VOLUME 160 NO. 4

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AMERICAN BEE JOURNAL

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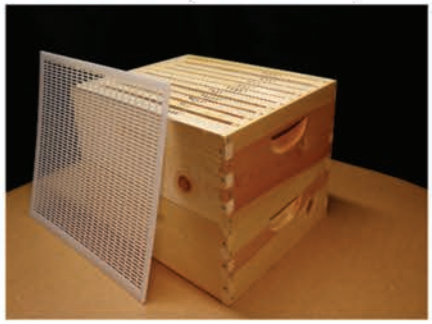

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ON THE COVER

Encelia californica, or California bush sunflower, is native to Southern California and Baja California, Mexico. Also known as California brittlebush, this lovely specimen was captured by Justin Largen at Debs Regional Park in Los Angeles.

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From the Editor

Eugene Makovec

editor@americanbeejournal.com

Moving Bees

It's early spring, and thousands of new beekeepers are eagerly preparing sites for their beehives. Here's a cautionary tale:

I started with bees in Kirkwood, Missouri, a St. Louis suburb that to this day remains bee-friendly — due in large part to favorite son Francis Scheidegger, a local photographer, beekeeper, and three-decade City Council member. After Francis died I was the only beekeeper I knew of in town, till I was approached at a club meeting by a young fellow with a strong British accent, who said he'd just taken up the hobby and wondered if I might have a look at his new hives. Let's call him Nigel, as that has a quintessentially British sound, and I'm not sure Phil would want me to use his real name.

Nigel, his wife and two young sons had relocated from London a couple of years prior for his job, and they happened to live just six blocks from me. So I walked over one day for a look-see, and was surprised to see two beehives right in his front yard — about five feet from his front walkway and perhaps 15 feet from the city sidewalk. I was a bit taken aback, but since his nucs had been installed several weeks earlier and were already bustling with activity I figured there was not much we could do about it now. That was a mistake.

Fast-forward a couple of months, to mid-summer, and an anxious call from Nigel. The family had just returned from a three-week vacation to their home country, and found in their mailbox a letter from the city. The message was, in effect, "A passerby was stung by a bee, and upon inspection we have determined your beehives to be a public nuisance. You have 10 days to remove them."

"We just got home today," Nigel said, "and tomorrow is the tenth day. What can I do?"

"Here's an idea," I said. "Call the city and see if they're okay with you moving them to the back yard, and if that can wait till this weekend."

Kirkwood was happy to comply, so we hatched a plan. To avoid confusing the foragers, we'd move them first to my bee yard 2½ miles away, then wait a few weeks and move them to his back yard. So we met Saturday pre-dawn at his house. Since it was the heat of summer, we first smoked what bearding bees we could into the hives, then closed entrances and lifted the four-story hives onto his neighbor's pickup truck and drove them over. (We left an empty box to catch the stragglers.) Turns out that was the easy part.

Three weeks later I walked to Nigel's house on a Sunday night, and we drove to the bee yard in his minivan. The supers had been removed in the meantime, so the now-two-story hives would be a cinch for the two of us to lift into the back of the van and drive home. It was a bit cooler that night so we just had to close the entrances and lift them on.

What I did not know was the second hive had an inner cover with a ventilation notch (aka upper entrance). Luckily the hole was on Nigel's side, so I remained blissfully unaware until I'd pushed the hive further into the hatchback and turned to find Nigel … gone! I turned in the other direction to see his bouncing headlamp beam 30 feet away … now 50 feet … and now on the ground. He'd finally managed to rip off his helmet and veil, and was frantically brushing the remaining bees off his chest when I caught up with him.

"My glasses," he said, arms out to signal me to stop. "I don't know where they flew, and I can't see without them."

"Stay here," I said, and wandered the area gingerly. They were nowhere to be found, not even near his veil or headlamp. "We'll have to come back when it's light."

We returned to the van, smoked what bees we could back inside and taped the hole. I drove us back to his house and we carried the hives to their new location out back. I had to navigate, as Nigel was blind as a bat without his glasses — much as I had been prior to Lasik surgery a couple of years before.

As we walked inside, I asked, "Do you have an old pair of glasses you can wear?"

"No," he mused, "but I have something that might work." He made his way up the stairs and came back in a minute, wearing swim goggles!

"Prescription?" I laughed. He nodded sheepishly. I'd never heard of such a thing. "I could've used some of those over the years myself," I said, thinking of all those times I'd blundered blindly in the pool, or just kept my head above water because I was wearing contacts.

I asked if he wanted to meet at first light to search for his glasses, but Nigel said he *had* to be at work in the morning — goggles and all — and would let me know later in the day. I would have *loved* to see him show up at the office the next morning in those specs! These were the days before I carried a phone with a camera, so you'll have to trust me when I say, he looked hilarious!

Nigel drove home at lunchtime on Monday and found his glasses — right near where his helmet and veil had fallen. After a couple of years of successful *backyard* beekeeping, his employer moved him back to Britain. But I still think of him every time I have to move bees.

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THERMAL MITE TREATMENT CONCERNS

It was with great interest that I read Ali McAfee's article in the January edition concerning thermal varroa mite treatment. I am a small beekeeper running an average of 10 to 15 hives. I am in my 8th year of beekeeping and have fought all the issues facing our honeybees. I do not like using chemicals in my hives and have relied on essential oils for treatment. I will start down the oxalic acid trail, reluctantly this year to control varroa. I do not view any treatment as safe that requires a gas mask, face shield and rubber gloves like oxalic acid does but the essential oils just are not enough.

That is the main reason I was hoping the thermal treatment would work, but the cost for Mr. Williams' Mighty Mite Killer unit is just a hard pill to swallow for something that is not independently proven. I talked with Mr. Williams a couple of years ago about his product but my take was a lot of claims but really not much proof. I continued to research this treatment and discovered another unit that runs on battery, also made in the U.S., called The Victor made by Robert Warner of **GreenBeehives.com**. It heats from the top down via warm air circulation whereas Mr. Williams uses convection heat from the bottom up. Hopefully someone will take the time for true research and side-by-side trials of both units. If Mr. Williams and Mr. Warner really believe in their products they should offer them up to an independent party to trial and publish the results. Another interesting fact is Mr. Williams sells his units for $349.00. Mr. Warner sells his unit for $179.00. This is a substantial difference especially for the small beekeeper.

In conclusion at least from my point of view the small beekeeper needs a viable option to chemical treatments for their bees. I can tell you in my short time as a beekeeper I have been sold some shoddy bees & bee supplies by folks in the industry that claim to be in it for the bees while taking advantage of fellow beekeepers. More than once I have considered getting out of beekeeping altogether because of this, yet I continue on. I have learned to do my research before parting with my hard-earned money especially in the beekeeping world. I really do hope these products work as advertised but I can't afford to take any more hits in the beekeeping world to try one of them.

Respectfully,
H.G. Gillispie

PRESCRIBED BURNS BENEFIT BEES
(ABJ Extra, January 30)

This is great! I'm a natural resource manager as well as a beekeeper and this is what I have been trying to express for years. So glad to see research shared to beekeepers on this level from this platform!

Thanks!

Clint Brooks
Brooks Mill Farms LLC
Locust, North Carolina

THESE NORTHERN QUEENS ARE VERY GOOD!

In response to "Are Northern Queens Really Better?" (February Letters):

The Queens that I get do come from Kirk Webster and they are very good queens. Yes, they do have some Russian in them. I have 10 hives; yes, they are all Russian and no, they are not mean like people think. I have been into bees from 1978 till now. I guess I will have hives till I cannot do it anymore and yes, I do have a full-time job too. That's a lot for one person to do.

Donald Fradet
Lou, Kentucky

ARE THESE ASIAN HORNETS?

I am writing in regards to the article from the February ABJ entitled "Giant Alien Insect Invasion Averted." Released from prison in 2016, I began beekeeping shortly thereafter. My first hive was a complete colony purchased very locally. Throughout that first year, I would occasionally see a really big, black/yellow/orange wasp dead in front of the hive. During my second year I saw more of the same, but additionally saw many of these insects alive around the hummingbird feeders I had added to the porch.

In late spring of 2018 I came home to discover about a dozen of these wasps flying around a hive of Carniolans I had purchased that year. They were picking bees from the sides/front of the hive and landing to eat them, at which point I killed them with my hive tool, much like John Duff from the article. By that time I had read of the threat of the Asian Giant Hornet, but assumed since experts were saying it was not yet in North America, I was seeing something different.

Parole proved to be too much for me and I was incarcerated again soon after this last encounter. On TV here in prison I watched a National Geographic program about predator and prey. Without giving the location of the hive, it showed amazing video of a group of AGHs attacking a colony of honey bees. It was exactly what I had seen at my own hive. Now here I read that in August of 2019 the first sighting of *Vespa mandarinia* in North America was confirmed in Canada.

So now I have questions. The size, color and behavior of the wasps I've seen is the same as described. Is there another wasp in the Southeast that is easily confused with *V. mandarinia*? If not, I live in extreme NW Georgia on the outskirts of the Chattahoochee National Forest. If I have seen these since 2016, 6-8 hours from the coast, then they have been here much longer. I regret that I am not home to "bag and tag" one of these insects this year. My mother saw them last year and I've asked her to keep an eye out and get a picture if possible.

Georgia beekeepers: Seen these wasps?

Sincerely,
Kane M.
Central State Prison
Macon, Georgia

Hi Kane,

I ran this by Jennifer Berry, Lab Manager with the University of Georgia Honey Bee Program, who said there is no evidence of the Asian hornet in Georgia to date. But if your mother could send a photo, or better yet an actual hornet, they would be happy to identify it.

Eugene

DECORATED HIVES

Wife and daughter decorated my new hives.

Bill Bledsoe
Contra Costa County, California

EASIER QUEENS IN SMALL QUANTITIES

The February article by Tina Sebestyen, titled "Are you raising your own queens this year?" was excellent, with "Cell builder/finisher" colony information. Having an extremely strong colony of worker bees to place the cells with larvae into is number one in importance. To "graft" you need a metal grafting tool or a Chinese grafting tool to scoop up a larva and place it into a plastic queen cell cup.

May I suggest using the "Cell Punch Method" as an alternative? With this method you remove the entire larval cell and transfer it to a frame to be placed in a "cell builder" colony mentioned above. I use a deep frame colony that I have removed the queen from. But any size box is fine. It just needs to be queenless.

Punching cells with eggs does not seem to work well. My guess is that cells with 2-day-old larvae are sending out pheromones that let the nurse bees know they need to be fed immediately.

For the "backyard beekeeper, attempting to ''graft'' larvae of the proper age is a bit of a task and results in unacceptable damaged larvae.

For more information contact me at **n4wm@bellsouth.net.**

Wil Montgomery
Southside, Alabama

FOUNDATIONLESS FRAMES

I discovered recently that the "F" style foundationless frames that I have been recommending to people to buy for their long hives are no longer available for sale. Walter T. Kelley was the only supplier that had them. Apparently Mann Lake bought out Walter T. Kelley and decided to drop the foundationless frame. I am sure it was a business decision based on sales. I have tried contacting both Walter T. Kelley and Mann Lake Ltd. to ask if they might consider bringing the "F" frame back. A nice salesperson from Mann Lake promised to pass on the information for me. I never got any response as a result of that. I put in an email inquiry to both companies and got no response at all. I am wondering if there are enough beekeepers out there that care about the frames, that if we contact the companies in a large enough number, they may consider bringing the frame back? I am sure there are other supplies which they offer that are not sold in large quantities. I am also thinking unless they moved quite quickly, they still have the machines available to put the frames back into production. Although there are other ways to rig foundationless frames, the "F" frame was very convenient. I would mention that we would be willing (at least I would be willing) to pay a little more for the "F" frame, because it was less expensive as it was because no foundation was needed. I would be willing to pay the price of a frame with foundation, I would hope others would as well. I don't know if that would be enough incentive to the company. If anyone out there has access to Mann Lake directly, and can get someone to hear our plea, it would be greatly appreciated.

Caroline Abbott
Otsego, Michigan

Hi Caroline,

As it happens, two weeks before your letter I'd had a conversation with Isabees, a St. Louis area Kelley dealer, about another discontinued frame that I used to buy there. Owner Jane Sueme couldn't help me with that, but mentioned that the demand for the foundationless frame you describe was such that she'd found a new manufacturer for it, and wanted to advertise it in ABJ. You should find her ad in this issue.

Eugene

TAX FILING TIP

Howard Scott ("Should I File or Not?", January ABJ) should have listed the schedule F form as a form to use to report beekeeping profits on your federal tax form.

Georgia and other states and counties give tax breaks to farmers. One way to prove you are a farmer is to file a schedule F tax form.

Jim Mabry
Marietta Georgia

Mr. Scott didn't suggest filing apiary income on a Schedule F (Farm Income) versus a Schedule C. Years ago a beekeeper with some tax preparation background expressed the opinion that the IRS is more tolerant of cycles of income and loss for farm income, as opposed to Schedule C businesses, which sometimes are used to just to create losses to shelter other income.

As a result of that advice from years ago I've always filed apiary income over at least the last 10 years (as far back as my Turbo Tax records go — but I filed with paper forms for years before that).

The only down side of doing so, was that when sending my 4 kids through college, college financial aid offices often wanted to know more about my "farm." But having bees scattered all over, including some farms of others but none of my own meant that there was no farm.

Well, they've all graduated, so it wasn't too bad. They all know a LOT about bees, too!

