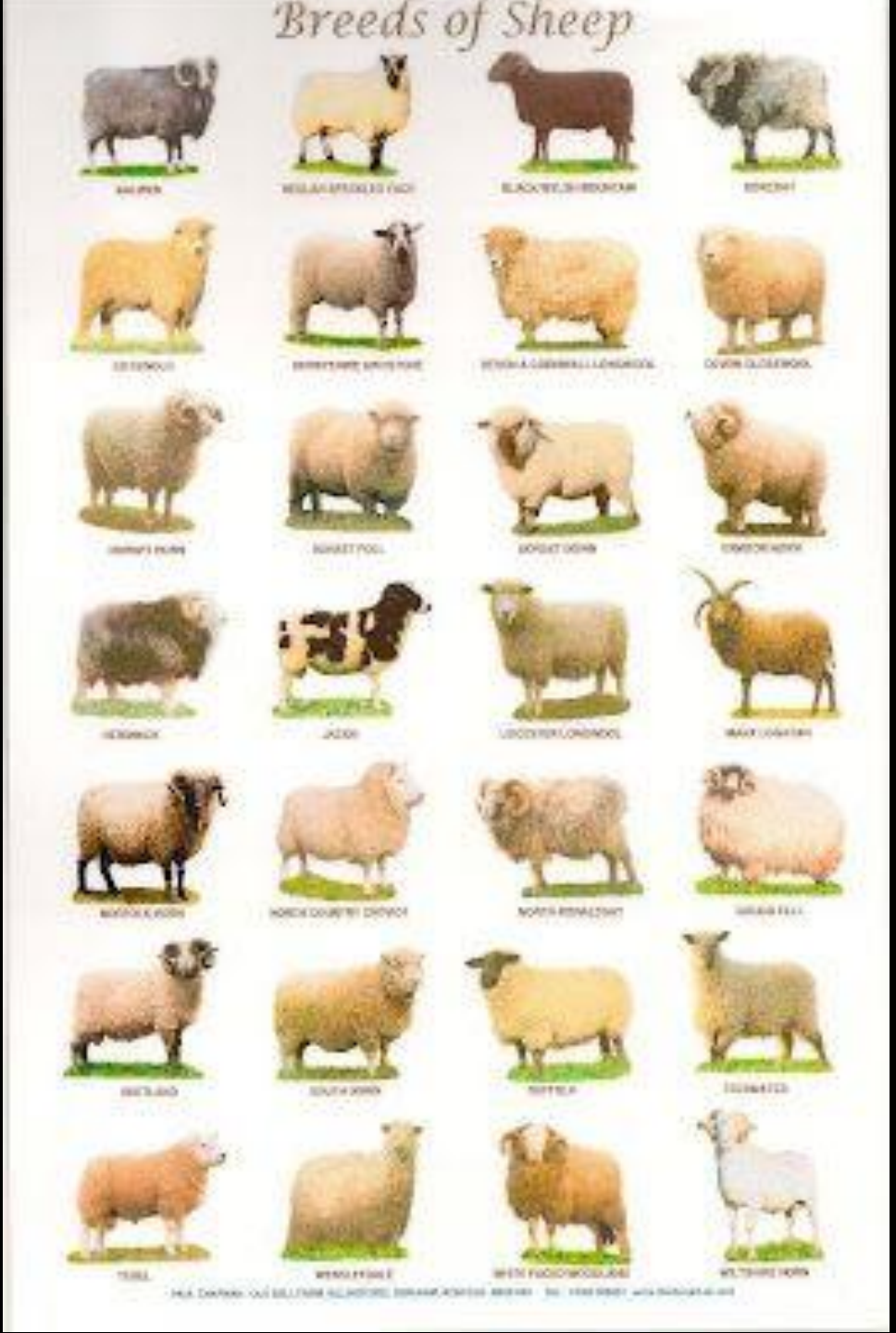
A K.I.S.S. Model for Breeding Locally-adapted Varroa-resistant Bees

By tradition, beekeepers bred for productive, workable survivors



Nearly all breeds of animals and plants were selectively bred prior to breeders knowing anything about genetics

Not magic—

it's a simple

process of

selection at each

generation.

Negative selection vs. positive selection

Negative selection:

Don't breed from undesirables.

Don't breed from colonies that sting a lot or aren't productive

Positive selection: favor desirable traits.

All the cultivars to the left are of a single species of mustard that were selected for specific desirable traits

Varieties of *Brassica oleracea—also kale, collard, kohlrabi*

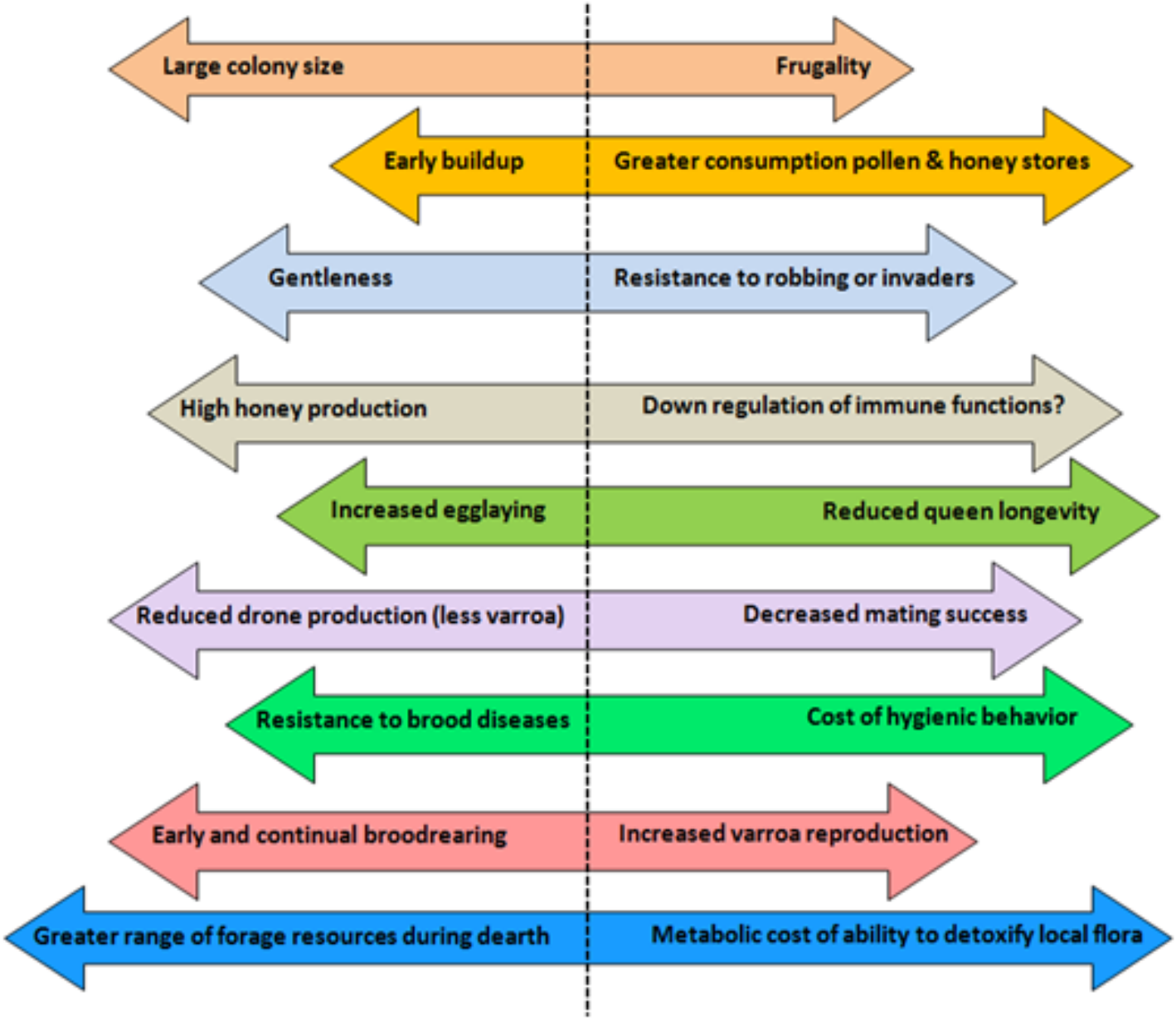
Prioritize your selection goals.

