Mite Drift Quantification:

A Citizen Science Project

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Hi All, I've gotten surprisingly few volunteers to join in this project, so thank you for being willing to collect this important information. It's now time to prepare our monitor hives in advance to get their mite populations down to zero. I'm including my original article below, with an extended protocol. Apologies for this late start—I was delayed by issues with the electronic scales.

Note: participation in this project is most appropriate for those with at least a few hives, and preferably for those who have previously counted mites on stickyboards. If you're interested, please read all below, and then email me your mailing address and the number of hives that you need mite strips for (please put the words "mite drift" in the subject line of the mail). Thanks, Randy

Thanks for your participation!

Randy

There's been a lot of discussion on "mite bombs" and the drifting of bees and mites from hive to hive. But there's been surprisingly little research to measure exactly <u>how</u> <u>many</u> mites actually do manage to successfully catch rides into other hives. I'd like to offer an opportunity for beekeepers to answer that question ourselves.

I've recently wrapped up a large and very interesting field trial on bee and mite drift, and will soon be publishing the results. But before I do, I need to ask for volunteers to join me in an across-country project to obtain hard numbers as to the amount of late-season varroa immigration that occurs in various areas across the country. This data set would be best if it included counts taken in hobby, as well as commercial apiaries, and from regions with low as well as high hive density. If you're interested in participating, read on.

BACKGROUND

Most of us have observed sudden spikes in the mite levels of our hives late in the season. Many suspect that an influx of mites restocked the varroa population in the hive after treatment. And my monthly mite washes taken for our selective breeding program strongly suggest that substantial mite immigration can take place in September and October -- I've previously written about this subject [1].

We can guess and computer model all we want, but what we really need is hard data. There have been few published studies on this, which I summarized in the graph below (Fig. 1).