Curtis Crowell
Hightstown, New Jersey

Howard responds:
I've mentioned Schedule F in former tax articles, but wanted to keep it simple.

AMAZED

Isn't it amazing what all they come up with? Such as "New in-hive device zaps varroa" (February "News and Events"). This will be a big hit for those diehards insisting on buying queens from afar. So far I've never heard of anyone having mite resistant bees when queens are shipped in from far off. But we do have beekeepers who have been breeding their own queens for years and these bees know how to zap their own mites. No treatments needed.

So is a Northern bred queen better? I would suggest the best queen is the one that is acclimated to your area, whether it be North, West, South or East. Why keep scattering all the different mites and viruses, etc.?

Sam Kanagy
Romulus, New York

RAISING COMMERCIAL QUEENS

To Tina Sebestyen,
I am a subscriber of the ABJ, I guess you could call me a commercial beekeeper as I currently have 936 hives of my own in the almonds with the hope of growing to about 2,500. My beekeeping journey started just over 10 years ago when I went to work for a commercial beekeeper in Northern Utah who was running 5,000 hives to learn the trade so I could go back home and start my own business. Six years later I bought a semi load of bees from him and started my business in southern Utah.

I have been getting the ABJ for about 4 years now and have learned a lot through the years. I mostly just flip through it and read the articles that interest me. I just wanted to let you know I really enjoyed your article in the February issue ("How to Raise Queens in a Migratory Operation"). My mentor always bought mated queens and taught me that they more than paid for themselves. I have been trying to get my brother to build our own from the time I started my business, with many setbacks. Last spring we finally came up with a program similar to what you outlined in your article. We only did a small percentage however because of our failures of the past, but it was the best success we have had, and the queens we built far outperformed the queens we brought in from the commercial breeder.

I really liked your concept and approach and I believe we will be incorporating a lot of your ideas into our program. We are planning on building all of our own queens this spring. Thank you for your enthusiasm about bees and your willingness to share what you have learned with others. It helps people like me who are always on the lookout of how to operate more effectively and efficiently to better manage and care for the bees to get ideas from many different standpoints.

Heber

BEE-FRIENDLY FORAGE
(ABJ Extra, February 7)

One thing was brought to mind when I saw the picture of what looked like "Maximilian" perennial sunflower at the beginning of your article. I will be 81 years old in May and still raise a large garden including lots of all sizes of sunflowers to feed the birds. Looking through about 30 seed catalogues each winter about 95 percent of the sunflower seed is listed as "pollen-free." I had 14 hives of honey bees two years ago and lost them all to forage stress and mites because my wife was very ill and I had to be with her always and couldn't work my honey bees as I should.

My point is that I had to constantly feed my bees and even though I would get bumble bees and other insects working the sunflowers, none of my honey bees were ever seen working them for the reason they were pollen-free. A lot of people near me grow several different varieties of sunflowers just because they are beautiful to look at and because they don't want bees around. I believe that if the people that grow sunflower seed commercially would grow 50% or more with pollen and encourage gardeners to plant them for the honey bees, it would be a great help in returning the bees to a healthy environment.

Also, donating mixed free seed of pollen-producing sunflowers and encouraging more people to sow these seeds in the open areas that have natural wild flowers would also be a great idea for bringing back a source of food for the honey bee. Donation to elementary schools would be a place to start. Children would love to do something like this throughout their community and it would also encourage adults to follow.

John Chidester

RESELLING ONLY LOCAL HONEY

We are a small operation and sell most of our honey wholesale to a small local market. Even in good years, we run out of our own honey quickly because they sell so much.

I have often considered the points brought up by Howard Scott as well (February, "To Buy Honey or Not?").

We are also lucky to have a largish beekeeping company close to us, close enough that we can consider their product "local."

What we do is have two different labels and the one we use for the bought-in honey says "Locally produced and Packaged."

The store owner is aware of this, and we are still providing a local product.

Neal Klabunde
Strongsville, Ohio

FISHING FOR HIGH SWARMS

This works on high swarms at 50-60 feet, even over a creek: I use a rod and reel with lead split-shot on the end of the line. I put a bucket on a nylon rope (tossed over the branch), put a little honey and old comb in the bucket and pull it up into the swarm. Hold for 20 minutes and then lower the bucket with the swarm in it! I hope this helps someone.

Roney Peters
Gate City, Virginia


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Submit your News or Event to *editor@americanbeejournal.com*, or to Editor, 51 S. 2nd St., Hamilton IL 62341. Deadline is 45 days prior to publish date — e.g. January 15th for the March issue.

2020 AMERICAN HONEY QUEEN & PRINCESS HAIL FROM TEXAS & WISCONSIN

The American Beekeeping Federation is proud to announce that Mary Reisinger and Sydnie Paulsrud were selected as the 2020 American Honey Queen and Princess at its annual January convention in Schaumburg, Illinois.

Queen Mary is the 19-year-old daughter of Peter and Stephanie Reisinger of Parker, Texas, and the granddaughter of Michael and Teresa Reisinger of Richardson, TX, and of Shirley Roberts of Plano, TX. She is a senior at the University of Texas at Dallas, studying speech-language pathology. Mary is an active volunteer in the Collin County Beekeepers Association and currently tends to six hives. She previously served as the Texas Honey Queen.

Princess Sydnie is the 20-year-old daughter of Thea Weinberger of Eau Claire, Wisconsin, and Jack Paulsrud of Augusta, WI, and the granddaughter of Jean Severson of Eau Claire, WI. Prior to serving as a spokesperson for the beekeeping and honey industry, she studied childcare services in college. Hailing from Chippewa Falls, WI, Sydnie also works for a DHL-Fleet Farm Distribution Center. She previously served as the Wisconsin Honey Queen.

Mary and Sydnie will spend the next year promoting the beekeeping industry throughout the United States in a wide variety of venues, including fairs, festivals, schools, and media interviews. To schedule an appearance with American Honey Queen Mary Reisinger or American Honey Princess Sydnie Paulsrud, please contact American Honey Queen Program Chairperson Anna Kettlewell at 414.545.5514.

WORLDWIDE

SLOVENIAN BEEKEEPING TOUR

Slovenian Beekeeping LLC presents the 2020 Beekeeping Tour to Slovenia from 19 May – 4 June, 2020. These tours are a great way to learn about the wonderful Slovene AZ hives, how to manage them and the benefits of keeping bees in a bee house. Slovenia is known as the Beekeepers of Europe as one in every 250 people is a beekeeper. Only the size of NH, it hosts over 10,000 beekeepers. This tour visits 14 beekeepers, a few wine tastings, a few days in Croatia on the Adriatic Sea, adventure sports, hiking and a chance to spend a day in Venice plus much more!

These tours are small, limited to 16 people. We stay in farmhouses where we eat local food and drink local wine. The Slovene people are very warm and welcoming, and the country is absolutely gorgeous. You will fall in love with this amazing country!

Contact Suzanne Brouillette, owner, Slovenian Beekeeping at **beeslovenia@gmail.com** & **www.slovenianbeekeeping.com**.

REGIONAL

MAINE

EAS MAINE 2020
The Art & Science of Beekeeping

AUGUST 3 - 7

University of Maine in Orono

We'll have all the great things you've come to expect from an EAS conference: nationally and internationally recognized speakers; beginning, intermediate and advanced short course tracks; sessions on queen rearing and microscopy; a children's program and on-site apiary. For 2020 there will be more hands-on workshops including cooking with honey, working with beeswax, and photography. Our aim is to cover it all during a week of "The Art and Science of Beekeeping."

CONFERENCE SPEAKERS
- Dr. Ernesto Guzman, University of Guelph, ON
- Sue Cobey, New World Carniolan Breeding Program, WA
- Dr. Samuel Ramsey, USDA-ARS, Bee Research Laboratory, Beltsville, MD

- Dr. Tom Seeley, Cornell University
- Cindy Bee, Master Beekeeper, Appalachian Beekeeping Collective, WV
- Sam Abban, USDA-ARS, Bee Research Laboratory, Beltsville, MD
- Phil Craft, Veto-pharma, ABJ contributor
- Jennifer Lund, Maine State Apiarist
- Kim Skrym, Massachusetts State Apiarist
- Andrea Nurse, Climate Change Institute, University of Maine
- Eric Venturini, Pollinator Conservationist, Xerces Society & NRCS
- Tucka Saville, Queen Rearing
- Michael Young, MBE
- Maggie Wachter, Second Nature Honey, Urbana, IL
- Lincoln Sennett, Swan's Honey
- Allen Hayes, "The Gadget Guy"
- and many more!

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Buzzing with the Bees
Maine Lobster Bake & BBQ Dinner
Bee Olympics
Honey Exchange
Swan's Honey's commercial apiary and Humble Abodes woodenware manufacturer
Farmers Market

YOUTH SCHOLARSHIP TO ATTEND EAS

Ages 18-25 (if veteran, age limit is 30). Win $1000 scholarship to attend entire week at Eastern Apiculture Society conference .

Applications due by April 30, 2019. Details at EAS website: **https://www.easternapiculture.org/masterbeekeepers/youth-scholarship.html**

HEARTLAND APICULTURAL SOCIETY

HEARTLANDBEES.ORG

(Evansville, IN) Heartland Apicultural Society (HAS) has announced the site for their 2020 beekeeping conference. The campus of the University of Southern Indiana in Evansville, IN will host hundreds of beekeepers for the annual event, July 6-8, 2020.

HAS features keynote addresses, breakout classes, and open-hive demonstrations on a variety of beekeeping topics with noted experts from across the country. Beekeeping vendors, queenrearing classes, and a honey show are highlights of the annual conference. More details can be found at **www.heartlandbees.org**.

Heartland Apicultural Society Inc. was founded in 2001 with funding from Eastern Apicultural Society and several state beekeeping associations. Annual conferences are held at rotating locations.

Contact:
Dr. Tom Webster, HAS Chair
Kentucky State University
502-597-5682
thomas.webster@kysu.edu

Barry Richards
2020 Public Relations/Communications
info@heartlandbees.org
615-504-7424

STATES

ARIZONA

Arizona State University Beekeeping Courses

Hobby Beekeeping
April 18-19, 2020 – Cost $200

What you'll learn:
Participants will learn how to follow technical rules and basic beekeeping techniques to maximize quality bee products and services from their colonies. Participants will learn sustainable beekeeping principles and essential skills such as re-queening, uniting and splitting colonies, and treatments for pests for successful bee management in small backyard beekeeping operations.

Who this course is designed for:
Hobby beekeepers and individuals interested in starting in beekeeping. This course is designed as a second level to the Introduction to Beekeeping course.

How to Make Money from Bees
May 2-3, 2020 – Cost $300

What you'll learn:
Honey bees can be used for pollination service and lots of valuable hive products production. The most common ones are Honey, Pollen, Propolis, Royal Jelly, Bee Venom, Beeswax, Bee Bread, Apilarnil, Queen Bees, Package Bees, Split Colony, Bee Removal, etc. In this course, you will learn how to promote your colonies for production. Also, you will learn some techniques for more production and how to harvest them.

Who this course is designed for:
Hobby beekeepers

Instrumental Insemination of Queen Bees
April 4-5, 2020 – Cost $300

What you'll learn:
The most important member in a honey bee colony is the queen. A colony needs a good quality queen to be strong and productive. In Arizona conditions queens can live up to two years, however, due to the climate, she begins to lay fewer fertilized eggs after one year. Colonies can rear their own replacement queens, but this may result in a colony becoming Africanized as these colony-reared queens may mate with feral drones. In this course beekeepers will get

hands-on experience learning instrumental insemination techniques. Knowledge of instrumental insemination will equip beekeepers to select the exact queen and drones to establish a healthier, productive and more stable colony. Mastery of instrumental insemination will also allow a beekeeper to rear quality queens and drones from select breeder colonies whenever needed.

Who this course is designed for:

Hobby beekeepers, experienced beekeepers, commercial beekeepers, and bee researchers. A background in beekeeping and queen rearing is preferred. Virgin queens and drones will be provided.

Prerequisite:

Instrumental insemination equipment is required for this course. Limited sets of instrumental insemination equipment will be available for rent. To reserve a set of insemination equipment please contact the instructor by email: **Cahit.ozturk@asu.edu**

COLORADO

Four Corners Beekeepers Assoc. will hold their annual spring seminar on April 4th at Fort Lewis College in Durango, Colorado. The speaker this year will be Jim Tew, long time beekeeper and columnist for Bee Culture Magazine. His professional interest is honey bee behavior and biology, with a strong leaning toward practical beekeeping. His feet-on-the-ground approach to beekeeping combined with his love of experimentation and sense of humor will make for a fun and educational day. There will also be hands-on workshops teaching uses of products of the hive in the afternoon. Please visit **www.4cornersbeekeepers.com** for registration information.

GEORGIA

The 29th annual Young Harris, University of Georgia Beekeeping Institute A meeting you don't want to miss!

When: May 13-16, 2020
Where: Young Harris College, Young Harris, Georgia

The UGA Honey Bee Program offers an annual beekeeping event in cooperation with Young Harris College. This event provides a vast amount of information in the form of lectures, workshops and demonstrations from esteemed local, regional, national and international beekeeping practitioners, authors, and researchers. The event also features hands-on training classes, beekeeping and honey judging certification programs, a distinguished regional honey show, and many other educational opportunities. Since 1992, the University of Georgia and Young Harris Beekeeping Institute (YHBI) has been the single most comprehensive opportunity in the Southeast for concentrated training in all aspects of practical beekeeping.

