Withstanding *Varroa*

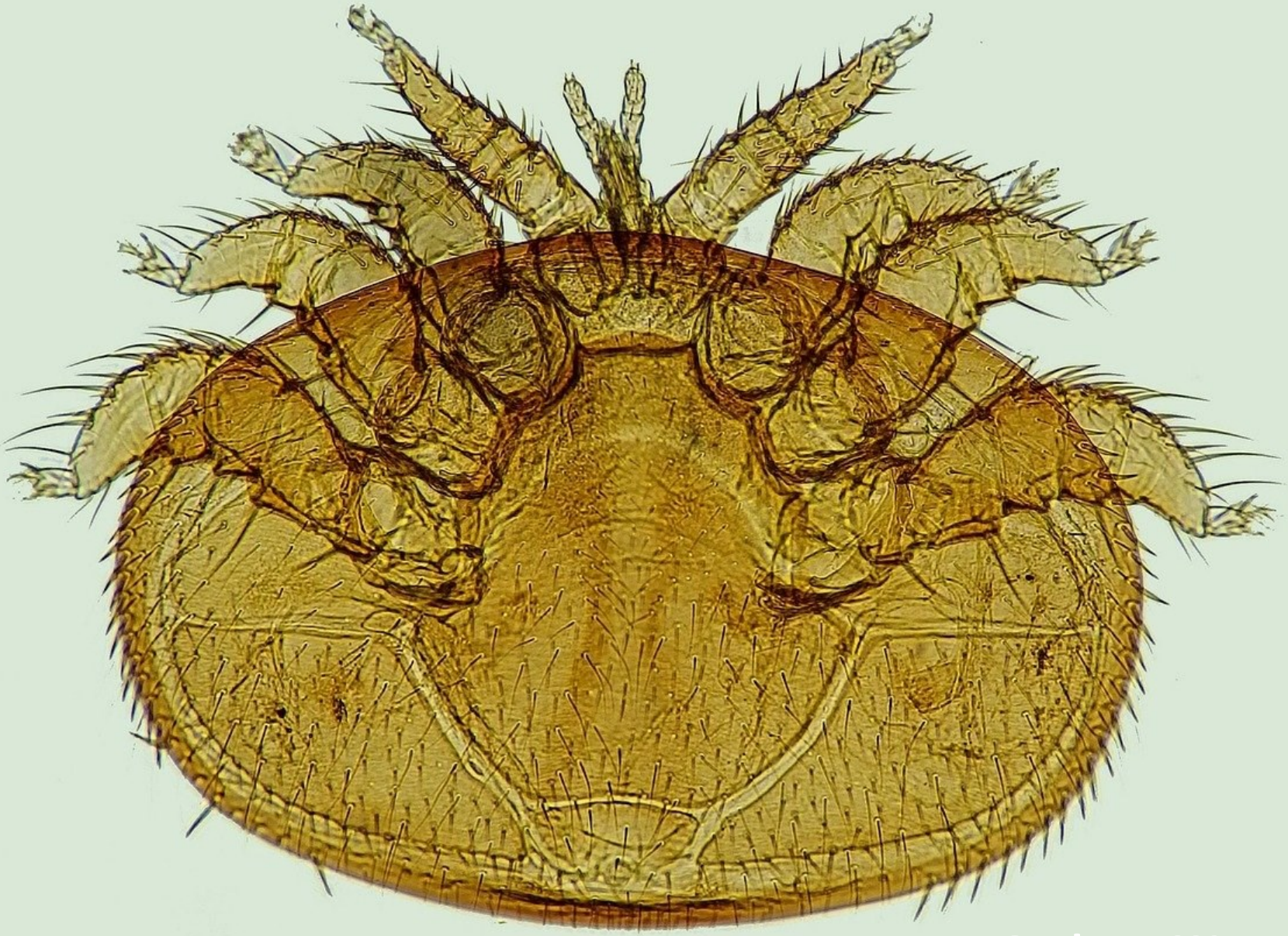


Image by olivierlevoux from Pixabay

Andrew Wootton

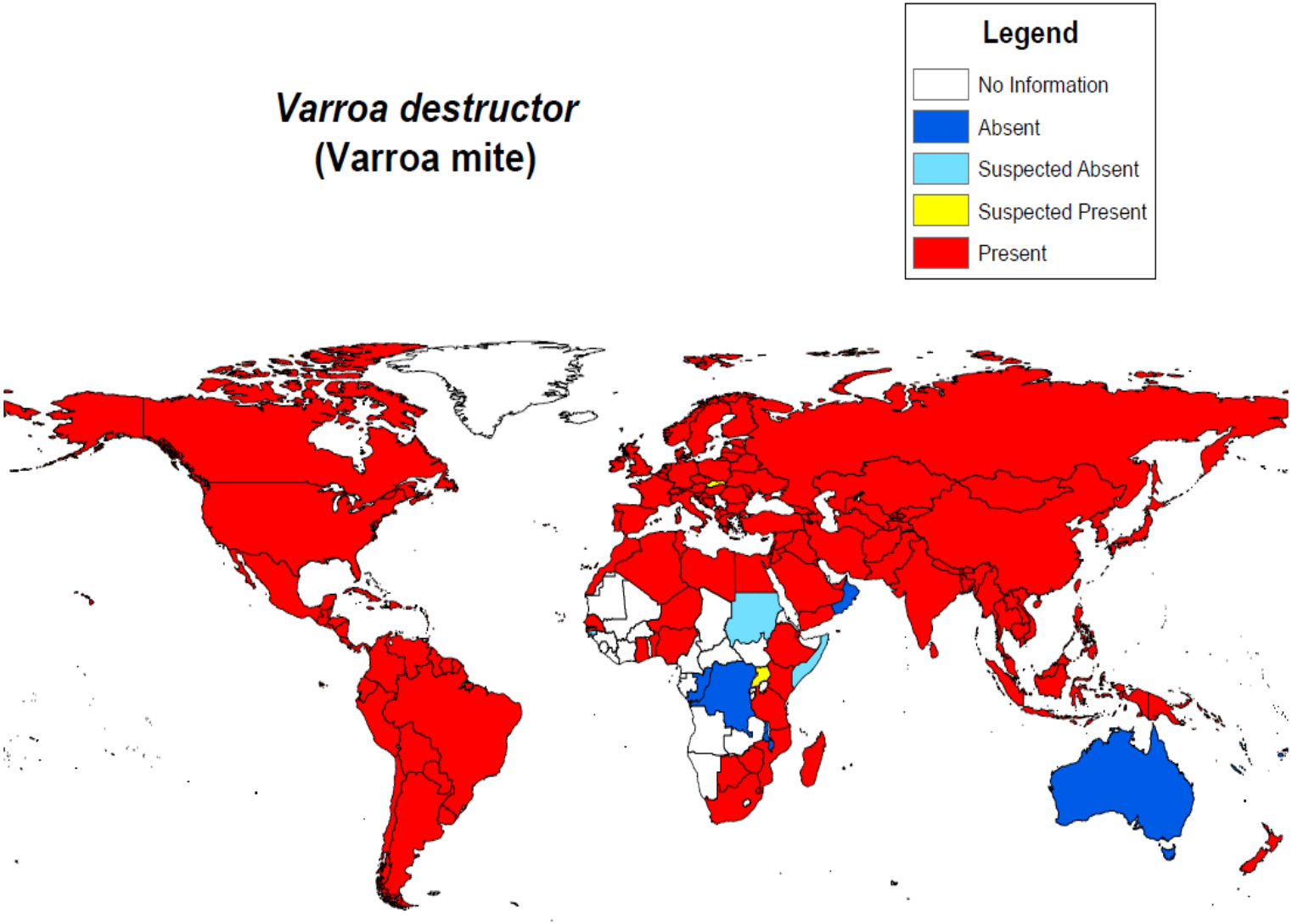
Yarra Valley Bee Group 28th Jan 2024

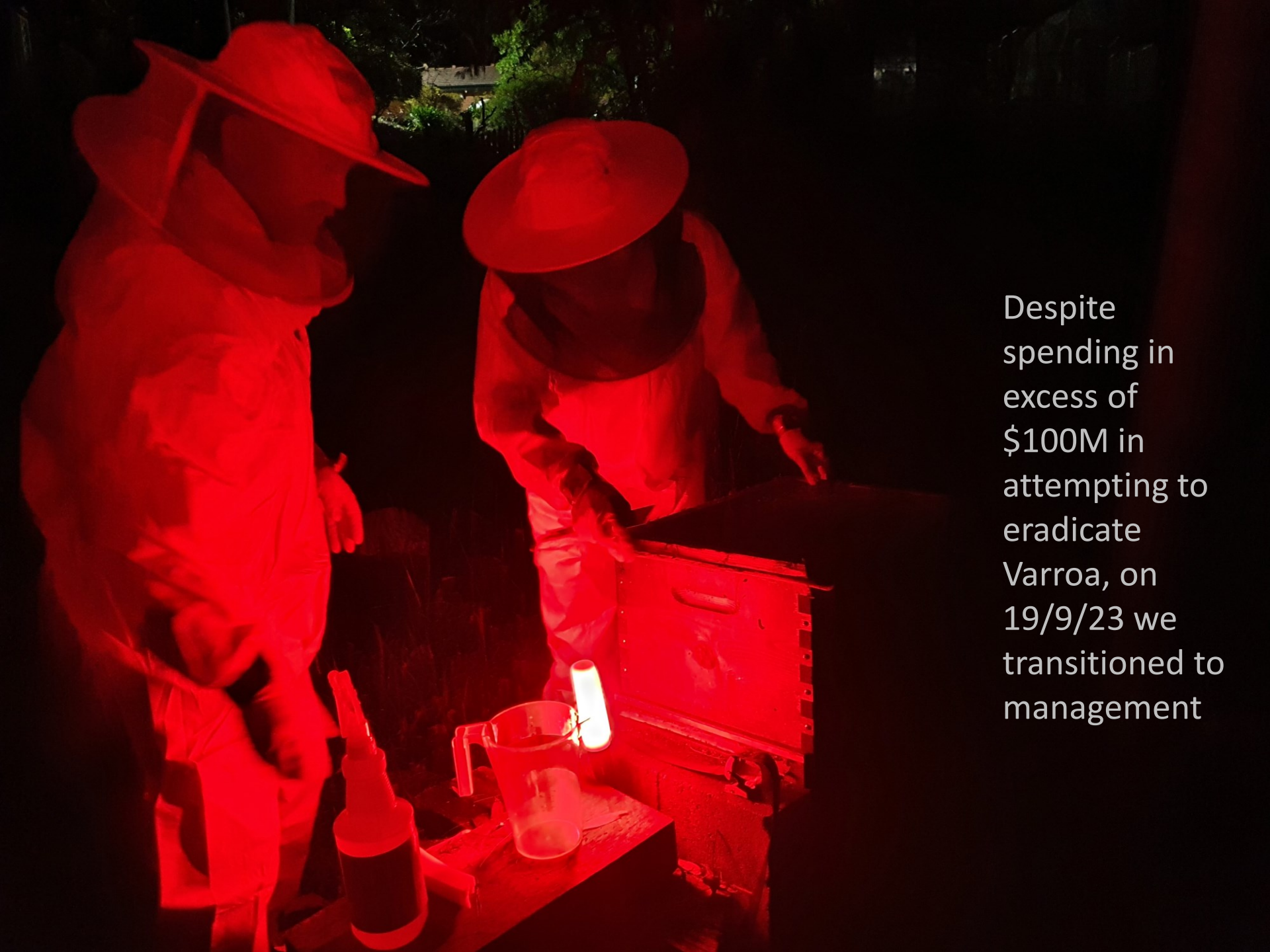
- Will I lose all my hives?
- What happens to the feral hives?
- What can I do to help my bees?
- Are treatments available yet?
- Are they breeding Varroa resistant queens? Can we import such queens?
- Can I go treatment free?