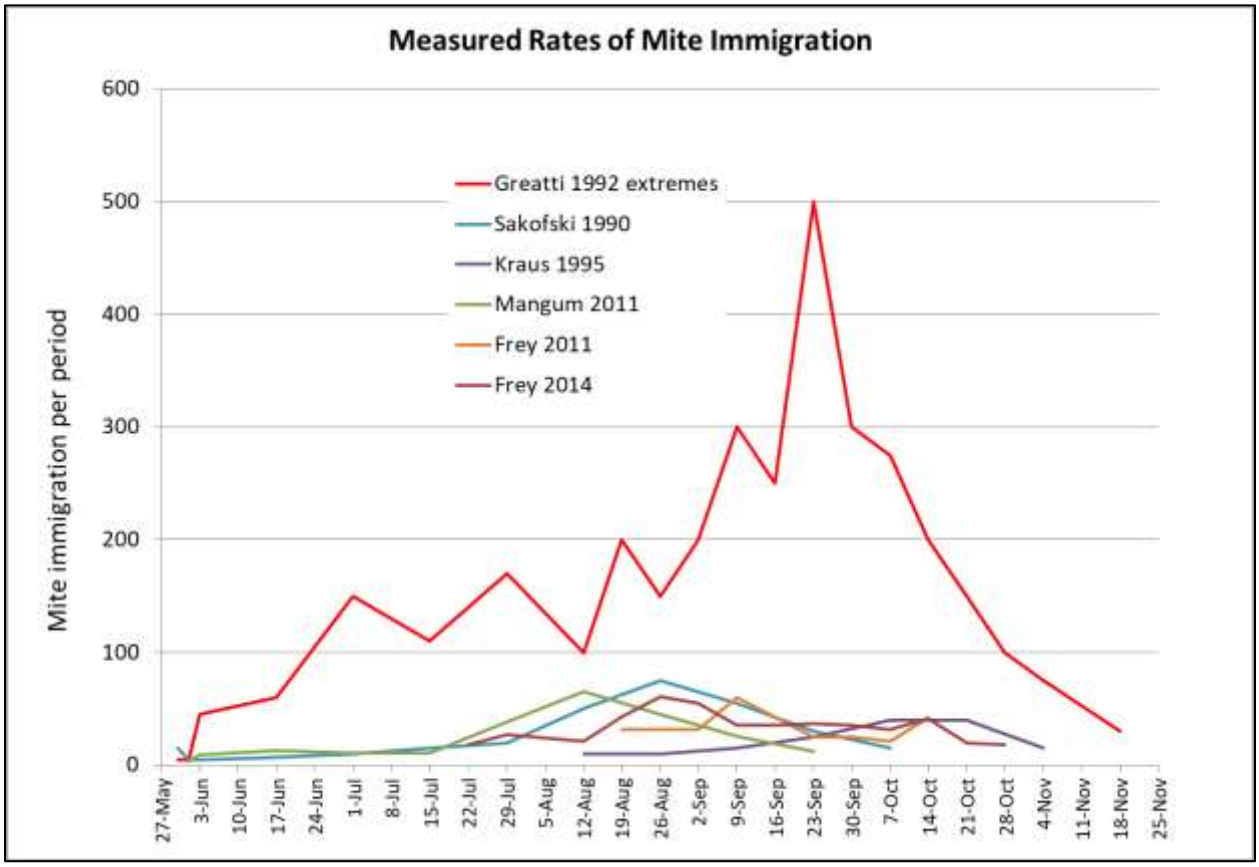


Figure 1. Greatti's [2] figures indicate that it's *possible* for thousands of mites to immigrate into a hive late in the season. This mite drift can then prime a treated and otherwise healthy colony for winter collapse.

I was curious as to just how many mites were coming into my hives last summer (and where they were coming from)—could it indeed be thousands? So last summer I set a dozen hives up to track mite immigration. Results: it varied greatly from hive to hive. The semi-weekly immigration into the hive that received the most mites in shown below (Fig. 2).