Held on the campus of Young Harris College, situated in the heart of the beautiful Blue Ridge Mountains, the Beekeeping Institute is a four-day event with separate curricula for beginners and more experienced beekeepers. It's not only the beekeeping meeting you don't want to miss, but also a vacation spot that anyone would enjoy.

Besides offering classes for beekeepers at all levels of experience, the Institute sponsors the Georgia Master Beekeeper Program (GA-MBP) and partners with the Welsh (U.K.) National Bee Keepers Association to provide one of North America's only two licensing programs for Welsh Honey Judges.

We hope you will join us for our 28th Beekeeping Institute. Please visit our website for program, accommodation and registration information at, **www.ent.uga.edu/bees**

More information is available by email to: **ugabeelab@gmail.com** or calling 706-542-2816

ILLINOIS

University of Illinois Bees and Beekeeping Short Course
April 18, 2020, 8:30 AM - 5:00 PM

Lectures, hands-on workshops, and informal discussions on:

- Bee Anatomy
- Bee Breeding & Genetics
- Bee Diseases, Parasites and Pests
- Bee Health
- Bee Learning
- Bee Nutrition
- Colony Collapse Disorder
- Pesticides & Bees
- Pollination
- Sting Allergies
- Swarm Control
- Wintering in the Midwest

INSTRUCTORS: Prof. Gene Robinson, Prof. May Berenbaum and Prof. Adam Dolezal of the University of Illinois, and Dr. Juliana Rangel, Texas A&M University

LOCATION: Bee Research Facility and Carl R. Woese Institute for Genomic Biology—both new, state-of-the-art buildings. The Bee Research Facility has specially designed flight cages that will allow us to do hands-on bee work indoors regardless of the weather, if necessary. Those choosing to participate in the hands-on activities must bring and wear their own protective veils, suits, or gloves. Non-participants can view from outside the flight cages.

FEE: $100 includes course materials, refreshments and lunch

REGISTRATION: OPENS JANUARY 13, 2020:
Email: **lcundiff@illinois.edu**; Phone: (217) 265-7614

Payment by credit card is the only means to register for the 2020 course. To pay by credit card, watch Facebook for link information:
https://www.facebook.com/IllinoisBeeShortCourse/

LIMITED TO 50 PARTICIPANTS, SO REGISTER EARLY!

NEW YORK

Conscious Beekeeping: Introductory Workshop for Beginners

April 24, 2020 at 2:00 PM - 5:30 PM

This half-day orientation for beginning beekeepers will cover: Basic biology of the honeybee colony; rhythms of the year and the beekeeper's role in the life of the hive; a discussion of "alternative" hive styles; siting your hives; and the basics of working with bees.Weather permitting, we will visit the Pfeiffer Center's apiary, where we'll open a hive and illuminate topics discussed in the classroom. $55
www.pfeiffercenter.org

Conscious Beekeeping: Practical Organic Approaches for Healthy Bees and Growing Apiaries

April 25, 2020 at 9:00 AM - 5:00 PM

What can beekeepers do to help our bees thrive and flourish? Starting from a consideration of the honeybee colony from the biodynamic point of view, we will look at swarming as an expression of the bees' vitality • healthy rhythms of life in the hive, and how to support them • learning to discern when to intervene and when to let your bees work out their problems on their own • working with top bar and Warré hives • the Varroa mite • and more. $95
www.pfeiffercenter.org

Grow Your Apiary Naturally with Splits and Swarms

May 9, 2020 at 9:00 AM - 1:00 PM

Get off the package treadmill! In this half-day workshop, Pfeiffer Center beekeeper Bill Day will present the biology of queen-rearing and swarming (the honeybee's natural form of reproduction), and how to apply that knowledge to catching swarms and making your own splits. Weather permitting, much of the workshop will take place in the Pfeiffer Center garden, where Bill will demonstrate the techniques discussed in the classroom. $55
www.pfeiffercenter.org

NEW YORK

Northeastern queen breeders are invited to a founding meeting of the Northeast Queen Producers Group in Peterboro, New York, in April 2020.

The goal is to facilitate an annual roundtable discussion. Date to be decided. Contact Abraham Yoder at 315-684-9177 for more information.

TEXAS

TEXAS BEEKEEPERS ASSOCIATION SUMMER CLINIC

June 20, 2020
Denton Convention Center
Denton, TX

Our featured speaker is world renowned biologist, researcher and author Thomas D. Seeley.

VIRGINIA

The 2020 Virginia State Beekeepers Association (VSBA) Spring/Summer Meeting will be Friday June 26th starting at 1 pm and all day Saturday, June 27th in Smithfield, Virginia. Featured speakers confirmed include Jennifer Berry (University of Georgia) and Petra Arnhert (author of Beeswax Alchemy and Beehive Alchemy). The Nansemond Beekeepers will host a Painted Hive Body Auction. See more at: https://www.virginiabeekeepers.org/

A special workshop focusing on Preparing, Exhibiting, & Judging for the Honey Show will be offered Friday June 26th from 8:30 am-12:00 pm prior to the start of the VSBA meeting, organized and sponsored by the ApiSolutions Consortium. For more information on this workshop contact ApiSolutionsBee@gmail.com

WASHINGTON

In conjunction with the Third Annual AZ Hive Day, presented by
BeeInspiredGarden.com

Sunday, July 26, 2020, 10:00am – 3:00pm
Cost $20/person including lunch.

Bee Inspired Garden, 482 Burnt Ridge Road, Onalaska, WA, 98570

Spend a fun-filled day learning about bees and four alternative beekeeping systems with hives that anyone can handle, including those of us with physical limitations. We'll give you a great introduction to the fascinating hobby of beekeeping using:

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Long (Horizontal) Langstroth Hives

We'll teach you about these beekeeping systems that don't require lifting heavy boxes - perfect for those who are unable to lift traditional American beekeeping hives, wheelchair beekeepers, and urban beekeepers who choose to keep a low profile with their neighbors.

Speakers will demonstrate (bee free!) each hive and discuss their advantages. Over a delicious lunch, you'll enjoy the camaraderie of like-minded people concerned with the fate of our pollinators and explore what you can do to help.

In addition, tour Bee Inspired Garden's demonstration pollinator habitat designed to educate the public concerning the critical role pollinators play in our lives and economy while promoting the conservation of forage and habitat.

With our (October 2019) planting of 2 acres of pollinator friendly wildflowers/clovers and our (February 2020) establishment of a 1200 tree and shrub pollinator hedgerow, we are demonstrating ways to increase wildlife corridors, provide forage and nesting sites for birds and extend the bloom season for all types of pollinators.

For more information and payment process, please see: www.BeeInspiredGarden.com or text your interest to: Kay Crawford at 360-880-0663.

Make it a weekend! On the day before (Saturday, July 25th) join our neighbor Burnt Ridge Nursery for a two hour farm and nursery tour of their 20 acres of organic fruit and nut trees. Led by their founder, Michael Dolan, you will learn about cultivation and propagation techniques and taste their delicious jams and preserves. Advance tickets should be purchased at www.burntridgenursery.com, by calling our office at 360-985-2873, or in person at the Olympia Farmers Market.

Lodging: You are welcome to dry camp (no hookups) with your RV at Bee Inspired Garden the night of July 25th (no tent camping please). *Please leave your dogs at home for both events and camping (leashed service dogs welcome).

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d GLASS 3 OZ. MINI MASON
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Gold Metal Lids Included

e GLASS 12 OZ. HEX EMBOSSED CYLINDER
$11.55 /12 ct. Case
Gold Metal Lids Included

f 12 OZ & 3 OZ GLASS SKEP JARS
12 oz skep jars $12.35/12 ct.
3 oz skep jars $14.95/24 ct.
Gold Metal Lids Included

g MUTH JARS
4 oz - $29.49/36 ct. Case
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includes corks

h CLASSIC GLASS JARS
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The Classroom

by Jamie Ellis

Gahan Endowed Professor
Honey Bee Research and Extension Laboratory
Entomology and Nematology Department
University of Florida

Email questions to me at: classroom@americanbeejournal.com

Follow my lab on social media (Facebook, Twitter, Instagram - @ufhoneybeelab) or www.ufhoneybee.com.

*Submitting a question implies you agree to have your question and my answer published in "The Classroom" column of the American Bee Journal.

Q THE CRUD

What is the best course of action for crud as far as treating the colony and re-using the comb?

Thank you

Eric Joswig
Florida, December

A

First, let me define the "crud" briefly for the reader. The crud is a general name given to a condition associated with bee brood. Colonies showing signs of the crud often have spotty patterns, uncapped brood cells that should be capped, dead or dying larvae and/or pupae, brood "melting" in their cells (I will call this "melty larvae"), etc. Some people also call this "snot brood" or other interesting terms.

There are a few things to know regarding the crud. First, we do not know what causes it. Without that information, it is very difficult to make management recommendations. Interestingly, I had a look at some crud colonies a few years ago and found European foulbrood (EFB) present in high levels. A Canadian colleague of mine reported the same thing at the time. Recently, I spoke to Dr. Meghan Milbrath (Michigan State University) who knows a lot about EFB and the crud. She suggested that there is a strong correlation between the two. She shared that she tested samples from many hives that had crud-like larvae (sunken capped brood, melty larvae), and they all tested positive for EFB. Often times, the same colony would have some larvae that looked crud-like, and some larvae that looked like classic EFB.

It is possible that the crud is a modified manifestation of EFB. It is also possible that the crud occurs when EFB manifests as a secondary infection, perhaps after a viral infection. You often hear beekeepers report that the crud manifests about the same time every year. Dr. Milbrath even noted the same thing, saying her beekeepers often see it after coming out of pollinating blueberries early in the year. I am not saying that blueberries are the cause, only that something routinely seems to be the trigger for the crud at that time of year.

To me, what many beekeepers call the crud can look like parasitic mite syndrome, which is just a fancy way of saying general brood stress due to *Varroa* and the viruses they carry. If this is the case, the crud would be best controlled by managing *Varroa*. Dr. Milbrath feels that the crud produces more distinct signs of infection than those produced by parasitic mite syndrome. Parasitic mite syndrome and the crud overlap in their melty larvae, but a colony with parasitic mite syndrome will often have bees that are dying on emergence from the cell (not seen in crud), and it often occurs later in the season as *Varroa* populations grow. The crud usually occurs early in the year and can be found in colonies where *Varroa* populations have been carefully controlled.

Nevertheless, until we know what it is, and what causes it, it is difficult to make specific recommendations for its control. I tend to tell beekeepers whose colonies have it to make sure their bees have adequate nutritional resources. Some beekeepers also suggest that it seems to disappear on its own when major nectar flows start. Many commercial beekeepers with whom I discuss this note that it often clears up after colony treatment with antibiotics. Dr. Milbrath agrees. A veterinarian can write a prescription for oxytetracycline for a hive that has the crud. If it is EFB-related, then it should subside with antibiotic use. Feeding the colony and use of a shook swarm is often good practice for brood disease in general, even if the cause is unknown.

How does one clean combs from colonies showing signs of the crud? Again, it is hard to answer this question given we do not know the cause. However, when in doubt, get rid of any combs that contain dead or diseased brood. It is possible that irradiation will sterilize the combs and this could help, but only if the crud is caused by a pathogen.

All that said, we desperately need to study this brood condition, determine its cause, and develop management strategies to address it. Thanks for bringing it to the attention of the American Bee Journal readership.

[This answer was reviewed and edited by Dr. Milbrath. I wanted to note her contribution and thank her for her valuable insight.]

Q ARE TRACHEAL MITES A THREAT?

I had an interesting conversation with a friend and we were wondering if tracheal mites play into parasitic mite syndrome, or is it a standalone problem of its own? Do you have any recommendations about treatments for tracheal mites? We were looking for grease patties, but not happy with the information we found.

Debbie Martin
West Virginia, January

A

I do not think that tracheal mites are a big problem any longer. Parasitic mite syndrome is exclusively related to *Varroa* and its virus complex. I think the things we do to control *Varroa* work pretty good against tracheal mites as well. If, though, you are worried about them (and I do not think you should be), I think that grease patties are the way to go. You mix vegetable oil and powdered sugar together until you get a Play-doh type consistency. You place a pancake-sized patty of this mixture on top of the brood chamber. I think this works as well as anything and it can be applied to your colonies at any time of the year.

It is funny: I once saw tracheal mites quite a bit when I worked in Georgia. However, I have never seen a tracheal mite positive sample since I have been in Florida. I do not hear talks about them, neither do I see research on tracheal mites. I get the impression that most beekeepers and scientists do not feel they are a significant threat any longer.

There are good online resources for conducting a tracheal mite dissection of bee samples. You would need a dissecting microscope and some basic tools. However, the technique is not that difficult to learn. My team and I developed a guide on the method. See: **https://edis.ifas.ufl.edu/in1072**. Likewise, you can find it by Googling "EDIS tracheal mite dissection."

Q

WHAT HAPPENS TO VARROA IN A DEAD HIVE?

What happens to the *Varroa* in a deadout hive? How long can they live on, sucking on the fat bodies of dead bees? How long do *Varroa* live? In a mild winter, can they survive to the spring, living off dead bees? Can they survive a light freeze? If this has not yet been researched, is there a place to post such questions, as suggestions to future grad students?