Worldwide distribution of Varroa (2020)

www.worldhoneybeehealth.com

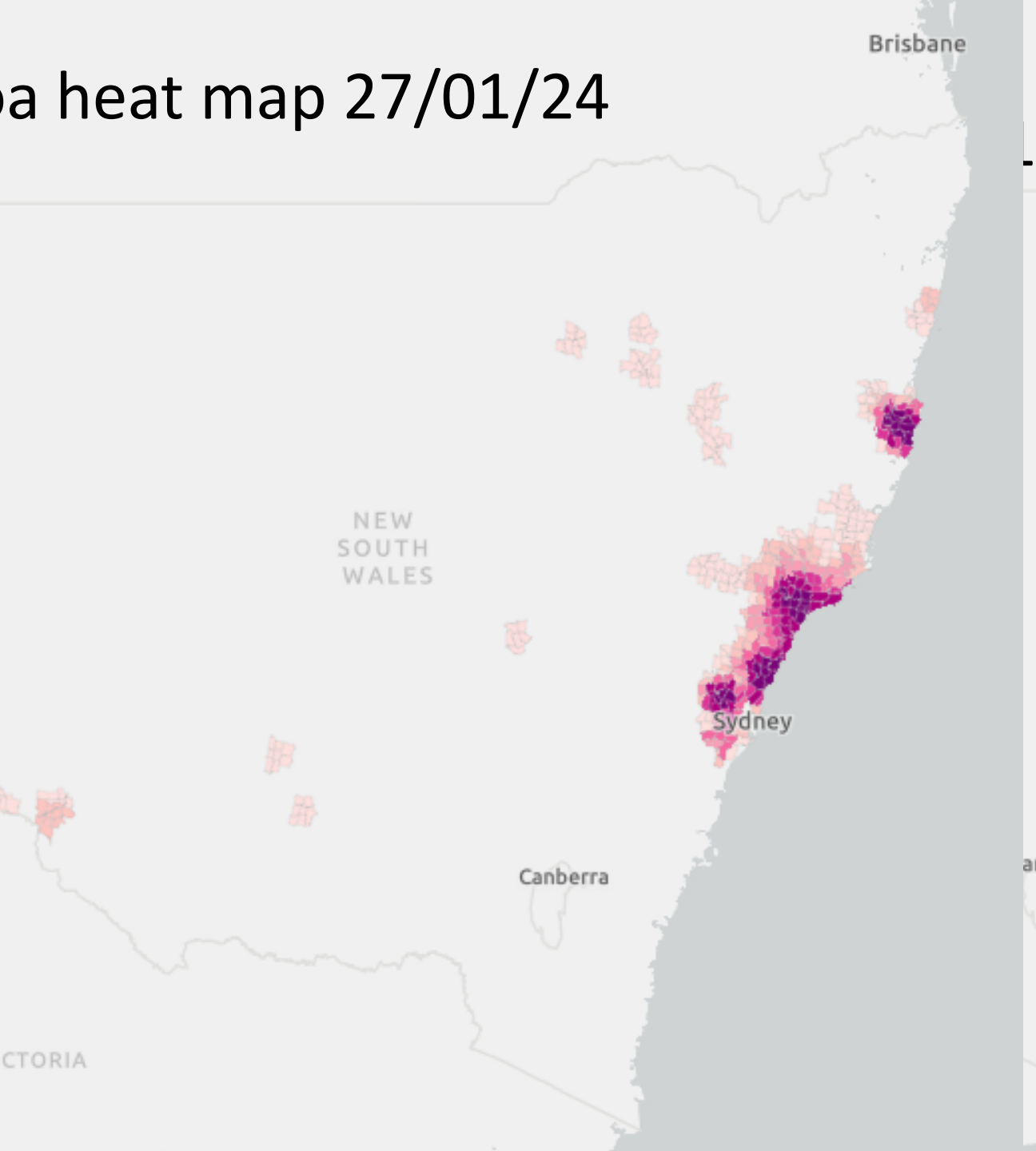
Varroa destructor
(Varroa mite)





Despite spending in excess of $100M in attempting to eradicate Varroa, on 19/9/23 we transitioned to management

a heat map 27/01/24



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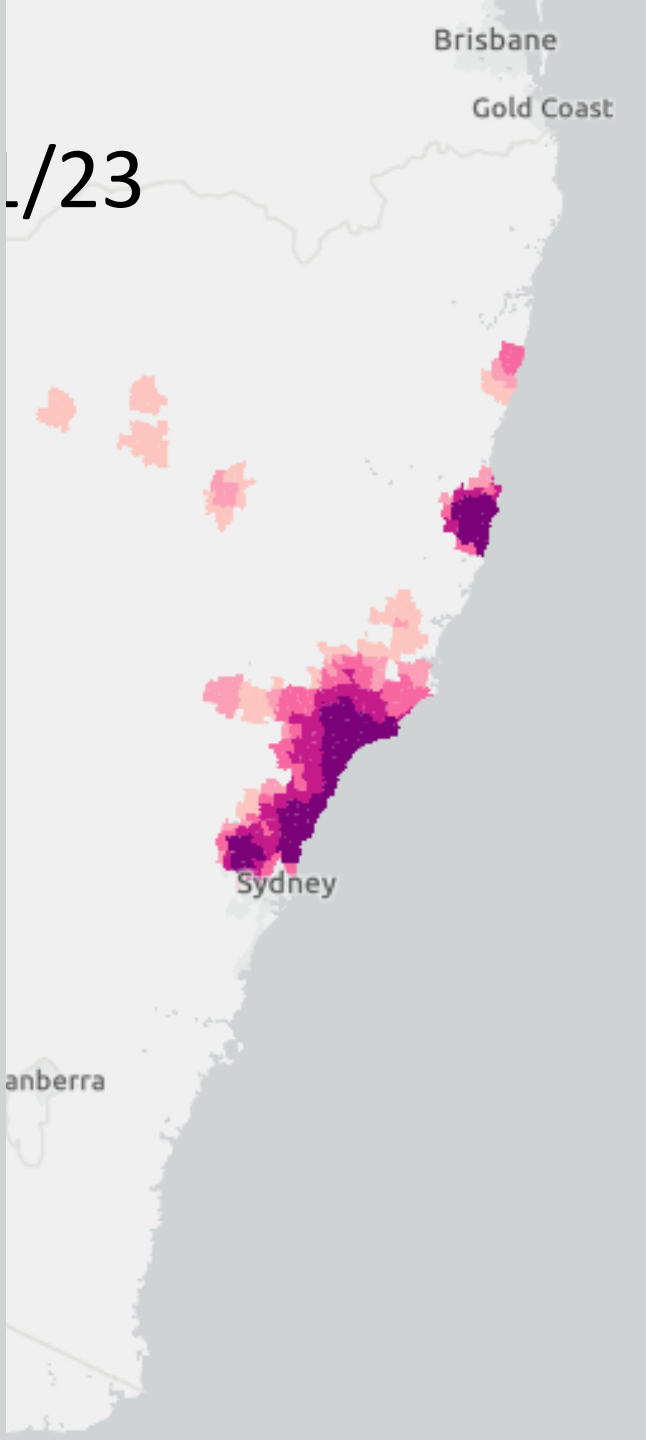
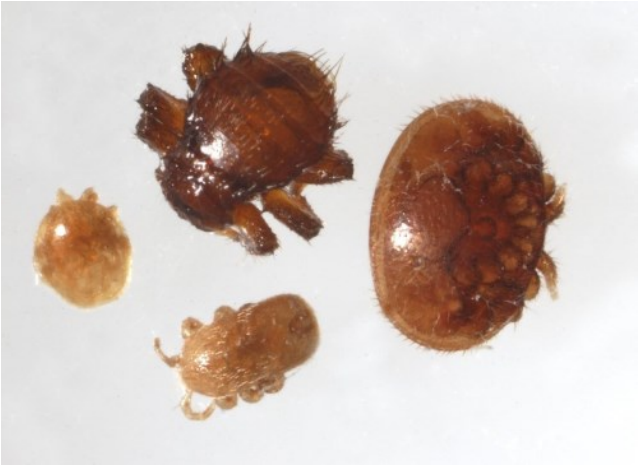


Varroa Mite (Varroa destructor)

- Present in all inhabited continents ~~except~~ including Australia
- Originally a parasite of the Asian honey bee *Apis cerana*
- 1957 first observation in *A mellifera*
- 1960-70 Japan, USSR, E Europe
- 1987 USA
- 1992 UK
- 2000 NZ
- 2023 Australia



https://commons.wikimedia.org/wiki/File:Varroa_destructor.jpg

BAYER

Varroa life cycle

- Mother foundress enters cell just prior to capping
- Feeds on prepupa by piercing cuticle
- Lays unfertilized haploid male egg after 70h after cell capping
- Then lays fertilized diploid female egg every 30h (theoretical total 5 in worker cell, 6 in drone cell)
- Mite maturation takes 6 days, then the male mates with females as they mature.
- Immature mites feed through mother's original cuticle piercing
- Mated females emerge with the adult bee (male and immature females do not survive)
- In high infestation, multiple varroa enter cells and cross-breeding occurs

Pathogenesis of varroosis

- Varroa mites feed on the bee's fat body: a tissue integral to proper immune function and pesticide detoxification
- Mites vector a number of honey bee viruses (DWV, BQCV, IAPV) with immunosuppression favouring their proliferation and damage