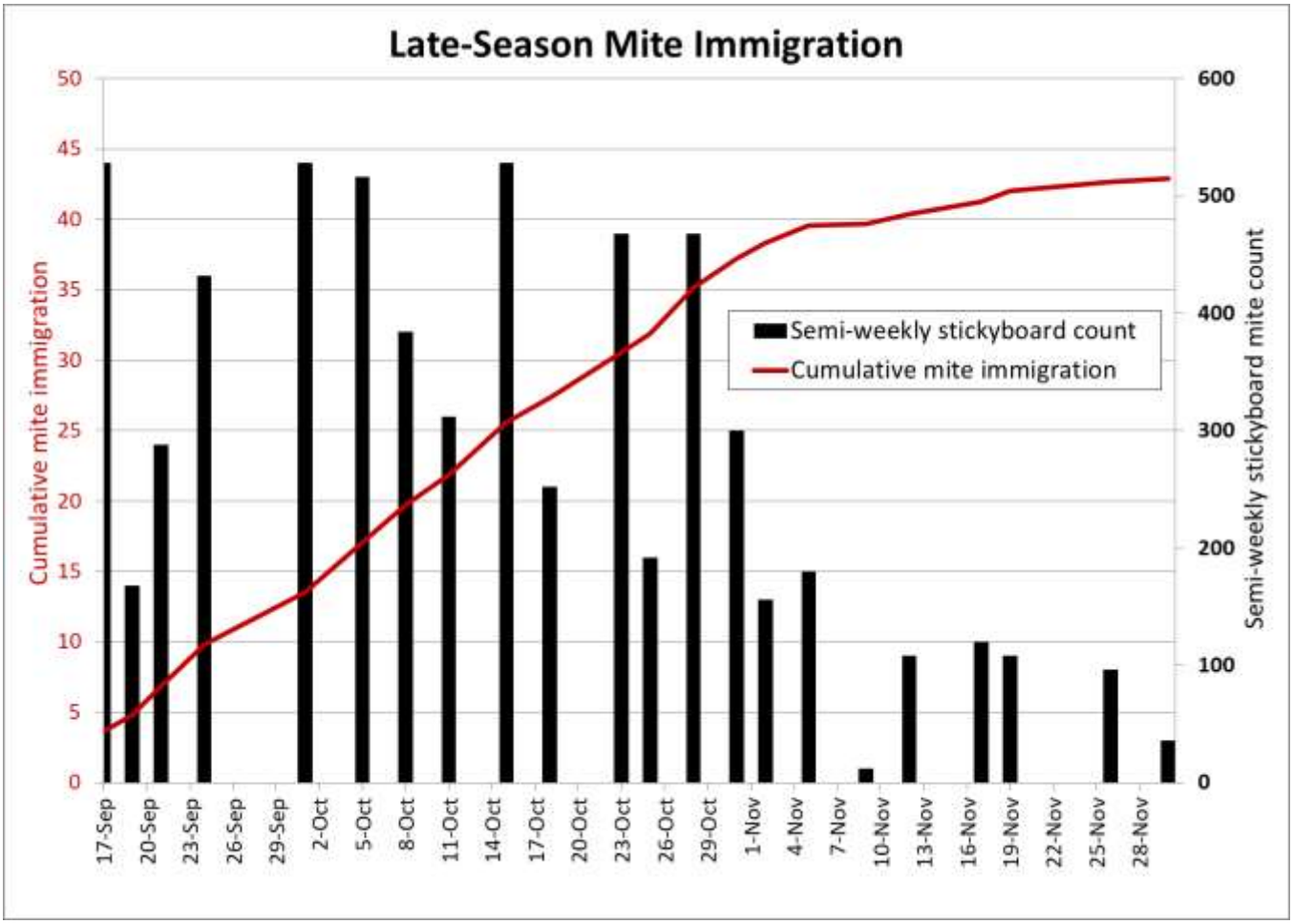


Figure 2. From mid September through the end of November, over 500 mites hitchhiked their way into this continually-treated, mite-free hive (red line); the semi-weekly counts are the black columns. A few weeks prior, I hadn't detected any mites coming in, so I'd waited until my experiment actually began in mid-September to start inserting stickyboards again. It looks as though I did so a bit late, as mites were already flooding in by then. When I reinserted stickyboards during a rainy period in December (not shown), mite drop in all monitored hives was zero – indicating that no mite reproduction had been taking place in any of the treated monitor hives.

Although we counted over 500 mites entering the hive above, based upon my tracking of mite infestation rates in my breeding program, I strongly suspect that the amount of mite drift had been, for some reason, several times higher the previous year.

Practical application: it's clear that mite immigration in late summer and fall can be substantial. A flood of incoming, reproductively-active mites coming into a hive, just as it's downsizing for winter, could cause real problems. Imagine that I had treated the colony above after I pulled the honey in early August, and then 500 mites moved in in September and October -- and reproduced just once. That could result in there being enough mites to take an 8-frame cluster into the winter with a varroa infestation rate of over 6 mites per hundred bees – high enough to lead to over-winter DWV collapse.

Another thing I found was that mite immigration varied greatly from hive to hive. Even in the same yard, the cumulative mite immigration counts varied tenfold.

Practical application: some hives in the same yard pick up far more mites than others. Why this is I don't know, but it has huge implications for mite management, and possible directions for selective breeding programs.

We clearly need more data of this sort from across the country! If you're interested in helping, here's the protocol:

THE PROTOCOL

MATERIALS AND AMOUNT OF WORK INVOLVED

You'll need to follow the protocol below exactly, so that we can compile and compare the data. Your monitor hives will need to have varroa completely eliminated well in advance, so best to start by mid-May -- ***you can't procrastinate***. Once you get the mites down, each monitor hive (more than one would be best) will need a screened bottom and two stickyboards to swap out. You'll need to perform stickyboard counts twice a week, or arrange for someone to cover for you. Luckily, you won't likely need to count too many mites each time—for the hive above, the highest semi-weekly count was only 44 mites.

THE PROTOCOL

1. Decide how many hives you want to include in this project. Each hive will require the counting of a stickyboard twice a week. This takes me, with reading glasses or a magnifier headband, well less than 5 minutes per count and reinsertion of the stickyboard.
2. ***Optional:*** If you're in an area in which colonies do not normally gain weight due to lack of nectar flows late in the season, you can collect additional valuable data by placing the hive(s) on electronic scales. This information will indicate whether the hive was engaged in robbing behavior at any point of time (and thus correlate with an increase in mite immigration). Any accurate electronic scale will do. Broodminder sells an inexpensive scale, and the owner, Rich Morris, will walk you through the setup if you mention that you are engaged in this project with me Rich@broodminder.com. If you do use a scale, be sure to verify that it is indeed collecting data, and print out the weight graph on a weekly basis.
3. At least six weeks in advance (I suggest mid-May), choose one, or preferentially more, healthy hives to monitor. They do not yet need to be strong, provided that they have young queens, and are expected to grow to full strength by mid-August. Starting with a nuc is great, since it is easier to completely eliminate the mites from a smaller colony. In order to avoid inadvertently selecting colonies that may exhibit some sort of resistance to invasion, it may be best to start with colonies that exhibit "normal" mite counts.
4. Eliminate the mites: First remove any honey that you want to harvest, since you will be applying miticides throughout the project. It the initial mite infestation rate is above 2 mites/100 bees, it be of help to first apply an oxalic or formic treatment for quick knock down. Otherwise, simultaneously apply *two different* time-release synthetic miticides (e.g., Apistan®, Checkmite II®, or Apivar®) at the full label rate for the size of the colony (Fig. 3). The label rate is typically 1 strip per each frame covered by the cluster of bees. I had very good results by applying both Apistan and Apivar strips at the rate of ***one strip of each type*** for every five frames of bees [3]. If you don't want to purchase full packages of the strips, **I'll be happy to provide the total number of strips needed, free of charge. Please email me your address, and the number of hives you need strips for. I will send 3 strips of each product per hive. If the hive is still**