Charles Breinig
Pennsylvania, January

A

Your questions are the subject of active research projects in a few laboratories around the world. I will answer what I know and then throw in a healthy dose of speculation. Just be aware that the scientific community's thoughts on this topic are evolving … even as I write my response.

First, I suspect a large number of *Varroa* in a deadout hive simply die. Parasites have a hard time living without their host, especially a parasite tied to its host as closely as the *Varroa* is tied to the honey bee. That said, it is known that there is quite a bit of *Varroa* dispersal from a colony that is in the process of dying. How does this happen? It likely occurs through robbing (bees from strong colonies rob the *Varroa*-sick ones) and drifting (*Varroa*-sick bees drift to healthy colonies). Both of these contribute to what a lot of people are beginning to call the "*Varroa* bomb." This is just a fancy way of saying that *Varroa* from sick-and-dying colonies seem to distribute quickly to neighboring colonies, almost like a *Varroa* explosion.

I did a few quick searches and could not find any evidence that *Varroa* feed on dead bees. This does not mean that they do not feed on dead bees. It only means that it has not been studied, or at least studied in detail. Someone in my laboratory is currently looking at *Varroa* longevity on dead adult and pupal bees (your questions are serendipitous). His preliminary data suggest that they can survive around five or so days on dead adult bees and a little longer on pupae (he said 7-10 days). So, it seems possible, but my guess is that dead bees are not an important food source for *Varroa* in the field.

We do know that *Varroa* can survive on adult bees for a few months. I have not seen data on the maximum longevity of *Varroa*, but they do survive winter on adult bees. I do not think it is realistic to expect them to survive winter feeding exclusively on dead bees. I also do not think they can survive a freeze of any type unless they are on bees engaged in an active cluster.

How do you get your questions to prospective graduate students? You can post questions like these on some of the online beekeeper listservs. You also can post comments such as these to the social media accounts of various bee research laboratories. For example, you can post it to my team's sites: **@ufhoneybeelab**. Finally, your questions are making it into the American Bee Journal and hopefully a lot of students will see them this way☺. Again, these are great questions and really have my wheels spinning. Thanks for asking.

Q

WELCOME ABOARD!

I read your letter of introduction to the Classroom in the January ABJ edition. Although I was sad to see Jerry Hayes leave, his guidance and knowledge are very valued, I'm pleased that someone of your caliber is taking his place. Over the years I've read a number of your articles in the ABJ and have always received a lot from them. I recently shared your Oct 2017 article on the Indispensable Nuc with our bee club. So, congratulations on your new role, I look forward to your commentary and wisdom, and am sure you are going to do fantastic!

David Williams
Washington, January

A

Wow, thanks David! I appreciate your support and am glad you are a regular reader of the Classroom. Also, I am glad the nuc article is of value to you and your beekeepers. For the readers, the article can be found by Googling "EDIS nuc honey bee." It is entitled "Using Nucs in Beekeeping Operations." Other resources my team and I produce can be found by visiting **www.ufhoneybee.com** and clicking on "beekeeper resources." Thanks again!

Q

LOCALLY ADAPTED QUEENS

There seems to be a common notion that raising honeybees over successive generations in a particular locale will, over time, result in "locally adapted queens" that will outperform queens imported from other places. I am not speaking of selective breeding programs (Buckfast, Saskatraz, or those described by Randy Oliver, Lawrence Conner and others), in which specific characteristics are rigorously evaluated and carefully chosen (or eliminated) in a queen breeding program, but rather the idea that simply breeding from survivor stock (ever try breeding from nonsurvivor stock?) will result in improved performance due to "local adaptation." Are you aware of any sound scientific observations that support this popular idea? On the contrary, for example, Doke et al. (J Econ Entomol, 19 Dec 2018) found no difference in performance in Pennsylvania of queens raised for multiple generations in Pennsylvania when compared to newly imported queens from Texas.

David Lewis
Wyoming, January

A

David, man, you are asking some loaded questions. I wonder if I am even the right one to ask. I have strong opinions about this topic but will try to hide those in a diplomatic way. ☺

You are correct in that this has become a common notion. I have heard this argument at nearly every meeting I have attended recently, both domestic and abroad. There are even groups popping up all over the place with a focus on protecting the "local honey bee." Let me try to discuss it from both perspectives.

First, I believe that the production of a locally adapted bee that performs well in a given climate is possible. This is what life is supposed to do if it is otherwise unencumbered. Species end up adapting to the conditions in which they find themselves. This theory, of course, makes sense. I hear this a lot, especially from beekeepers in northern states. As you likely are aware, many/most of the large queen breeding operations are in southern states, principally because the warm climate favors early and rapid production of queens. In fact, as I type this answer, I am freshly back from speaking to beekeepers in a northern state where they were complaining about having to use "southern bees" that "are not adapted for our climate."

Coupled with this, there was a series of articles published in the Journal of Apicultural Research on "local bees" and their performance in their local range vs introduced range. An example of the research can be found here: **https://www.tandfonline.com/doi/10.3896/IBRA.1.53.2.03** (Buchler et al., 2014, JAR, 53(2)). Various members of this team continued quite a few collaborations on this topic as a result of being part of the COLOSS working group on sustainable bee breeding: **https://coloss.org/task-forces/sustainable-bee-breeding/**. You may even be aware of the work coming out of Puerto Rico on a locally adapted strain of African honey bee that shows some promise as a managed bee. (If you are not aware of this, it is worth Googling.)

So, yes, there seems to be some traction on this idea. Furthermore, there is a growing list of publications in which results of tests of this idea are being reported. As noted, many are out of Europe, but I am beginning to see similar publications from North America. Thus, it seems feasible and might even work.

But (and there is always a but): A good question to ask is, "What is a local bee?" Is it a closed population? How long does it have to be in an area before it can be considered "local"? Honey bee colonies are moved extensively over much of the U.S. throughout the year. This, naturally, spreads colonies, drones, and genes all over the place. This leads me to wonder how sustainable a local population is without some sort of breeding effort to maintain it.

I could go on-and-on, but to summarize: (1) I think developing a "local" population is *possible*. (2) I think *maintaining* a local population will be difficult without some strategic management effort. Is it the answer to our bee problems? I suspect not. I still feel that directed breeding programs will move the bar further and faster. However, I have certainly been wrong before. I really look forward to seeing where the research takes us on this topic.

Q BARRIERS TO SMALL HIVE BEETLE LARVAE

It seems to me that the moment when the beetle is most vulnerable to control is when it leaves the hive. Inside the hive, the adults and larvae have the mechanisms and behaviors that enable them to survive, and once in the soil they are in a protective element where they can pupate. Have you or anyone else done any research on physical barriers to exiting larvae that will trap them around or under the hive and prevent them from reaching the soil? I am thinking of something like a plastic tub lid, upside down, that the hive would sit on. The upturned edge of the lid might in itself present a barrier that the larvae could not climb, but if needed perhaps something like Neverwet sprayed on the edge would work, or maybe even Vaseline. I assume that this sort of thing has been studied and rejected, since you and others concerned with beetle behavior do not mention it, but I would appreciate it if you could give me some references that deal with this sort of control.

Jim Mello
Virginia, February

A

People have considered trapping small hive beetle larvae that have exited colonies and are going into the soil to pupate. There have even been a few tests of this idea. Nevertheless, there have been a few recurring issues with such traps. First, the beetle larvae have been very good at crawling out of many of the traps that have been designed to date. Second, such a trap is not very practical for use in operations with lots of colonies. Third, designing a trap that does not also capture bees has been tricky. For these reasons, most trap research has focused on trapping adult beetles inside the hive

With that background, I am part of a small team that did some trap work on small hive beetle larvae recently. We have a manuscript that will be published soon on the topic. While the trap seemed to work, I wonder how practical larval trapping is anyway, mainly given my first and second comments above. This is coupled with the fact that adult beetles fly and can reinfest your colonies from elsewhere, even if you are trapping the larvae that they produce. So, I am not sure how far a larval trap goes at protecting colonies over the long term. I feel that, in theory, it can help; but, I believe that they will work best when integrated with other treatments and general control strategies.

Q OXALIC ACID, DRONE CONGREGATION AREAS

I have two questions that I can't get answers on and wondered if you could help me. The first: Is there a difference in oxalic acid 99.6% and 99.8%? And does it make a difference when treating your bees?

The second question: I keep hearing that drone congregation areas aren't what they used to be. Is it because everyone is using foundation with all worker sized cells? I realize the bees will draw drone cells anyway but is it as many as they normally would? I'm more interested in raising queens rather than honey and I also know I can stick a drone frame in my colony, but I would rather the bees make their drones as they normally would.

John McKee
Ohio, February

A

1) Oxalic acid (OA): I would not guess there is a meaningful difference between 99.6 and 99.8% when it comes to oxalic acid, though I do not know for sure. I highly doubt that a 0.2% difference between the two is impactful. However, it is important to know that I can only recommend OA products that have been labeled for use in bee colonies. So, I cannot advocate purchasing OA in bulk, unless the OA product is labeled for use in honey bee colonies. Failure to use OA according to label is against the law.

2) Drone congregation areas (DCAs): I, too, have heard that drones are "not as good as they used to be," but I am not really sure what that means. I think it is the same comment that people make about a lot of things in general. My guess is that we do not have much data on what the quality of DCAs was in the past. We do have some data on this topic. Papers have been published and lectures given on this issue. However, there were not many people studying DCAs in the past; and it is still not heavily investigated now, compared to the level of investigation on other honey bee topics. Thus, I am not sure the idea that "DCAs are not as good as they used to be" is supported. However, let us assume it is true and think about why this could be the case.

First, there could be fewer DCAs if *Varroa* have killed a lot of the feral colonies. This would lead to fewer colonies available to contribute drones to DCAs. Also, some work is being done on how certain stressors (pesticides as an example) impact drone reproductive success, sperm loads, etc. I am certain that various stressors do impact drone numbers and health. I simply am not sure how/if this translates to the overall quality of a DCA. A former masters student and I did some DCA work in the past. We looked at DCAs close to a few managed colonies and found what we considered robust DCAs, with a lot of available drones.

With that background, our use of foundation does coerce honey bees to make proportionately fewer drones than they would in the wild. This has been documented. Despite this, the bees always seem to alter a section of each comb and rear drones anyway, though maybe not as many as they would have had they constructed the comb in a foundationless box. A lot of queen producers will include a frame or two of drone comb in their drone source colonies to ensure a larger number of drones in an area. This is similar to what you are doing. My guess is that you would want to identify your drone source colonies and include a frame or two of drone foundation in each colony. You really want to flood the area with drones to make sure enough are available to mate with your queens. I think this is a better strategy than allowing the bees to do it on their own (which makes for a series of messy combs in a hive). Dr. Bob Danka, Research Leader from the USDA Honey Bee Breeding, Genetics and Physiology Laboratory, said that it is good to target one drone colony (with at least one drone comb) per ten mating nucs. He says he has seen this ratio yield good mating success in commercial operations and his own breeding/research projects. He also said it is a good idea to have 2-3 drone yards for every mating nuc yard. He is definitely an expert on this topic so his idea makes sense to me.

I have a few sources of information that you can review on DCAs. First, I was fortunate enough to coauthor a book with Drs. Niko and Gudrun Koeniger and Dr. Larry Connor on the topic. The book is entitled Mating Biology of Honey Bees. We describe the current state of knowledge on DCAs therein. Also, have a look at **www.ufhoneybee.com** > resources > honey bee biology > mating biology for a doc I wrote on honey bee mating behavior and DCAs. This document, first published in the American Bee Journal, was a summary of the book I coauthored.

Q MORE ON OXALIC ACID

What is the main difference between vaporization and fogging with oxalic acid? How do we beekeepers truly know when a mite treatment is approved in the USA? Is there one organization we can go to/inquire to confirm whether a particular method is approved or not? Also, could you comment on the oxalic dribble method? Is this a viable varroa treatment for honey bees?

Bruce Snavely
Missouri, February

A

It is clear to me that oxalic acid is a popular topic, as it has been the topic for which I have received the most questions in my short time writing this column for the American Bee Journal. Fortunately, we have an in-house oxalic acid expert at the University of Florida. He name is Cameron Jack and I have included some of his comments to your questions in my response. Just for your information, Cameron and I have had the "vaporization" vs "fogging" vs "sublimation" discussion. He has a better answer for it than do I.

Let me answer your second question first. How can you know if a treatment is approved for use in the U.S.? Look at the product label. The label will tell you if it is approved for use in honey bee colonies, what it is used to control, and how to apply it. If this information is not on the label, then you should not put it in colonies. Also, the Honey Bee Health Coalition has a really good document on *Varroa* control (Google "Honey Bee Health Coalition *Varroa*" to find it online). They have information about the use of OA in it. Now, here is Cameron's response to your other questions:

"The principle of vaporization, sublimation and fogging are essentially the same. You want the OA to cover the entire inner surface of the hive. Vaporization is the process of turning a solid, to a liquid, then to a gas. When one thinks of vaporizing OA, one is typically thinking of placing OA crystals in a small dish connected to a metal rod that gets heated when connected to a car battery. This dish is inserted into the hive to allow the OA vapors to spread through the nest. Sublimation is turning a solid straight to a gas. I do not know of any machine that would allow for true sublimation. Fogging requires the beekeeper to dissolve the OA in pure alcohol, heat it, typically with a propane tank, and then direct it into a colony. If it is working properly, the alcohol should burn up immediately, releasing the OA into the hive.