“Wild type” is most fit in nature.

I often hear folk speak of breeding a "better" bee. Wild type is generally most fit as far as survival.


“there’s
no such thing
as a free
lunch.”

EXAMPLES OF TRADEOFFS IN SELECTIVE BREEDING



← The epitome of wolf breeding

But would he survive in the wild?

Breed for performance rather than looks

I'm surprised as to how many select for queen color--you can only select for a limited number of traits!

BUT WHICH VARROA-RESISTANCE TRAITS TO SELECT FOR?

- Varroa sensitive hygiene
- Shutting down brood rearing when no flow
- Grooming behavior
- Kairomonal suppression of mite ovulation
- Semiochemicals in combs to inhibit mite reproduction
- Minimal drone brood
- Less robbing
- Self removal of bees carrying mites
- Frequent queen supersedure and swarming
- “Apoptosis” of parasitized pupae

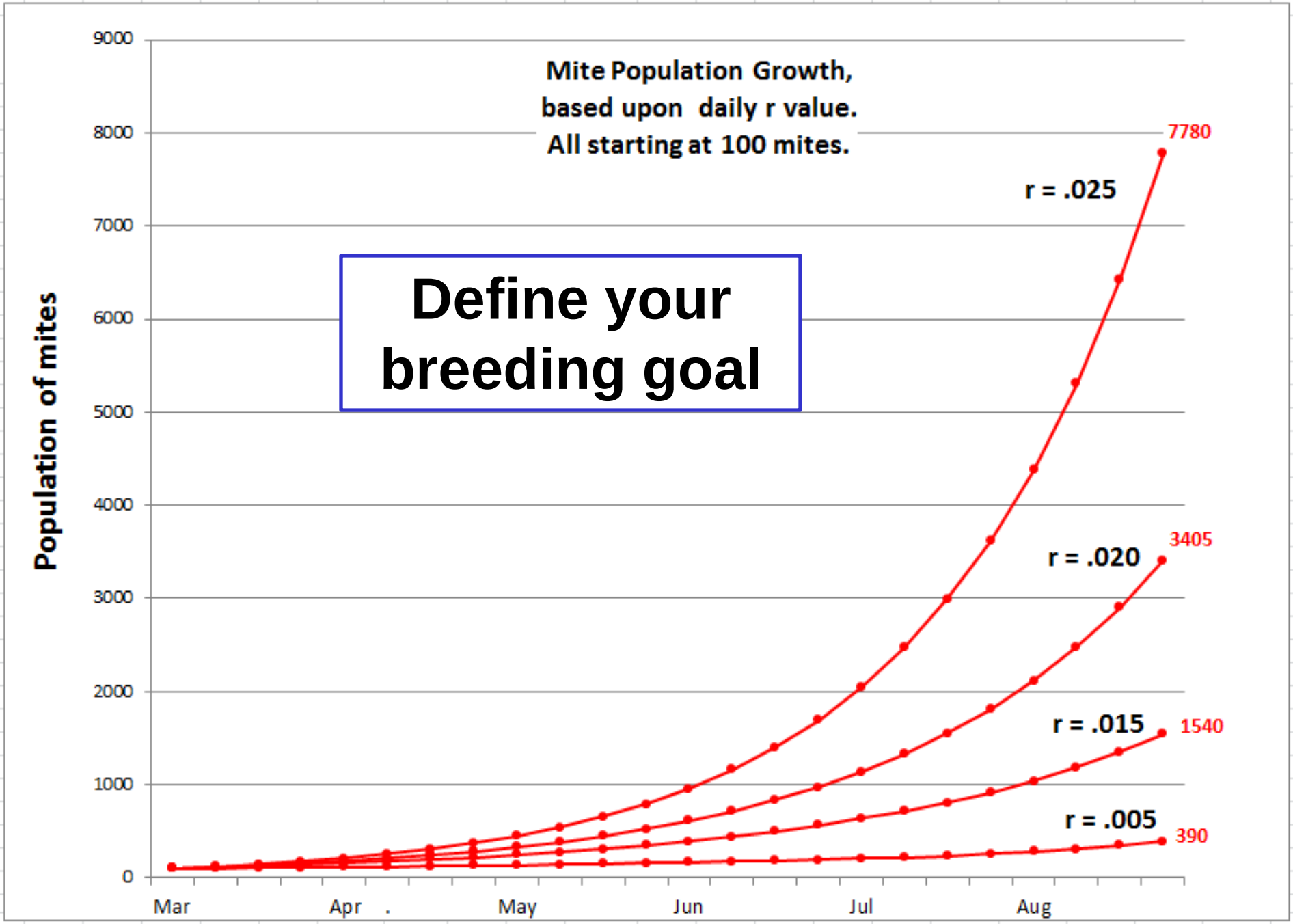
Selecting honey bees for resistance to *Varroa jacobsoni*

John R. Harbo*, Jeffrey W. Harris

USDA-ARS, Honey Bee Breeding, Genetics and Physiology Laboratory,

Apidologie 30 (1999) 183–196

"By comparing the growth of mite populations in each colony, one can determine which bees are more resistant to mites."