growing, insert 1 strip of each product per 5 frames covered with bees to start with, and add additional strips as the colony grows. Allow the strips to remain in the hive until the end of mite counting. The strips must be distributed throughout the cluster, in contact with the bees, since the miticides are distributed by contact with moving bees.

Figure 3. I used one strip each of Apivar and Apistan for every 5 frames of bees in the cluster. Since you'll be leaving the strips in the hive for the duration of the experiment, you cannot harvest any honey for human consumption from these hives – instead use it for winter feed. Monitor the mite drop with stickyboards (Figs. 4-6) until it drops to zero per day (and you feel confident that there are no mites left in the hive). This should occur by the first of July.

5. By early July, install bottom boards adapted for stickyboards. These are readily available commercially, or you can build your own (details below). At this point of time, semi-weekly mite drops should be zero.

Our bottom boards already have ¾” beeways, so I simply move the rear beeway to the front of the bottom board, and build a three-beeway frame with 1/8” hardware cloth stapled onto it. I flip the screened frame over and tack it on top of the existing beeways. This leaves a screened bottom board with an entrance to the rear (the bees climb up the front beeway to enter). The stickyboard slides in from the rear.

At the rear of the bottom board I insert a tapered block to prevent any bees from entering the stickyboard space.

6. Starting in late July or August, keep a stickyboard in the hive continuously, taking regular mite counts twice a week (to avoid accumulation of hive trash on the stickyboards). It's easiest to simply assign two days each week for monitoring—e.g. Saturdays and Tuesdays. Do not feed the hives any pollen sub during this time, as it will make counting the mites difficult. Since there are no mites left in the hive by this time, any mites found on the stickyboards must have been carried in from outside, and then quickly killed by the miticides. Record this data by date and mite count (sample data sheet attached). Continue these counts until colonies go dormant from the cold (winter data would be of interest from where bees fly all year). If you need to go on break, no worry—just continue with mite counts when you return, leaving a gap in the data.

7. If you're over 25 years of age, for counting the mites, be sure to use magnification for accurate counting of the mites. You can wear strong reading glasses, however, I prefer to use a flip-up jeweler's magnifying headband as shown below—available at https://www.magnifier.com/headband-magnifiers.htm

Figure 4. Each monitor hive must be set up with a screened bottom of 1/8" hardware cloth, over a holder for a stickyboard. Be sure that the screen does not sag anywhere near the stickyboard, nor insert a

warped stickyboard, or the mites may be scraped off when you withdraw the stickyboard for counting. On this stickyboard I've drawn a grid in order to make accurate mite counting easier (Marks-A-Lot brand felt pen ink is stable in the Vaseline), and labeled the stickyboard with the hive number. I prefer accessing the stickyboard from the rear of the hive. You can either make two stickyboards per hive, so that you can swap them at the hive, and then count the mites inside. Or you can simply count the mites right there at the hive (there shouldn't be too many), and then lightly re-oil the stickyboard for reinsertion.