"The issue I have with the foggers is that you do not actually know how much OA you are actually putting into the hive. You are just guessing, not to mention the foggers require expensive alcohol which is extremely flammable. Personally, I favor vaporization. It allows you to control the exact amount of OA you put into every hive and takes about five seconds to treat a hive. From what I have read, the dribble technique is still effective. A few years ago, a group of researchers from the U.K. showed that OA vaporization was more efficacious than the dribble or spraying technique. I think you should try out the different methods of application for yourself and see what is best for you. Just a tip, make sure to monitor the mite populations before and after treatment so you can tell if the treatment was effective for you. Good luck!"

These are wise words from an OA expert. (Thanks Cameron!)

Q WHY NOT IMPORT *APIS CERANA*?

This spring marks my 50th year among the bees, although the goal of my beekeeping today has been reduced to just keeping some hives alive. I do not harvest honey anymore. The *Varroa* situation is looking pretty hopeless.

How about this idea? Why not bring *Apis cerana* to the USA, and simply switch honey bee species? *Apis cerana* co-evolved with *Varroa* and the eastern strain of *Nosema*, so maybe American beekeeping can become based on *Apis cerana*. *Apis mellifera* was not native here either.

Nathaniel Mann
Tennessee, January

A

Happy 50th anniversary. I only have 30 years under my belt myself. You paint an accurate picture in your opening paragraph. *Varroa* really make things seem hopeless.

As you note, *Varroa* originate from Asia where they live with their natural host *Apis cerana*. *Apis cerana*, sometimes called the Asian, Oriental, or Eastern honey bee, has a number of mechanisms through which it limits *Varroa* impact. So, why not import them into the U.S.?

There are good reasons I recommend we NOT import this bee into the U.S. First, it is illegal to import them. ☺ The USDA-APHIS is the group responsible for monitoring for importation of non-native plant and animal species and they deem *A. cerana* as a credible threat to the honey bees already here. Second, they are a honey bee species suited for warmer climates. They likely could not survive the harsh temperate winters in many places in the U.S. Furthermore, they would not perform as well as *A. mellifera* (the honey bee species we keep) does here. *Apis mellifera* is more suited for use in temperate climates. In addition, *A. cerana* make smaller colonies (therefore, less honey per colony) than do the honey bees we keep. Ironically, *A. mellifera* is the popular honey bee species to use in many parts of Asia, despite the fact that they are not native to Asia. A lot of Asian beekeepers prefer *A. mellifera* because they make large colonies, are easier to manage, and make more honey. Finally, *A. cerana* may harbor other pests/diseases that will threaten the honey bees we keep and, possibly, other bees that are native to the U.S. For example, they might have *Tropilaelaps* (another mite pest of Asian honey bees), other pests, or any number of pathogens.

All that said, it is best if we do not import them. Does that mean that they are of no value in our battle against *Varroa* or pathogens such as *Nosema*? Of course not! We can learn a lot about *Varroa* control by studying how *A. cerana* battles the mite. Perhaps they have behaviors that lower mite impact, behaviors that we can select for in the bees we keep. Thus, I think their contributions to our understanding of *Varroa*, *Nosema*, and the control of both are valuable, but best left studied in Asia.

One final note: You are correct that that the honey bees we keep also are not native to the U.S. However, they have been here 400+ years and are now "naturalized." Some people think that this bee *has* negatively impacted the American landscape and that it never should have been imported in the first place. We can debate that until the cows come home. However, I think it is best that we stick with the honey bee we have at this point and not bring additional species into the U.S.

Q JAMIE'S TOP TEN MANAGEMENT RECOMMENDATIONS?

In your introduction to the Classroom you said, "I kept bees through middle school and high school, learning what it took to keep bees alive and what stressors were guaranteed to kill my bees if I did not address them appropriately." OK, so what are your top 10 stressors that are guaranteed to kill bees? Most are obvious, but maybe you've learned some that aren't so obvious.

Phil Hargis
Nebraska, January

A

Phil, every time I get quoted, I begin to believe people actually read what I write. ☺ I really like this question. However, I am going to broaden it a bit if you will permit me. You might know that I cut my teeth with the American Bee Journal by writing a column titled Field Guide to Beekeeping. In my January 2015 article, I wrote "Resolutions for your 2015 Beekeeping Year." In it, I listed ten things I think are important to do as a beekeeper. Thus, rather than point out just stressors, I am going to provide you a top ten list, in no particular order, of things I feel are important. In fact, I cut/pasted below exactly what I said in that article. I hope this helps!

1) Make *Varroa* control a priority. Many beekeepers and bee scientists believe that *Varroa* are the number one biological treat to honey bees on the planet. They harm bees in three ways. First, they feed on bee fat bodies. Second, they vector pathogens that harm bees. Third, beekeepers use chemicals to control *Varroa*, and many of these products have been shown to impact bees negatively in some way. As a result, every beekeeper should make it a priority to stay up to date on the latest *Varroa* control measures

and do whatever it takes, within the realm of legal options, to control this devastating pest.

2) Experiment with resistant queen stocks. I find that most beekeepers have not given queens bred for resistance to various pests/pathogens a fair chance. Most beekeepers have never used resistant stock in the first place, let alone used the stock appropriately. Purchase a few queens bred for resistance to *Varroa*, for example, and see how they perform in your particular management paradigm.

3) Practice effective swarm control. Swarm control is not viewed as a favorable practice in some beekeeping circles and that is absolutely ok. However, swarm control is necessary if you want your colonies to be as strong and productive as they possibly can be. I consider swarm control an essential part of bee management. Think of it as the best way to keep your bees.

4) Focus on bee nutrition. It is no secret: Nutrition is important to bees. I often feel that our bees do not have the available nutrition they need to thrive. We tend toward the belief that as long as something is available in the environment, the bees have everything they need. However, not all pollen and nectar are created equal. Generally speaking, nectar quality is more stable than is pollen quality. I tend to find that colonies lack in nectar quantity (not enough nectar to make into honey) and often need to be fed, while they lack in pollen quality (not a nutritious pollen) and need a better source. Learn when to feed and what to feed.

5) Ensure that your colony is headed by a good quality queen. This is not to be confused with the advice I offer in point 2 above. Instead, I am advising that beekeepers learn to recognize good queens and poor queens, and work to remedy the latter. I see many beekeepers satisfied with simply having any queen in their colony, regardless of the quality and productivity of the queen. Beekeepers should be able to identify failing queens and have the confidence to replace those queens with better quality queens.

6) Conduct an honest assessment of the quality of forage resources in the area where your bees are located. Not all apiary sites are equally good for bees. Bees perform better when they are managed in optimum environments. The best way to determine the quality of a potential apiary site is to locate a few bee colonies there and allow them to tell you how good the site is.

7) Control the pests and pathogens that are manageable. Some pests, such as *Varroa* and *Nosema*, cannot be controlled easily and predictably. However, many beekeepers spend so much time and energy addressing these problems and ignore controlling pests and pathogens that can damage colonies significantly but are otherwise easy to control. These include European and American foulbroods, chalkbrood, tracheal mites, wax moths, and, to some extent, small hive beetles. It is important not to overlook the "minor" problems.

8) Spend time researching the latest information related to beekeeping. There is so much information related to beekeeping being generated around the clock. A lot of this information concerns new ways to treat pests/pathogens, the latest news on bee nutrition, etc. This information can be found in the national bee journals, beekeeper newsletters, the latest books, online communities, etc. In my experience, the more informed the beekeeper, the better the beekeeper. The better the beekeeper, the healthier and more productive the bees.

9) Join and actively participate in local, regional, and/or state beekeeper associations. This is a supplemental point to point 8. The best beekeepers work to stay informed of the latest information related to the craft. Beekeeper associations allow you to network with other beekeepers, shape policies related to beekeeping at the local, state, and national levels, interact with the "movers and shakers" in the beekeeping industry, etc. I believe membership in beekeeper associations should be a priority for every beekeeper.

10) Do not forget the small things that [may] matter. Have you rotated your combs out of hives in the past ten years? Do your bees have an adequate water source nearby their hive? Do you believe your bees are exposed to pesticides outside the hive regularly? Do you live in an area where bears are present? How good is the physical hive in which the bees live (does it need to be painted or parts replaced)? Do you have too many colonies in your apiary(ies), thus leading to limited resource availability? They say the "devil is in the details." Attention to small details such as these can make the difference between a successful beekeeping season and a catastrophic one.

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Beekeeping Basics

DON'T BE SURPRISED BY SWARMS

by MEGHAN MILBRATH

Photo and queen by Meghan Milbrath

Happiness is a big booming hive in the spring. A strong colony coming out of winter (or any long period without food) means that you did your job as a beekeeper — you kept varroa under control and ensured that your colony had sufficient resources to raise a hearty generation of winter bees. Good job! Before settling into your success, however, make sure that you don't mess it all up by letting that big beautiful colony swarm! Big hives can quickly get away from new beekeepers, and all their hard work can leave the hive on a sunny day.

Swarming itself is not bad, but if the process is uncontrolled, it can have negative consequences for us and our bees. When we manage the swarm process, we give our bees a better chance of success.

Why do bees swarm?

The ultimate goal of every animal is to reproduce, and honey bees are no exception. Beekeepers should not be surprised that their colonies will swarm, because that is literally the whole point of a colony (from the bees' perspective). We need to teach beekeepers that splitting for swarm control is not an advanced skill, it is a basic and necessary skill — there are not bees that won't aim to reproduce, so there is no beekeeping without swarm control.

Good beekeepers work *with* biology, and follow the cues to recognize which colonies are likely to swarm, identify the conditions that promote swarming, and take steps to manage the process — before swarms occur on their own. It's a much calmer and happier approach to beekeeping that is safer for you and your bees.

How do we know if a colony will swarm? Most beekeepers will respond that we can tell a colony will swarm if we see swarm cells. However, if we wait until we see swarm cells, we really limit our options, and it may even be too late. In order to manage swarming well, we need to look for the signs that indicate that the bees are *on the path to making swarm cells*. Bees create queen cells, including swarm cells, when queen pheromone drops. This is easy to see with emergency queen cells — the queen is gone, her scent diminishes, and the bees build cells. Supersedure cells are prompted by the fading of a queen's scent as

THE SAD SIDE OF SWARMS

It is risky for the parent hive. New queens usually have about an 80% chance of coming back from a mating flight. This means that about 20% of hives that swarm will die from queenlessness. A hive in the north faces additional risk as they may not be able to build up sufficient workers and honey for winter after a swarm.

It is bad for the swarming bees. Many beekeepers think swarms just live long and happy lives as feral colonies. Unfortunately, survival for unmanaged colonies is really low. Remember, honey bees wouldn't naturally be in your area; they are only living there because you bought them for your own benefit. The least you can do for these animals is give them a fair shot at a long and healthy life.

It is bad for your other bees. For every swarm you let escape, you create an unmanaged colony in the neighborhood of the hives you are trying to care for. Mites grow unchecked in unmanaged hives, and when these colonies collapse, you have basically just "mite-bombed" yourself.

It is bad for your neighbors. Honey bees are cavity dwellers, and the only cavities nearby may be your neighbors' soffits, floorboards, or siding. Your bees can cost your neighbor thousands of dollars in repairs and removal. Swarming can turn your beekeeping hobby into a public nuisance.

It is bad for your wallet. When you lose a swarm, you basically lose a package of bees — worth well over $100. You also lose their production; swarms generally contain a lot of bees of wax-building age, and you miss out on the value of the comb they would've drawn, and the honey they would later collect.

Backfilling in the brood nest. Some beekeeper (me) didn't put supers on quickly enough, and the workers filled the brood nest with nectar before the queen could lay in them. The center of this frame should have eggs in it, but instead is full of nectar. You can see all the fresh nectar on this frame, indicating there is a pretty good honey flow on. Photo by Sarah B. Scott

she is failing. With swarm cells, the queen scent drops because of the hive conditions, and the bees will begin queen cell construction even though the queen is still in the hive. Bees can sense when pheromone levels change in the hive, but as weak humans, we are terrible at pheromone sensing. We can't use our antennae to sense pheromones, but we can see two conditions that indicate that queen pheromones will be lowering:

1. Backfilling in the brood nest, and
2. Full frames of brood.

Backfilling in the brood nest: In a normally functioning hive the brood nest will hold only brood — the queen will lay an egg in each newly vacated cell. As the queen lays, her glands leave a scent on the eggs, and as the larvae grow, they release their own brood scent. This combination of queen scent and brood scent is key for bees; these pheromones indicate that the hive is healthy and has space for normal function — empty cells for incoming nectar above the brood nest, and room for new eggs within the brood nest. If there is no empty drawn comb above the brood nest, the bees will begin to backfill — putting nectar in the cells where young bees have recently emerged. During a strong honey flow, a big colony will have thousands of workers returning with nectar, looking for empty cells to deposit their load. The numerous loaded workers will outcompete the queen and quickly fill the open cells with nectar, leaving the queen with no space to lay. Soon the whole part of the hive that should be reserved for brood rearing is instead filled with food.

The brood nest area should be filled with eggs and developing bees, all giving off pheromones. When it is backfilled with nectar, the colony scent drops considerably — lowering pheromone levels. If you remember one thing to look for, let it be this: **Backfilling is the first sign that a colony is fixing to swarm.** Once you see backfilling, you know that you have a large population, and there is food coming in. At this point, you can begin to do your swarm management.