Mite Population Growth,
based upon daily r value.
All starting at 100 mites.
Population of mites
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Mar
Apr
May
Jun
Jul
Aug
r = .025
7780
r = .020
3405
r = .015
1540
r = .005
390
Define your breeding goal

Just define the job description…

and “fire” all those that don’t perform.

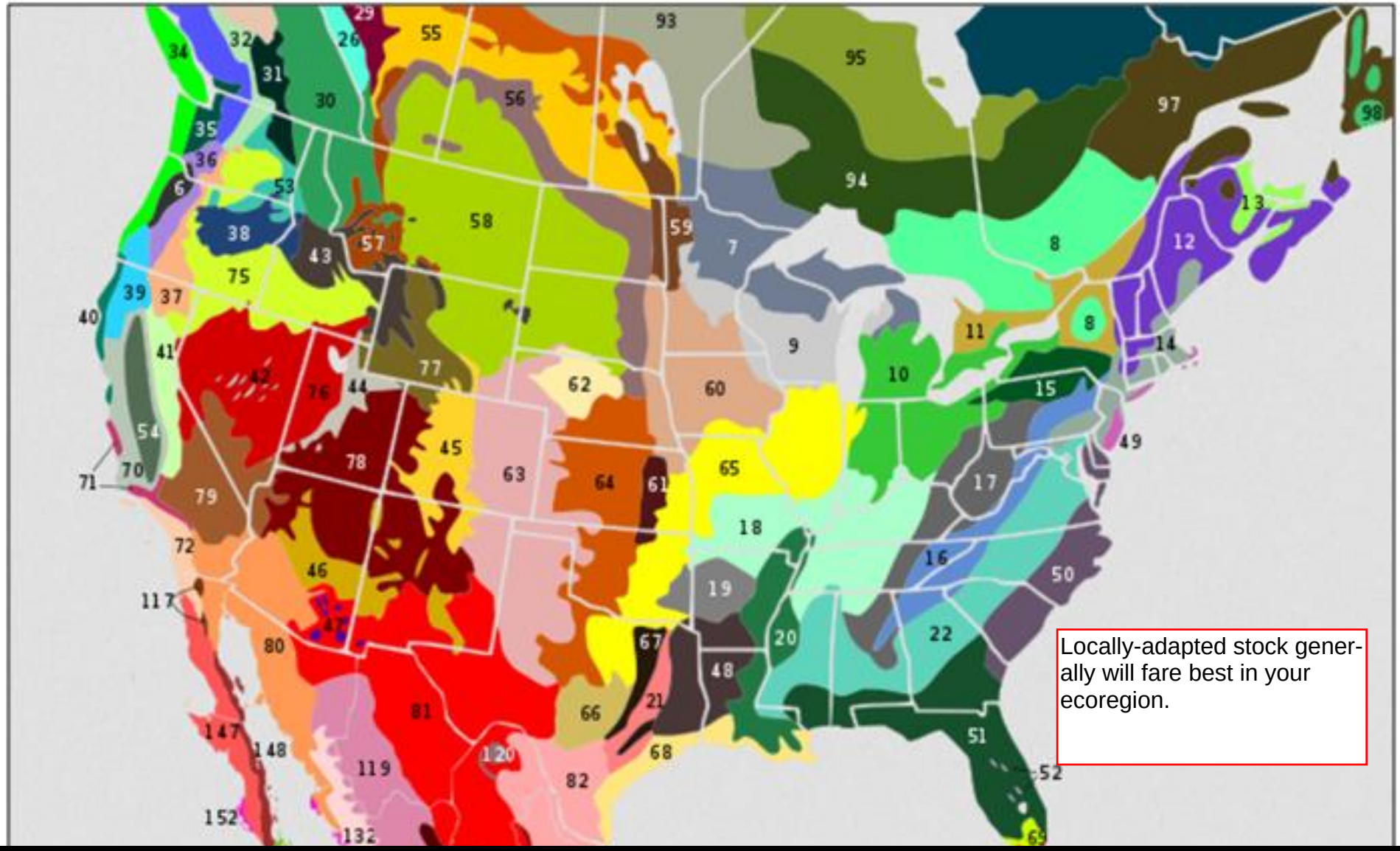
Golden West Apiaries

Managed Bee Job Description

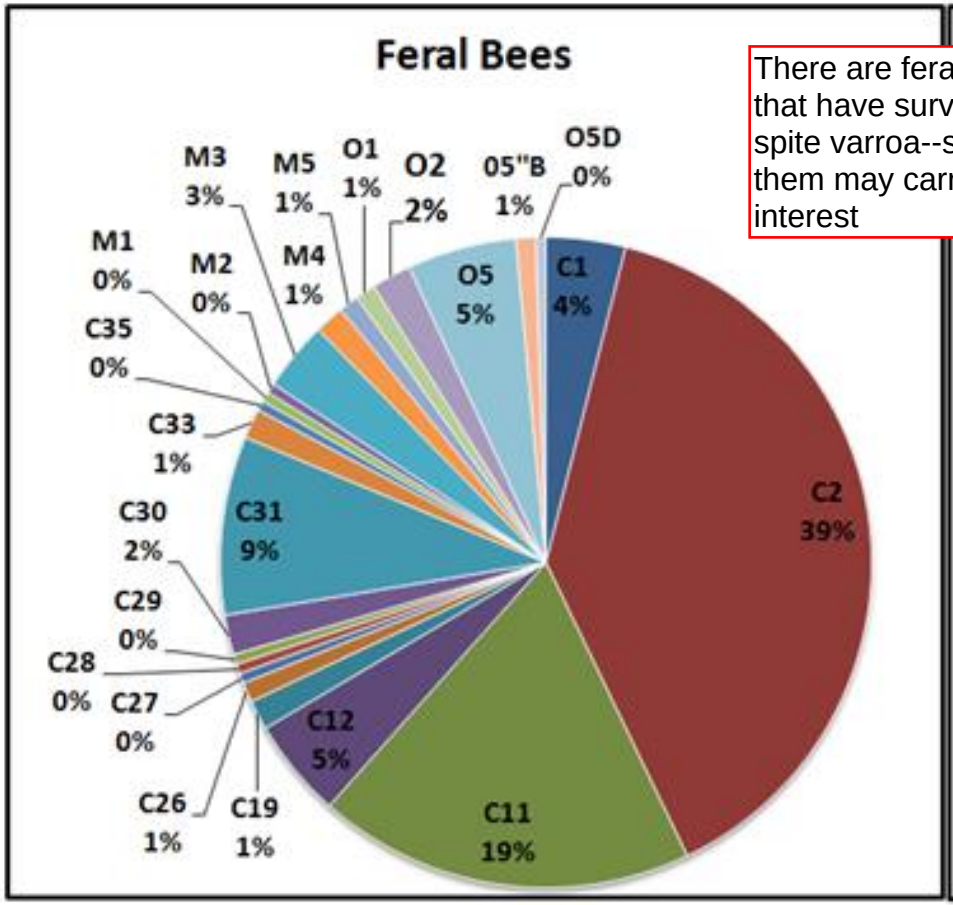
Location:	Sierra Foothills, California
Job Description:	• Overwinter in snowy foothills • Be moved to almond pollination • Be split into nucs for sale • Be run for honey production in the foothills
Job Specifications:	• Be gentle and workable • Brood up early and be strong for almond pollination • Remain free of diseases • Produce a honey crop on local flora • **Minimize the rate of varroa buildup**

