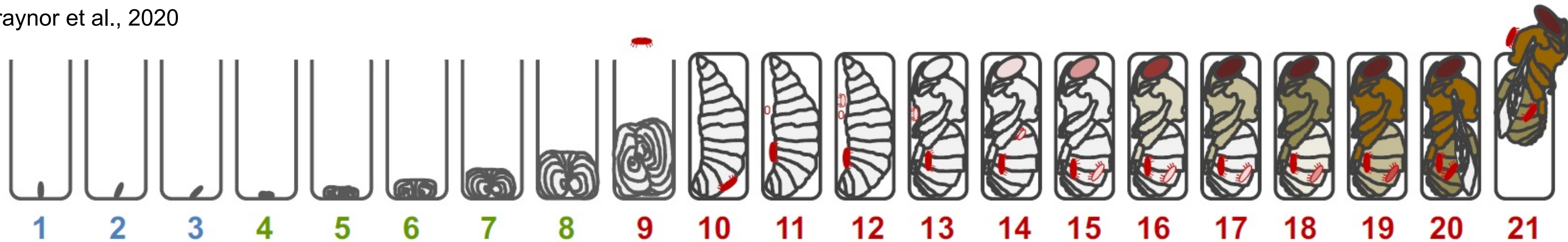
Varroa destructor - Life cycle



Varroa destructor - Life cycle



Traynor et al., 2020



First egg laid is male
Next: 1 female egg / 30 hours

First daughter is mature and mated at ~ 10.5 days after capping

At day 21: **1-2 female mites** produced
Drone brood: 24 days: **3-4 female mites** produced

Mite population growth in a colony is exponential !

Varroa destructor - PHASES



adult female



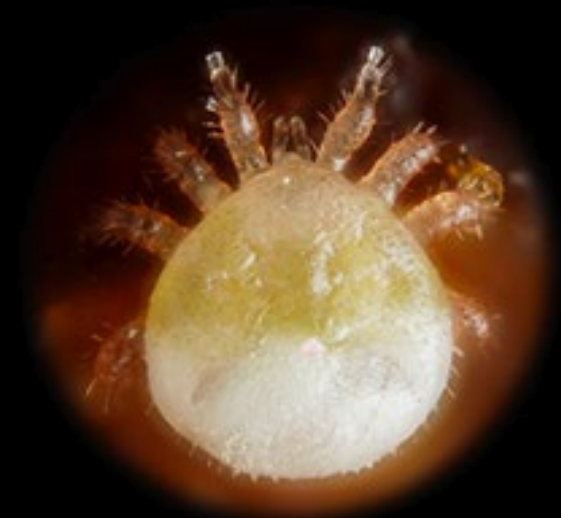
female deutonymph



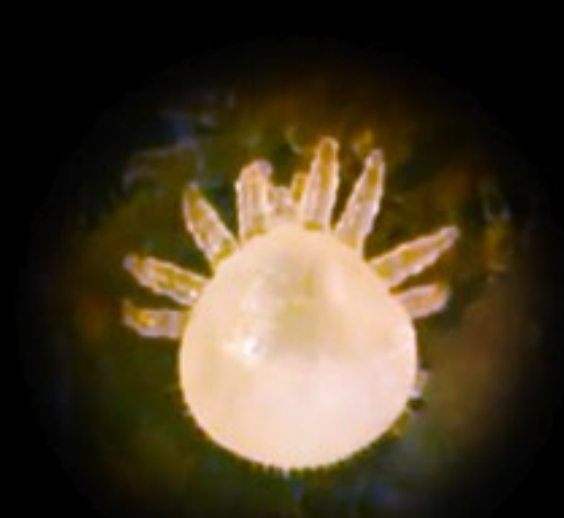
protonymph



larva
(inside egg shell)

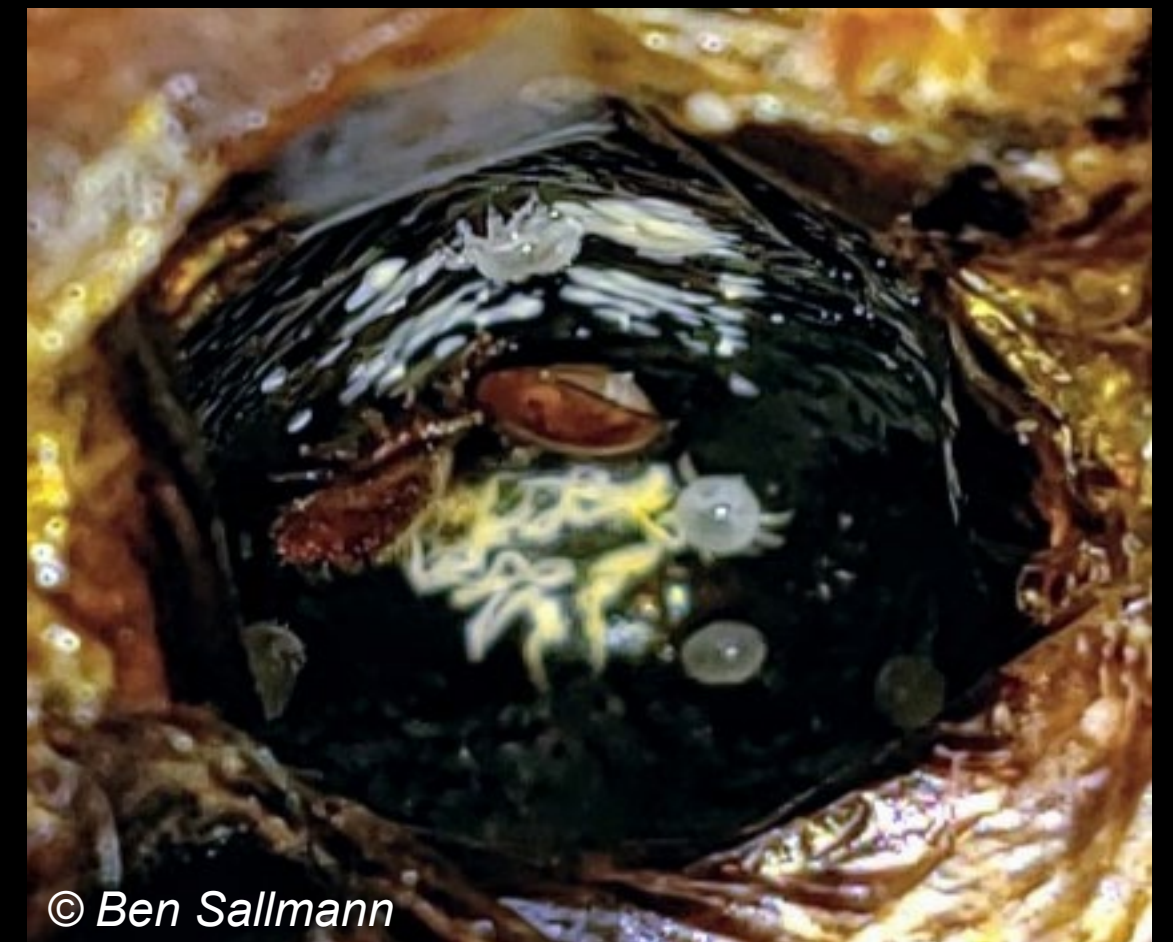


adult male



male deutonymph

1 mm



© Ben Sallmann

Responsible beekeeping requires intervention



Deformed wing virus (DWV)

Knowing **when** and **how** to intervene is fundamental to mite management and keeping colonies healthy.



Cannibalization



Parasitic mite syndrome

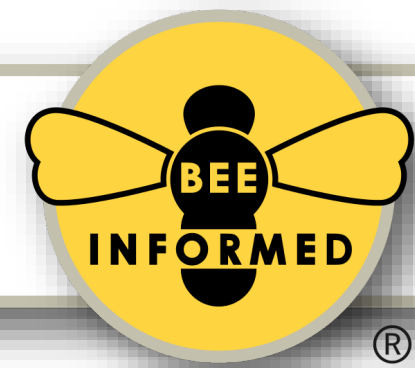
Viruses - Transmission



VIRUS	Transmission							Association				Lifestage Infect./Pathol.				Seasonal Incidence		
	Horizontal			Vertical				Varroa	Acaparis	Nosema	Malpighamoeba	Egg	Larva	Pupa	Adult	Spring	Summer	Fall
	Oral-Fecal	Contact	Air	Varroa	Venereal	Transovarial	Transspermal											
ABPV	+	-	?	+	+	+	?	+	?	?	?	+/-	+/-	+/~	+/+	+	+++	++
KBV	+	-	?	+	~	+	?	+	?	?	?	+/-	+/-	+/+	+/+	+	++	+++
IAPV	+	-	?	+	~	+	?	+	?	?	?	+/-	+/-	+/~	+/+	+	++	++
BQCV	+	-	?	~	?	+	?	+	?	+	?	+/-	+/-	+/+	+/-	+	+++	+
DWV	+	-	?	+	+	+	?	+	?	?	?	+/-	+/-	+/+	+/+	+	++	+++
VDV-1	+	-	?	+	+	+	?	+	?	?	?	+/-	+/-	+/+	+/+	+	++	+++
SBV	+	-	?	-	?	?	?	~	?	?	?	?/?	+/+	+/-	+/~	+++	++	+
SBPV	+	-	?	+	?	?	?	+	?	?	?	?/?	+/-	+/-	+/+	+	+	+
CBPV	+	+	?	-	?	?	?	~	~	?	?	~/-	+/-	+/-	+/+	++	++	+