Full frames of capped brood: Full frames of capped brood are a strong signal that it is getting to be time to swarm: The colony has reached a sufficient size — big enough to split, and big enough for both resulting colonies to stand a chance at survival. As the bees in these frames emerge, the hive will experience **lowered brood and queen pheromones**. Brood pheromone is lowered because you will have thousands of brood becoming adults, and their scent will change (and their cells will likely get backfilled). Queen pheromone also is lowered through a dilution effect. Workers in a hive touch the queen to pick up her scent, and they pass it among themselves. When you have more workers, you have more bees passing around the scent, and each bee experiences less.

The emerging of full frames of brood also causes a generational shift in the workers, changing the balance in the hive. After emergence, workers usually play the role of nurse bee, then wax-builder/house bee, then forager. When thousands of new workers emerge at once, ready to take on their role as nurses, the current cohort of nurses graduates to wax-making house bees — perfect for the colony that needs to set up a new place to live! The new nurse bees can't fly yet, so they stay with the parent hive, but these house and wax bees will fill up their bellies, and go with the new swarm, ready to build a new home.[1] Anyone who has caught a swarm can tell you that these bees are the absolute best for drawing out new wax. It makes sense when you think about all of the newly commissioned bees that are relieved of nursing duty, and ready to build!

These two signs (backfilling, and full frames of brood), indicate that a colony is strong and that there is plenty of food available — and that means that this would be a good time for the colony to swarm.[2] Like everything in beekeeping, the answer to what time of year we are likely to see swarms is "it depends." The timing of swarming depends on when the colony gets big enough, which depends on the incoming food, which depends on the temperatures. In "Nectar Management Principles and Practices," Walt Wright indicates that swarm season in Tennessee is from apple blossom to hardwood greening. In Michigan, the average bloom time for apples from 1980 to 2012 was May 6.[3] That seems about right for the start of swarm season for me. The earliest that I have ever caught a swarm in Michigan is April 30, and swarming is usually done by mid-May. However, I am writing this article from Hawaii, where on one island a beekeeper told me his swarm "season" is April to October, and on another island I was told that it was all year. Talk to local beekeepers and take good notes — write down when you start hearing about swarms every year.

Just like everything in beekeeping, the timing of swarms will change every single year. If there is an early warm up that allows colonies to raise brood earlier, they will swarm earlier, while a cool spring will push them later. If you feed pollen or 1:1 sugar water in the spring, it may stimulate brood rearing and push the colony toward swarming earlier. Like everything with bees, it is hyper-local. You can ask your nearby beekeeping friends, but the best way to know when to expect swarms is to watch your own hives. ***Remember, swarm control happens <u>before</u> swarming.*** *Don't wait until May 1, or apple blossom, or whatever your cues are to start checking. All of the management techniques discussed in this document are to be performed **before** the swarm leaves — well before you hear reports of swarms.*

The main trigger to the swarming process is a drop in pheromones, prompting bees to create queen cells. Young queens will have a stronger queen scent (pheromone), which inhibits the creation of queen cells. Old queens have less overall queen scent, lowering the threshold to start swarming. If a colony with an old queen is too small to swarm in spring, it will generally re-queen itself right after swarm season through supersedure. (I get a million calls for "missing" queens right after swarm season; almost always, if the beekeeper waits, they will find a new queen was in the works.) You can lower the chance of a swarm or a midsummer re-queening by going into winter with a young queen. **Re-queening in late summer/fall with young queens is a key part of getting control of swarm behavior.** You don't even have to kill the old queens (it is okay to admit that you are sentimental about your queens) — you can put them in nucs, or use them elsewhere, or keep them for an emergency. Ideally, you will make a nuc from each hive in late summer with the old queen, and will give the big hive a young queen. That way your main hive will be less likely to swarm, and you have a backup for winter. At minimum, mark your queens and take good notes so you know what colonies are more likely to swarm.

Bees will leave the hive when the conditions are ideal for reproducing, but they will also leave the hive when the conditions are bad. Crowded swarms frequently occur for second-year beekeepers, who are unfamiliar with how much faster a colony will expand when they have drawn comb — they don't realize that a strong colony on a good basswood flow can fill a super in less than a week! They also don't yet know their honey flows well, and when to expect the rush of food. An experienced beekeeper will put on two supers in anticipation of a good honey flow (that they know is coming because they know their local blooms). A first-few-years beekeeper will often peek in the hive to see if it is crowded, observe that the top super is only about 50% full, and not add a super … only to have the flowers turn on the flow the next week, and their bees swarm into the trees. Crowded swarms are 100% beekeeper error. It means that you didn't provide your bees with enough space to account for the incoming nectar. <u>The bees always want to put nectar above the brood nest</u>, but if there is no drawn comb above the brood nest, then they have no choice but to put the nectar in the brood nest, leaving no room for eggs, initiating a swarm. It will take experience to judge if you have the right amount of space — you will need to know your main honey flows and estimate the strength of a colony. This is one of the arts of beekeeping. A rule of thumb is that there is little danger of over-supering a **strong** colony **early in the season**. If you overestimate space, you can always remove boxes later. Just make sure you don't over-super a weak colony — they won't be able to protect all the extra space from pests.

Full frames of capped brood.
Photo by Randy Oliver, www.scientificbeekeeping.com

Sometimes the bees leave even if the hive isn't crowded. I'll hear beekeepers say that their bees are so dumb, because they swarmed in September! Or I can't believe my luck, I caught a swarm so late in the season! Usually those bees are absconding. In a situation where the colony absconds, the conditions in the hive are too poor to support proper colony growth. The most common cause of absconding is when colonies are overrun with viruses — the workers are trying to raise brood, but most of the brood are dying. All this dying brood signals to the bees that the conditions aren't good and it is time to abandon the hive. We also see absconding from over-crowded nucs and overheated hives. The bees just can't live in those conditions, and they hedge their bets in a new location. You can sometimes see bees and queen cells after an absconscion, making it look like a swarm. The bees will generally abscond in the middle of the day. Young bees that can't fly are left behind, and the foragers who are out working will return to a relatively abandoned hive. These poor old and young bees will try to make emergency queen cells. These post-absconscion colonies rarely recover in good health — they have a poor queen that is raised in stressful conditions, and are missing the bulk of the workers that make up the heart of a functioning colony.

Bees give us tons of cues to tell us they are going to swarm. If a beekeeper is surprised by swarms it is usually because they didn't know what to look for. The signs were all there, the beekeeper just missed their significance. This is a situation where you need to learn to "speak bee" to perceive the world from your bees' perspective.

Filled queen cells at the bottom of a frame — indicating that this colony is well on the way to swarming. A quick way to check for these cells is to open the boxes of the brood nest like a clamshell, and peek under the bottom of the top box. Photo by Randy Oliver, **www.scientificbeekeeping.com**

Pay attention to when the nectar flow starts, watch the brood nest for backfilling, and for when you will have large numbers of bees eclosing.

Swarm management: I just hate that many old books and beekeeping resources still recommend cutting queen cells. Why would you do that?! Please don't. First, you likely won't find every last cell, and you only need to miss one for the colony to still swarm. Secondly, swarm cells are perfectly good queen cells — why kill them? At least make up some nucs. Third, once the cells are capped, the colony may already have swarmed. If you cut the cells, you may eliminate the colony's chance of survival. Finally, and most importantly, you have done NOTHING to eliminate the triggers for swarming. You still likely have a backfilled brood nest, and low pheromone levels! You haven't slowed the urge to swarm at all, and at best pushed it back a few days.

The final step of swarm management is usually a split. However, in Michigan and other northern areas, we usually get nectar coming in before it is warm enough to split a colony. If we do nothing, the brood nest can fill up, but if we split too early, we risk chilling the brood and setting the hive back. Because of this daytime nectar and cold nights, I will generally do my swarm control in two steps. First I add extra space above the cluster, and then I will come back later (maybe a week or two) and make splits. In step one, I put a deep box of mostly drawn comb (or two mediums) on every hive that is on the bigger side. This does a few things — it gives the bees space above the brood nest, it gets equipment out of my garage, and it allows the bees time to ready the comb before the main honey flow. The only limitation to this method is that you have to have mostly drawn comb — bees will not draw out wax until after swarm season. My opinion on early supering is that everyone should do it. I don't see a downside to putting boxes of drawn comb onto big hives in the spring. I'll be back out to the bee yard to make splits soon, so I can remove them or make corrections then.

Spring management is all about finding the balance between a warm brood nest and space for incoming food. If the colonies are starving, and I am feeding them, then I don't put supers on (they won't be storing food if they need to eat it). I watch closely to see when food could be coming in — paying attention to blooms, days with foraging weather, and bees bringing in pollen.

Do I use reversals? I don't really reverse brood boxes as a measure of swarm control, because reversals won't give you a lot of room in colonies that are big enough to swarm. If colonies are small (and not needing swarm control), I'll often move the box with the bees to the bottom and give them a new box with drawn comb and foundation. I'll then cull many of the frames in the bottom box.

My bees will stay in their early spring configuration (with empty boxes up top, and no changes to the brood nest), until I start to see signs of backfilling and full frames of brood. At that point, I'll start making splits. There are about as many ways to make splits as there are beekeepers.

Making splits: The best way to gain experience in making splits is to start trying some. At a minimum, you'll be able to keep your bees from going into your neighbor's soffit. If you aren't comfortable making splits, you can try some simple versions like a "walk-away" or "dirty" split. In this method, you just split your existing hive in half, making sure both halves have eggs. One half will have the queen, and the other hive will raise a new queen. You can keep both new hives in the same yard, just be aware that the hive in the original location will get all the foragers, so make the one in the new location heavier. A second way to make a walk-away split is to number the frames, and put odd frames in one box and even frames in another (See Fig. 1). Push these frames to the middle, adding empty frames to the outside. Both of these splits require one hive to make a new queen. It is essential that you give the new queen time to develop before you go digging in there. A very common mistake is to open the hive too early and disrupt the process. To prevent mucking it up, write down the day you made the split, and figure out the queen math to determine when you would expect to see brood. Don't open the hive until that date. Don't even peek. Write a stern reminder note on top of the hive if necessary. Nothing good comes from peeking in the hive early. Most of the time when there is a problem, it is because the queen didn't come back from a mating flight. If that happens, just combine the hive back with the original hive. By this time, reproductive swarm season will be over, and you can move on with life, or make another split later in the season.

Some splitting techniques allow you to create the split in the same hive. Using a physical barrier and some distance, the brood are moved away from the queen, and the bees are separated into two clusters within the same column of boxes. Techniques that keep the split in the same hive have a great advantage for those of us in northern climates in that they reduce the chance of chilled brood.

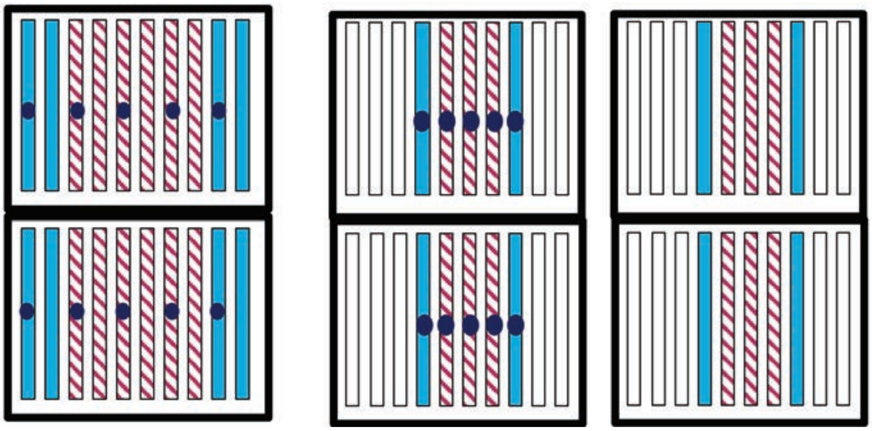


Fig. 1 *The leftmost hive is the original hive. All the odd frames go into one hive (middle), and even frames to another (right) — keeping all the bees with the frames they are on. The old frames are pushed together, and the boxes filled with empty comb.*

The general set-up for an in-hive split is that the old queen is in the bottom box, with just a few frames of brood, and plenty of open comb to lay (if you take all the brood, the bees will just leave her, so you want to leave enough so there are some nurse bees to take care of her). Usually you add a queen excluder next, to confine her to the bottom box, and some boxes with drawn comb to provide space for nectar above her brood nest, and to provide distance to prevent bees in the top from receiving her pheromone. The brood frames from the original hive are added on the top, with an upper entrance.

Once you get the hive into this position, you have a few options, depending on what you want in the end: two separate hives, one really big recombined hive, or a 2-queen system.

1) If you want two separate hives, you can remove the top box and place it in a new location, and provide it with a queen cell or mated queen (or if it is large enough, allow it to raise a queen).
2) If you want to recombine the hive, you can use a Snelgrove board. A Snelgrove board is a modification to the double-screen that has a series of entrances that are opened and closed systematically to reunite the hive after the threat of reproductive swarming is passed. (See "The Snelgrove Method of Swarm Control," by Sid Lehr, March 2020 ABJ.)
3) If you want a 2-queen system, which is great for making honey, you can use a double-screen below the top brood box, and allow the bees to raise their own queen (or give them a queen cell), and then switch the double-screen for a queen excluder once the queen has come back and is mated. If the queen doesn't get mated, you can just recombine.