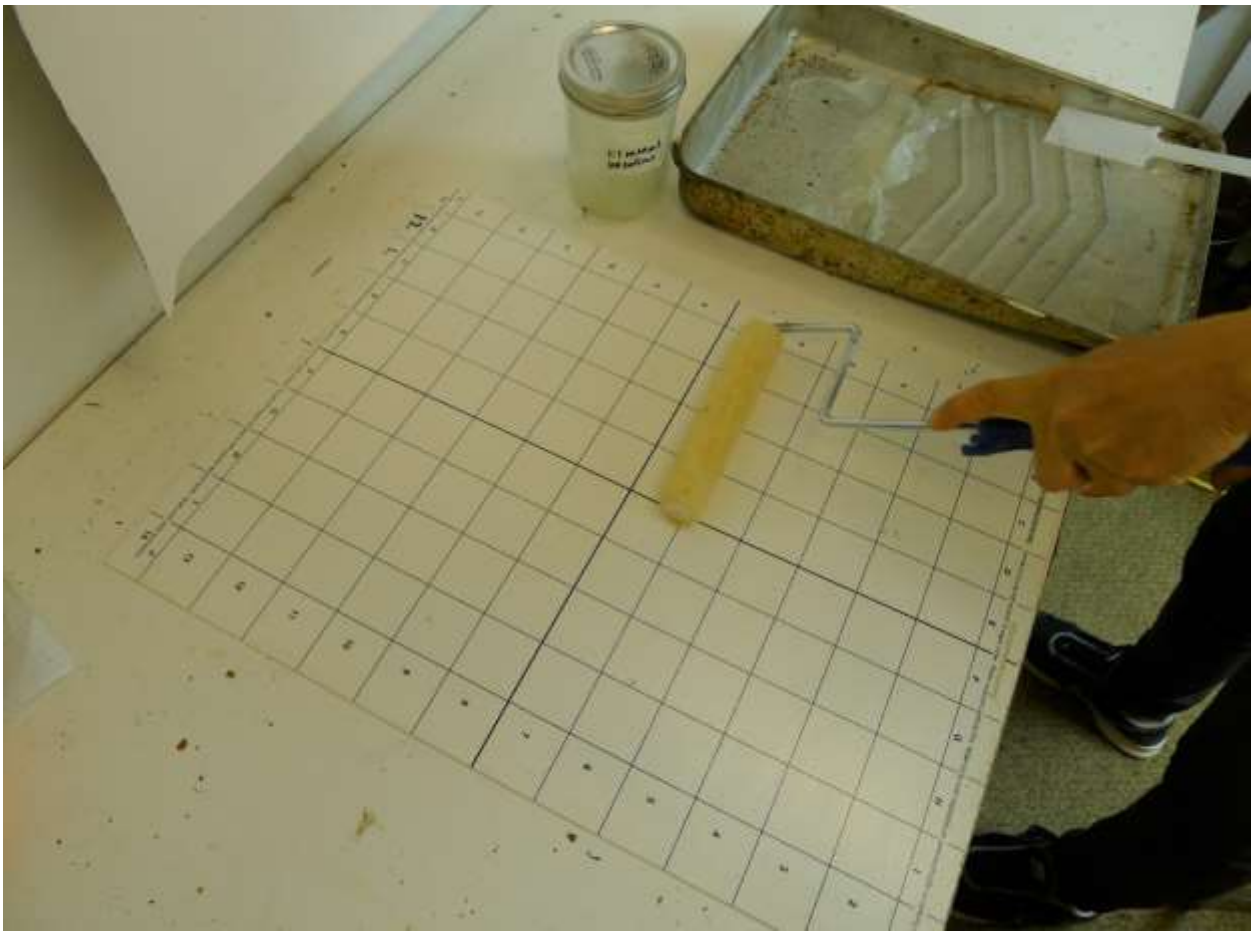


Figure 5. I've tried a number of types of stickyboards. The best I've found are those I made myself by using a table saw to cut a sheet of white "FRP wallboard" into appropriately-sized pieces [4]. We then use a mini paint roller to apply a mixture of mineral oil and petroleum jelly [5] – which prevents any live mites from crawling away, or ants from carrying them off. **Tip:** use a *very thin* film of jelly from a fairly "dry" roller, since too thick a layer makes the mites more difficult to count.