From: de Miranda et al., 2012

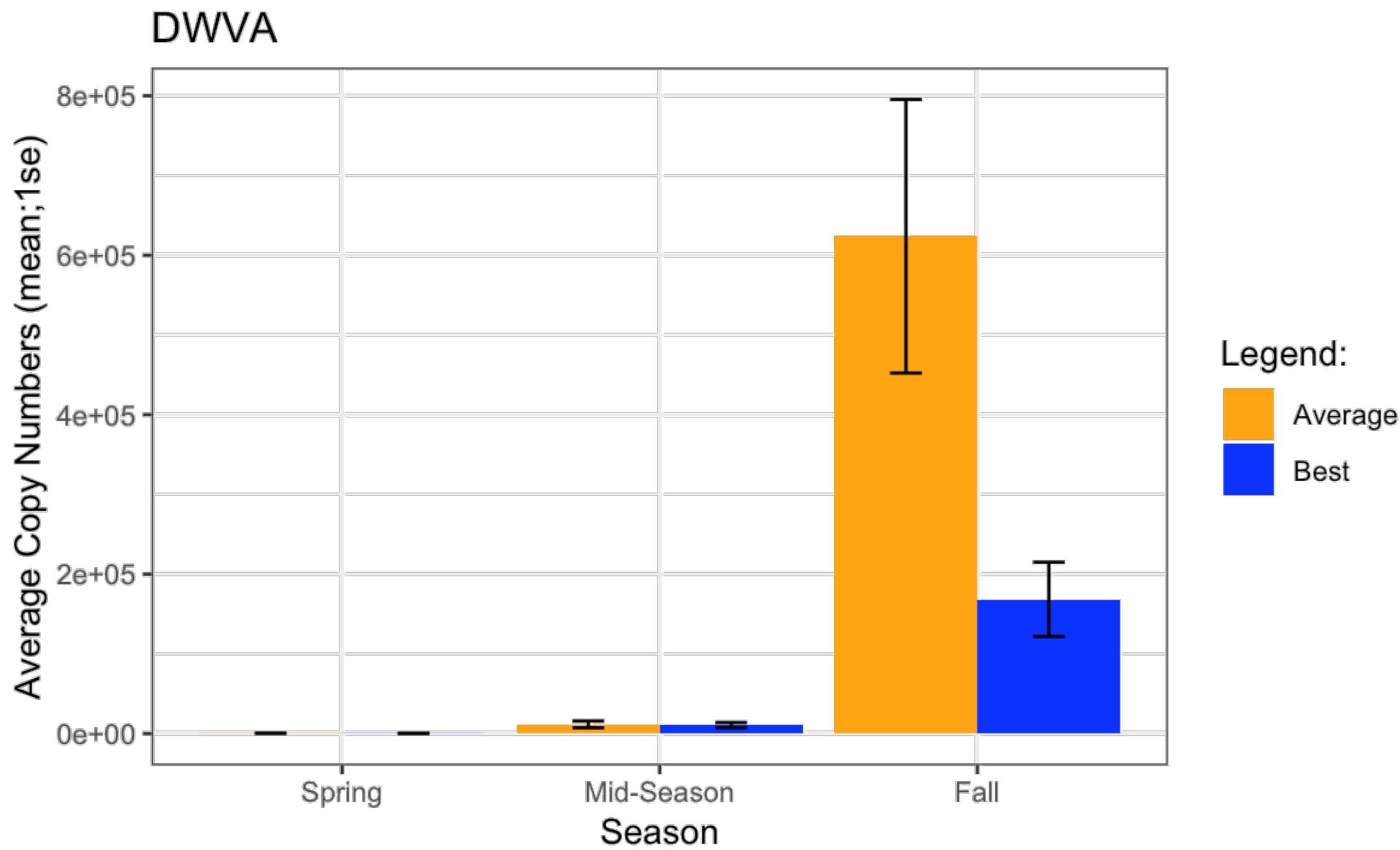
Viruses – Varroa mediated transmission



Field trial from UMD:
7 locations across the US
x 20 colonies
over 3 years



Dr Kelly Kulhanek
UMD

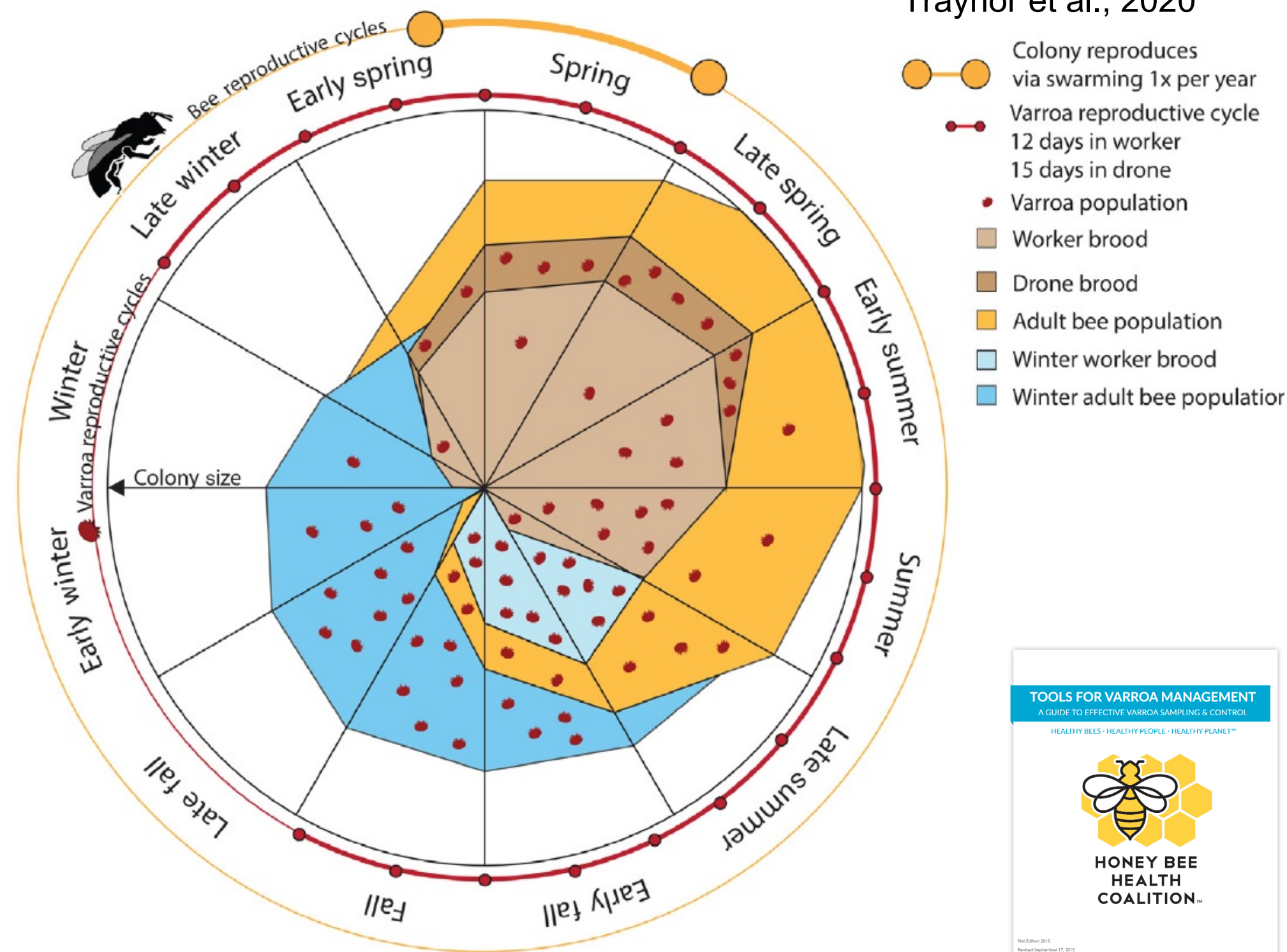


Have a plan: prevention, monitoring, control



honeybeehealthcoalition.org

Illustration from:
Traynor et al., 2020



TOOLS FOR VARROA MANAGEMENT
A GUIDE TO EFFECTIVE VARROA SAMPLING & CONTROL

HEALTHY BEES • HEALTHY PEOPLE • HEALTHY PLANET™

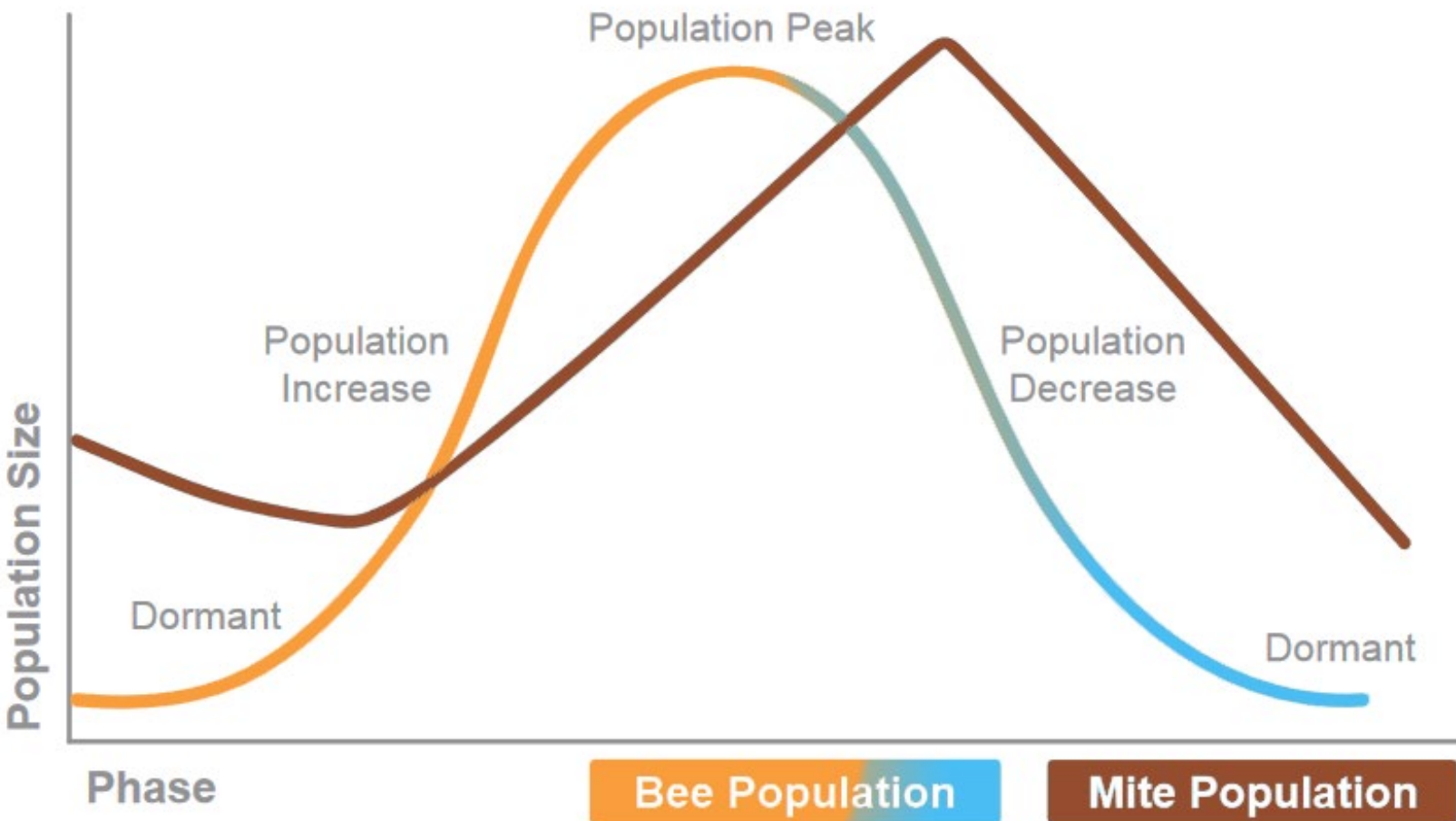


HONEY BEE
HEALTH
COALITION™

First Edition 2015
Revised September 17, 2015

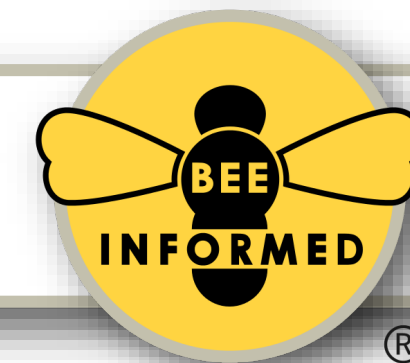
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Figure 1: Honey Bee & Varroa Mite Seasonal Phases



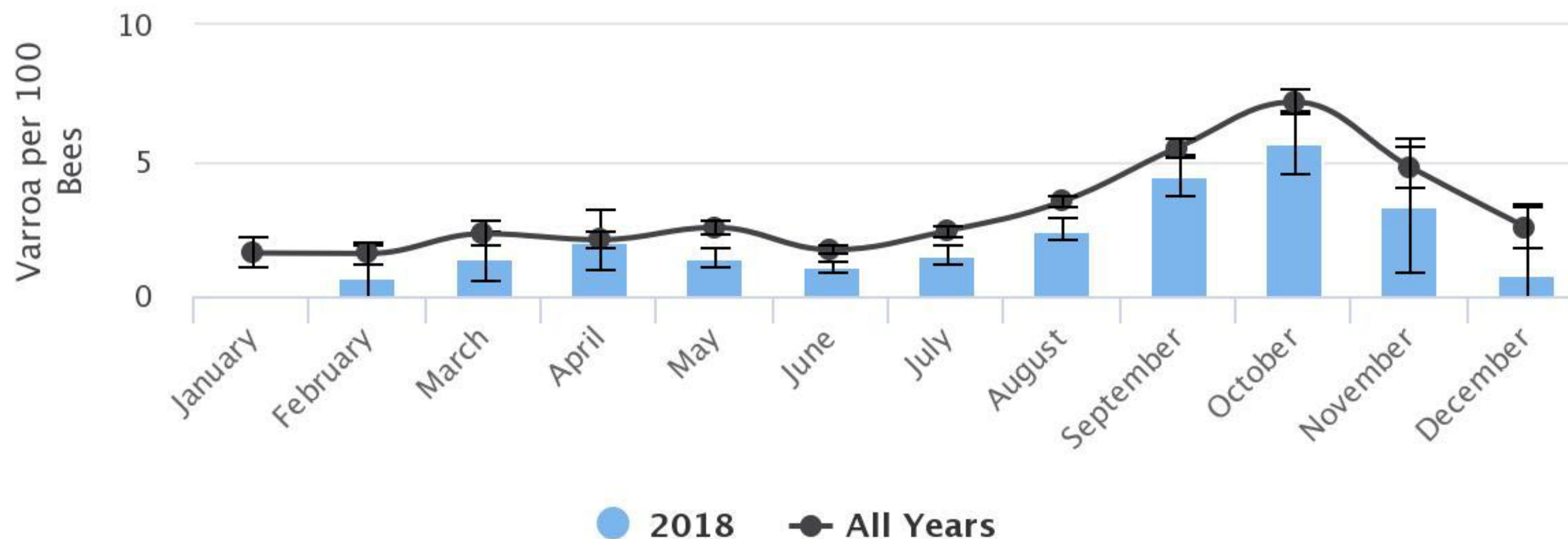
Colony Phase	Acceptable Further control not needed	Caution Control may be warranted	Danger Control promptly
Dormant with brood	<1%	1-2%	>2%
Dormant without brood	<1%	<2-3%	>3%
Population Increase	<1%	<2-3%	>3%
Peak Population	<2%	<3-5%	>5%
Population Decrease	<2%	<2-3%	>3%

Have a plan: prevention, monitoring, control



Average Varroa

Comparing National Average for All Years (n=7316)
to year 2018 (n=1058)



Have a plan: prevention, **monitoring**, control



NOT recommended

Visual Inspection
(adults &/or drone
brood)
Ether Roll

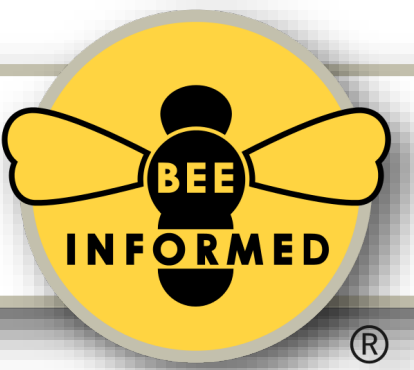
Sticky Boards

Powder Sugar
Shake

Recommended

Alcohol Wash

Have a plan: prevention, **monitoring**, control



Canyon Rim Honey Bees

3.59K subscribers

How to do an Alcohol Mite Wash for Varroa Monitoring

<https://www.youtube.com/watch?v=MrNRP6XHYzw>



Have a plan: prevention, monitoring, **control**



Rationale for not controlling

- Out of sight, out of mind
- Do not want to use chemicals
- Survival of the fittest

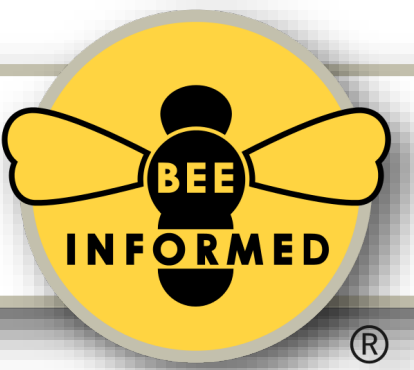
BIP Recommends to Treat for *Varroa*!

- Animal Husbandry
- Start by monitoring
- Be a good neighbor

- Follow the Honey Bee Health Coalition Guidelines



Resistant Stock (it's coming!)



- These efforts take a long time
- It cannot be achieved quickly by small scale beekeepers
- Dilutions issues



Varroa-sensitive
hygiene



Hygienic behavior



Grooming

NOT a *Varroa* Control Option



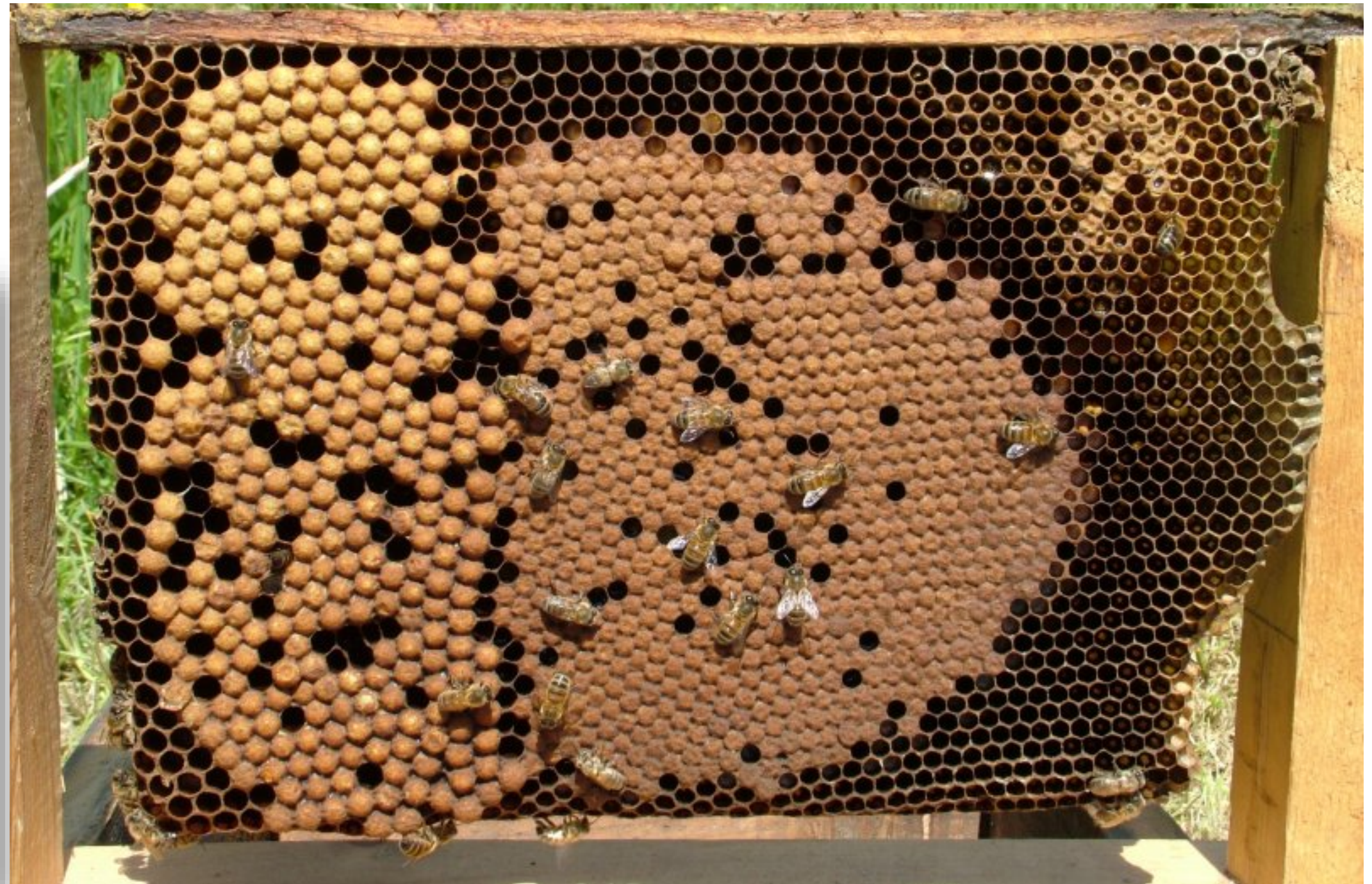
- Powdered Sugar
- Screened Bottom Board
- Small cell foundation
- Mineral oils
- Essential oils
- Thermal Regulation???