One of the biggest reasons that I like doing the in-hive split is that you can set up the original hive on one day, and then think about what to do next. After you have the hive in this arrangement, you have put an immediate stop to the swarming process: The queen has plenty of room to lay, and the bees have plenty of space to add nectar. The next thing you need to worry about is the creation of emergency queen cells in the upper boxes. You need to choose what to do before you have virgins emerging and killing your queen down below (virgins can squeeze through a queen excluder).

A PERFECTLY FINE METHOD OF SWARM CONTROL

Below I'll outline the method that I have used the last few years for managing swarms. It may or may not be a good method for you (or who knows, it may not be a good method for me, either). I'm writing this in 2020; four years ago I tried this method on a few hives and liked it, so the last few springs I tried it on all my hives, and have been pretty happy with it.

The basic process:

1) During the first spring warm up, and I see nice food coming in: Put extra boxes of drawn comb on the big hives.
2) Once I see dandelions and the

Here are two of my hives from last spring. The one on the right is huge and is likely to swarm; the one on the left doesn't have enough bees to swarm. It is good to mark which colonies need swarm control early in the season so you can plan. Of course, the big colony could always starve, and the small one could grow large enough to swarm if the weather and food were right. If food was coming in, I would reverse the colony on the left, giving it a new deep box above the cluster and removing the bottom box, and I would add an extra deep on top of the hive on the right. Photos by Meghan Milbrath

weather is warmer: Start inspecting for backfilling and full frames of brood.
3) When I see backfilling etc.: I'll make an in-hive split on a really nice day.
4) A few days later: I'll move the splits from the tops of the hives when I need to and add queens or queen cells the following day.

The reasons I like this method:

There are a few reasons why I split within the same hive.

- First, during the splitting process, it can get crazy, with bees flying everywhere. With this method, the bees are calm and inside the hive when I want to move them.
- We have limited nice days in the spring. We often get warm followed by cold followed by warm — you get the idea. I want the weather to be nice when I'm digging in the hive, but I don't care what it is like when I'm just moving hives. By separating the digging from the moving, I don't "waste" nice weather driving around.
- As mentioned before, if we get a cold night, keeping the split within the same hive will allow for a little more protection for the brood. The bees can choose themselves how they should separate between the two clusters to keep the brood warm.
- The best part is that it allows me to take a step back, plan, and gather equipment. I'll make all my splits, and then note how many splits will be coming from that yard. At the end of the day I can go home, have a beer, and figure out where I want to move the splits, what I need for hive stands, how many bottom boards to load into the truck, and how many queen cells I'll need. I don't have to make decisions in the yard when I'm hot and trying to get everything done.

1) Move your splits to a new location

Another great thing about the in-hive split is that you can set up the original hive on one day, and then move the splits on a different day. If you move the bees at night, or on a cool rainy day, you'll bring a lot more bees with you. If you move them on a sunny day, when the foragers are out, you'll leave a lot more bees at the original location. Neither way is right, you just have to choose what you want. One reason that I like moving them on a rainy day, is it allows me to get more work done — I can be out even when the weather is horrible, as it often is in Michigan — but I don't have to worry that I'm damaging my bees or chilling brood.

After I leave the yard on split day, I'll write down how many splits I'll plan on taking from that yard, and I'll load my truck with that many bottom boards, lids, and ratchet straps. On the day I'm moving the bees, I'll set the bottom boards on the ground next to the hives, and pull each split off, give it a cover, and recover the original hive as swiftly as I can. I'll drive the bees to the new location and leave them alone.

1) Add queens to the splits

I usually add queens the day after I move the splits. You can use mated queens or queen cells. I am generally using cells, because that is what I can get locally at that time. The split is opened, and I'll add in the cell between the frames of brood. I'll write down the date that I need to come back and check the queens, and if they didn't work (the queens didn't get mated), I'll just combine them with another hive.

That's it!

Best of luck to you and your bees this coming swarm season.

An overly crowded hive — shown by the honey stored in the burr comb. This is a lovely sight in October, when you know there is no more honey coming in, but it is not good in a colony midseason. It is a sign of overcrowding in a growing colony. This beekeeper may have missed out on a lot of honey and a lot of brood, and is risking losing the colony to a swarm. Photo by Andria, CC BY-ND 2.0, https://flic.kr/p/9wsoF

Footnotes

1 There are some neat swarm control methods that take advantage of the fact that these newly commissioned wax bees can fly but can't orient to the hive, including the Taranov method.

2 Many beekeepers think that bearding is a sign of swarming. It does mean that the weather is warm and the colony is big, but it isn't associated with any changes in pheromones, so it doesn't have anything to do with queen cell production/swarming.

3 2013 Bloom dates for southwest Michigan tree fruit crops, Mark Longstroth, Michigan State University Extension. https://www.canr.msu.edu/news/2013_bloom_dates_for_southwest_michigan_tree_fruit_crops

Meghan Milbrath is a beekeeper and honey bee and pollinator researcher and Extension specialist at Michigan State University.

Coming to America

Honey Bees in the New World

by PETER L BORST

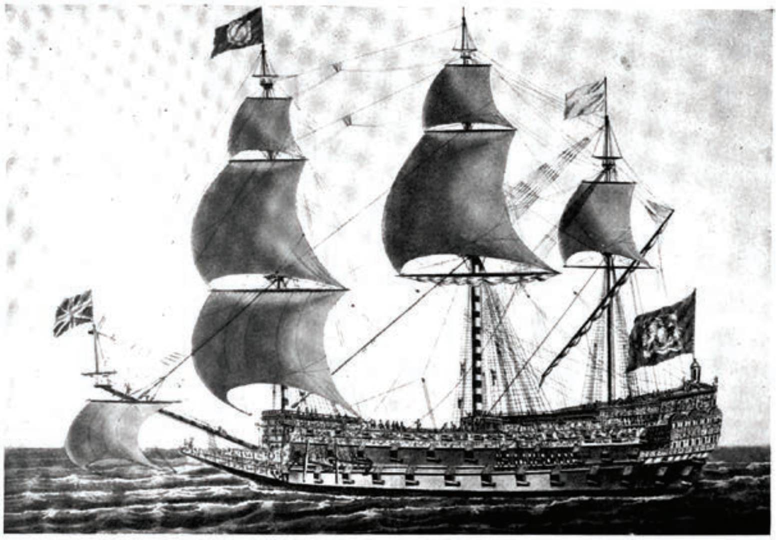


FIG. 61. THE "SOVEREIGN OF THE SEAS." BUILT IN 1637. p. 229.

(Chatterton, E.K., 1915, Sailing Ships and Their Story)

> He who rescues from oblivion interesting historical facts is beneficial to posterity as well as to his contemporaries, and the prospect thereof to a benevolent mind causes that employment to be agreeable and pleasant which otherwise would be irksome and painful. (Hutchinson 1769)

Beginnings

The story of the honey bee in North America is based on hints and interpretations, larded with streaks of hyperbole. By the 1700s, honey bees were so numerous the question arose as to whether they were actually native to America. Benjamin Smith Barton treated it extensively in 1793, in his: "An Inquiry into the Question, whether Apis mellifera, or True Honey-Bee, is a Native of America." He wrote:

> So many animals and vegetables have been introduced into the countries of America, since the great discovery of Columbus, that naturalists are frequently at a loss to determine, which species are natives, and which are foreigners. (Barton 1793)

Barton lists some of the introduced plants, including plantain (*Plantago*), mullein (*Verbascum*), lamb's quarters (*Chenopodium*), St. John's wort (*Hypericum*), and the common dandelion (*Taraxacum*). Of animals, he mentions rats, mice, clothes moths, fleas, and bedbugs. Probably only the moths were new; the New World was amply supplied with rats, mice and the rest. Europeans definitely brought diseases with them, including smallpox, typhus, measles, chicken pox, mumps, and the flu. But what about honey bees?

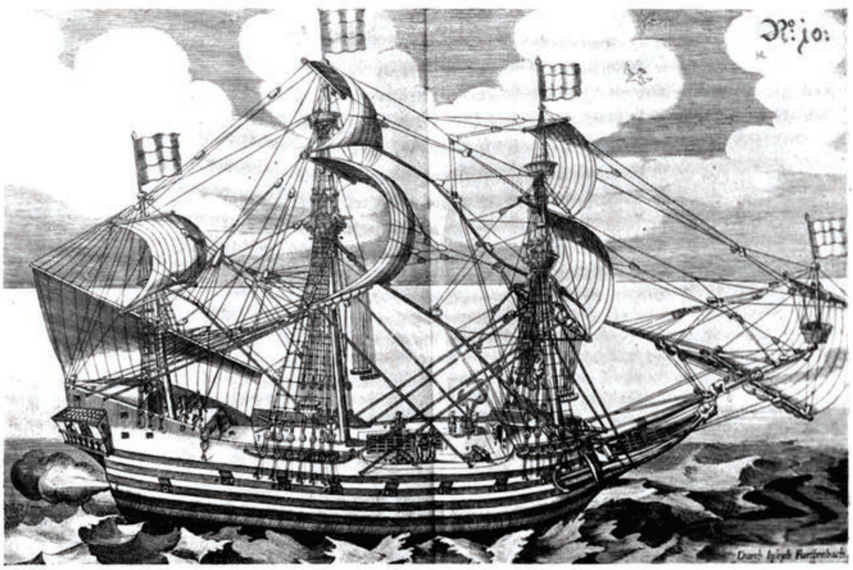


FIG. 59. A FULL-RIGGED SHIP OF THE EARLY SEVENTEENTH CENTURY. p. 219.

A Full-rigged Ship of the Early Seventeenth Century (Chatterton, E.K., 1915, Sailing Ships and Their Story)

Barton cites work by his contemporary, Dr. Jeremy Belknap, who wrote in depth about the travels of Christopher Columbus. Appended to his work, he also questioned whether the honey bee is native and lists many reasons to suggest that it is not. Belknap wrote:

> There is a tradition in New England, that the person who first brought a hive of bees into the country was rewarded with a grant of land; but the person's name, or the place where the land lay, or by whom the grant was made, I have not been able to learn. (Belknap 1792)

Belknap refers to accounts of the Spanish, who exploring Mexico, found the natives producing honey. Stingless bees of various types (genera *Melipona, Trigona, etc.*) are found throughout tropical America; none of them are true honey bees (genus *Apis*). These are undoubtedly what they encountered. As evidence of this, we can take the mention of a tribute being paid with 600 cups of honey, which is a particularly small amount compared to the yield of true honey bees. The harvest from a stingless bee nest can be measured in cups; the yield of a honey bee hive can be many gallons. Further, Belknap mentions the wax and says: "Though they extracted a great quantity of wax from the honey comb; they either did not know how, or were not at the pains to make lights of it."

What he means is that they didn't produce candles. Unlike honey bees, which build comb from pure beeswax, stingless bees form their rudimentary cells from a substance called *cerumen,* also called "black beeswax." It contains small amounts of wax secreted by the bees, but it is primarily made from things they gather such as plant resins and also soil, seeds, even small stones. Hence it would be hardly suitable for candles. Native Amazonians use it as an adhesive. They cook it, which causes it to blacken, and use it in making arrows. Still, as late as 1809, writers were adamant that honey bees had been here all along. Samuel Williams wrote in his "History of Vermont":

> Whether the honey bee is a native of the country, seems to be viewed by some as uncertain. I do not find much reason to doubt but that it was in America, before the Europeans made their first settlements in the country. They live in the hollow trees in the woods of Vermont, from year to year; and are always found, of their full dimensions, vigorous, and plentifully supplied with honey; and they bear the cold of our winters, much better in the hollow of a large tree, than in any of our artificial bee hives. (Williams 1809)

Bees in the Woods

Honey bees were indeed abundant in the woods, as evidenced by stories about bee hunting, with instructions on how to find them using the time-honored technique of "bee lining" or following bees back to their nest. Paul Dudley, a lawyer born in Massachusetts in 1675, was an accomplished naturalist. He was made a Fellow of the Royal Society of London in 1721. The Royal Society had been founded in 1660 and published scientific articles on a wide range of topics from astronomy to biology. It printed several of Dudley's articles, including one where he described and illustrated the method of discovering bee-trees and how to rob the honey:

> All the Bees we have in our Gardens, or in our Woods, and which now are in great numbers, are the produce of such as were brought in Hives from England near a hundred Years ago, and not the natural produce of this part of America; for the first Planters of New England never observed a Bee in the Woods, until many Years after the Country was settled; but that which proves it beyond question is, that the Aborigines (the Indians) have no word in their Language for a Bee, as they have for all Animals whatsoever proper to, or aboriginally of the Country. (Dudley 1721)

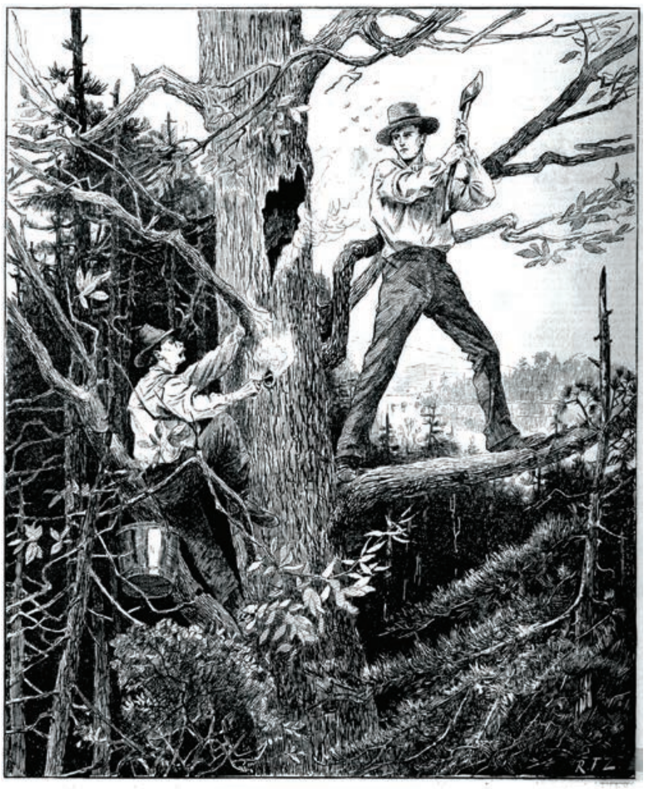
This example serves to illustrate several important facts. First of all, by the 1700s, honey bees were numerous in the forests surrounding the settlements. Second, beekeeping itself was not really the main source of honey; it was more common to obtain honey by robbing feral bees. Dudley may have been the first to write about it, but many others did as well.