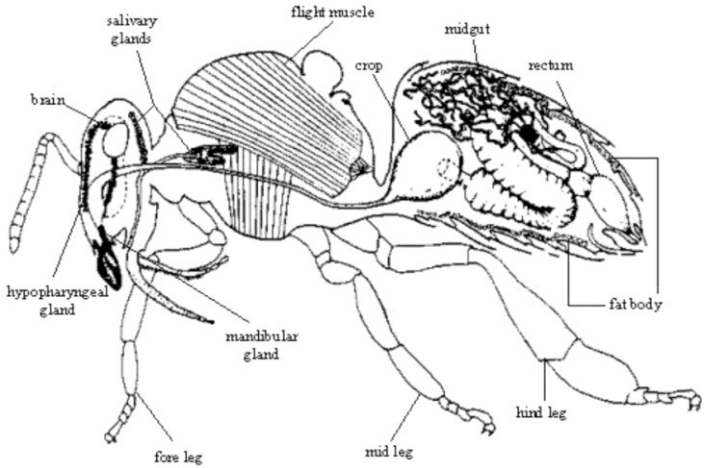


Illustration adapted from: M Winston 1987

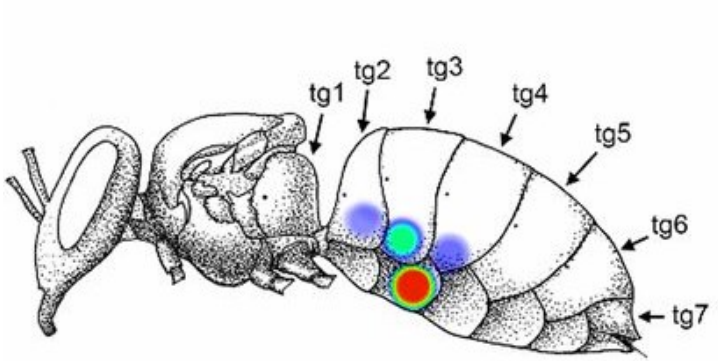
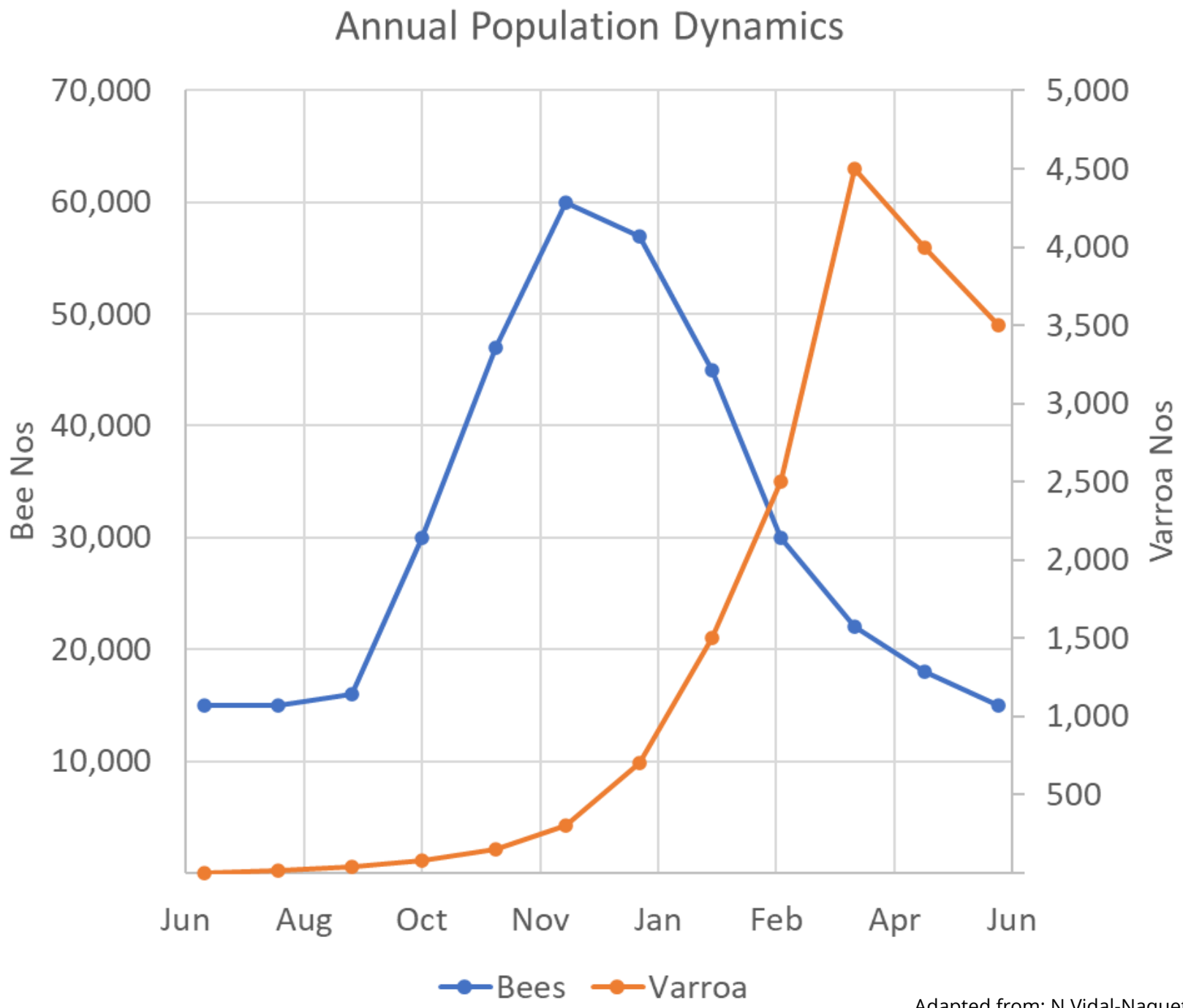
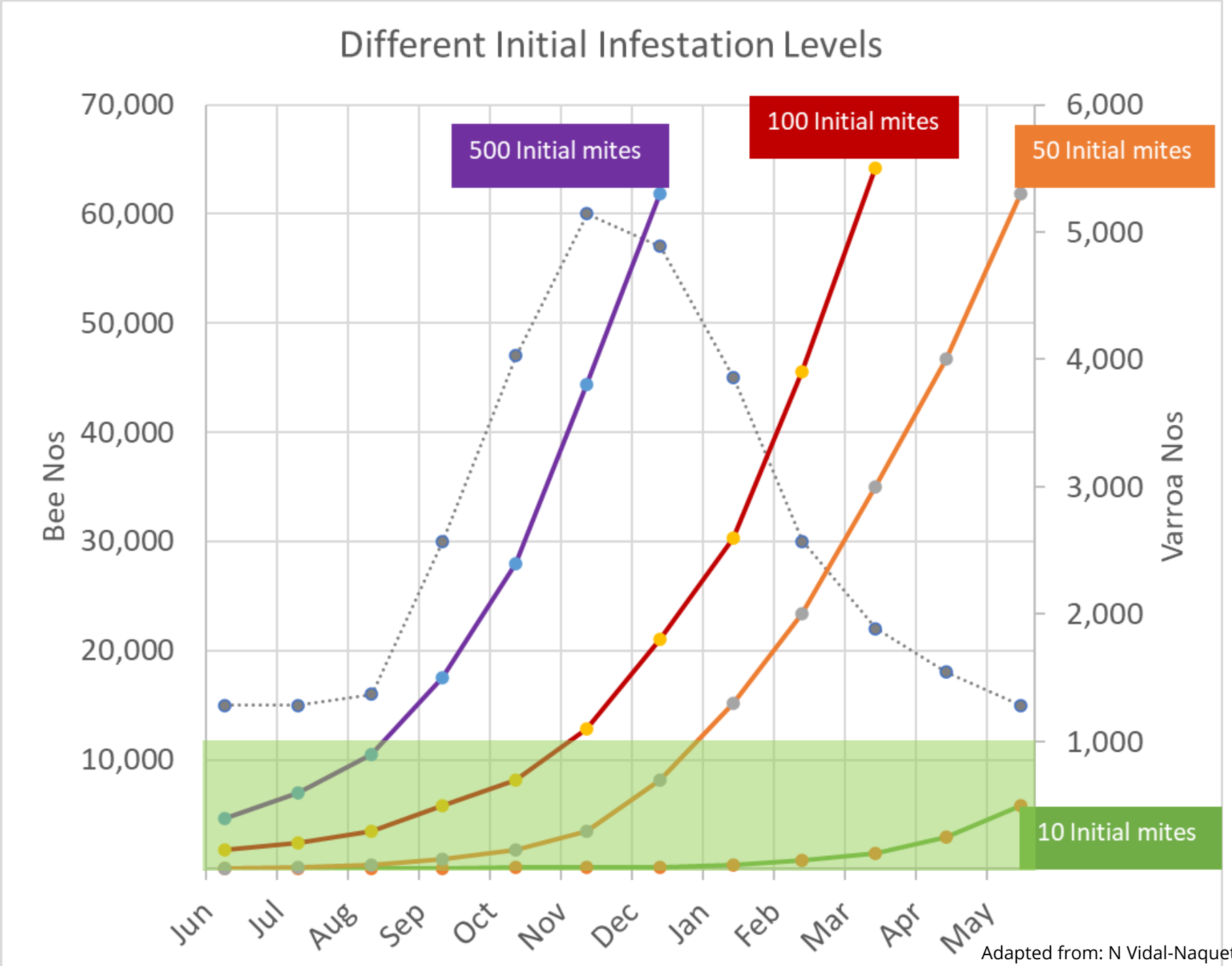


Illustration: S Ramsey et al PNAS 2019; 116, 1792



Adapted from: N Vidal-Naquet 2015



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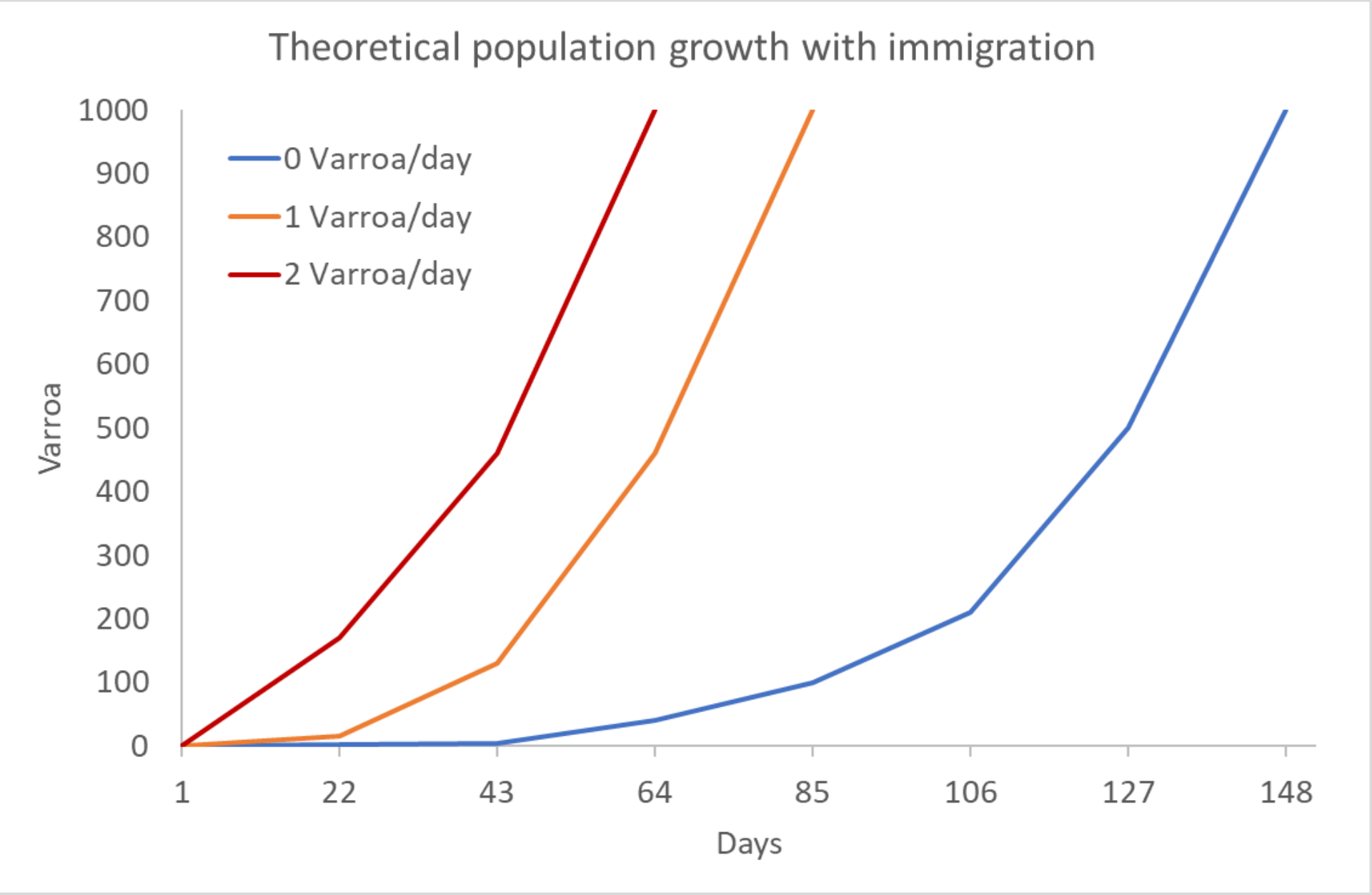
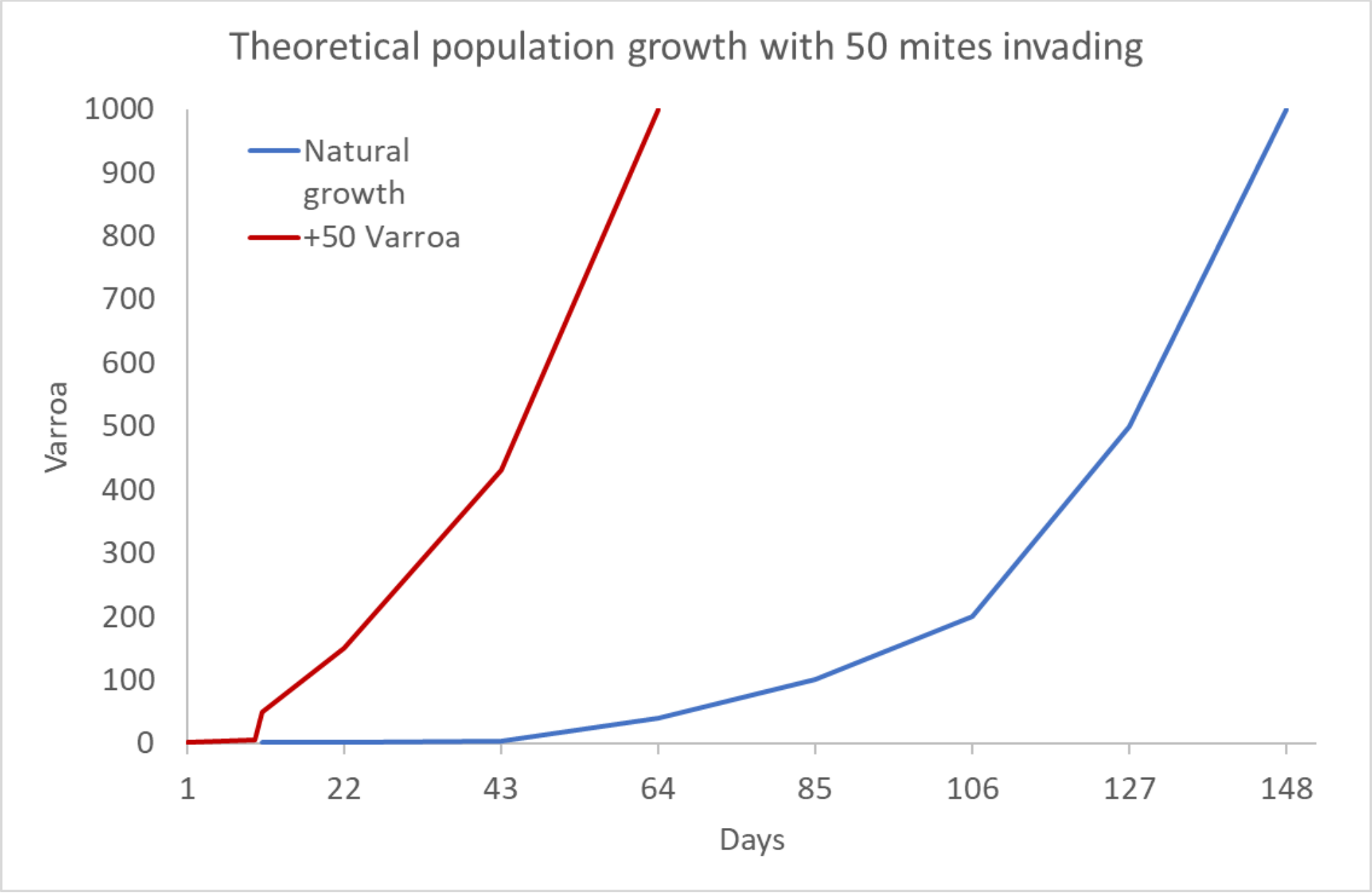