Mechanical Control Options for *Varroa*

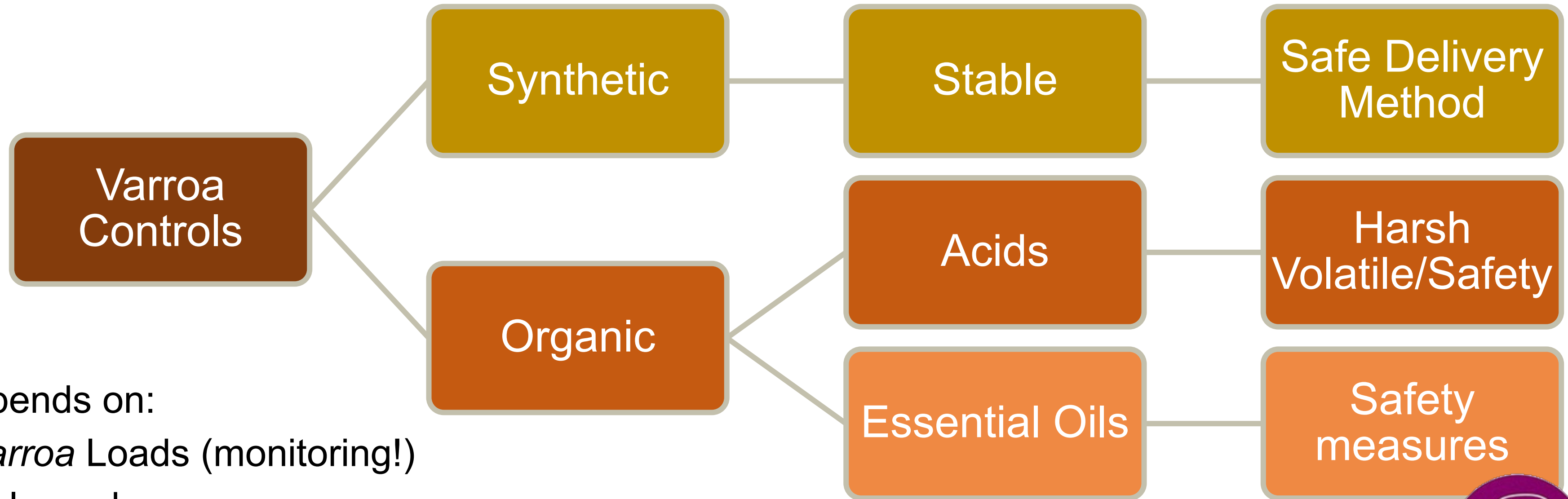


- Brood break (splitting / caging Queen)
- Drone brood removal

Do NOT let it
emerge!

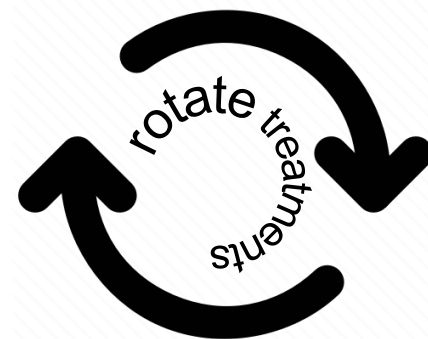


Synthetic vs Organic Control Options for *Varroa*

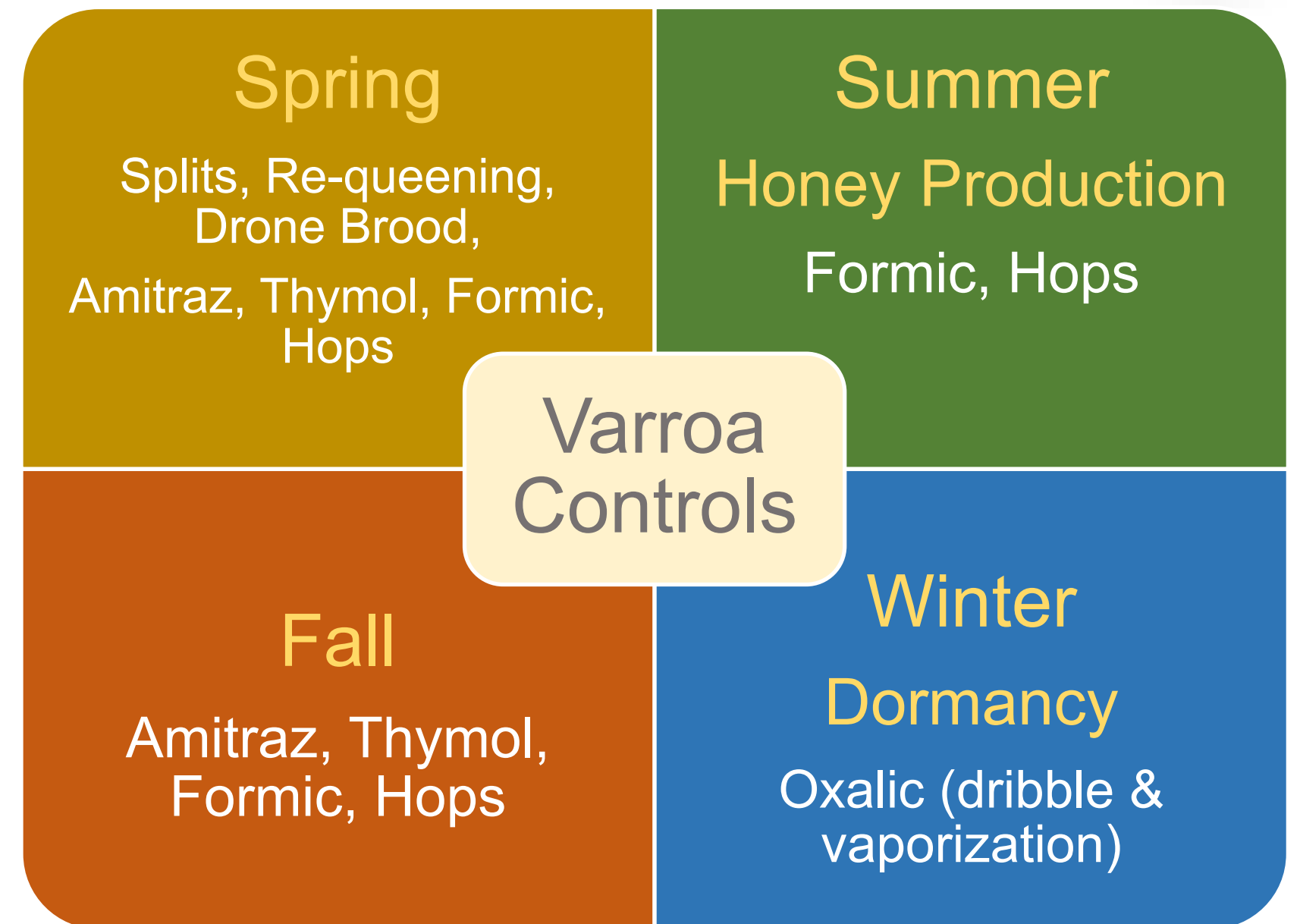
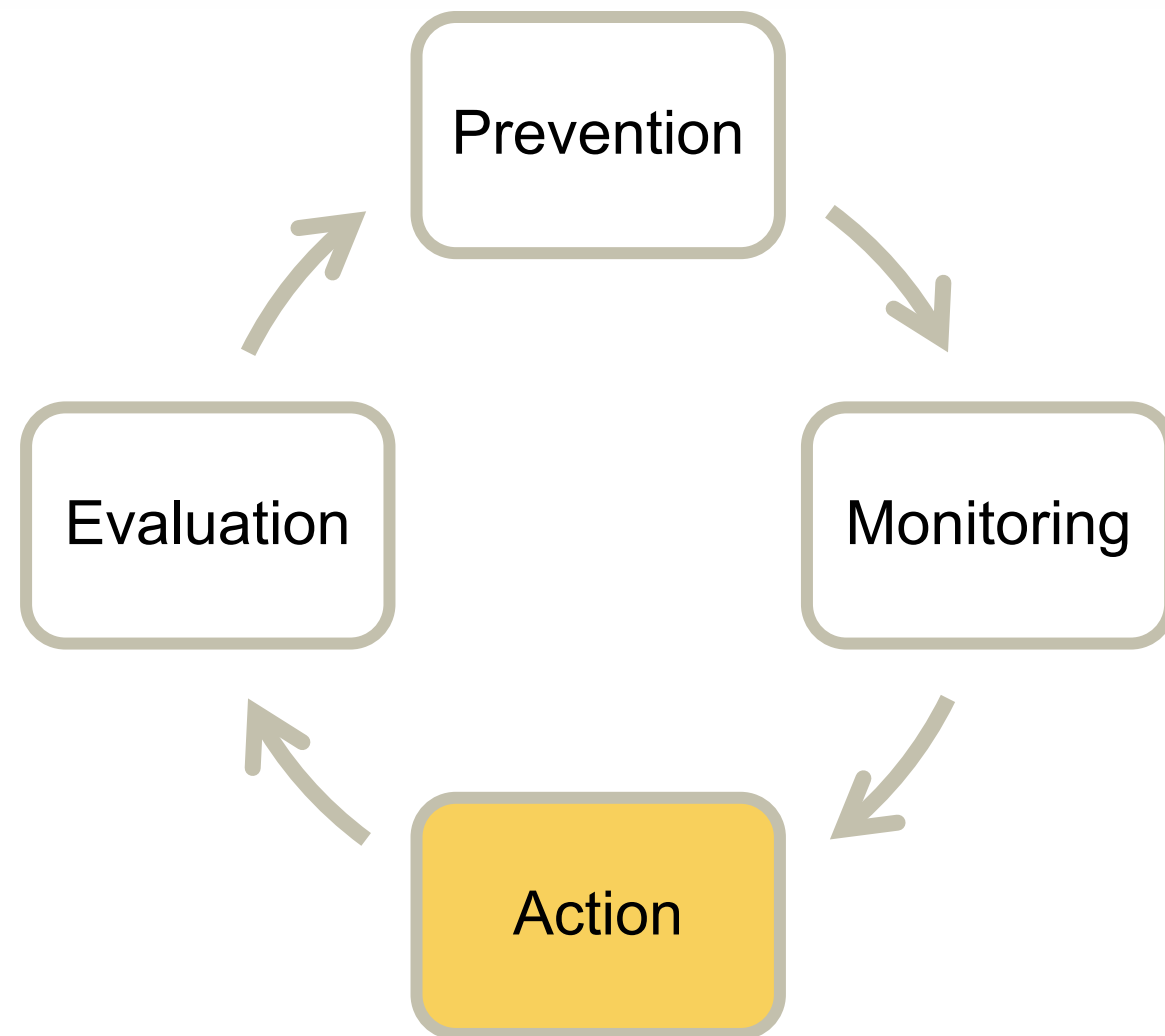


Depends on:

- *Varroa* Loads (monitoring!)
- Colony phase
- Temperature
- Colony population
- Honey Supers on/off
- Last Control Performed

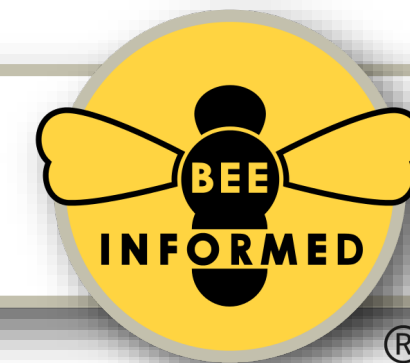


Example of control option schedule



Best resource:
The Honey Bee Health Coalition
<https://honeybeehealthcoalition.org/varroatool/>

Control Options for *Varroa*



- Active ingredient: Amitraz

Benefits

- Slow release – 6 weeks effect
- Safe delivery, easy to use

Drawbacks

- Not effective on high mite loads
- Cannot be used with honey supers



Control Options for *Varroa*



- Active ingredient: Thymol

Benefits

- MAY prevent other diseases (chalkbrood)
- Fairly safe and easy to use

Drawbacks

- Not effective on high mite loads
- Cannot be used with honey supers
- Temperature restrictions



Control Options for *Varroa*



- Active ingredient: Formic Acid

Benefits

- Flash treatment, may work with high mite loads
- May be used with honey supers

Drawbacks

- Safety concerns
- Brood and Queen damage
- Temperature restrictions



Control Options for *Varroa*



- Active ingredient: Hop Beta Acids

Benefits

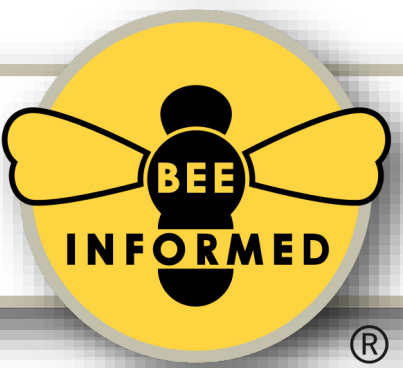
- May be used with honey supers on
- Fairly safe and easy to use (use gloves)

Drawbacks

- Not effective on high mite loads
- Temperature sensitive



Control Options for *Varroa*



- Active ingredient: Oxalic Acid

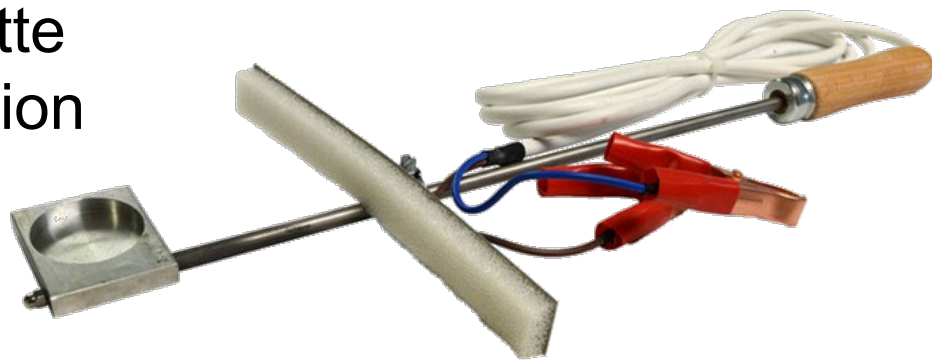
Benefits

- Flash treatment, may work on high mite loads
- Highly effective during broodless periods

Drawbacks

- Observe Safety Measures (particularly OAV)
- Not as efficacious when brood is present

See Kevin
Platte
section



Nosema

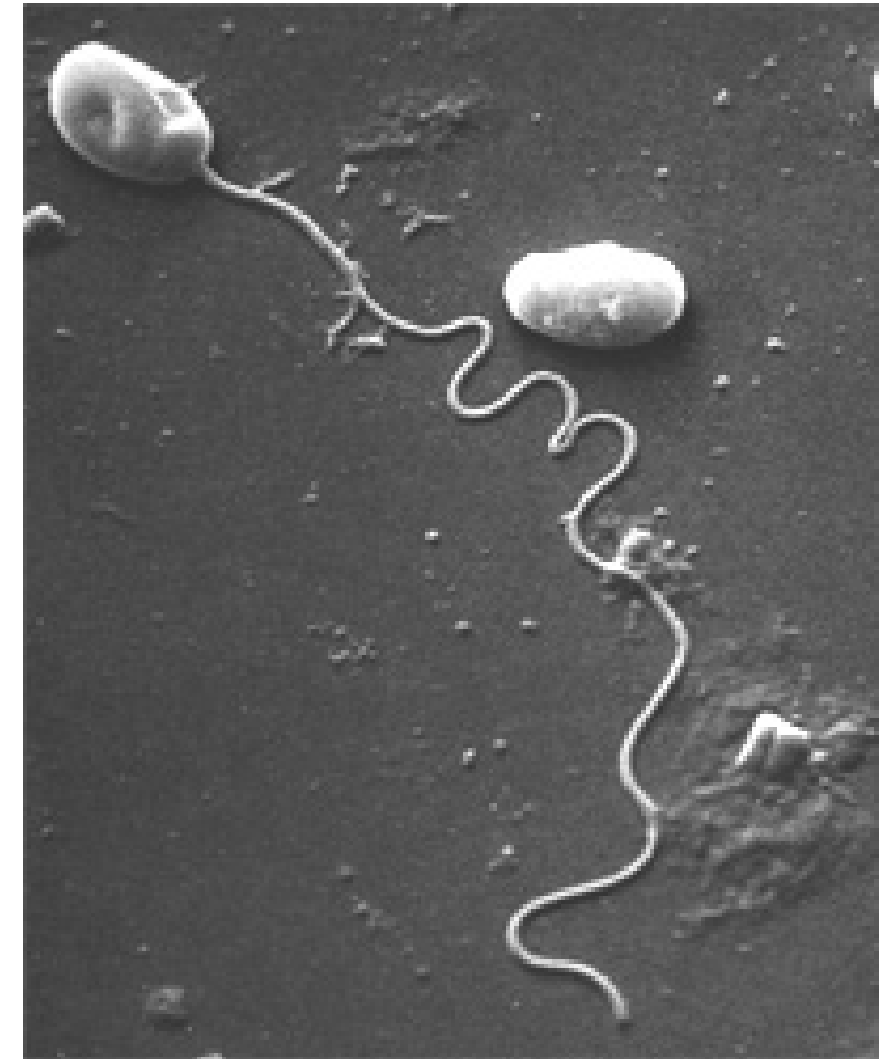


Microsporidian (spore-forming unicellular “fungi”)