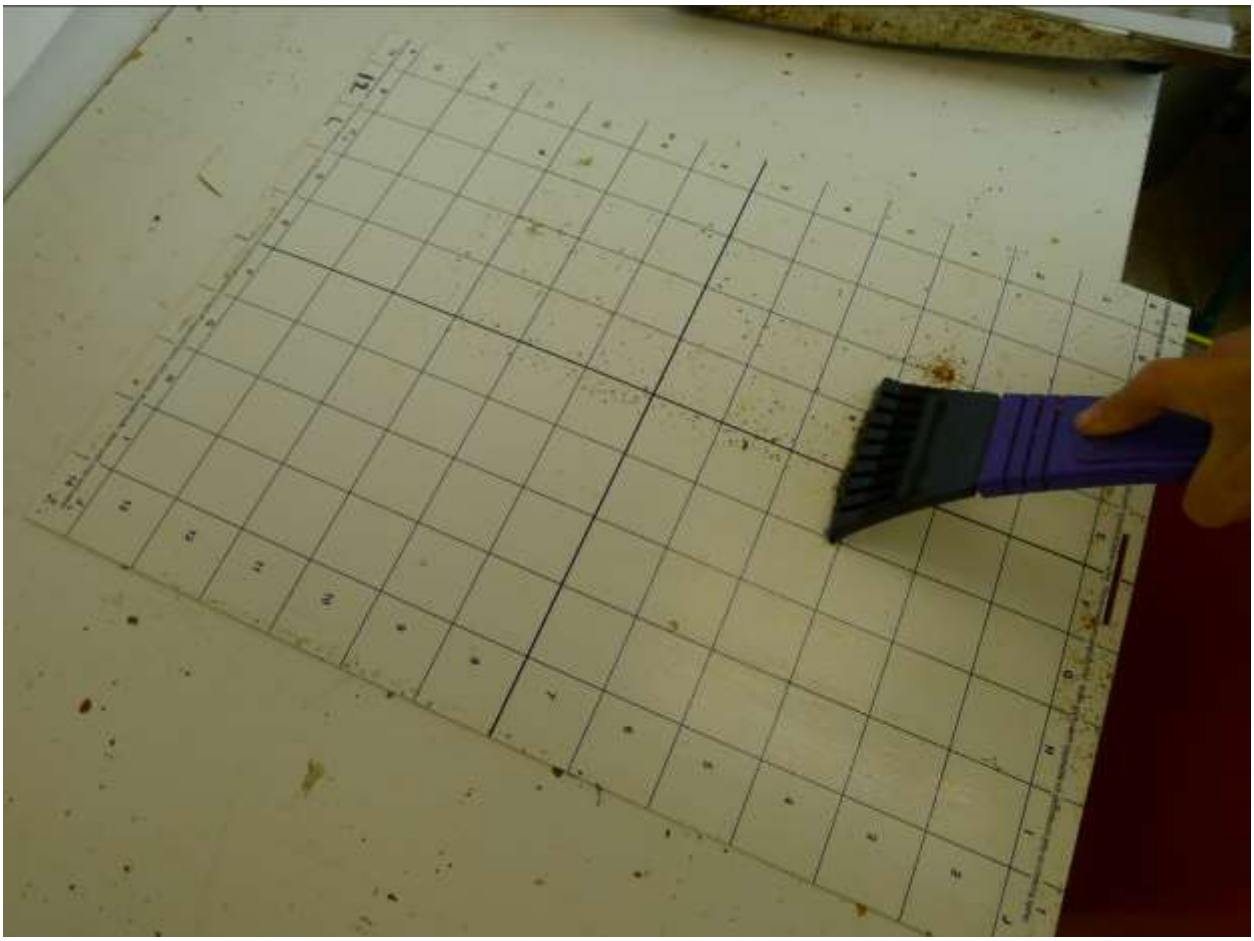


Figure 6. In this photo I show a non-FRP stickyboard with a tighter grid, which I use for experiments in which I expect to have to count larger numbers of mites. Plastic stickyboards can be easily scraped clean with a windshield scraper or drywall knife, then rerolled with a petroleum jelly mixture.

8. Validation of the method: confirm during the monitoring counting period that the treatment strips are indeed continuing to prevent varroa from reproducing in the monitor hives by checking by one or more of the four following methods:
    a. Check the drop rate on rainy days when there is no bee flight (it should be zero by the second day of rain).
    b. During the monitoring period, alcohol washes should be zero (there may occasionally be one newly-immigrated mite that hasn't yet been killed.
    c. Use a dissecting 'scope or penlight and magnifying glass to confirm that no mites are in the brood (Fig. 7).
    d. The easiest confirmation is that mite counts will drop back to zero once mite drift ceases and cold weather prevents bee flight. Refer back to Figure 2 – if mites had been reproducing in the colony, the drop counts would have gone up as the colony cut back on broodrearing in November.

Figure 7. Here I'm using a dissecting 'scope to confirm that there are no mites reproducing in the brood of a monitor hive, by using forceps to pull out 100 dark-eyed pupae, and then peering into the cell to see whether there are any signs of a mite. This last method is a bit tedious, and generally not necessary.

End of protocol. Any questions, please email me with "Mite Drift Project" in the subject line, or phone me at 530 277 4450. If you need miticide strips, please email me with your mailing address and number of strips needed (typically 3-4 strips of each product per hive).