How to do it

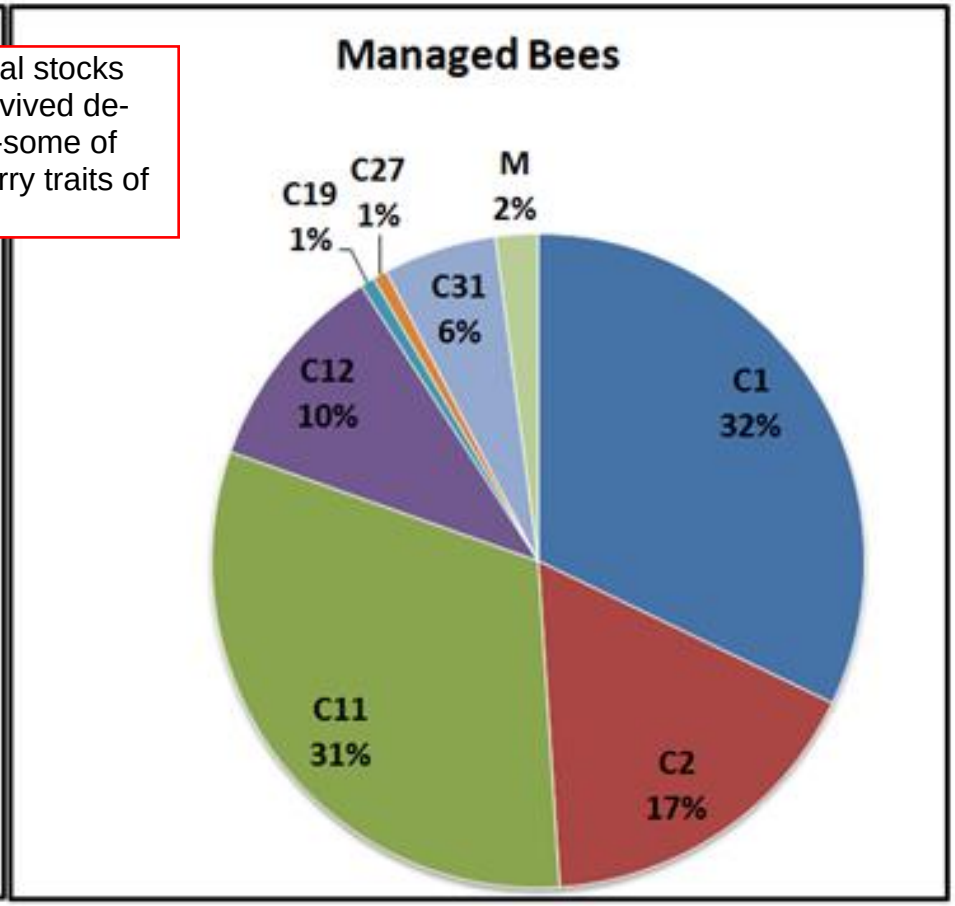
(Adapt to your circumstances)



Start with locally-adapted stock



There are feral stocks that have survived de-spite varroa--some of them may carry traits of interest



Start with stock that has a fighting chance!

The Concept:

From your breeding population,

identify the colonies

in which mites build up at the slowest rate.

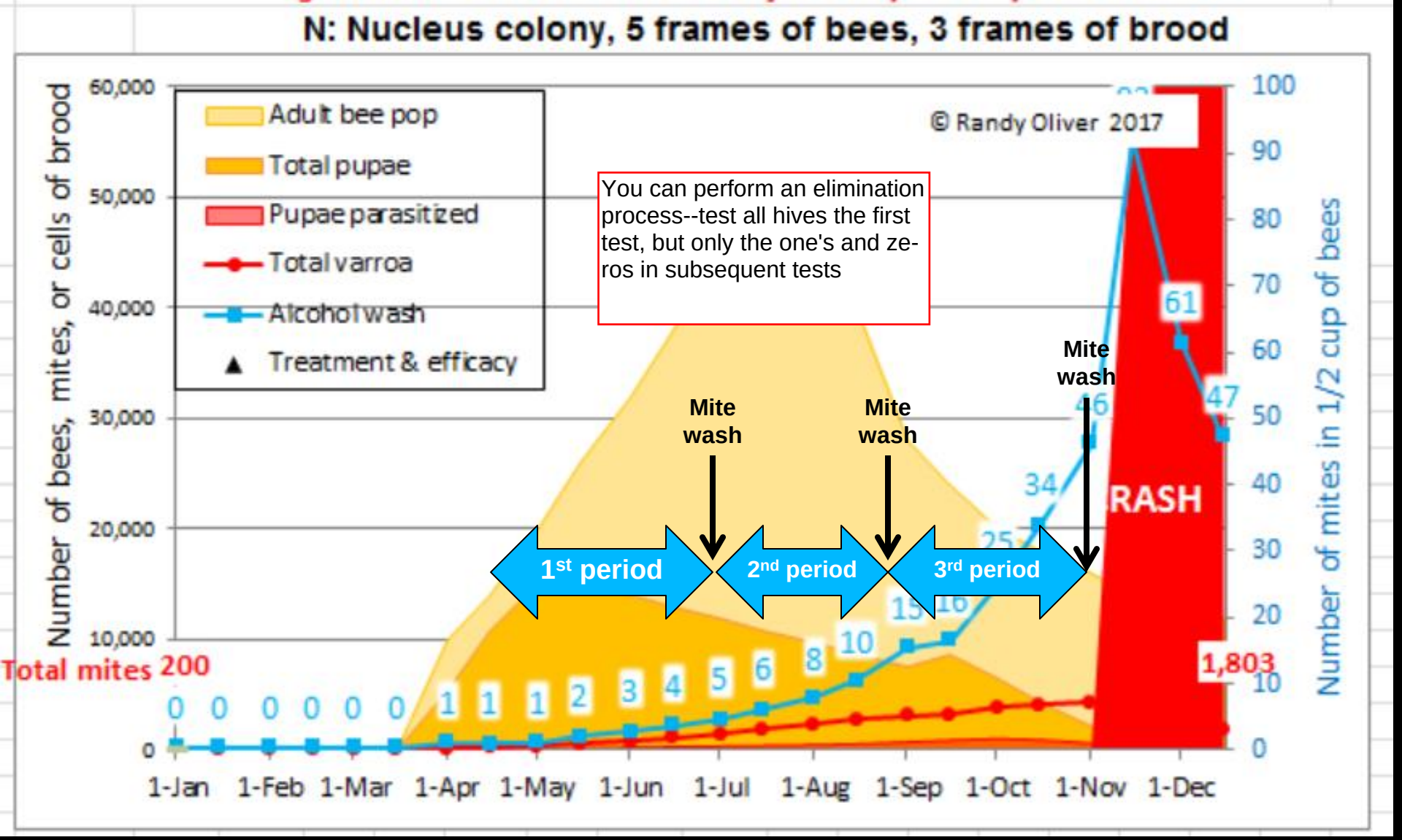
Produce a bunch of cells from promising queen mothers.