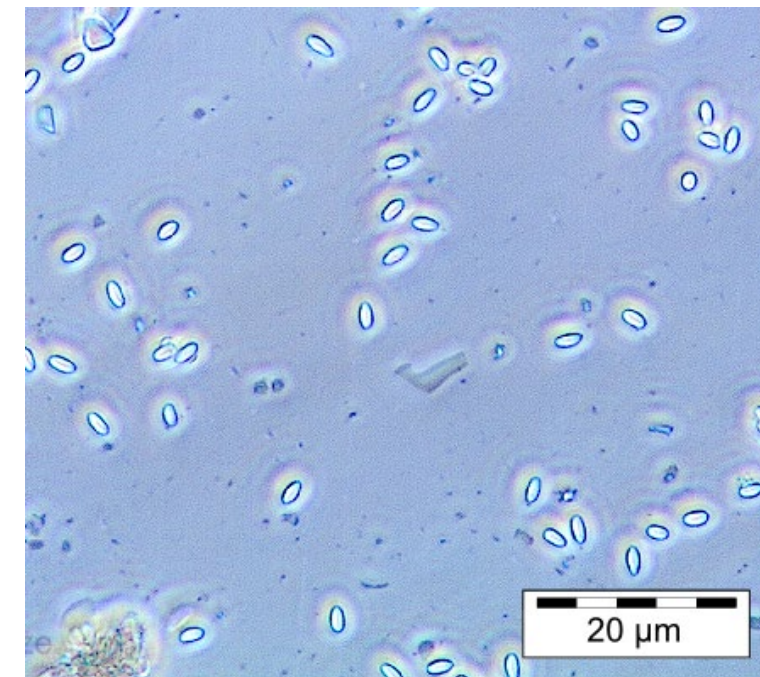
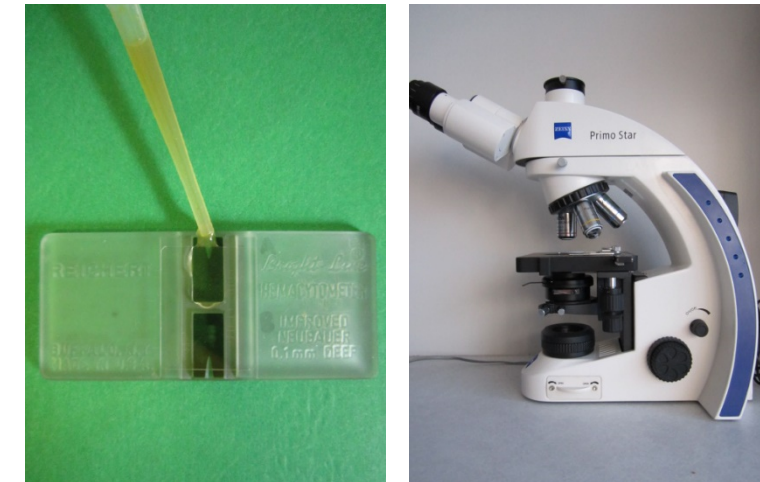
- Obligate parasites
- Infect the gut lining
- Spores can be detected in the gut content

2 species relevant for Honey bees:

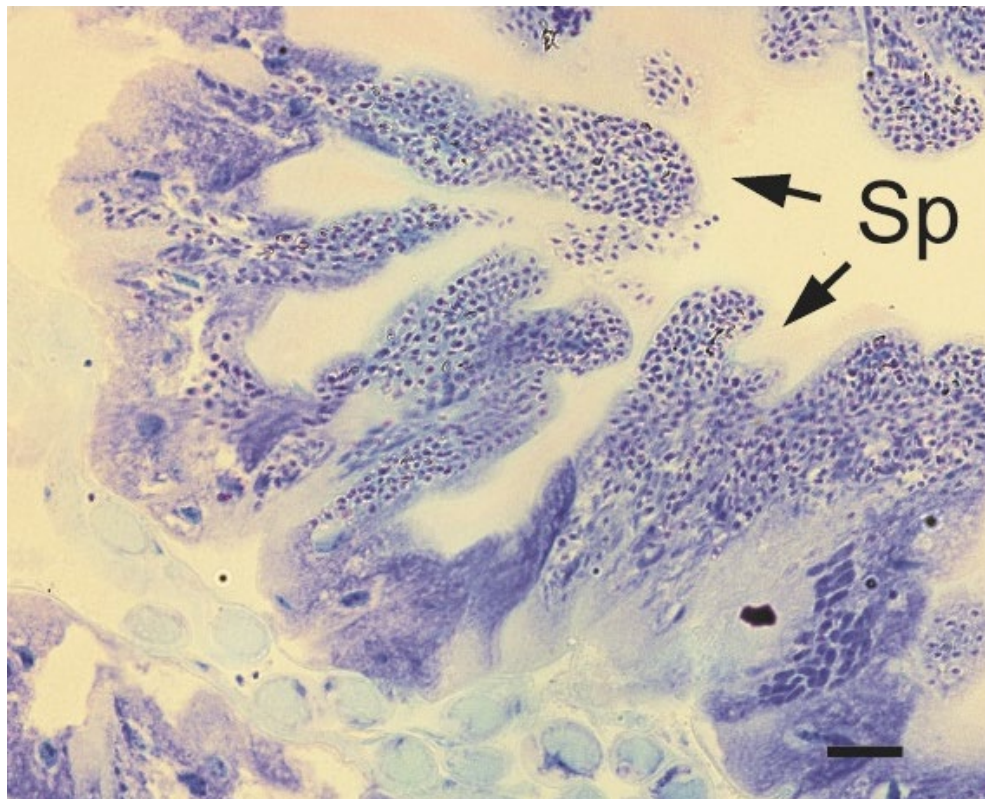
- *Nosema apis*
- *Nosema ceranae*



Long tube is used to inject
spore contents into cells lining
the midgut
PC: R. Larsson

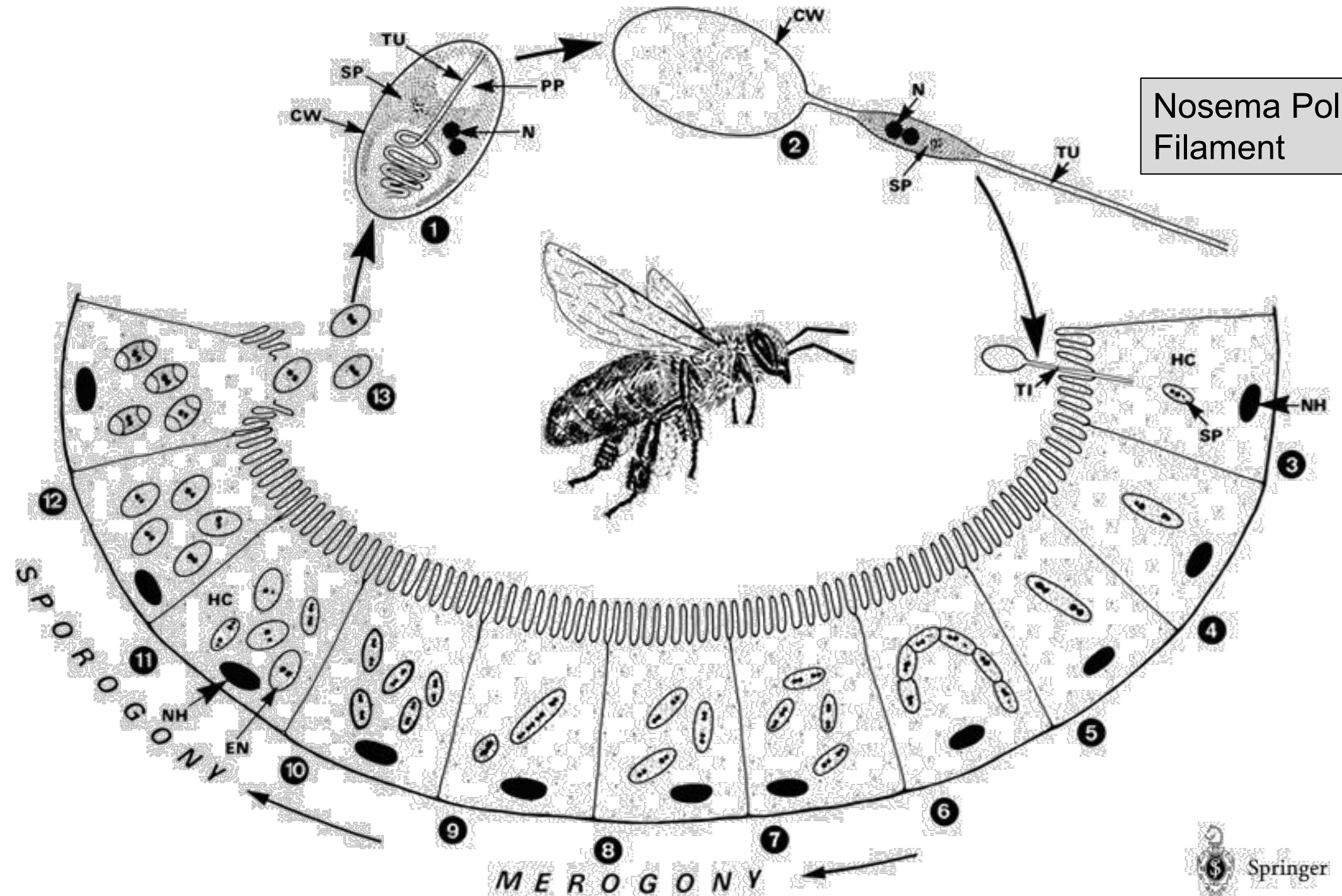


Nosema



Nosema Spore

Nosema Polar Filament



Nosema



Nosema apis

- Discovered on *Apis mellifera*
- In the U.S. by the early 1900s
- “wet” Nosema
- dysentery



Nosema ceranae

- Discovered on *Apis cerana* (Asian Honey Bees)
- Reported in Europe in 2006
- May have been in the U.S. since 1990s
- “dry” Nosema

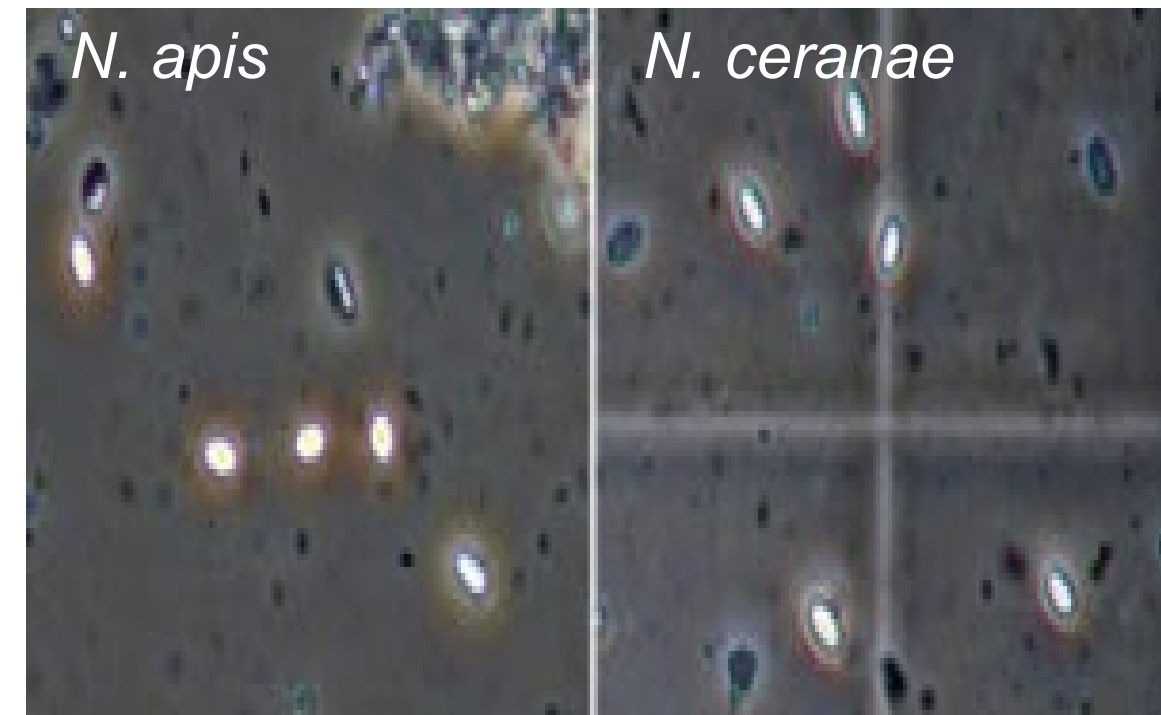
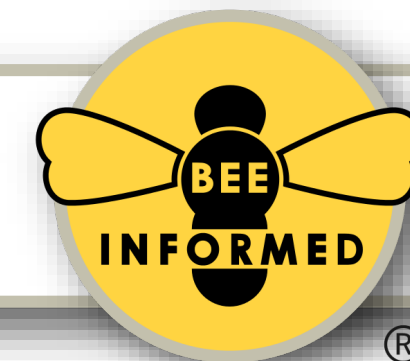


Photo Credit: <https://txbeeinspection.tamu.edu/nosema/>

Dysentery?