Redrawn from: M Taylor and M Goodwin 2021



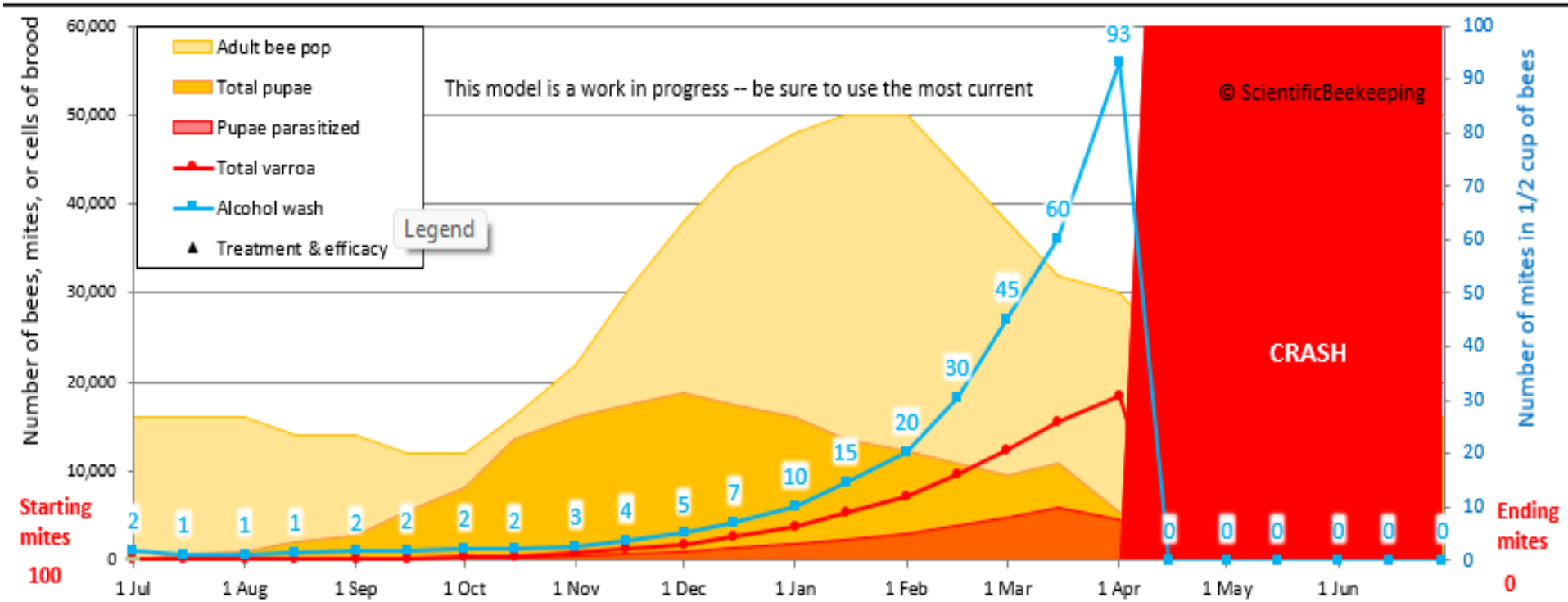
Redrawn from: M Taylor and M Goodwin 2021

Population calculations

- Reproductive rate is 1.3 in worker brood, 2.6 in drone brood (due to longer drone pupation stage)
- Mites perform 2-3 reproductive cycles
- Various mite mortality factors means population can approximately double every 4 weeks
- Total mites in colony is much higher than estimate from mite wash - x6 when in full brood production and x3 when there is less brood
- Natural mite fall is variable with season and estimates are x400 in winter; x30 summer and x100 in spring and autumn
- Above a threshold of 1000 or 2000 mites in a colony is critical risk of collapse
  - (may be different in Australia while DWV is absent)

Randy's Varroa Model

https://scientificbeekeeping.com/randys-varroa-model/



Allows modeling with different colony type (normal/nucleus, climate dry/temperate, swarm +/-), mite population and immigration

Monitoring mite levels

- Sugar shake
- Drone uncapping
- Alcohol wash (or soap)
- Mite fall with screened bottom board
  - Natural
  - After miticide

Alcohol washing

BEE PEST BLITZ

Alcohol washing is a quick and effective method for detecting the presence and monitoring the level of external Varroa mites within a honey bee colony. Alcohol washing can remove over 90% (with multiple washes) of external Varroa mites present on adult honey bees and can also detect Tropilaelaps mites.

Materials you will need

KEY:

1: Solid lid and jar for shaking jar option 1

2: Mesh lid for shaking jar option 1

3: Shaking jar option 2

4: A second container (slightly larger than your shaking jar) for collection of the solution

5: Thin durable white filter material for straining the solution and capturing any mites (such as nylon mesh cloth, baby wipes, paint strainer or coffee filter paper) and a means of affixing the filter material to the container (rubber bands, pegs or clips)

6: ½ measuring cup to collect 300 nurse bees

7: Solution of choice

8: Medium-large plastic tub to collect bees shaken off frames (you can also use your hive lid)

The Australian Honey Bee Industry Biosecurity Code Of Practice

- REQUIREMENT
- 3.2 In at least 2 inspections per year (at a minimum of 4 consecutive calendar months apart) at least one hive in each apiary must be examined for the presence of arthropod pests, including Varroa and Tropilaelaps mites, using one of the following methods:
  a. Sugar shake
  b. Alcohol wash
  c. Drone uncapping

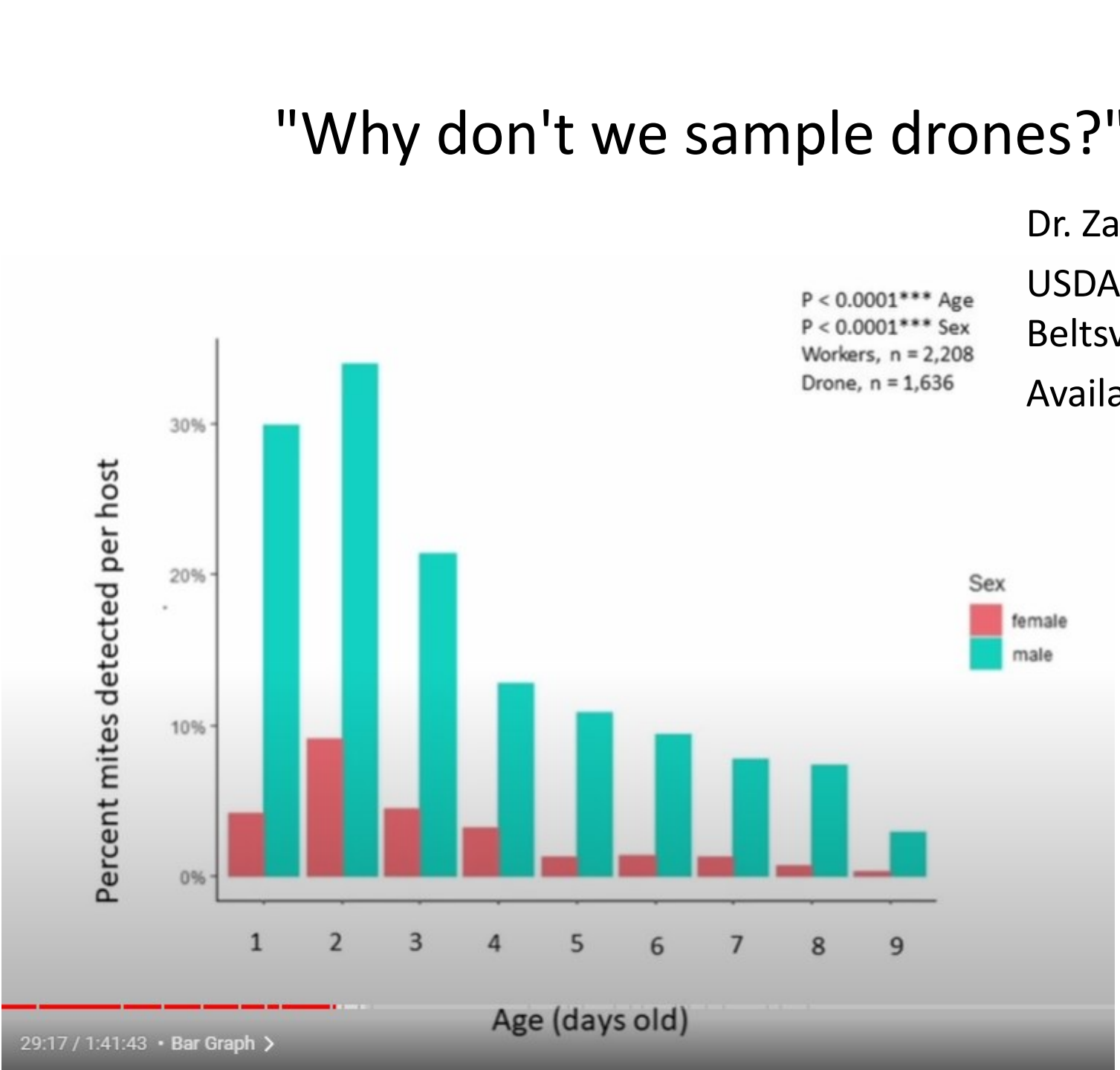
- All beekeepers in NSW are required to complete hive testing (alcohol washing, soapy water wash or miticide strip and sticky mat) every 16 weeks and report the results to NSW DPI within 7 days.