Start a large number of nucs or package colonies


Roughly equalize
starting mite levels.

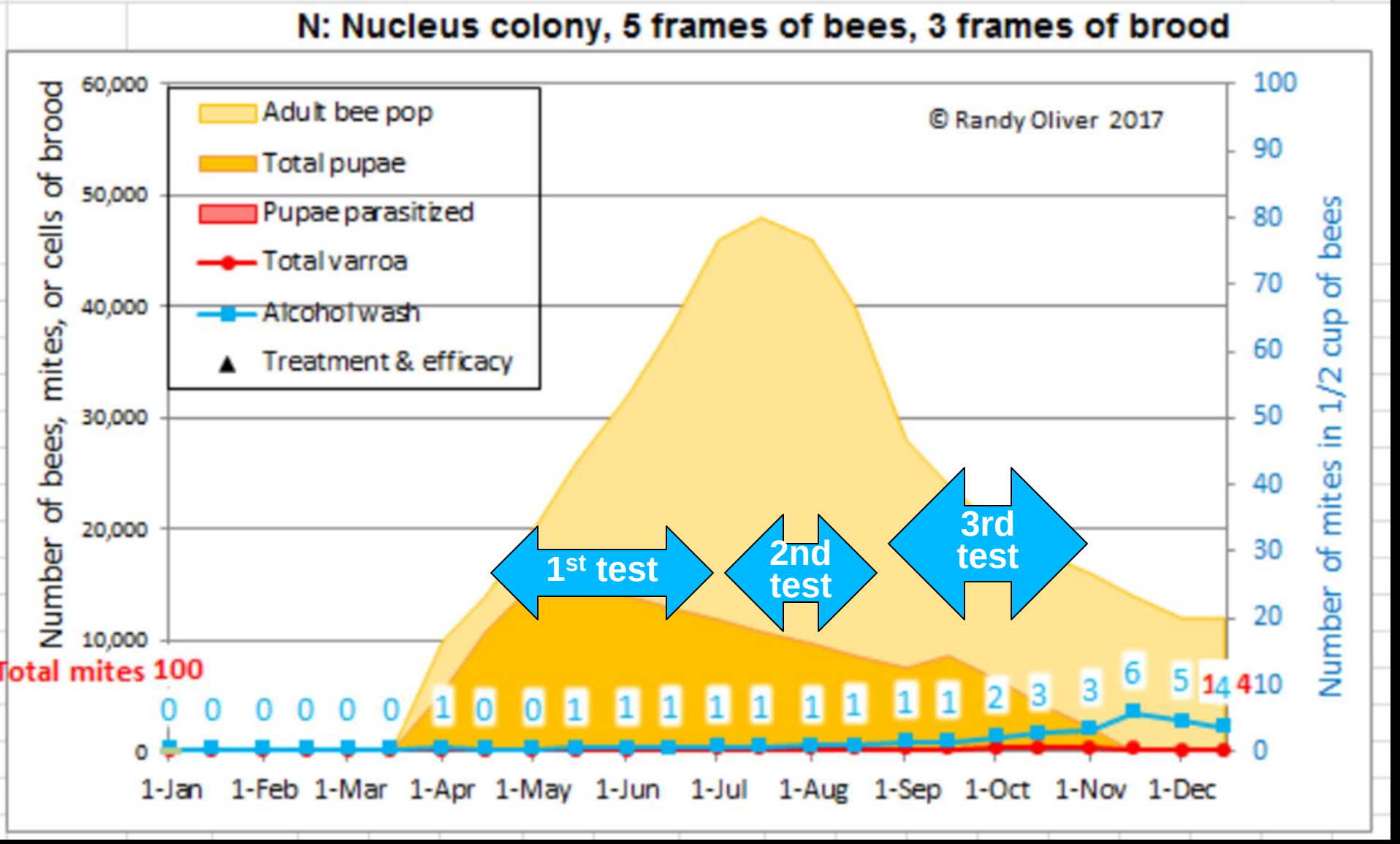
Place groups of hives in yards for comparison

Then start the "varroa race."



Compare their rates of mite buildup

Monitor by alcohol wash



Don’t treat those that resist mite buildup


No need to allow any hives to die from varroa!


Remove high-mite hives
from the breeding
program, and treat them.

Selection takes place ***at the queen level***.

Keep all your hives alive, but breed only from the winners next spring.


Next spring,
rear daughters
from the best

You need to control matings

So give queen cells to all your neighbors

Repeat the process each season.

* Simple
* Profitable
* Desirable stock

The Problem: the cost of monitoring

The Solution: an efficient method!

Sample from a similar frame from each hive

Portable table to the right


No need to pull a brood frame--
there are plenty of the target nurse
bees on any frame with beebread
or near the broodnest.
Any frame with beebread


Look for the queen

One experienced sample taker


With a good eye for spotting queens

Assess gentleness and colony buildup


Assess brood patterns

Assess productivity


Look carefully!


Return her


Hard snap
shake


Any more bees makes it hard to spot the queen
No more bees than this

Allow any old bees to fly off

The remaining young bees immediately spread out


Easy to spot
the queen


Scoop up ½ cup


Level it off


Dump into alcohol


Snap on lid

Mark hive with cup color

I generally leave my hive tool on the cover, and replace it with the marker when I shake the remaining bees back into the hive


36
Option: inkjet-printed labels

If there is a nectar shake on, shake more gently or use a brush. It's hard to spot the queen or scoop bees if they are sticky with nectar. Dry the tub afterward

If nectar shake, rinse tub

Helper carries samples to wash table

Tara and Rachel helping today. Normally just two of us

One or two trained technicians


Tara does all pouring over the large white plastic tray
The wash station

Motorized washer runs continuously. We just rotate the cups in order.