Dysentery is often associated with *Nosema*

Dysentery may be a sign of *N. apis*
(NOT a sign of *N. ceranae*)

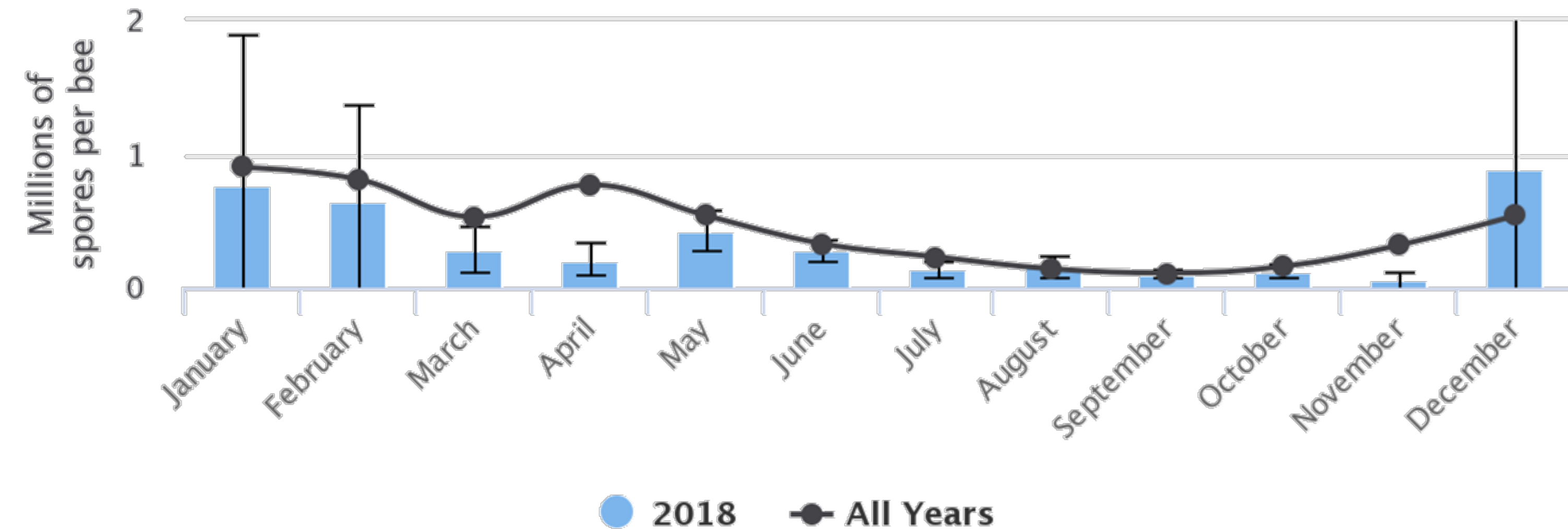
Dysentery is often a sign of something else...

Nosema



Average Nosema load (intensity)

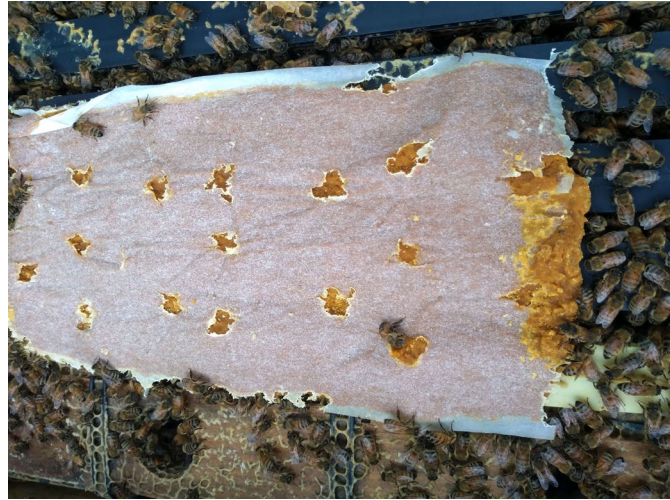
Comparing National Average for All Years (n=7439)
to year 2018 (n=1059)



Prevalence:

- 2018:
65% of apiaries
(n=720)
- All years:
67% of apiaries
(n=1,479)

Nosema Prevention

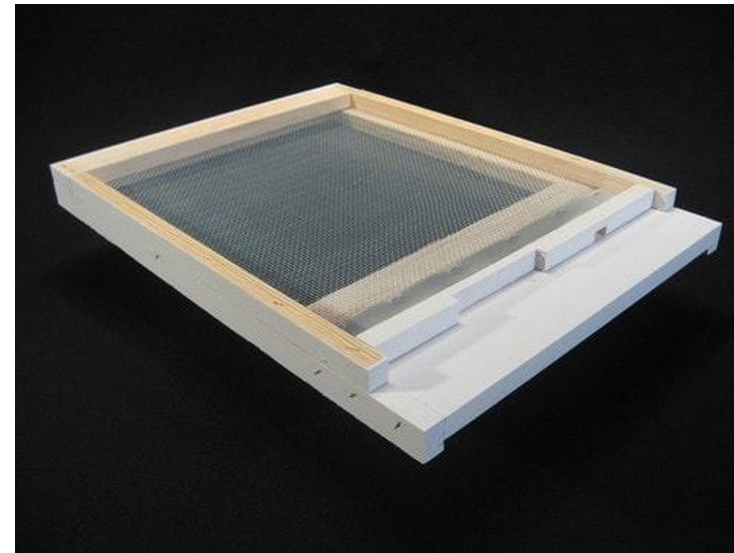


Good Nutrition

A Young Prolific Queen



= Good Brood Production



**Moisture control
Ventilation**

Nosema Equipment



- Thermal Decontamination (120F-24hrs)
- Irradiation
- Fumigation
 - Acetic Acid
 - Ethylene Oxide
 - Phostoxin



Photo Credit:
<https://honeybee.uoguelph.ca/resources-for-beekeepers/acetic-acid-fumigation/>

Nosema Control



- Fumagilin approved to treat Nosema on Honey Bees
- Unclear efficacy...



<https://www.mannlakeltd.com/fumidil-b-500-gram-bottle-case-of-12>

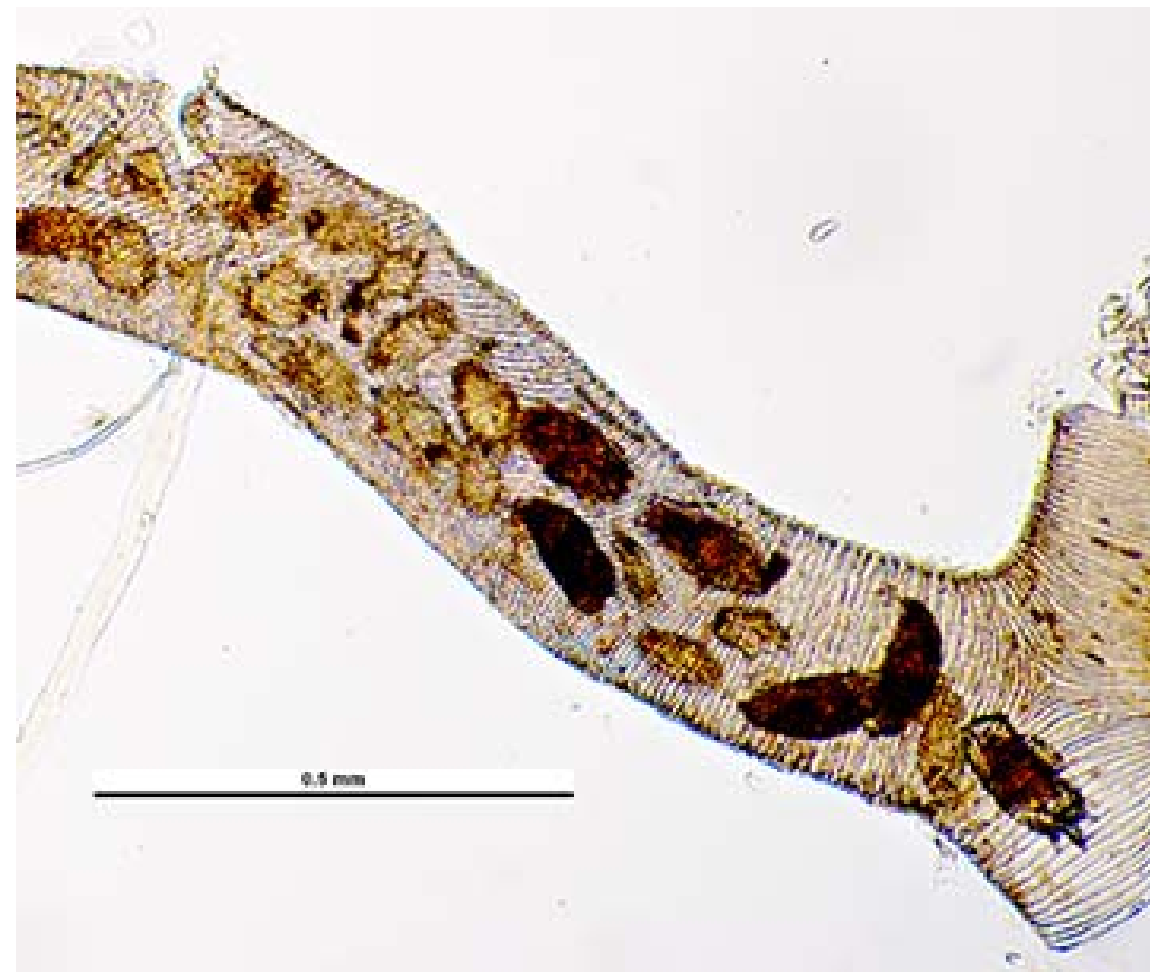
Tracheal mites (Acariose)



- *Acarapsis woodi*
- Internal parasite: adult bee trachea
- Symptoms:
 - bee incapable of flight
 - wings in cross
- Treatment:
Same as *Varroa*



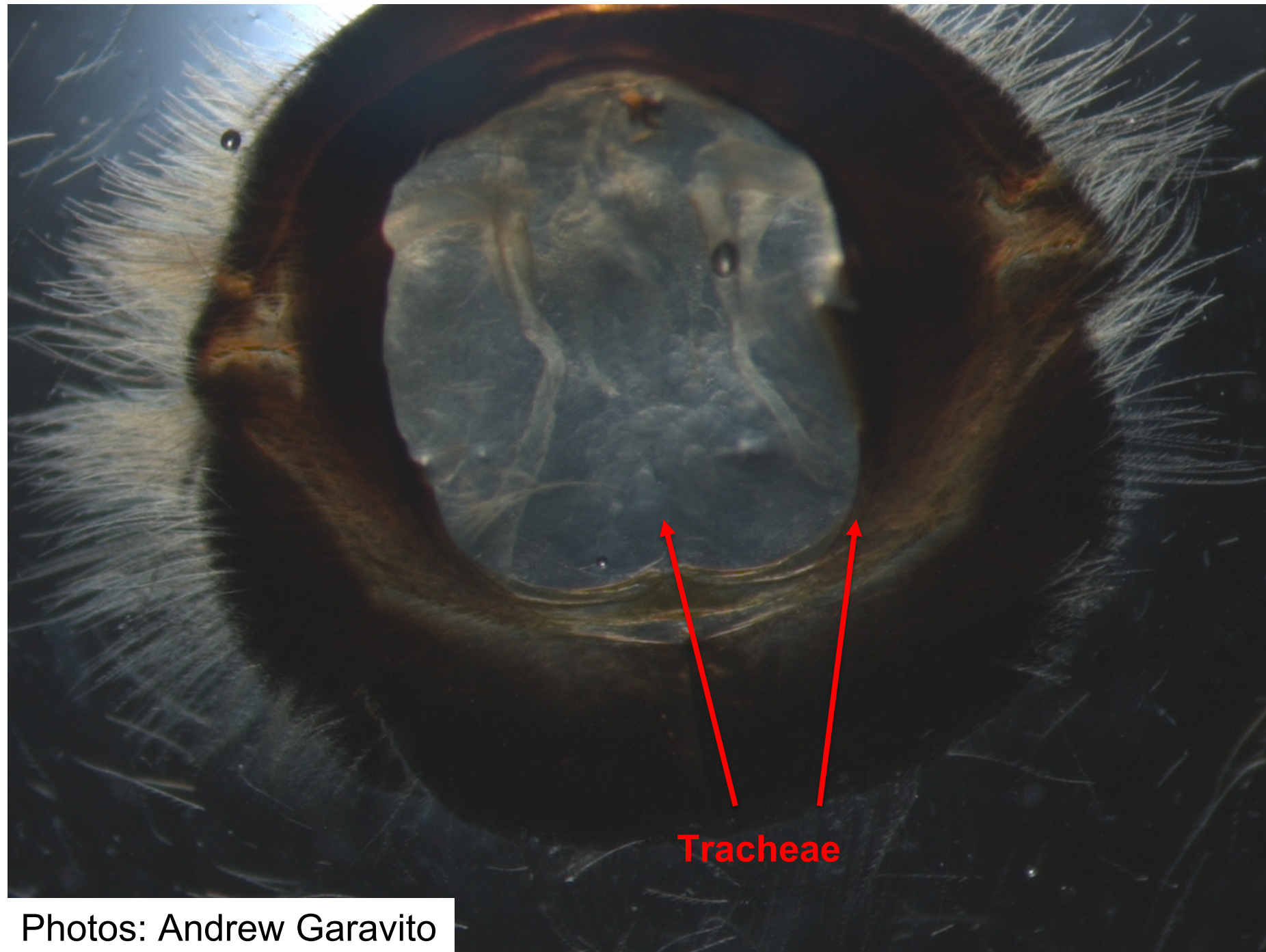
© Rob Snyder



Tracheal mites (Acariose)



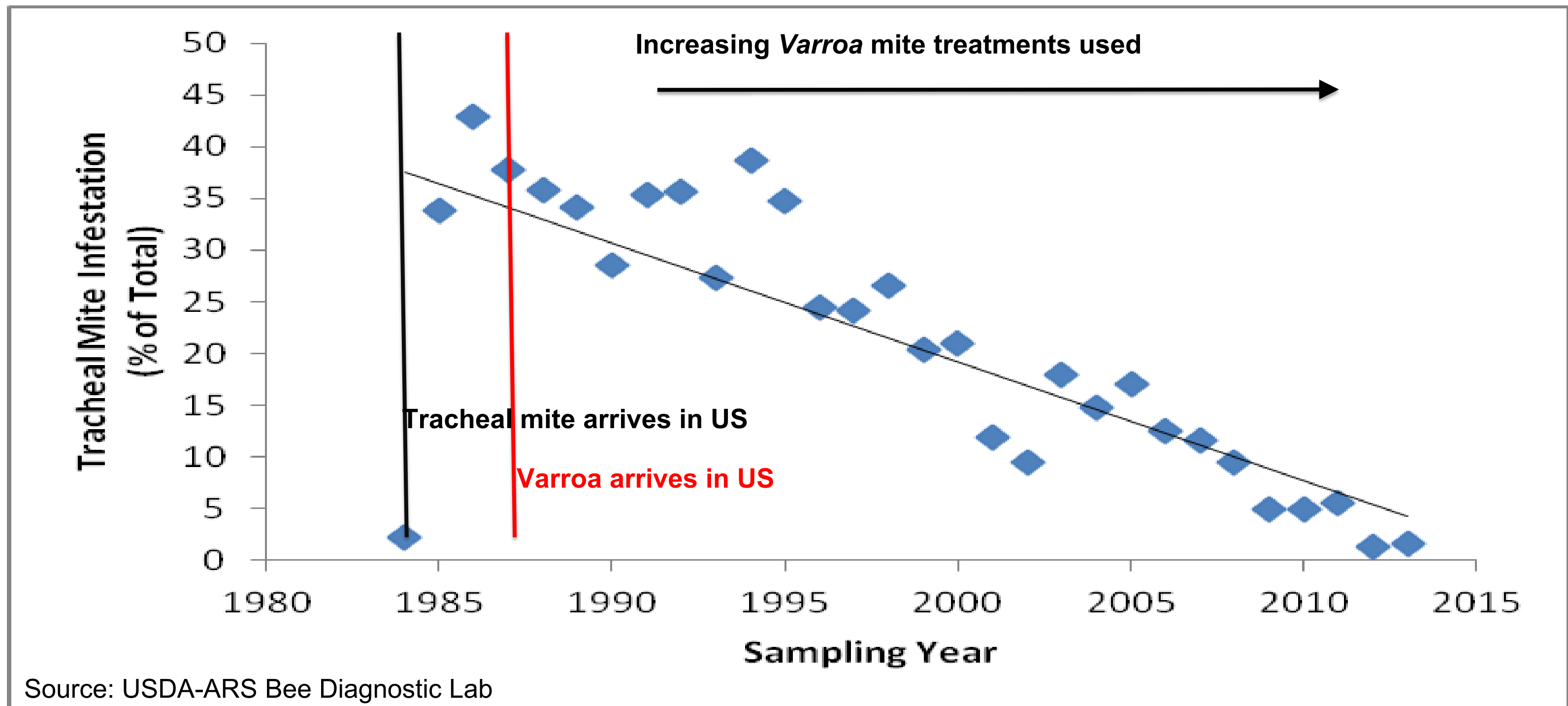
Dissection



Photos: Andrew Garavito



Tracheal mites (Acariose)