"Why don't we sample drones?"

Dr. Zac Lamas

USDA-ARS Bee Lab in Beltsville, Maryland

Available on YouTube



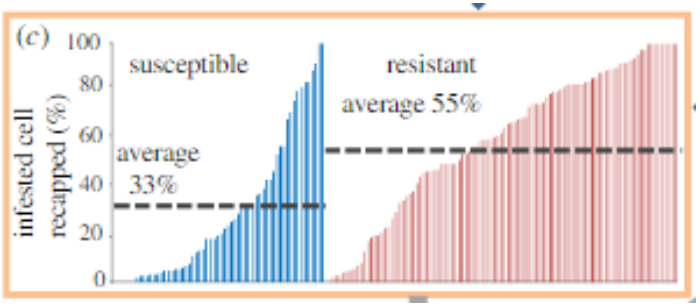
Can I go treatment free?

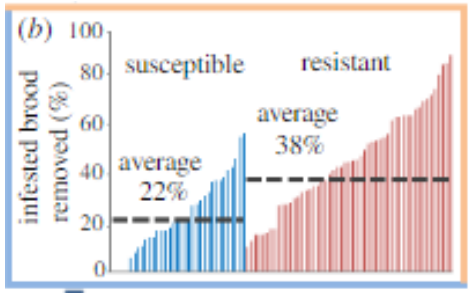
Evidence

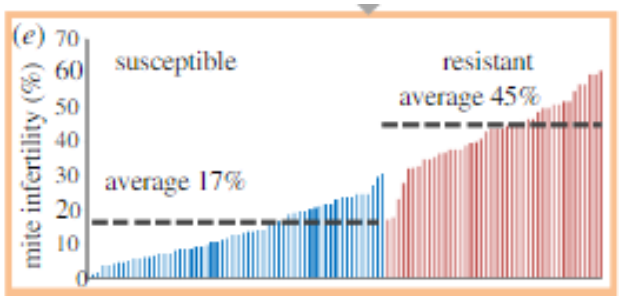
- Apis cerana
  - Uncapping/recapping
  - Grooming
  - Entombing
- Africanised honey bees
- Apis mellifera capensis
- Resistant populations emerging in France, Norway, USA, Russia, Gotland, UK
- Small number of treatment free beekeepers in Europe, UK and USA

Behaviour traits (*A mellifera*)

- Hygienic behaviour (detection and removal of diseased brood (originally AFB)
- Suppressed Mite Reproduction (SMR) – increased non-reproducing mother mites
- Varroa Sensitive Hygiene (VSH) – detection and removal







Tolerance

Host reduces impairment caused by the parasite when the infestation is at a level that typically causes damage

Resistance

Host reduces parasite fitness (reproductive success) to keep the population below a damaging threshold

↓

High MNR, low fecundity

↓

Low mite population growth

↓

Low infestation

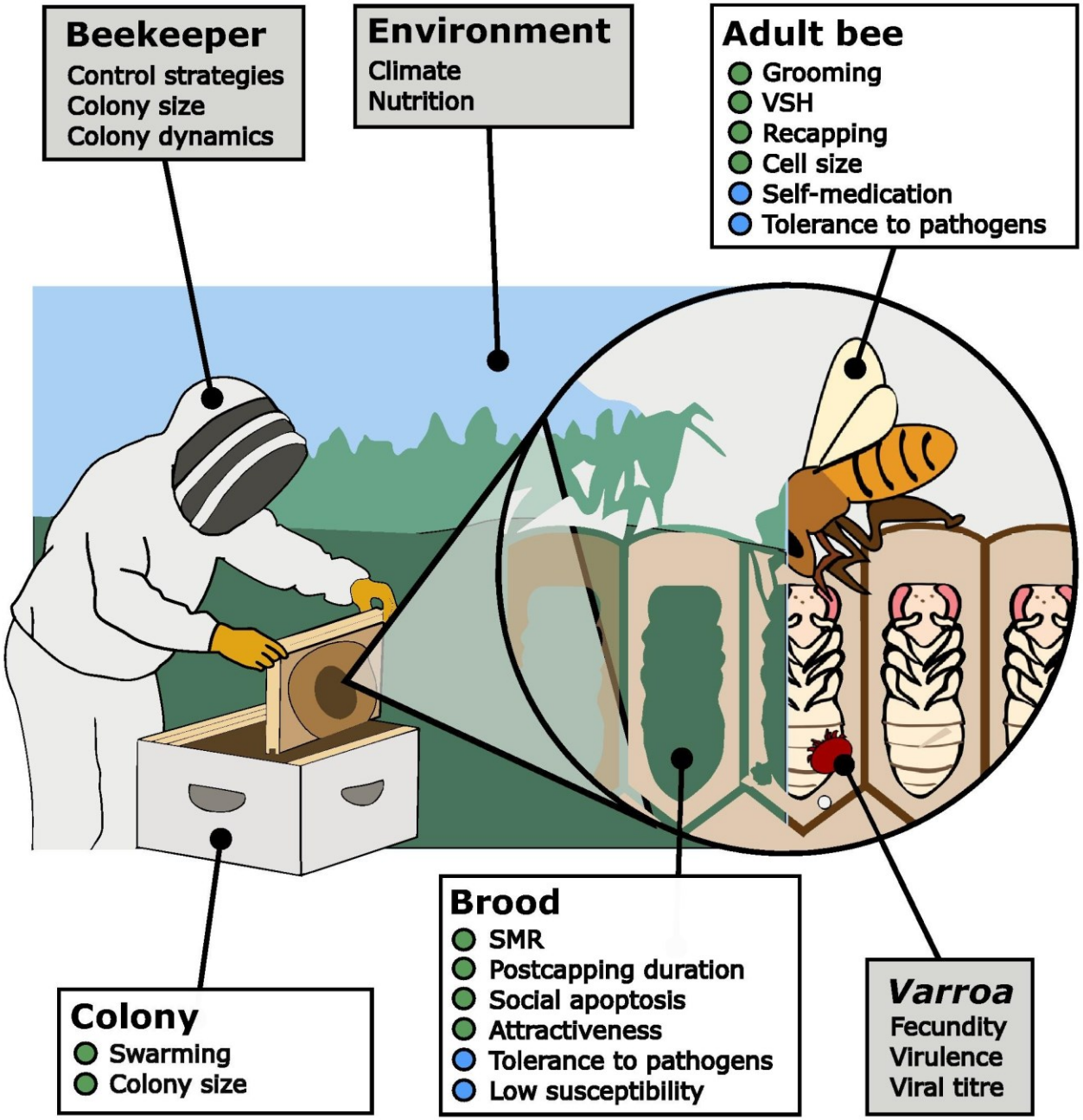
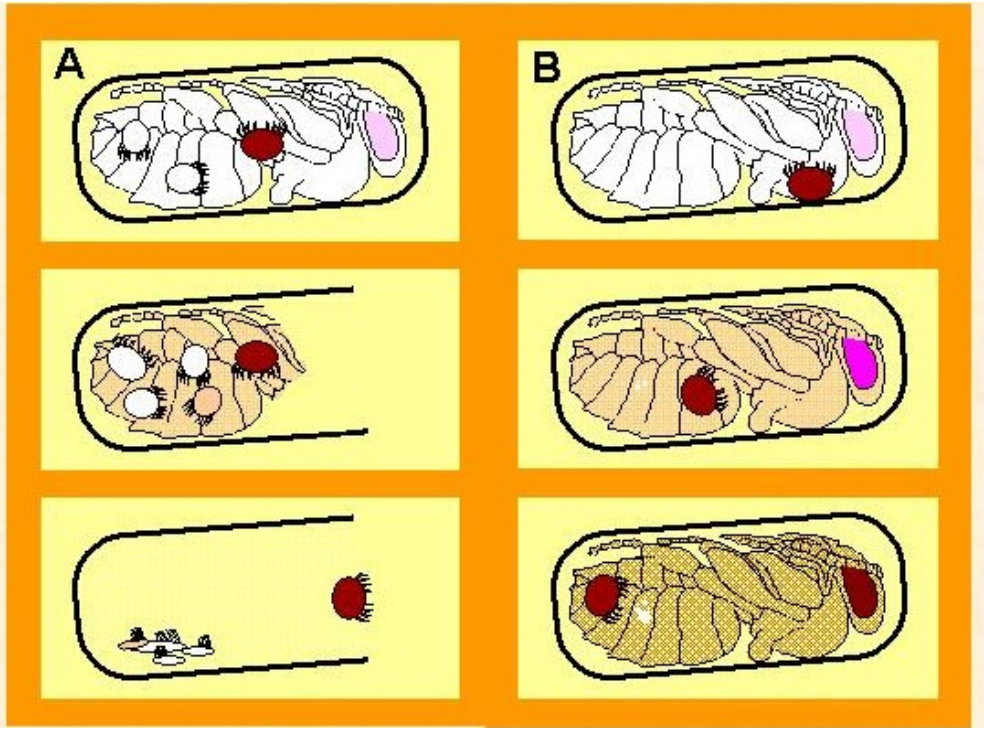
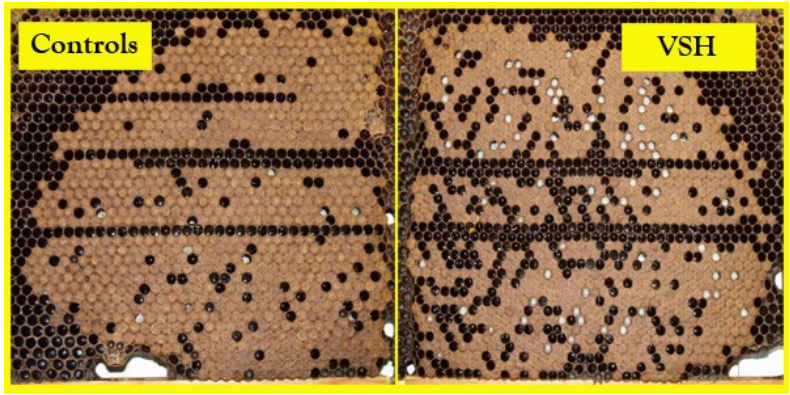