Apologies in advance: I deal with a large number of emails every day. For this project, ideally I will only need to send these instructions to each collaborator, perhaps package and mail treatment strips, and then receive data sheets to compile. Thanks for understanding the limits of my time!

WANT TO BE A COLLABORATOR?

The common complaint that "varroa must have flooded into my hive late in the season" needs to be confirmed and quantified, so that we can develop better Best Management Practices for varroa control, so that I can enter that information into my free mite model [6], and so we can account for this problem when breeding for mite-resistant stock [7]. We beekeepers can collaborate in order to determine the amount of mite drift that actually occurs in neighborhoods, country, and agricultural areas all over the country, and for hobbyists as well as commercial operations.

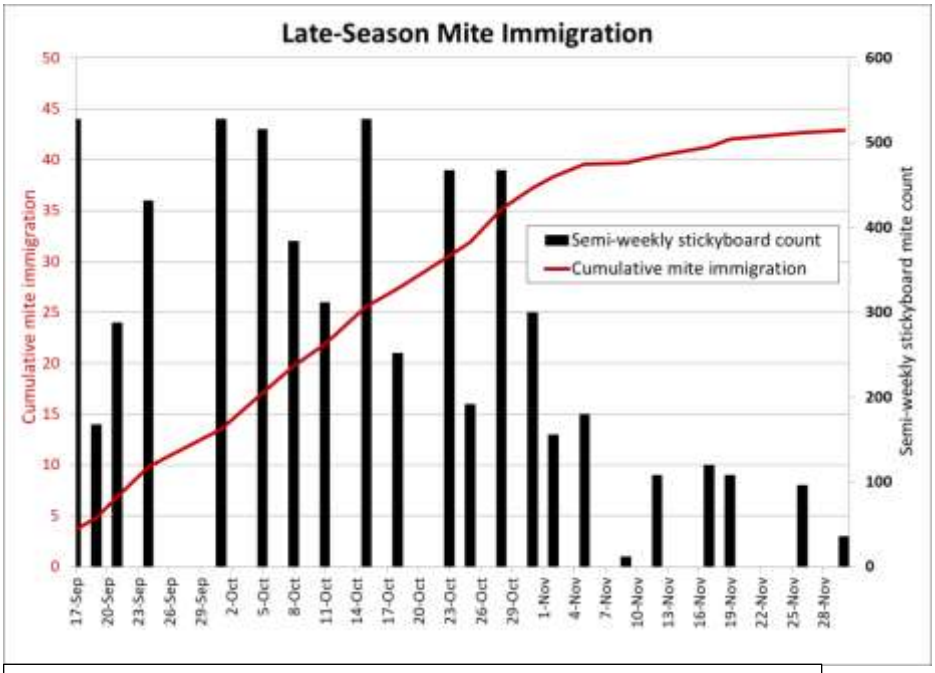
If you're willing to commit to this project, please email me for the protocol, data sheets, plans for stickyboard holders, miticide strips, or questions at randy@randyoliver.com. Be sure to put in the subject line "mite drift project."

Caveat: this is not an appropriate project for first-year beekeepers. It would be most appropriate for those who have previously used stickyboards and counted mites.

WHAT THE RESULTS WILL LOOK LIKE

Here are some examples of actual data that I collected in the summer of 2018:

	Mite Counts	
Date	Hive 5	Hive 6
17-Sep	44	21
19-Sep	14	15
21-Sep	24	14
24-Sep	36	31
1-Oct	44	29
5-Oct	43	42
8-Oct	32	30
11-Oct	26	30
15-Oct	44	39
18-Oct	21	32
23-Oct	39	32
25-Oct	16	8
28-Oct	39	4
31-Oct	25	6
2-Nov	13	14
5-Nov	15	13
9-Nov	1	5
12-Nov	9	10
17-Nov	10	4
19-Nov	9	5
26-Nov	8	ND
30-Nov	3	0
Total	**515**	**384**



Data for Hive 5 plotted out.

Data Sheets

The data from your hives will be easiest for me to process if you can send it to me at the end of the trial in Excel or other spreadsheet format. This will allow me to import your data, rather than having to hand-enter each value. Thanks!

NAME AND LOCATION

Your name and email.

Your location (State, Province, GPS coordinates if you have them)

Please describe your location -- the landscape vegetation (urban, rural, farmland).