Other fungal diseases



Chalkbrood

- *Ascosphaera apis*
- “chalky larvae” (brie cheese?)
- Highly prevalent



Stonebrood

- *Aspergillus*
- Mummified larvae
- rare



Chalkbrood



- *Ascosphaera apis*
- Larval death by spore infection
- “chalky larvae” (brie cheese?)
- Highly prevalent

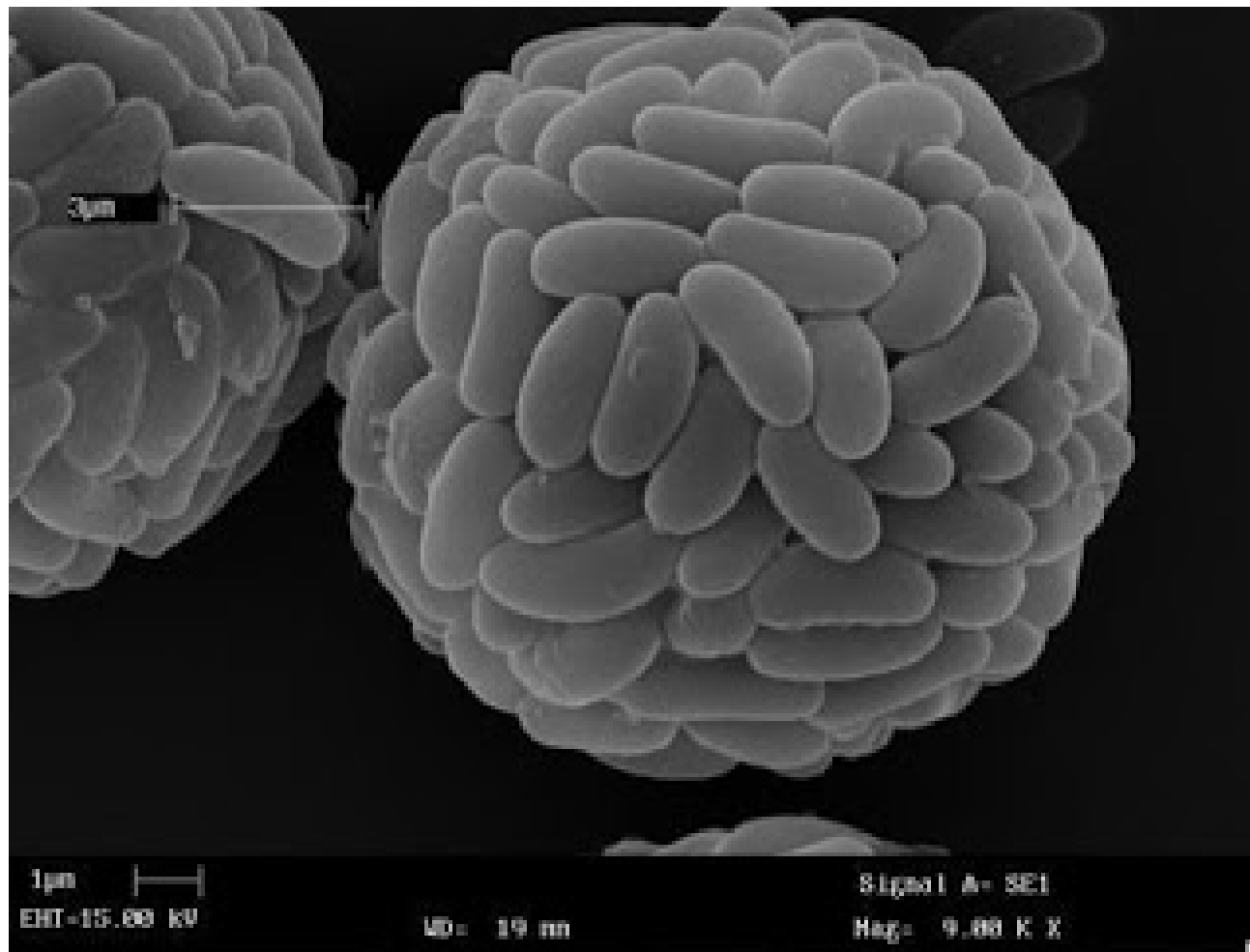
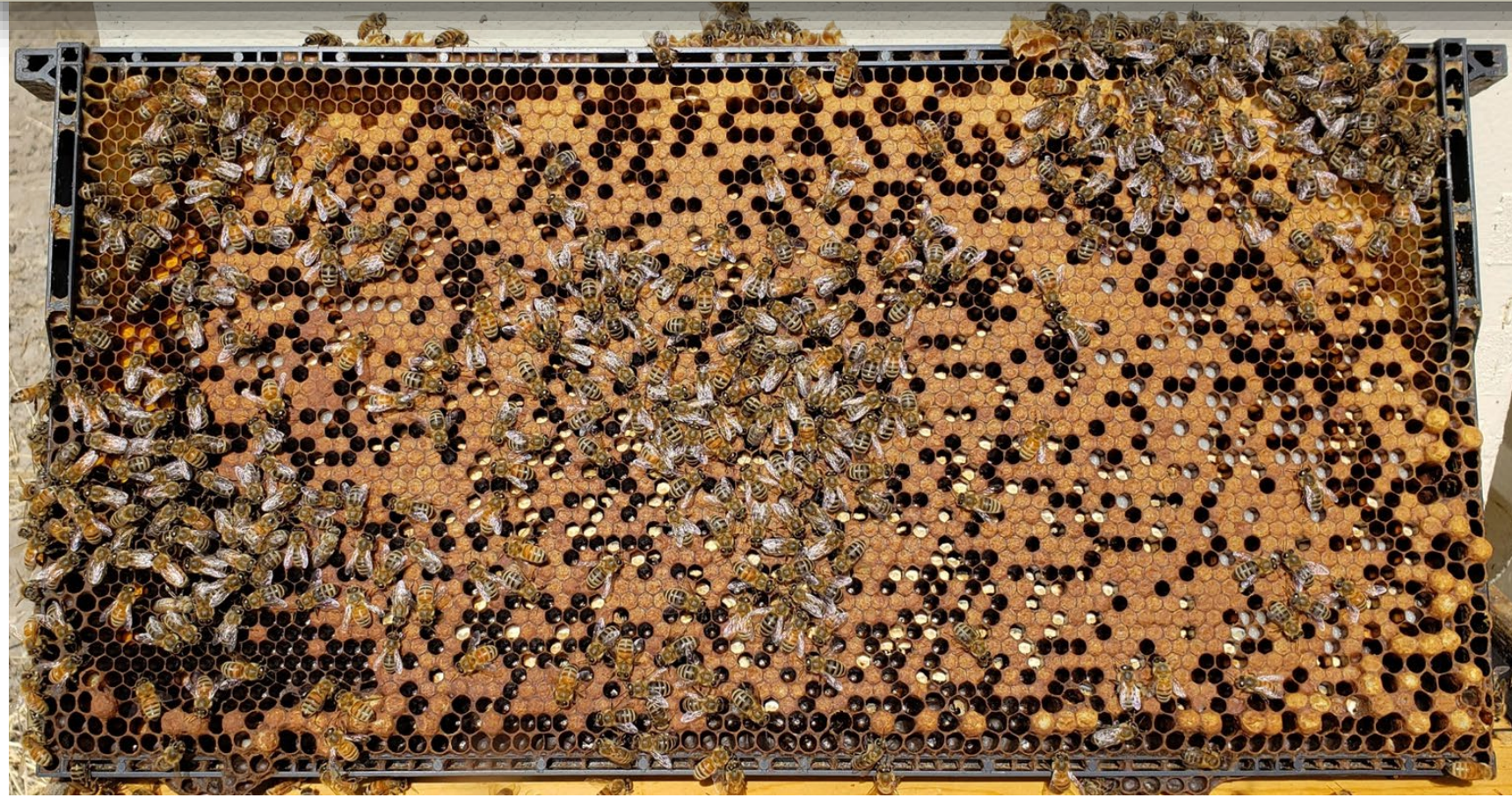
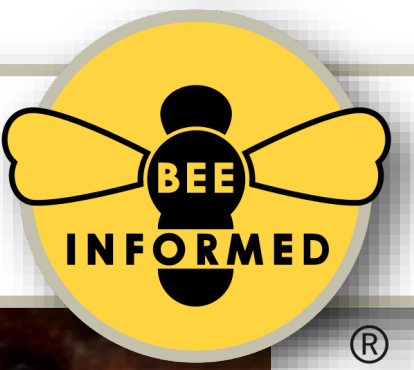


Photo credit Electronic Journal of Polish Agricultural Universities



Chalkbrood



Chalkbrood

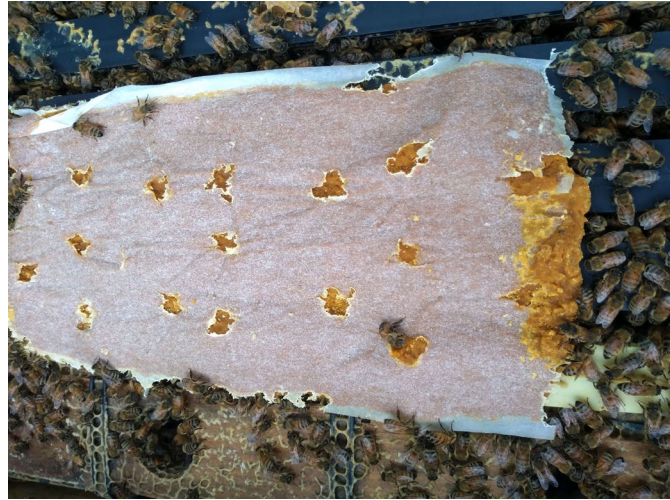


Early stages of Chalkbrood



Late stages of Chalkbrood

Chalkbrood Prevention

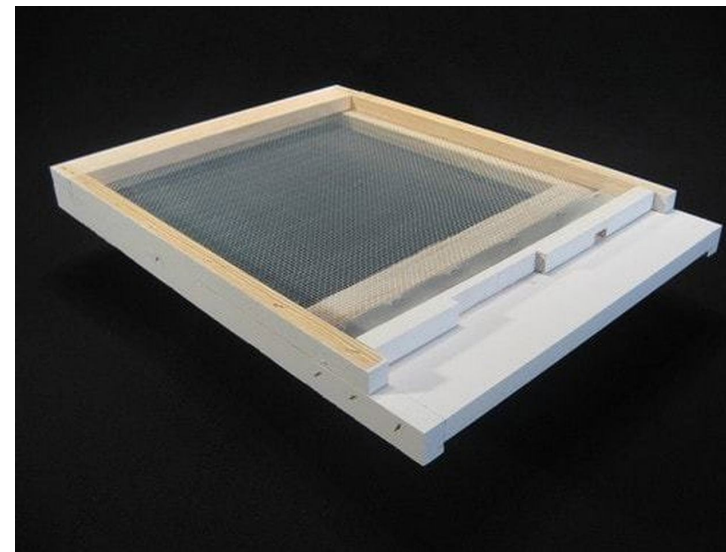


Good Nutrition

A Young Prolific Queen



= Good Brood Production



**Moisture control
Ventilation**

Foulbroods (bacterial diseases)



European Foulbrood

EFB

- *Melissococcus pluton*
- Increasing prevalence?
- Misdiagnosed common disease
- Antibiotic treatment possible

American Foulbrood

AFB

- *Paenibacillus larvae*
- Most contagious and deadly!
- Relatively uncommon at present
- No remedy – destroy colony

Foulbroods (bacterial diseases)



European Foulbrood EFB

Field testing: EFB or AFB test kits

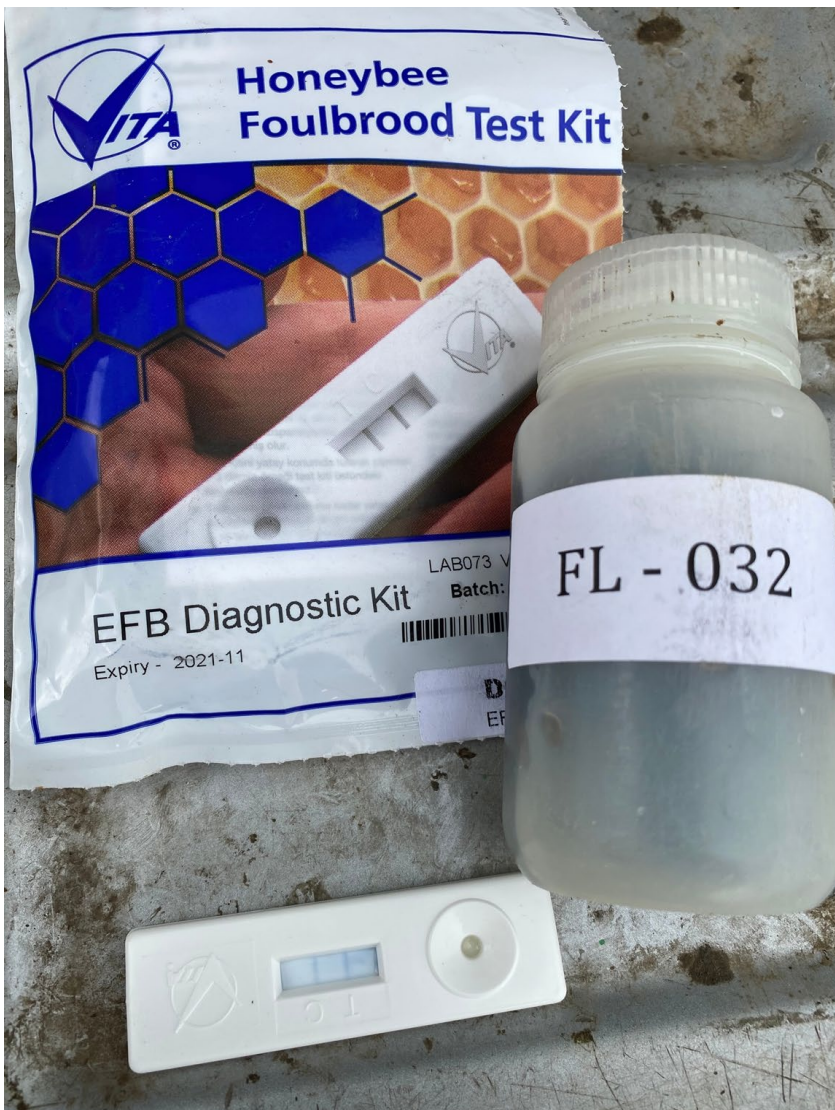
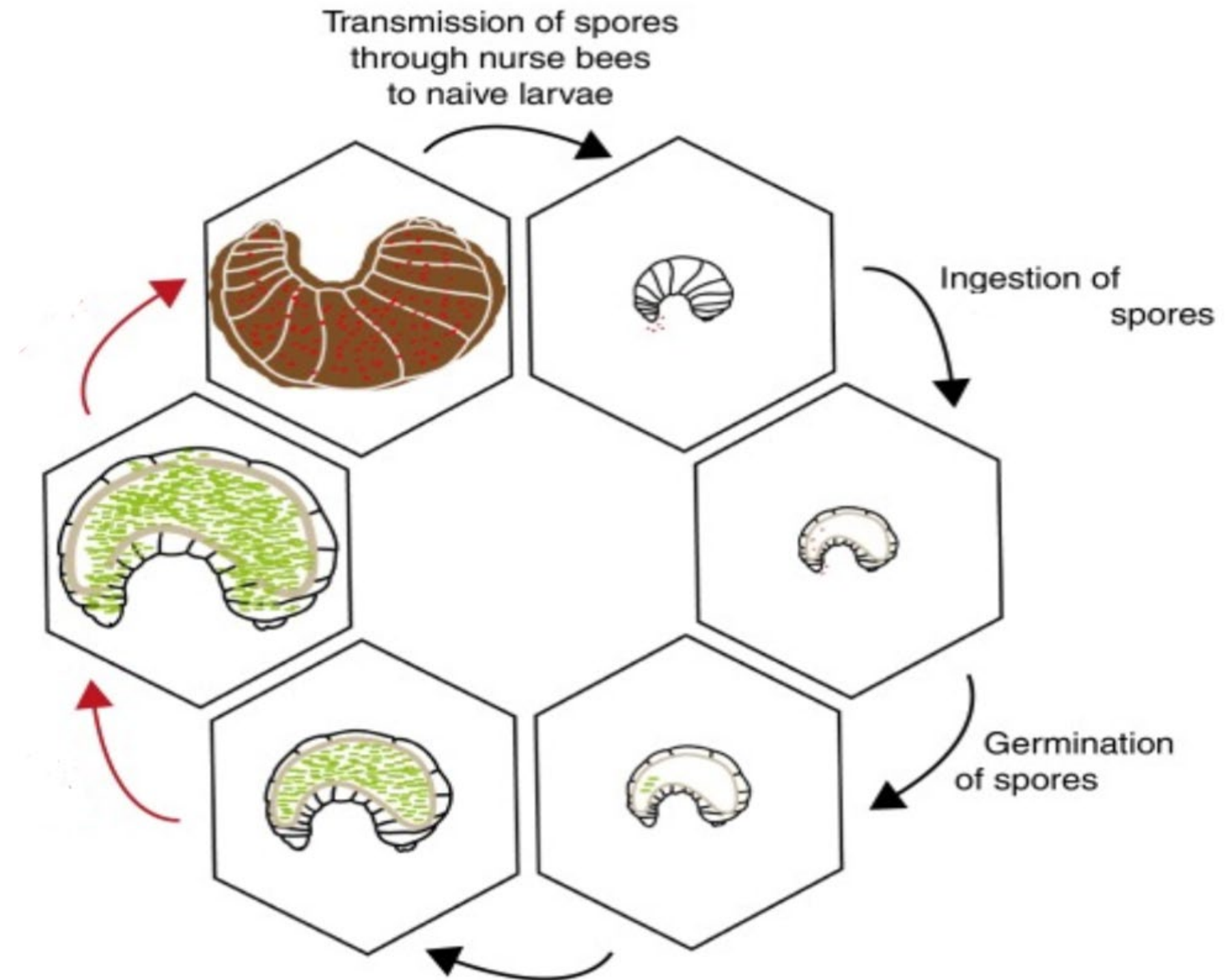