Illustration: F Mondet et al. Int J Parasitology 2020; 50, 433

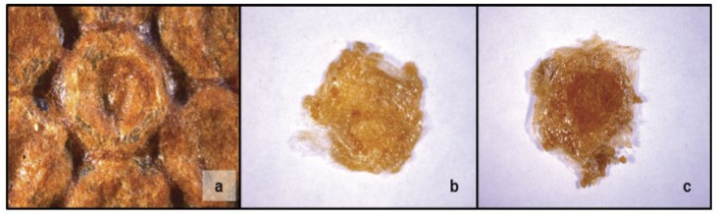
Mechanisms



U.S. DEPARTMENT OF AGRICULTURE, Agricultural Research Service



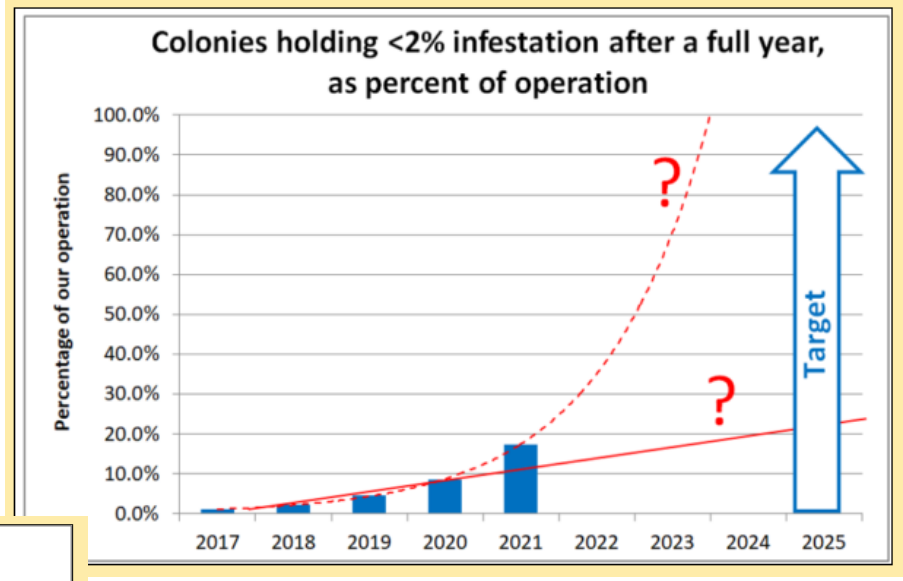
USDA-ARS Baton Rouge Bee Lab

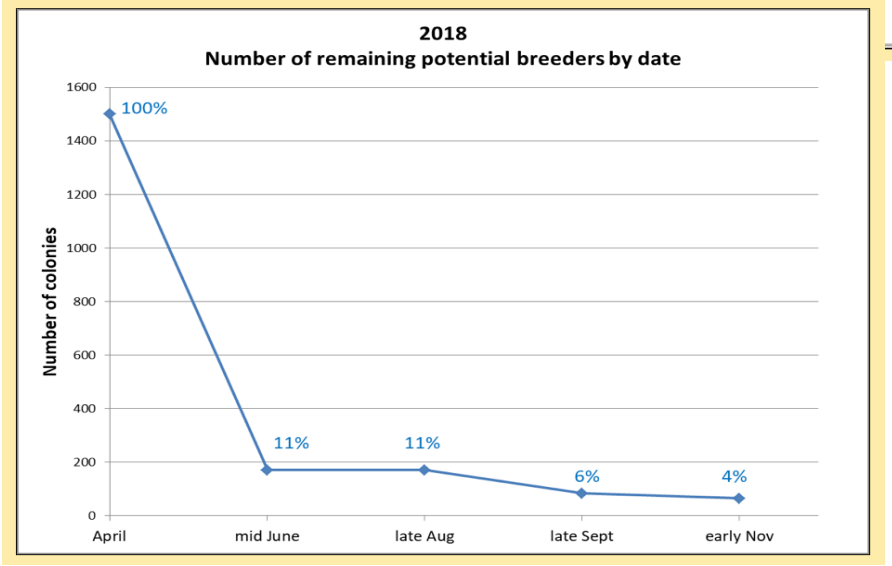


Melissa Oddie Using Natural Adaptation to Breed Varroa-Resistant Honey Bees

Randy Oliver's Selective Breeding For Mite Resistance Program

- 1000-1500 colonies
- Monthly mite wash and eliminate from breeder pool any with count > 1% (treat these)
- Breed from the remaining few next season





https://scientificbeekeeping.com

However….

- New Zealand (and rest of world) experienced an acute infestation phase for several years when feral and untreated colonies acted as “mite bombs”
- Very large numbers of managed colonies were lost
- Gradually beekeepers have learnt to better manage Varroa
- Until naturally resistant strains are available (either imported or developed here), some form of treatment will be required

Approved miticide treatments

Product name	Active ingredient	Status
Apivar	Amitraz (synthetic formamidine)	Registered
Apiguard	Thymol (organic)	Registered
Apistan	Fluvalinate (synthetic pyrethoid)	NSW Emergency permit
Bayvarol	Flumethrin (synthetic pyrethoid)	NSW Emergency permit
FormicPro	Formic acid (organic)	NSW Emergency permit
Api-Bioxal	Oxalic acid (organic)	Application in preparation

What percentage mite of infestation is considered to be potentially harmful?

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

Table: Honey Bee Health Coalition

Depends on the seasonal phase
Post treatment sample percentage should be < 3%

Integrated Pest Management

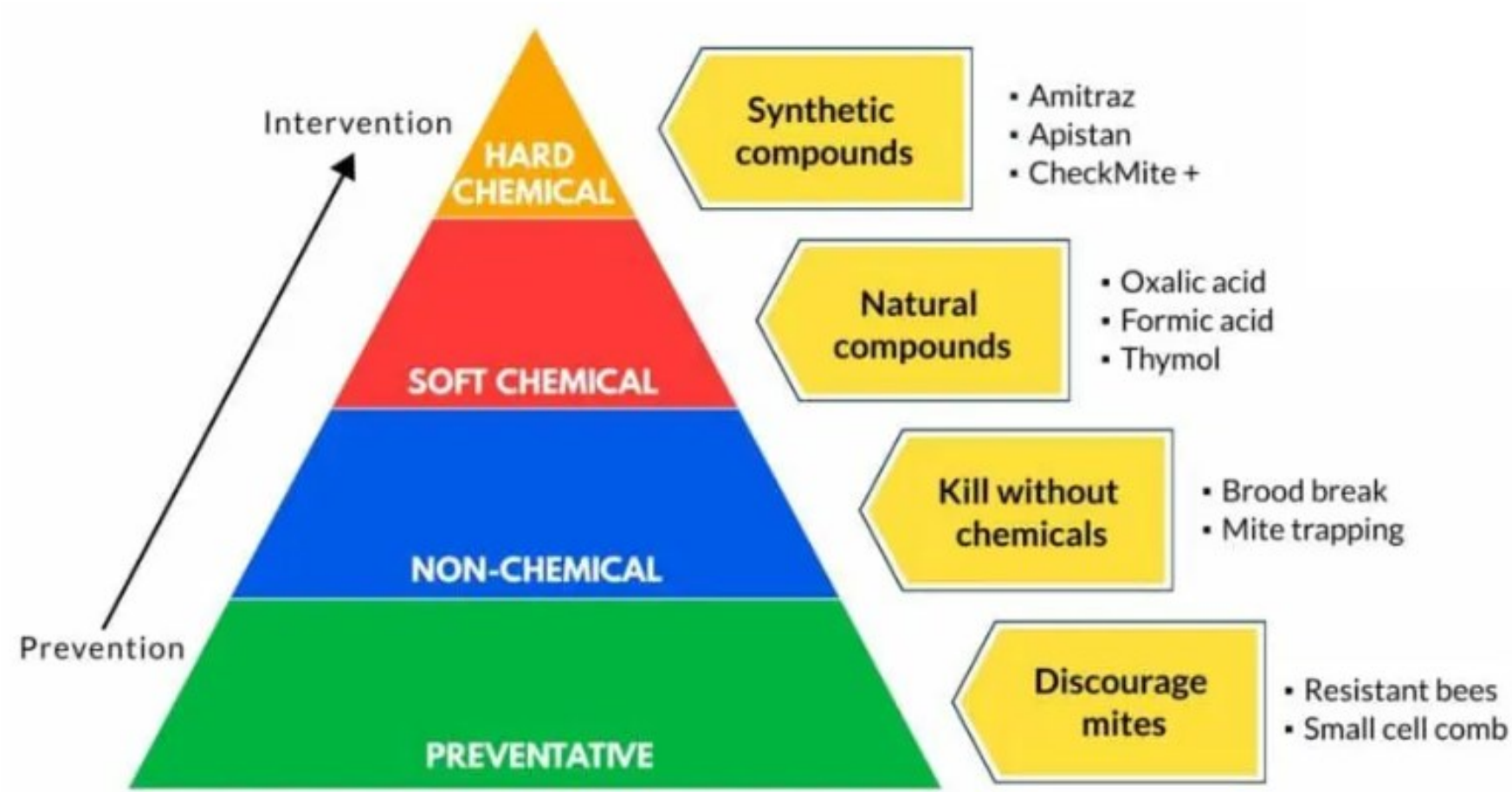


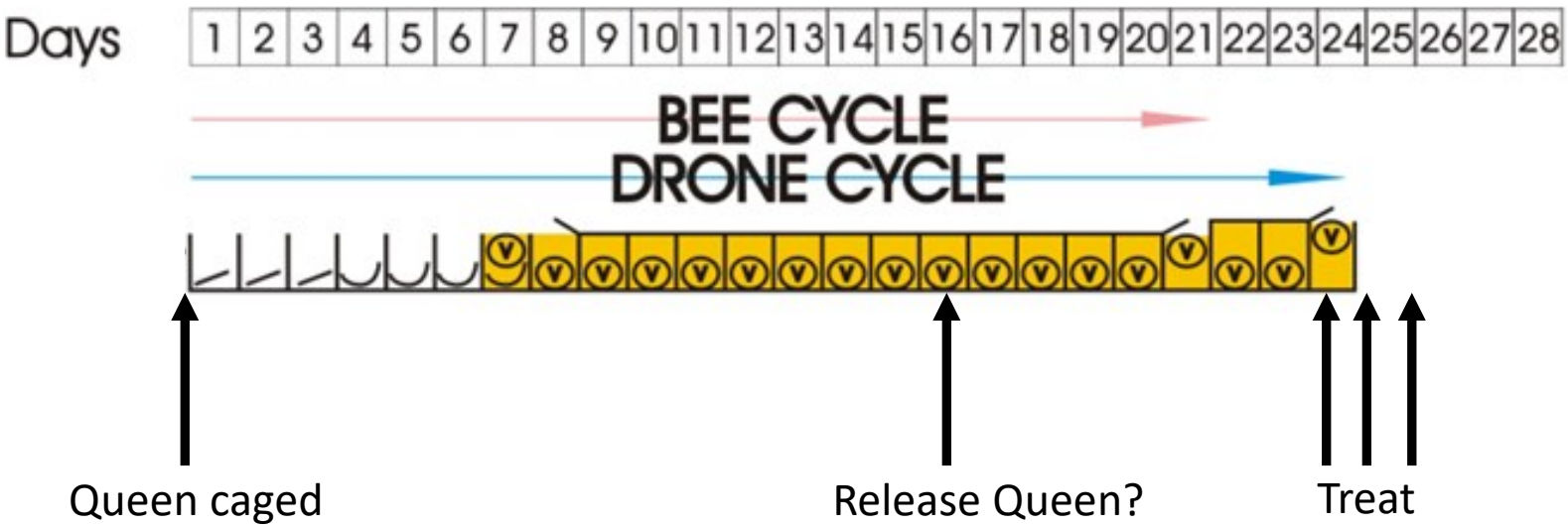
Illustration adapted from: P Wood 2023

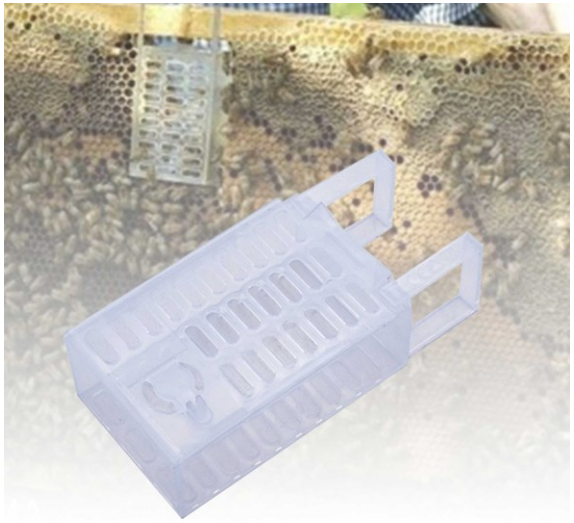
Non-chemical Cultural & Mechanical-Physical Controls