60 sec in electric washer

Remove the lid first, then lift them out slowly, so as not to stir up the mites.

Lift out washed bees

We never find any more mites draining out. Note that the mites remain in the color-coded cup

Allow to drain

Pour off excess alcohol

Make sure that all the mites are settled, and gently pour the excess alcohol off while watching for mites. Leave about 1/4" of alcohol above the mites--this makes for easier counting when the alcohol is discolored.

Count the mites


Too many mites!

Swirl up the mites and pour off. With higher counts, you generally need a second rinse.

Strain and reuse the alcohol

Next day, simply decant the clean alcohol off the top for reuse.

Sediment will settle overnight

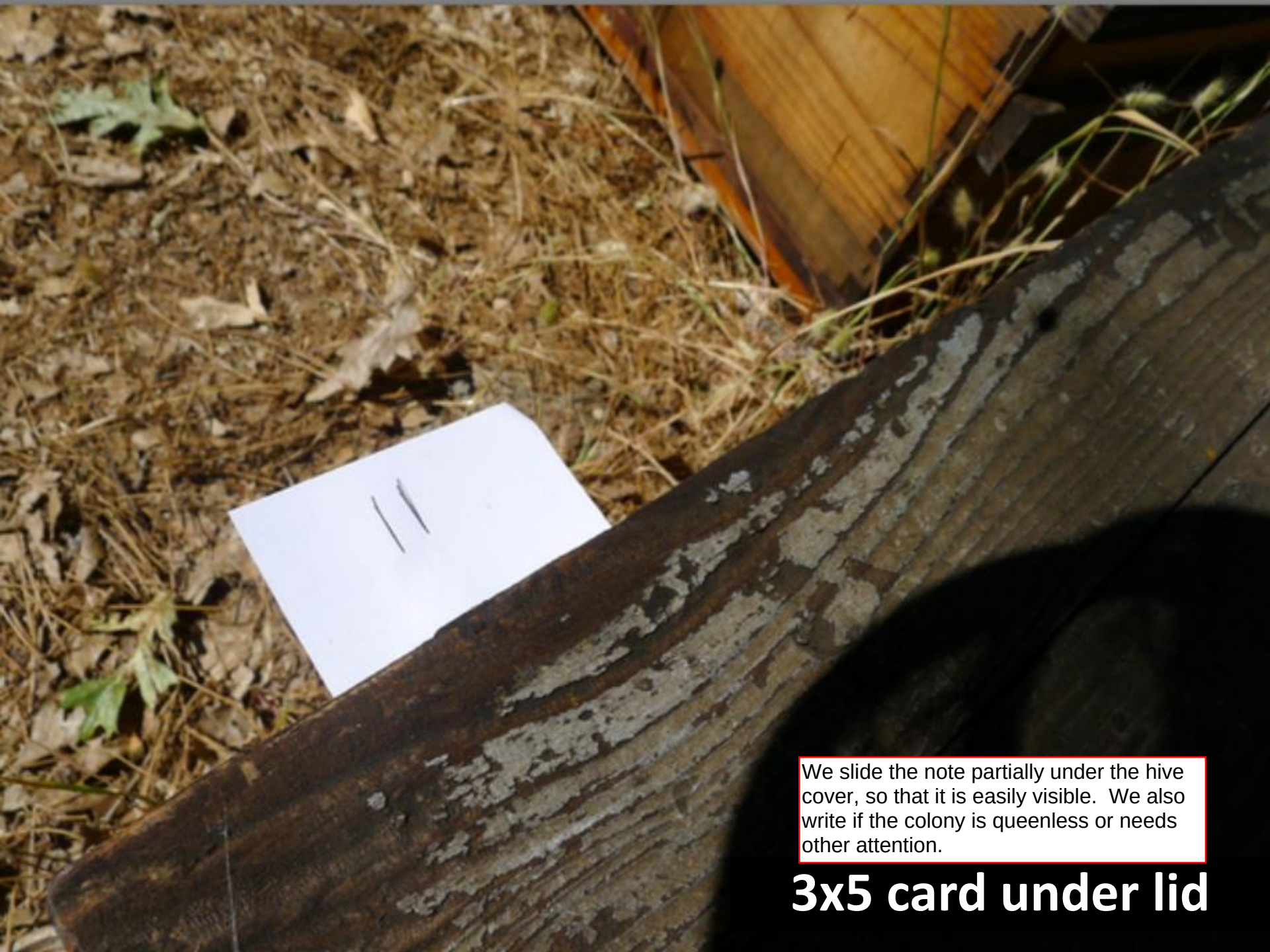
Rachel's coming back with refilled cups and their corresponding hive tags.

Refilled cups being returned


Hive note

Match the cup color and note to the marker. Now remove the marker. No confusion! A 4-cup rotation works great.

Match notes by color



We slide the note partially under the hive cover, so that it is easily visible. We also write if the colony is queenless or needs other attention.

3x5 card under lid

Zeroes and ones are marked as potential breeders

This tag says

Breeder
Ø

Meaning zero mite count, so don't treat

This is at a sedate pace. We can crank even faster--1.5 minutes per hive, complete, for 2 of us.

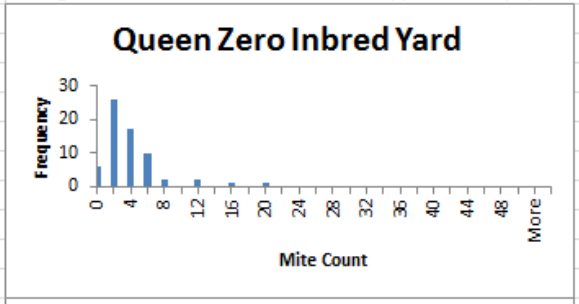
Yard of 30 hives takes ~40 minutes

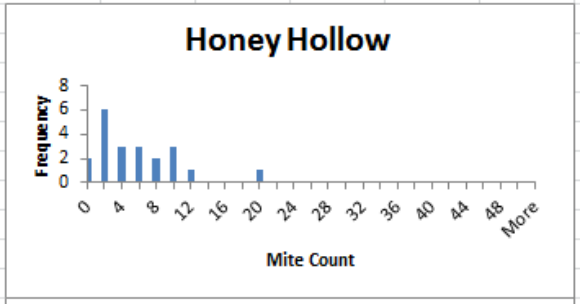

Labor cost at $25/hr runs about $1.50 per hive.