Photo: Dan Wyns

EFB & AFB cycles



- Infect larvae or pupa
- Followed by secondary infections



Source: Current Opinion in Insect Science

EFB - European Foulbrood



Transmission of spores
through nurse bees
to naive larvae

Ingestion of
spores

Germination
of spores

Transmission of spores
through nurse bees
to naive larvae

Ingestion of
spores

Germination
of spores

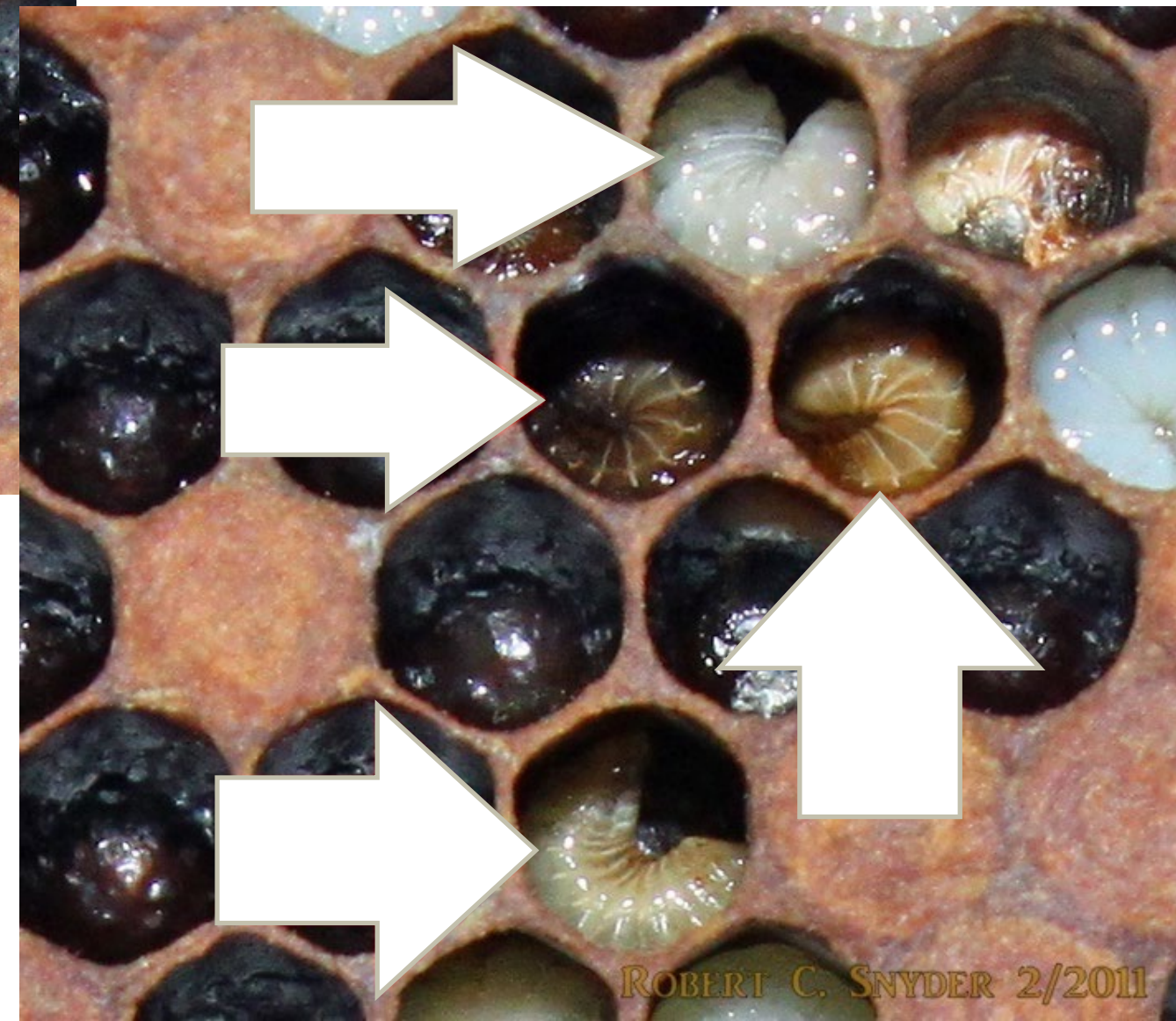
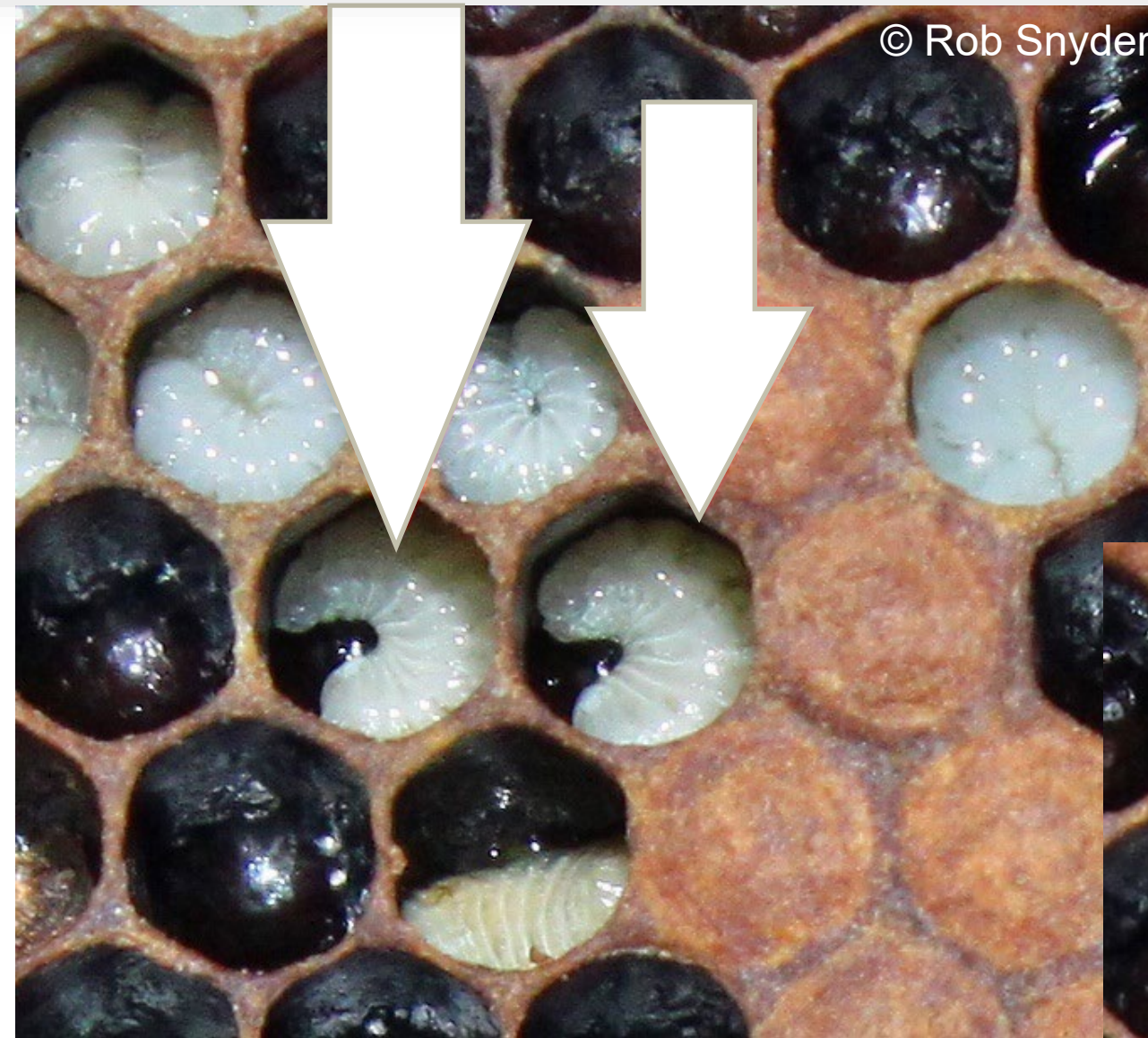
Source: Current Opinion in Insect Science

EFB - European Foulbrood

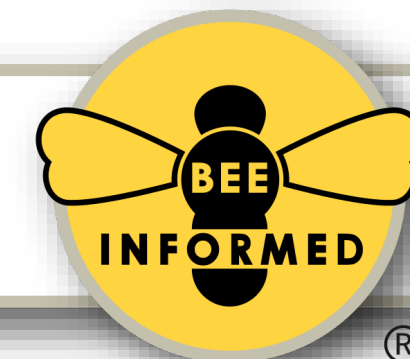


Signs:

- Poor brood pattern
- Contorted/twisted larvae
- C-shaped larvae
- Discolored brood food
- Discolored larvae
- Defined trachea
- Melted larvae



EFB - European Foulbrood



© Robert Snyder 2013



© Robert Snyder 2013

EFB - European Foulbrood



Contaminated brood food

AFB - American Foulbrood



Signs:

- Poor brood pattern
- Sunken, greasy, or perforated cappings
- Caramel colored larval material
- Dark scale on cell floor
- Pupal tongue (rarely seen)

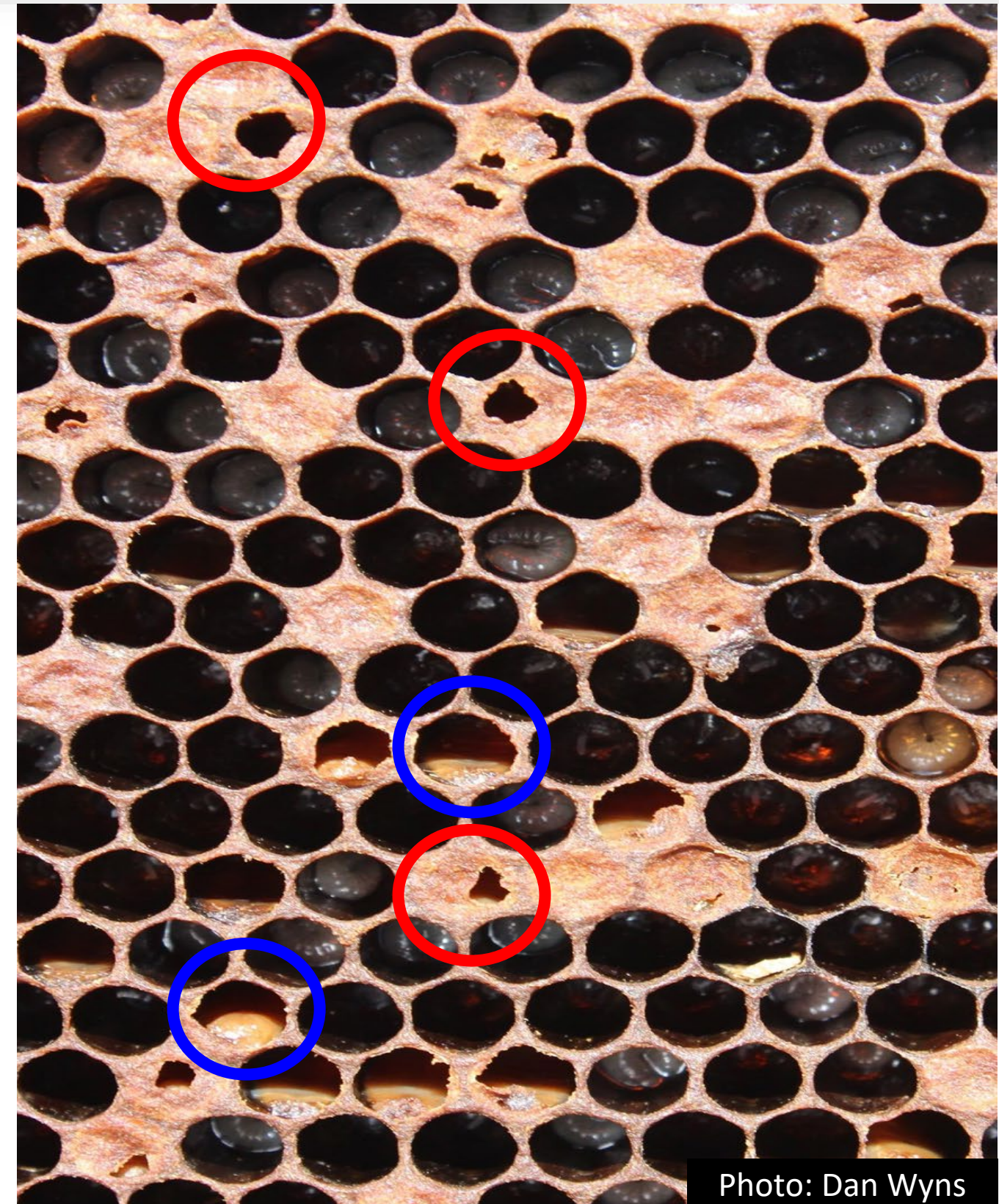
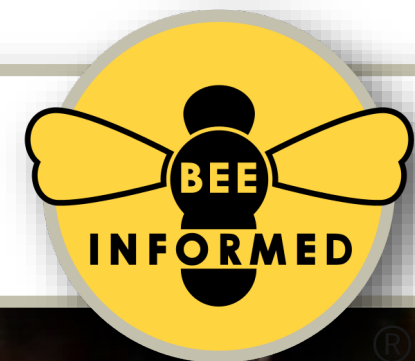