- More Effective
  - Drone brood removal
  - Brood interruption
  - Requeening

- Minimally Effective
  - Screen bottom board
  - Comb culling
  - Powdered sugar

Brood break


Days
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
BEE CYCLE
DRONE CYCLE
Queen caged
Release Queen?
Treat



Queen ringing
– an alternative method for inducing brood interruption
(Uzunov & Chen, 2023 - Bee World)

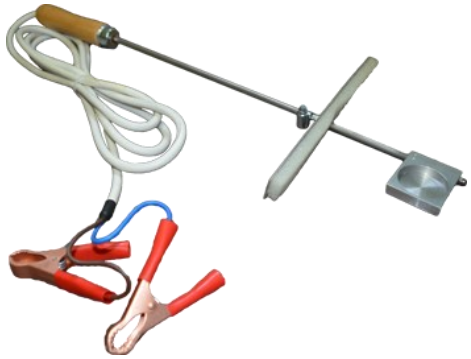
Bee World

Improved brood break!

Oxalic Acid

Spray, dribble & vapor

- Acidic, multifactorial modes of action
- Lethal to open larvae so apply when colony is broodless, eg brood break, swarm or early winter
- Corrosive; must use safety equipment, including respirator

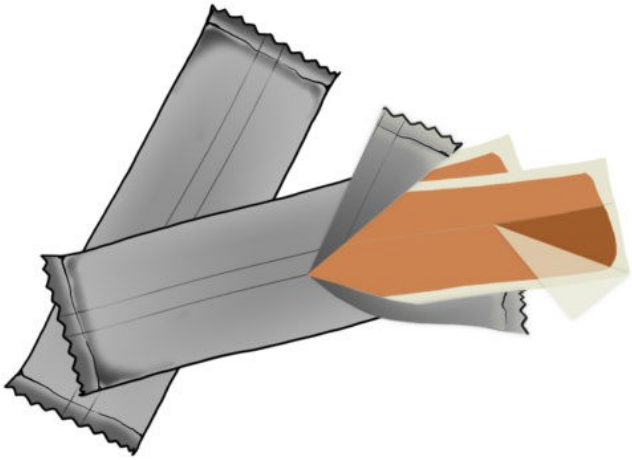


Extended release oxalic acid OAE (NB not legal)

- Prepare 1:1 with glycerin on a half Wettex pad (50g OA per hive)
- Apply pads to brood chamber at time of placement of honey supers
- Only use once while colonies are rearing brood
- Pads should remain in hive for 60-75 days

Formic Acid: Formic ProTM

- 2 paper strips applied for 14 days
- Inhibits cell respiration
- Kills mites under caps & can use when supering
- May cause adult bee loss and can disturb or kill queen
- Outside daytime temperatures should be between 10 – 30° during the treatment period



Thymol: Apiguard (essential oil)

- Gel formulation providing controlled release
- Disrupts proteins and cell membranes
- Not for use when supers on
- Best used late summer/autumn
- Temperatures 15 - 30
- Can cause brood/queen loss

APIGUARD®

Extended-release thymol (preliminary experimental and not legal)

- Absorbed on medium density fibre board (cellulose based)
- Saturated solution of thymol in ethanol
- 24 g thymol well tolerated and gives 90% mite count reduction after 3 weeks

Apivar®

- Amitraz synthetic chemical (formamidine) impregnated plastic strips
- Interferes with CNS receptors leading to paralysis
- Place for 6-10 weeks, temps <30
- Should not be used with supers, honey flow
- Spring, autumn
- Brood loss, mites developing resistance
- Does not persist in wax

Development of Chemical Resistance

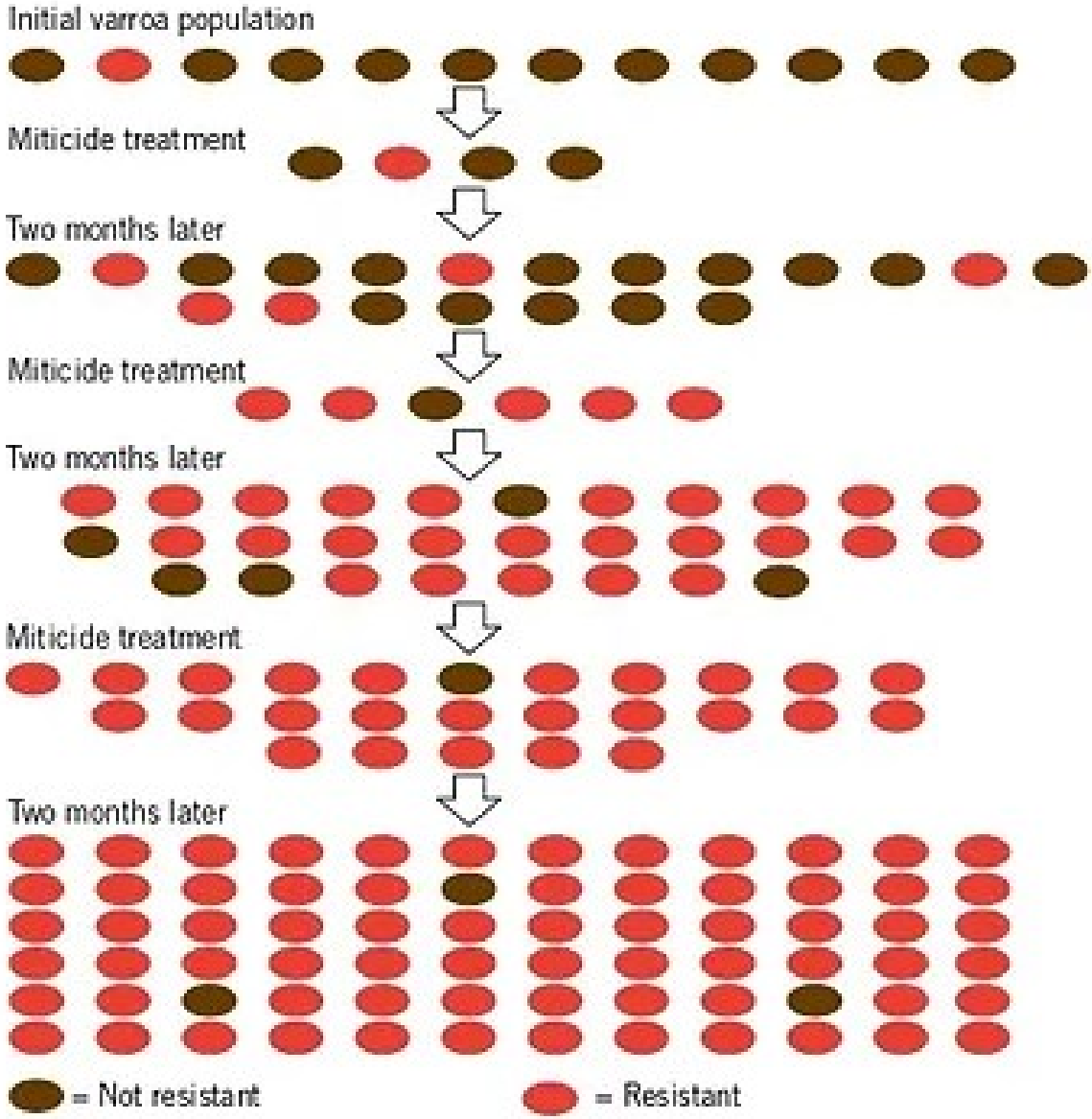


Illustration: M Taylor and M Goodwin 2021

Fluvalinate: Apistan

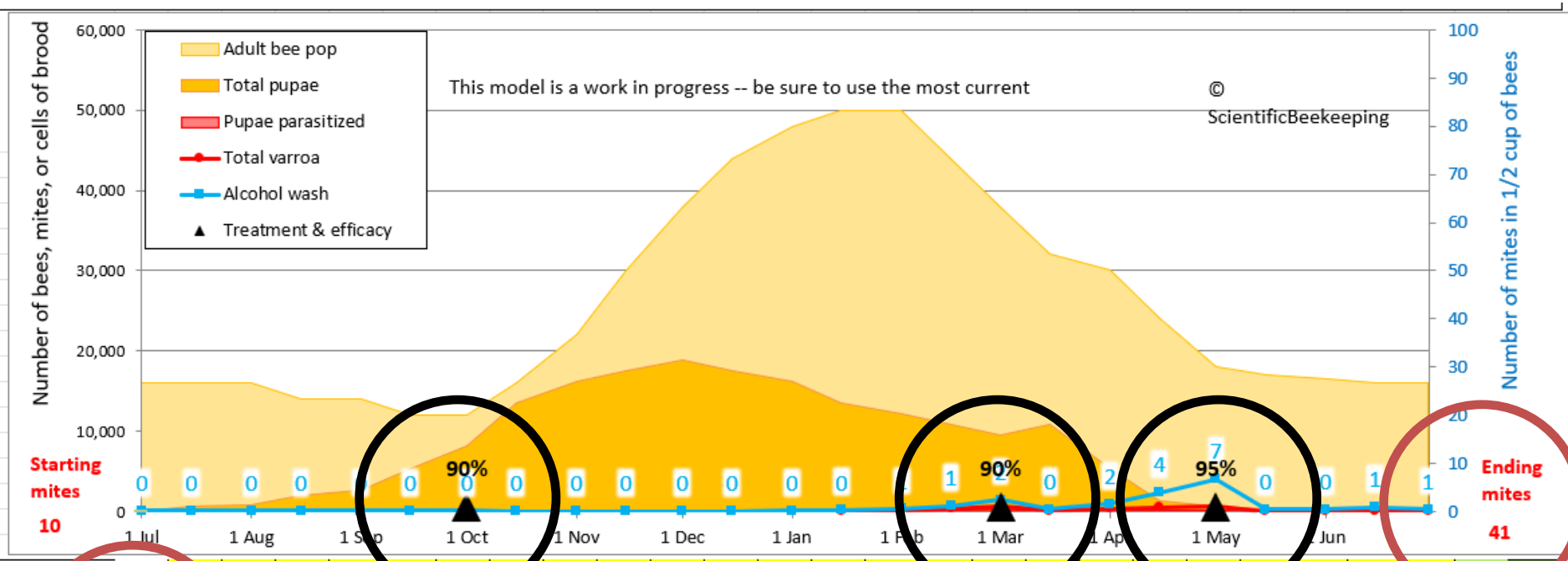
- Synthetic pyrethroid strips hung between brood frames for 8 weeks
- Accumulates in wax but not normally found in honey
- Targets voltage-gated sodium channels causing paralysis
- Resistance is a potential problem (and cross-resistance with flumethrin (Bayvarol))

Flumethrin: Bayvarol

- Synthetic pyrethroid strips hung between brood frames for 8 weeks
- Does not accumulate in wax or honey
- Resistance is a potential problem (and cross-resistance with fluvalinate (Apistan))

What should I do?