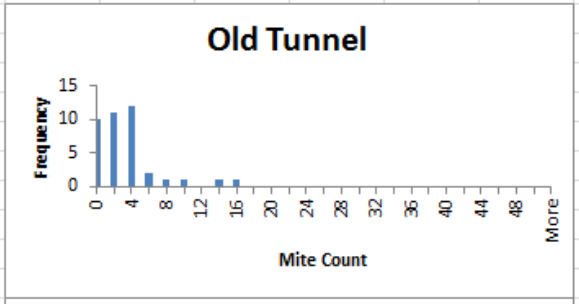
Not only that, but when we leave a yard, every hive needing attention has a note, we've identified potential breeders, and identified all the "mite bombs" that need special treatment. The yard crew follows us the next day, knowing what they'll need.

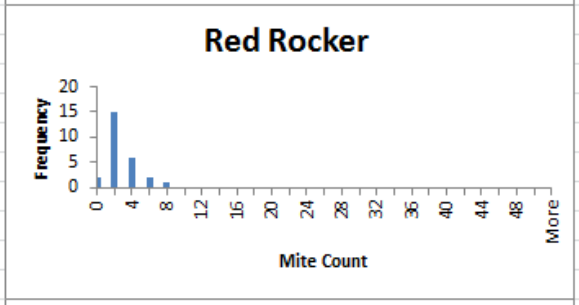
Cost is cheaper than most treatments

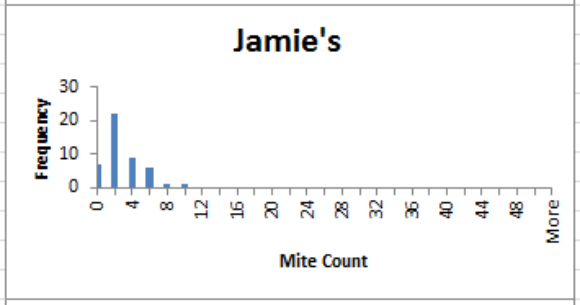
Histograms of mite counts from colonies approx. 65 days post spring treatment

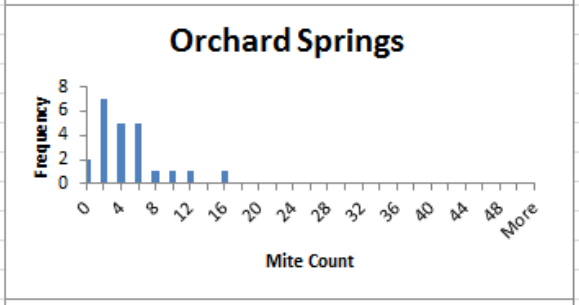


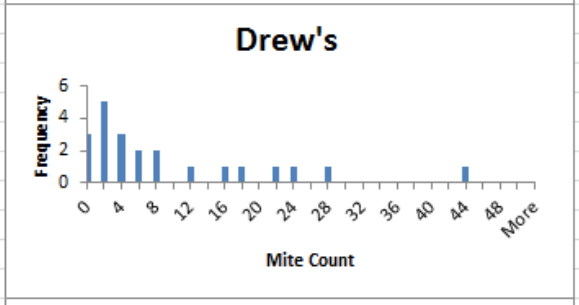


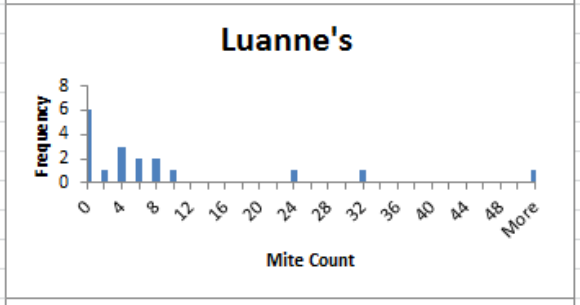


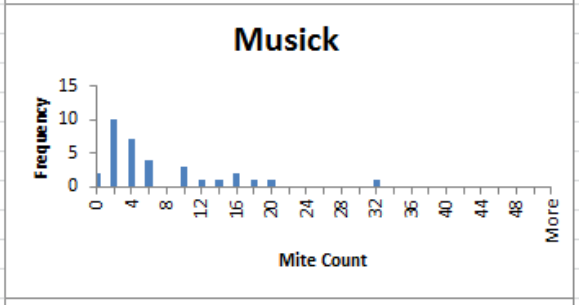


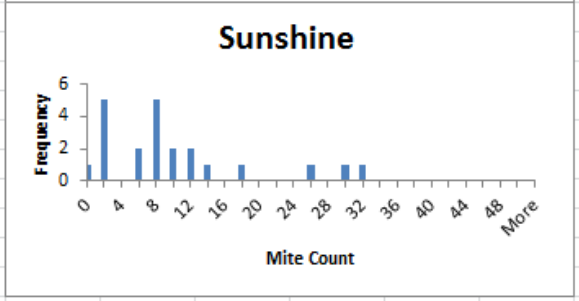


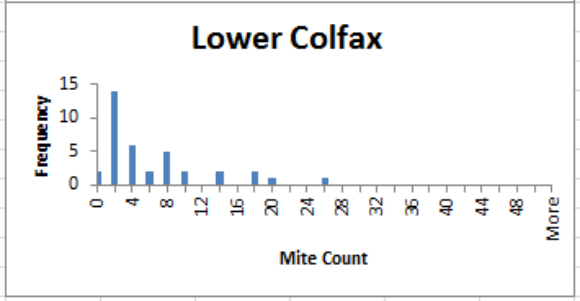


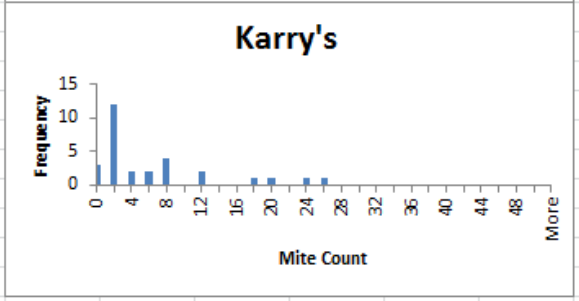












For $1.50/hive I can know the mite level of every hive in the operation

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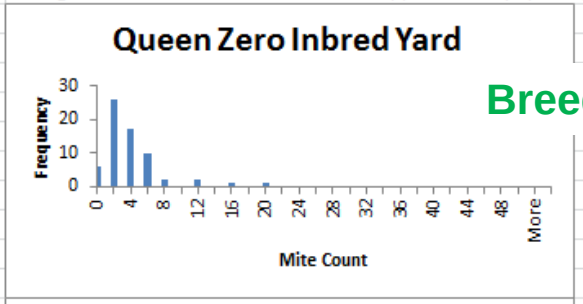