Photo: Dan Wynn

AFB - American Foulbrood (late stage)



AFB - American Foulbrood



- An infected colony should be dealt with immediately
- Burn and bury infected equipment
- Shook swarm / frame exchange + antibiotics (per label)
- Other colonies in apiary:
 treat with antibiotics
- Quarantine infected apiary



Photo: Sarah B Scott

Use of antibiotics



- Require a **prescription** or **veterinary feed directive (VFD)** from veterinarian

<https://pollinators.msu.edu/programs/bees-need-vets/>

- Critical to apply according to label

Antibiotics

- do not work against spores
- do halt replication in the vegetative form



Photo: Sarah B Scott

Wax moths



- 2 species: greater (*Galleria mellonella*) and lesser (*Achroia grisella*)
- Opportunistic pests
- As larvae: eat beeswax, stored pollen, remains of honey bee larvae
- Mostly problematic in stored, unattended combs

Lesser wax moth



Greater wax moth



Wax moths



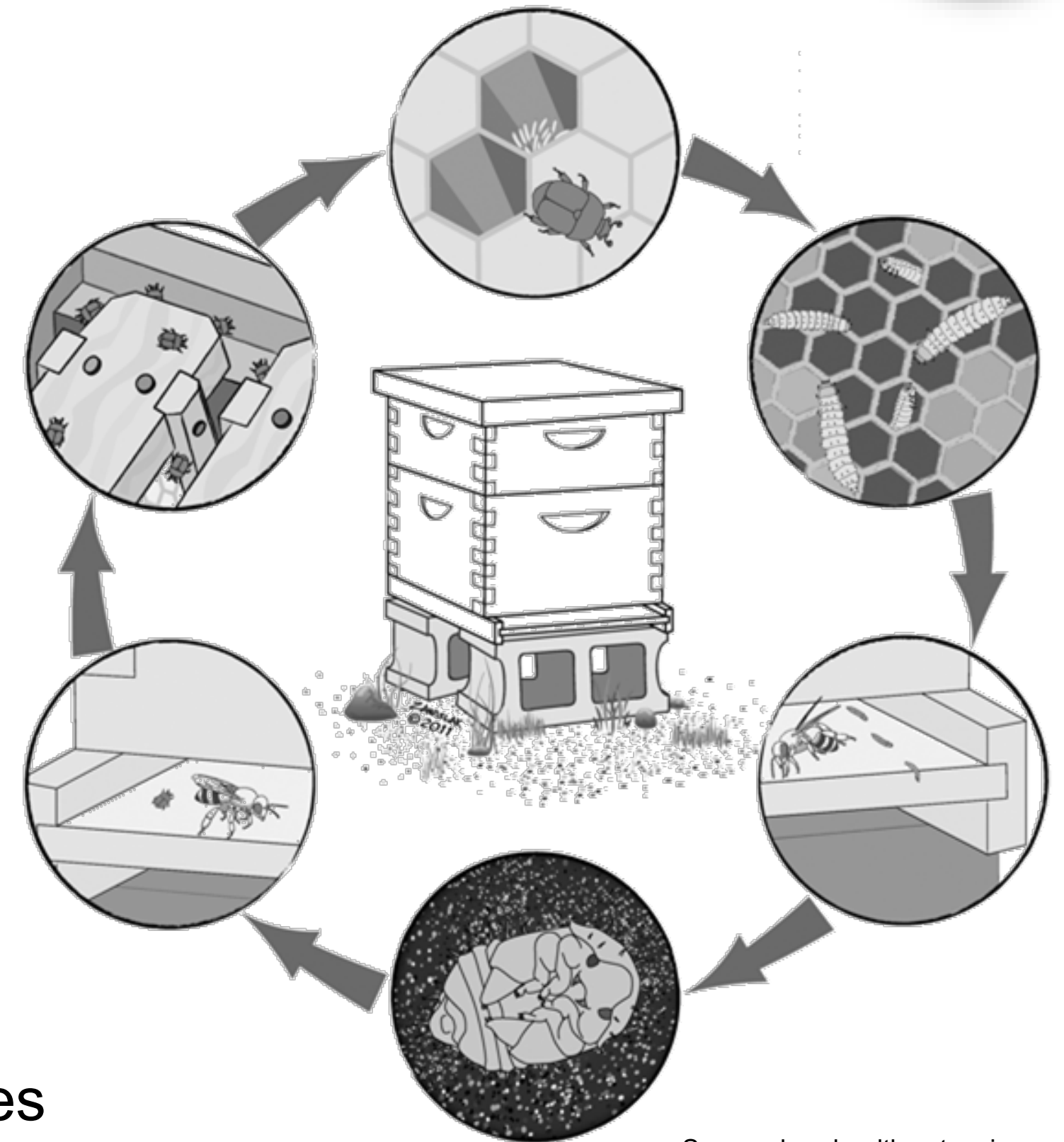
- Look for tunnels of silk, and white cocoons
- Inspect weak, stressed and queenless colonies
- Keep strong colonies / keep strong bee-to-comb ratio
- Inspect unattended combs; keep unattended comb out of apiary



Small Hive Beetle

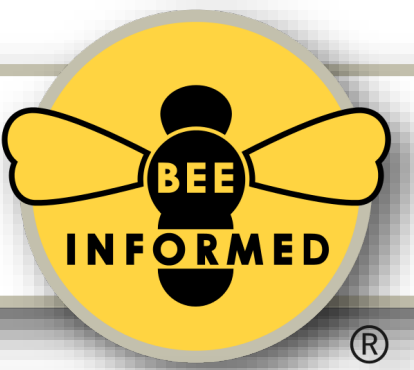


- *Aethina tumida*
- Opportunistic pests
- Arrived in the US ~1998
- As larvae: eat honey, stored pollen, bee larvae
- Mostly problematic in the South and in weak colonies



Source: bee-health.extension.org

Small Hive Beetle



Wax Moth vs Small Hive Beetle (larvae)



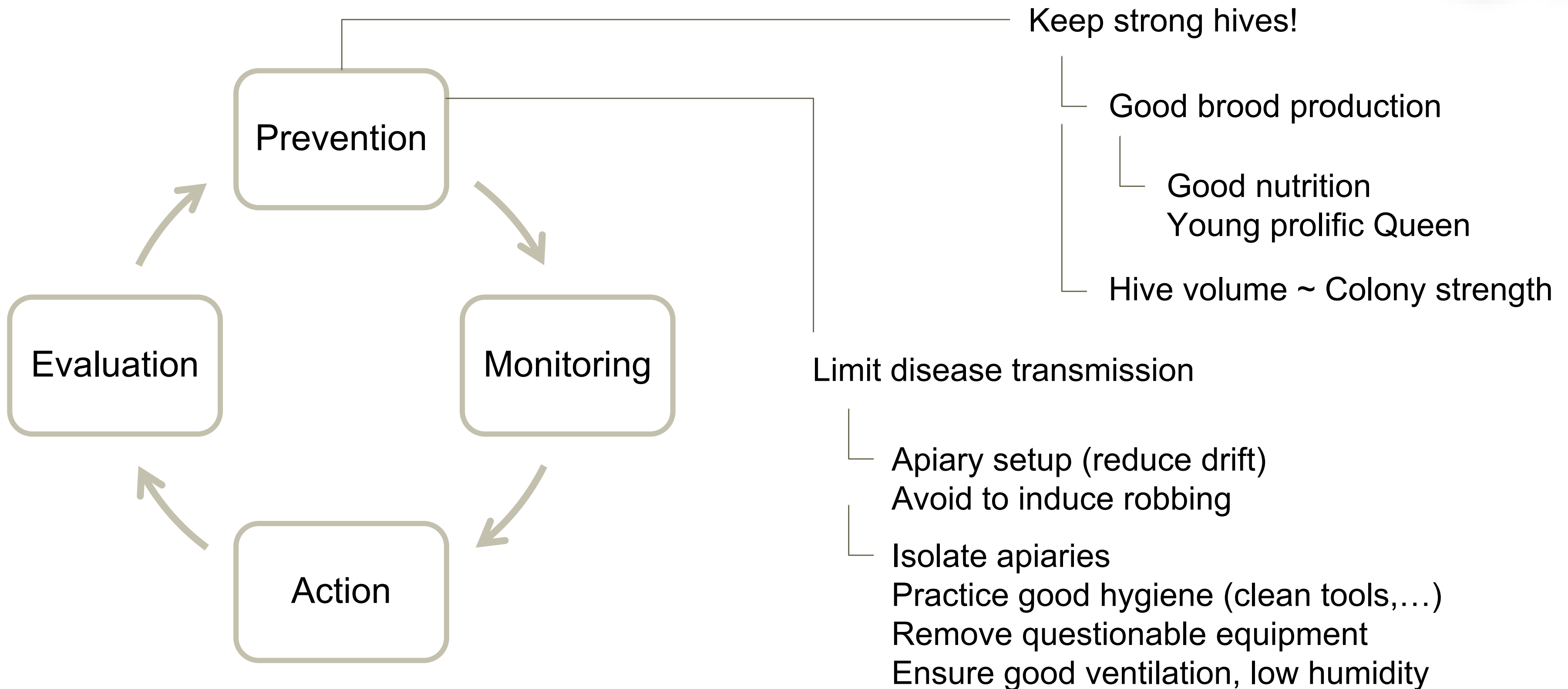
Wax moth —

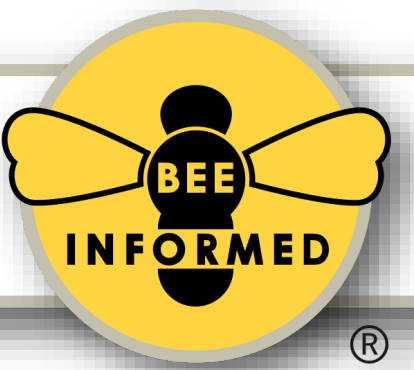
SHB —



Source: Southeastern Indiana Beekeepers Association

Conclusion: Pest Management





Case scenarios

What would you suspect if confronted with the following scenarios
What would you do (if anything)?

Scenario 1



A fellow beekeeper calls you to get advice on what's happening with one of their colonies.

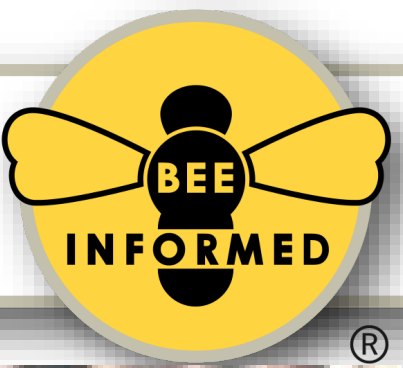
It is early spring, the bees have barely started to pick up the pace.

They went to have a first look at their colonies after the winter, and noticed a lot of debris at the entrance of their colony, among which a fair amount of dead bees.

Should they be worried?



Scenario 2

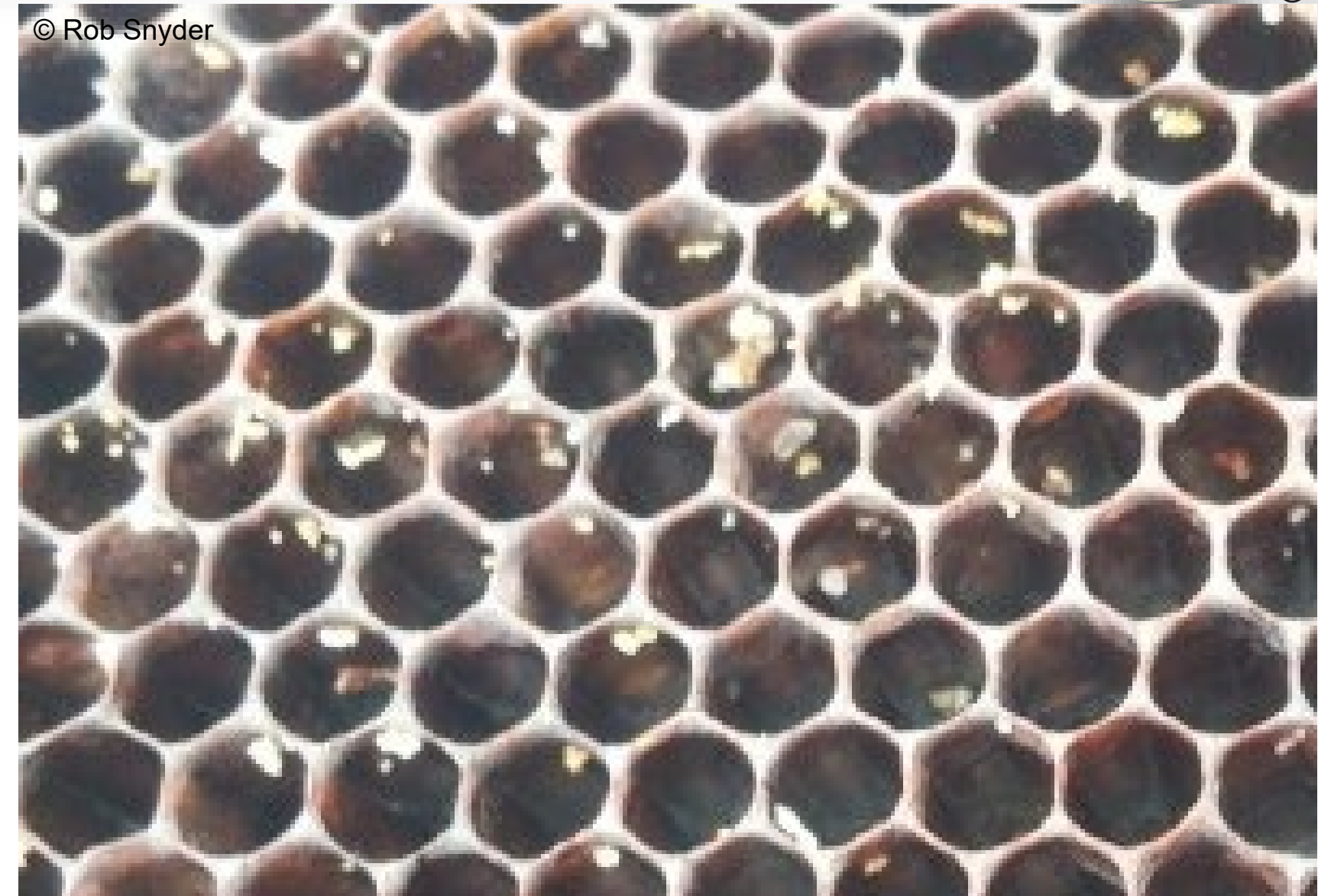


A fellow beekeeper calls you to get advice on what's happened with one of their colonies. We're in early spring in DC. They just peaked in to see which of their colonies made it past the winter.

That one colony was very strong last summer and still looked big into the fall. They made sure it had enough food too.

Unfortunately, it didn't make it. A tiny cluster of dead bees is all that is left, the size of a softball. There are hardly any dead bees on the bottom board. There is still a lot of honey left in the top supers. There is some patch of capped brood left, very spotty, maybe with some bees dead on emergence too.

What happened?



At close inspection:

If you look closely in the cells around the brood, you will see white crystals stuck to the cell walls, looking like someone sprinkled coarse salt in the brood nest.

Scenario 3



A fellow beekeeper send you a picture of one of the brood frames in their colonies. It shows a typical “shotgun” pattern. (Note: the missing cells are not just back-filled with honey or pollen)

Can you advise them on what they should do from here?
Should they be worried?