The total numbers of hives in your apiary.

Did any hives in your apiary collapse from varroa, and if so, at around what date?

Your best estimate of the total number of hives within a mile radius.

Do you suspect that there were many "managed" hives within a mile that collapsed from varroa?

If so, do you know the date range of their collapses?

Do you suspect that there are many feral colonies or escaped swarm colonies in the vicinity?

Do you also have weight data, and did it indicate a correlation between weight gain and mite immigration?

Other notes of importance?

MITE COUNT DATA (RAW DATA ENTRY)

Mite Immigration by Date Please enter semi-weekly mite counts. See note on following page if you are also collecting hive weight data.			
Date	Hive #	Hive #	Hive #

Please print this data sheet out for field entry of your mite counts. I prefer to print my data sheets on cardstock paper, so that they don't get damaged. ***Please also enter the raw data on a weekly basis into a spreadsheet (such as Excel), so that no data gets lost!***

Note: it is difficult to count mites on a stickyboard if hive trash is allowed to build up for more than a few days. Therefore, I suggest that you take mite counts at least twice a week. **This data sheet is to record that raw data, *at the time and place of counting***. On the next page is a data sheet into which you can combine your mite counts into totals for each week.

If you also take weight data, you will need to expand this data sheet.

Upon completion of data collection, please either email me the data in a spreadsheet, Word doc, or other form. Thanks!

MITE IMMIGRATION DATA (SUMMED WEEKLY COUNTS TO SEND TO RANDY)

Please copy the data sheet below into a spreadsheet that you can send to me.

The dates are arbitrarily set to Saturdays, so that we can easily compare data, since it's really a mess to graph out the data if we all use different dates. So please simply total your mite counts ***for the seven day period that overlaps the indicated Saturday date***. If you did not collect data for a particular time period, please enter "ND" for "No Data."

Totals for the Week			
Date	Hive #	Hive #	Hive #
4-Aug			
11-Aug			
18-Aug			
25-Aug			
1-Sep			
8-Sep			
15-Sep			
22-Sep			
29-Sep			
6-Oct			
13-Oct			
20-Oct			
27-Oct			
3-Nov			
10-Nov			
17-Nov			
24-Nov			

OPTIONAL HIVE WEIGHT DATA (TO MONITOR ROBBING)

If your hive is on a scale, please check the weekly graphs of hive weight, so that we can look for a weight spike due to robbing. **I will leave it up to you to determine whether any weight gain spikes correlate with a similar spike in mite immigration. If so, then please expand the data sheet to enter hive weight for each time point, so that we can graph the correlation.**

REFERENCES

[1]http://scientificbeekeeping.com/selective-breeding-for-mite-resistance-1000-hives-100-hours/#analysis-late-season-failure

http://scientificbeekeeping.com/the-varroa-problem-part-16a/

http://scientificbeekeeping.com/the-varroa-problem-part-16b/

[2] Greatti,M, et al (1992) Reinfestation of an acaricide-treated apiary by *Varroa jacobsoni* Oud. Experimental & Applied Acarology 16: 279-286. *The sources of the other data are in The Varroa Problem part 16b.*

[3] The mites in my operation had no history of exposure to either of those miticides, so I expected high efficacy. No retreatment was required—I just left the strips in 'til the end of the monitoring. You must confirm via alcohol wash or brood dissection that no mites are reproducing in your monitor hives.

[4] FRP wallboard are 4-ft x 8-ft "fiberglass-reinforced plastic" sheets, readily available at home building supply stores, and used for waterproof wall paneling. The sheets are very strong, don't warp, and can be reused over and over. I cut them on a table saw, then draw a grid on them before the first application of the petroleum jelly mixture with a black Marks-a-Lot® brand felt pen, which I find holds up very well. The stickyboard in this photo, however, was *not* made of FRP.

[5] What works well for us is to scoop a 13-oz container of petroleum jelly (Vaseline®) into a saucepan, add a 1-pint bottle of mineral oil, and stir it over gentle heat until the jelly is dissolved. Then pour the mixture into wide-mouth shallow jars to cool.

[6] http://scientificbeekeeping.com/randys-varroa-model/

[7] This mite immigration was evident in the USDA program for breeding the Primorsky Russian bees, and appears to have been a problem in my own program. Such late-season immigration can overwhelm what might otherwise have been colonies that could manage varroa on their own, if not subject to an influx of mites from outside.