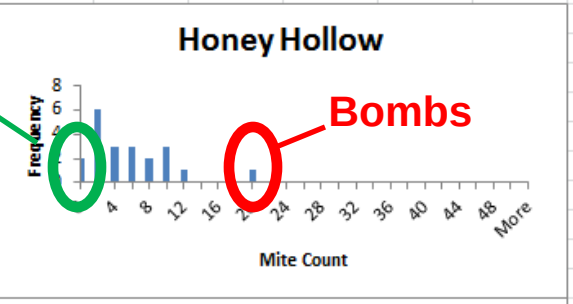

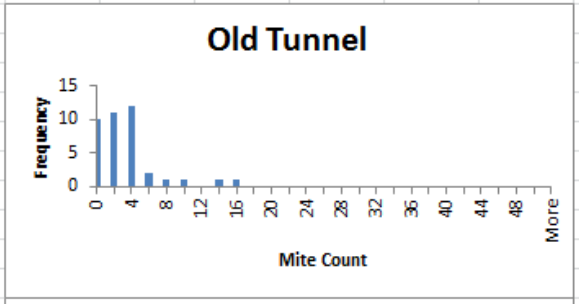

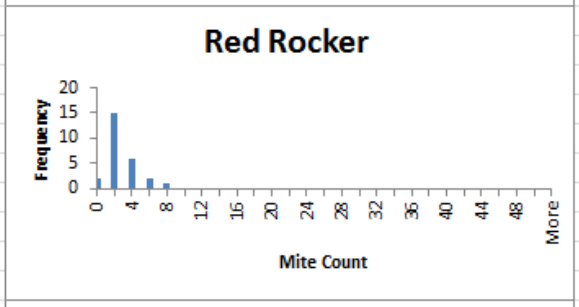

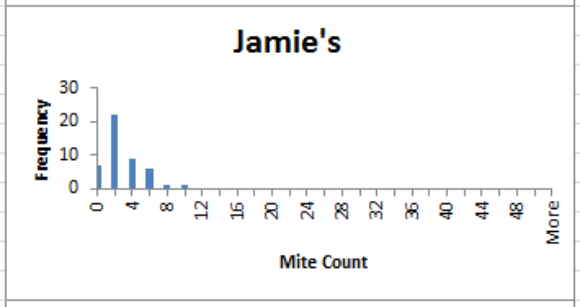

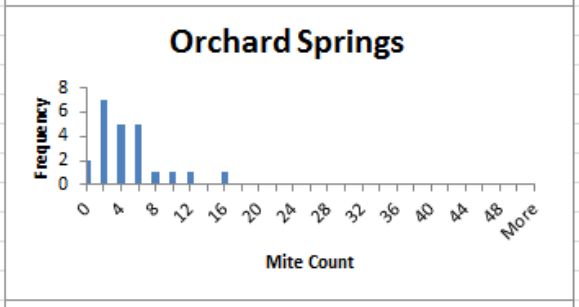

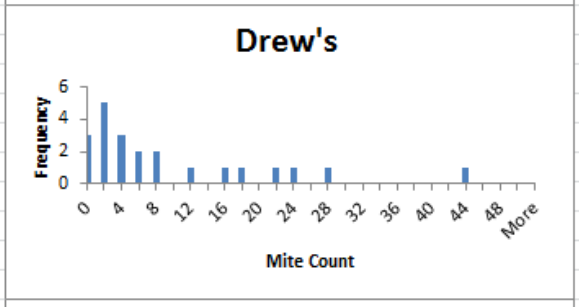

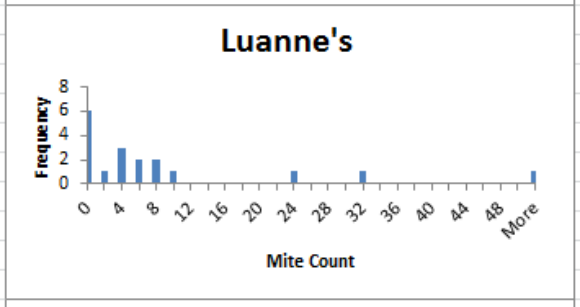

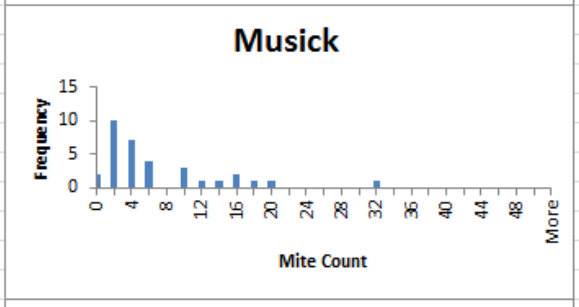

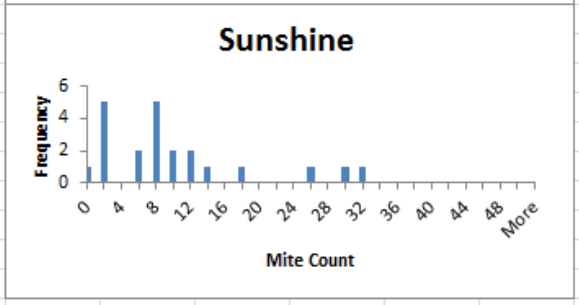

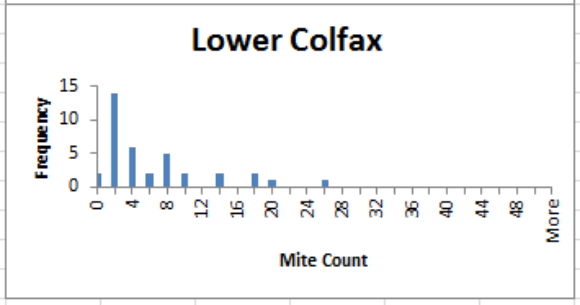

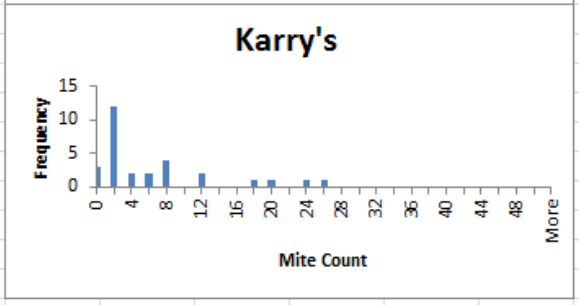

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Every accomplishment begins with the decision to try something different