- Monitor mite levels
- Try combination of organic acids and brood breaks
- Treat with miticides if this proves insufficient
- Use Randy Oliver's model to determine number and timing of treatments
- Rotate treatments to avoid developing resistant mites
- Wait for availability of resistant bees
  - Support these efforts
- Don't create mite bombs
- Don't give up!



Mite reductions→							90%										90%				95%					x
Colony type*	d	D: Default colony in temperate climate, managed to prevent swarming (slight fall brood buildup)																								Type "x"
Mite population	10	9	10	12	16	21	30	5	8	12	18	37	63	109	192	386	678	107	322	519	628	34	39	45	41	above for
Mite immigration**	3	0	0	0	0	0	0	0	0	0	10	10	21	45	130	175	210	180	130	75	14	0	0	1000	Total	Southern
% mites in brood	%	40%	42%	50%	53%	65%	73%	78%	75%	70%	67%	63%	60%	57%	56%	56%	56%	60%	52%	42%	39%	35%	34%	0%	36%	Hemispher

Expected mite reductions by treatment option:

95%: High-efficacy synthetic miticide, such as amitraz (Apivar) applied over several weeks. Not quick acting, so best applied proactively, early in the season.

90%: Two 50-g Apiguard (or three Apilife Var) treatments at 10 days, in a rim. Best used in August, as thymol suppresses broodrearing.

70-90% (sometimes less): 2 MAQS or Formic Pro pads, or strong formic acid treatment (time release or hard flash). Best treatment for quick mite knockdown in warm weather. **Can be used during honey flow.**

50% (approximate): 1 MAQS or Formic Pro pad, or single weak formic acid "knockback" treatment. Quick knockback for buying time, easier on the queen.

80-90%: Hopguard 3 if colony is broodless; would require repeated applications if brood present. **Can be used during honey flow.**

25%: A single powdered sugar dusting, assuming 50% drop of phoretic mites. Requires multiple and continued applications.

15-20%: Complete removal of drone brood, if done early in the season, each removal. Provides some reduction, but labor intensive.

80-95%: Oxalic dribble or vaporization when broodless. Excellent reduction when colony is broodless, due to natural or induced brood break.

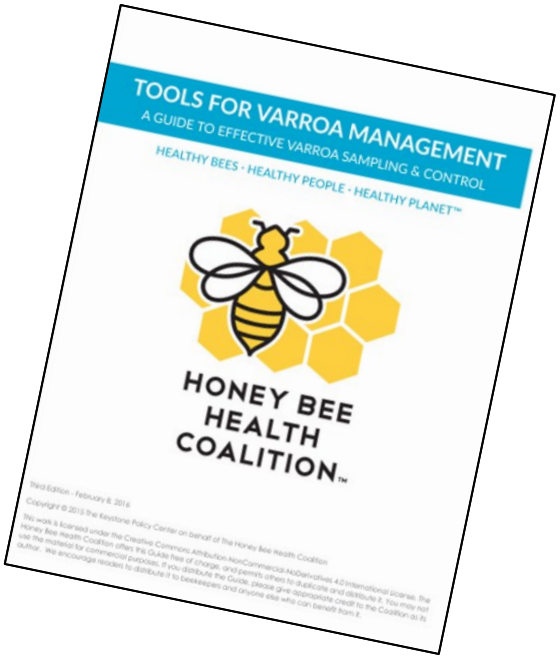
15-45%: One Oxalic dribble or vaporization in hive containing brood, proportional to the % mites of phoretic. Limited reduction when colonies contain brood.

85%, 3x: Extended-release OA/glycerin sponges; for end result at 45 days, enter 85% for three consecutive time periods, starting at time of application. **Not yet approved.**

~30%: The issuance of a prime spring swarm. Assume 80% of mites in the brood, 70% of workers leave, 14 day brood break.

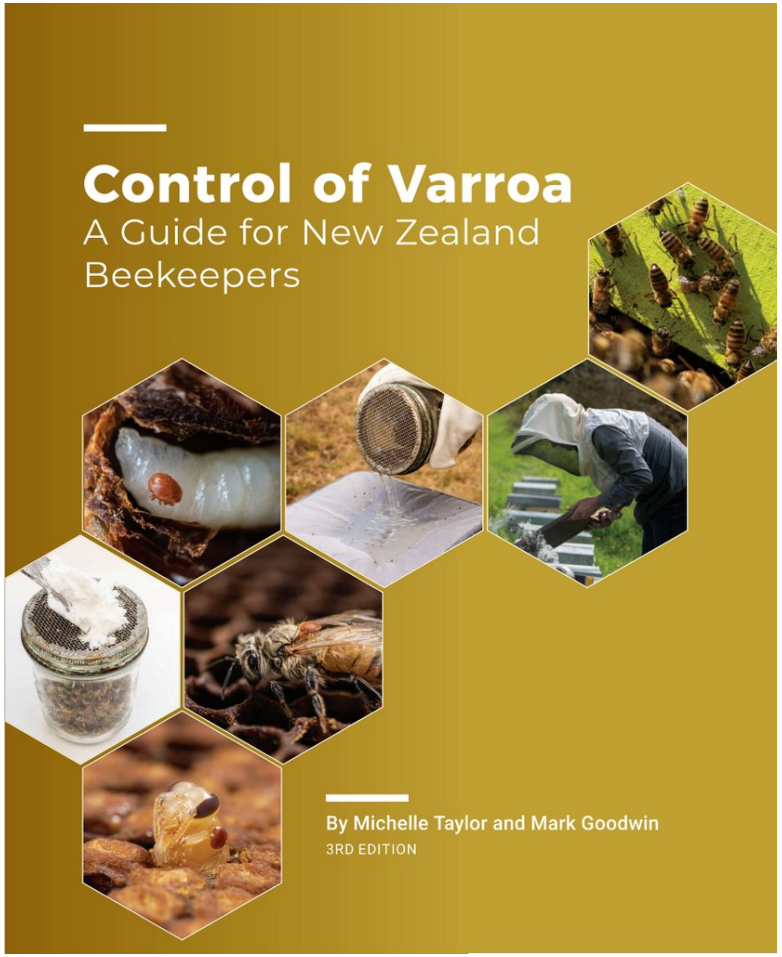
~50-55%: An induced brood break by removing the queen or a "walkaway split." Assume a 26 day brood break.

Resources: Tool for Varroa Management Guide



Download the Guide: www.honeybeehealthcoalition.org/varroa

Books


Control of Varroa
A Guide for New Zealand Beekeepers
By Michelle Taylor and Mark Goodwin
3RD EDITION


Varroa management
A practical guide on how to manage Varroa mites in honey bee colonies
KIRSTY STAINTON

Scientific Beekeeping

https://scientificbeekeeping.com/varroa-management/

ScientificBeekeeping.com

Beekeeping Through the Eyes of a Biologist

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Varroa Management

Allow me to start with an excellent assessment by Bee Culture's Phil Craft (BC July 2015):

Perhaps beekeepers who have come to the craft in the last few decades aren't aware of the effect varroa had when it first arrived on this continent and of how it earned its full name, Varroa destructor. Whatever the reason, every year, beekeepers all over the country lose colonies to mites and the viruses of which they are carriers, and they never know what hit them. They blame pesticides,or CCD, or habitat loss, and sometimes those really are causes, or at least significant factors. However, too, too often, the underlying cause is a lack of effective management, which allows a mite infestation to overwhelm a colony or weaken it to the point that it succumbs easily to other stressors. The most frustrating thing about these losses is that they don't have to happen.

Watch Dennis vanEngelsdorp explain why mite management is critical for colony survival, and which methods work or don't at ***https://www.youtube.com/watch?v=4bm3Y4t1NwQ***

The Status of Our Industry Regarding Varroa Management and What Can We Do About It?

Yarra Valley Bee Group 28th Jan 2024

Will I lose all my hives?	Yes if you don't monitor and treat
What happens to the feral hives?	Nearly all will die
What can I do to help my bees?	Informed and evidence-based beekeeping
Are treatments available yet?	Yes, available as required
Are they breeding Varroa resistant queens? Can we import such queens?	Support Corinne Jordan and the beegenetics.com.au program. Import unlikely due to viruses
Can I go treatment free?	Not yet! Perhaps in 5 years

PENDERS

Beekeeping Supplies
ABN 27 009 052 155

VITA beehealth

Varroa Treatment

PENDERS carry a complete range of containers from 500 grams to 35kgs. All items are priced competitively and discounts apply to carton lot purchases. The 500 gram square plastic container is especially attractive when full of honey and has been very popular. ALL PRICES INCLUDE GST. Postage is extra.

APIGUARD PACKET (10 X 50G TRAYS)

- 1+ Packets $71.45
- 8+ Packets (Carton): $65.95
- 16+ Packets: $61.30
- 48+ Packets $58.00

APIGUARD 3KG TUB

- 1+ Tubs: $395.00
- 2 + Tubs: $348.15
- 8 + Tubs: $325.00

APISTAN PACKET (10X STRIPS)

- 1+Packets $71.45
- 5+Packets$65.95
- 20+ Packets $61.30
- 120+ Packets (1x Carton) $52.25
- 480+ Packets (4x Cartons): $50.00

PENDERS

Website: www.penders.net.au

2/72 Munibung Rd, Cardiff 2285
Trading Hours - Monday - Friday
8:00am - 4.30pm
Other Times by Arrangement
Phone: (02) 4956 6166 • Fax: (02) 4956 6399

https://www.vicbeekeepers.com.au/events

2nd Announcement

Victorian Apiarists' Association

Recreational Beekeepers Conference

Melbourne, Saturday 9th March 2024

Are you ready for varroa?

Successful Beekeeping in Challenging Times

Join us for this one day seminar with the latest on varroa treatments from the AgVic team plus updates on the national management plan. Hear from international experts on honey bee viruses, resistance breeding and disease detection. With live hive and practical demonstrations to explain, reinforce and entertain. Hurry, early bird discounts end soon!

Session 1: Improving your beekeeping skills

The 4 seasons of beekeeping
Feeding bees
Splitting Hives
Flow Hive tips and tricks

Session 2: Tackling biosecurity today

Integrated Pest Management and varroa treatments
Breeding varroa resistant bees
Viruses of the honey bee
AFB/EFB testing
Honey testing

Keynote Speakers

Prof Madeleine Beekman
Madeleine is Professor Emerita at the University of Sydney where she studied behaviour and evolution of social insects and particularly honeybees. Her special interest is in the role Varroa plays in vectoring honeybee viruses and she has embarked on a set of experiments to disentangle the role of Varroa on the spread of the deformed wing virus.

Prof Travis Beddoe
Prof Beddoe is Head of the Department of Animal, Plant and Soil Sciences at La Trobe University (Bundoora campus) where he leads the Agriculture Bio-Solutions laboratory. His research program focuses on field deployable diagnostics, the molecular understanding of disease pathogenesis and sustainable treatment solutions (vaccines). His research team have developed rapid in-field assays for EFB and AFB.

Dr Jody Gerdtz
Dr. Jody Gerdts is the founder and Director of Bee Scientifics, a Benalla, Victoria-based company that specialises in honey bee breeding and apicultural research. Jody's interest in breeding bees for varroa resistance has been supported through two prestigious fellowships: International Specialised Skills Institute and Veski Fellowship providing opportunities for international travel and collaboration with some of the world's leading experts.

Tickets: Members $150 (early bird $120) Non-members $200 (early bird $170)
Catering including lunch, tea and coffee supplied.
Location: Victorian Croquet Centre, 65 Nobel Banks Dr, Calmlea VIC 3023

Organising Committee: John van Weeghel, Andrew Wootton, Adam Maxwell
Enquiries: rec_conference@vicbeekeepers.com.au
Website: www.vicbeekeepers.com.au/events