Henry Rowe Schoolcraft was born March 28, 1793 in Albany County, New York and led several expeditions to what was then the "wild west." He published a book titled "Rude Pursuits and Rugged Peaks: Schoolcraft's Ozark Journal, 1818-1819." In it, he gave a description of bee hunting in the woods:

> We discovered a bee-tree, which Mr. Pettibone and myself chopped down. It was a large white oak, (*Quercus alba*) two and a half feet across at the butt, and contained, in a hollow limb, several gallons of honey. This was the first discovery of wild honey which accident had thrown in our way. It should here be remarked, that the white hunters in this region (and I am informed it is the same with the Indians) are passionately fond of wild honey, and whenever a tree containing it is found, it is the custom to assemble around it, and feast, even to a surfeit. (Schoolcraft 1821)

James Fennimore Cooper penned a novel called "The Bee Hunter," whose main character he named "Ben Buzz." Cooper says:

> As he was one of the first to exercise his craft in that portion of the country, so was he infinitely the most skilful and prosperous. There were a score of respectable families on the two banks of the Detroit, who never purchased of any one else. (Cooper 1848)



ROBBING A WILD-BEE HIVE.—Drawn by R. F. Zogbaum.

Robbing a Wild-Bee Hive (Harper's Weekly, Vol. 27 1888)

In the literature of the 1600s, there are references to bee hives in the American Colonies, but many of these are of doubtful authenticity. I will give one example:

> What shall I say more? you shall scarce see a house, but the South side is begirt with Hives of Bees, which increase after an incredible manner: That I must needs say, that if there be any terrestrial Canaan, 'tis surely here, where the Land floweth with milk and honey. (Denton 1670)

Unfortunately, Mr. Denton was prone to exaggerate, presumably to entice travelers to populate the struggling colonies. He claims in the same paragraph that "many people in twenty years time never know what sickness is," and that as few as two or three deaths occurred annually in a town. According to John Duffy, in his book on the history of public health of New York City from 1635 on:

> A word of caution should be given here. In the seventeenth and eighteenth centuries the New World was rightly looked upon as an exotic and marvelous place, and travel writers who wished to keep their readers dared not disturb this image. Moreover, many works were written under the patronage of wealthy land grant holders who were eager to people their vast holdings in America. (Duffy 1966)

Other writers, instead of arguing if or when bees were imported to the coast of America, tracked their progress across the wilderness. Gene Kritsky, professor of Biology at Mount St. Joseph University and the editor of "American Entomologist," has been writing about honey bees for decades. His 1991 article in American Bee Journal has detailed maps showing the years of first sightings of honey bees which had escaped into the wild, beginning with their arrival at Jamestown, Virginia in 1622, on to being seen in Georgia in 1736, a distance of about 500 miles. At this rate they would be traveling about 5 miles per year. Kritsky has them at the Mississippi River by 1800, based upon various sources.

It seems clear from the evidence that more honey was obtained from wild bees living in hollow trees, than was harvested from what manmade hives may have been kept in the new settlements. As further proof of this suggestion, I found mention of the subject in an early issue of the Scientific American magazine, which had been established in 1845 in New York City. This paragraph written in 1897 gives a glimpse of beekeeping of the past as well as the late 1800s:

Bee Hunting in the Adirondacks (Harper's Weekly, Vol. 12 1868)

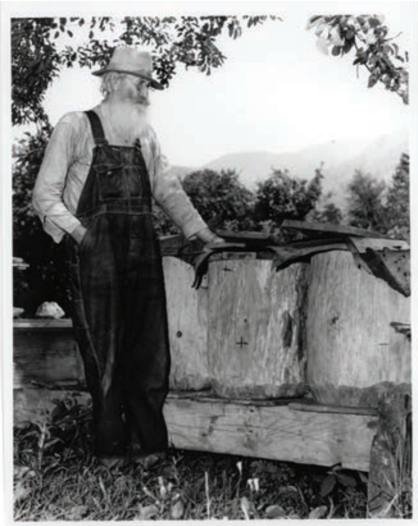
> Half a century ago honey was considered a luxury, and the market was supplied by the professional bee hunters, who made a precarious living in locating the natural hives of the bees in some old rotten tree right in the midst of the thick forest; but to-day, 30,000 bee keepers vie with each other to supply us with all the varieties of delicious honey that we are willing to pay for, and at prices within the reach of every one. (Walsh 1897)

Overseas Journeys

In the course of trying to find out as much as possible about how and when honey bees were brought to colonial America, I found a comment in a book about the ocean voyages and the ships that were used. The author wisely stated that most of the details were so commonplace that they didn't merit mention at the time. On the other hand, a detailed description of a typical sailing ship can give us a general description which would apply to the others.

The Mayflower had been used for years to transport wine before it was chartered to carry pilgrims to the New World; it was therefore called a "sweet ship" in contrast to ships that routinely carried more mundane cargo. Crossing the Atlantic in the 1600s was not without perils, but the ships themselves were rarely the cause of death; only a few were wrecked. Most often malnutrition and disease were the greatest hazards. The passengers were generally treated little better than livestock, which the ships usually carried as well. Animals such as cows, pigs, dogs and the like were very much in demand in the colonies and would fetch a high price; some of them were of course eaten by the voyagers. The captain generally feasted the entire voyage, while the passengers were given the cheapest food possible: hard biscuits, pickled meat, and beer barely fit to drink.

> The problem of food and water on these long passages was serious; Cotton Mather relates several instances of vessels which exhausted their supplies, and the crews of which were miraculously delivered from starvation. A small Vessel set sail from Bristol to New England, September 22, 1681, with the Master, whose name was William Dutten; there were seven Men a board, having Provisions for three months. "She was delayed so long at sea by



Uncle Dan Myers and bees
https://digitalheritage

> headwinds and bad weather that all her supplies were consumed; the beer was exhausted, and most of the drinking-water was lost by reason of leaky casks. The ship's company lived for a time on rats and rain-water "drinking a thimblefull at a time." (McElroy 1935)

Contemporary ship logs and bills of lading show that settlers attempted to bring bee hives with them on several occasions, but there are no records showing whether they survived the trip or the early years of settlement when starvation was the greatest peril the newcomers had to face.

> Seventeenth-century merchant vessels, bluff ended and round bottomed, were slow and inefficient sailers that bobbed like apples in wind-whipped sea swells. Every inch of cargo space was precious; so a skipper jammed colonists, belongings, livestock, and freight together in his ship's small hold. Disease was common, since sanitary facilities were minimal. Fresh water was scarce, and even cooking hot meals invited the risk of setting the ship afire. (Billings 2012)

The Mayflower anchored at Plymouth Rock in late 1620, and formed the first permanent settlement of Europeans in New England. More than half of the original settlers died during that grueling first winter. Since so many people as well as their livestock perished, it is fairly reasonable to suppose that many of the bees also did not survive. Eventually, though, live bees escaped into the woods surrounding the colonies at Plymouth and Jamestown, as evidenced by ample records of bee hunting in the colonies.

Early References

This is the earliest reference to a shipment of bees to Virginia:

> Wee have by this Shipp and the Discoverie sent you divers sorts of seeds and fruit trees as also Pidgeons, Connies [rabbits], Peacocks, Mastives and Beehives, as you shall by the Invoice perceive. – Letter to the Governor and Council Of Virginia, dated Dec. 5, 1621. (Neill 1869)

If you consult the very many books and articles written on the history of beekeeping, you will often see the date 1638 cited as when honey bees were successfully brought to New England. But as Lee Watkins tells in his piece entitled "First Honey Bees in New England — 1638?" (American Bee Journal, 1968) this is a perennially repeated error based on an inaccurate reading of "An Account of the Voyages to New England" by John Josselyn, published in London in 1674. Josselyn states plainly that honey-bees were carried over by the English, and "thrive there exceedingly!" — but he does not affix a date to their arrival.

I often wondered how the bees were transported. William Cotton describes an elaborate plan to transport bee hives to New Zealand. His scheme was to have the bees placed on ice in the ship's bilge, which would be the coldest, darkest place. However, the bilge was also the most unhealthy place in the ship, where foul water and other waste accumulated, so I doubt this plan was carried out. A more realistic approach was described by Edward Goodell, in his article titled "Bees by Sailing Ship and Covered Wagon." He claims to have found a book published in Antwerp in 1830, but offered no further bibliographic information. Goodell describes in great detail how hives would be shipped:

> A strong crate or chest was built to hold the hives. (I presume they were straw skeps.) This crate had two shelves built into it, one above the other then was divided into four compartments into which each of the skeps fitted snugly. (Goodell 1969)

The entrances of hives were closed while placed on board, and kept closed till they were out at sea. According to Goodell, a platform was built at the stern of the ship and the crate with the hives was bolted to it. The crate had ventilating holes in the bottom to allow air flow. They could be shut if the weather was very bad but also opened to allow the bees to come out and fly. The bees were unlikely to wander far from the ship, as there were no flowers to entice them, and they would easily find their way back: Bees naturally memorize their surroundings and the only thing memorable at sea would be the ship. Goodell says that the shippers knew that the bees would not do well if kept below deck for many months, so they were kept topside. Many of these ships carried a variety of animals, as I already mentioned.

An interesting parallel exists between the importation of bees and of other livestock. G. A. Bowling, writing in 1947 in the Journal of Dairy Science, states that "The scarcity of data relative to the first importations of cattle into Colonial North America has lent obscurity to one of the most interesting phases of early American husbandry." So the lack of concrete evidence is not unique to the story of the honey bee.

Concluding Remarks

Despite the fact that the record is littered with gaps, inaccuracies and fiction, I think there are several conclusions that can be gleaned. The colonization of the American colonies took place over many years, and was accompanied by many failures, caused by lack of preparedness due to insufficient resources, poor planning, and plain bad luck.

While it is certain that honey was valued by the settlers, in isn't clear how much skill or attention was directed toward bees, at least in the beginning. Perhaps honey bees were much more capable of making do with what was available than the European colonists, who relied very heavily on trade with and instruction from the native "Indians." Another researcher came to much the same conclusion:

> So prevalent had the forest bees become that by the late seventeenth century most people could rely on "wild" honey for their sweetening, rather than actively cultivating bees. It was considered a challenging and dangerous

sport, as well as a productive activity — a bee tree often produced as much as fifty to seventy-five pounds of honey. The availability of wild honey held back the growth of formal apiculture in the Chesapeake region. (Pryor, 1983)

In summation, honey bees as well as numerous other species escaped and found niches in the New World. Mostly, they simply found a way to "fit in." In many cases they became what are called "invasive species," which often crowd out the locals using traits such as rapid growth and reproduction, wide dispersal, and adaptability. In this sense, both the European settlers and honey bees invaded the American continent and now are found almost everywhere.

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Peter managed 500 colonies of his own in the 1980s. From 1999 to 2006, he was Senior Apiarist at Cornell's Dyce Lab for Honey Bee Studies. and worked as an apiary inspector for New York State from 2006 to 2008. He is retired from Cornell University, and is a past President of the Finger Lakes Bee Club.

Peter has published over 50 articles on topics as diverse as beekeeping technique, the composition and value of pollen for bees, and the history of bee breeding. He has done presentations on these topics for venues ranging from local elementary schools to beekeeping organizations in many states.

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Have Honey Bee Researchers Really Been Corrupted by Industry Dollars?

By Alison McAfee

Wannabe whistleblowers believe that funding from the agrochemical industry invalidates research, but this view is overblown

If Bayer offered me $1 million to start a research program, would I take it? If I accepted the funds, my hypothetical laboratory would have years of prosperity. But if the results of my research happened to favor the pesticide industry, I would promptly be labeled a shill.

Would that be justified? There's a stereotype that industry-funded research is inherently compromised. Perhaps this is true for some specific cases, but for honey bee and pollinator research, it is not the norm for researchers, data, or communications to be manipulated by industry relationships, and it is certainly not a widespread conspiracy. But the *perception* of back-scratching is damaging enough, sufficient for me to consider forsaking funds, even if I know my integrity is sound. And that bothers me.

The first time I thought hard about the optics of industry backing was at an agricultural biotechnology conference in Saskatoon, Canada, in 2016. I was relatively new to research, just two years deep into graduate school. One of the speakers, Dr. Kevin Folta, a professor in Horticultural Sciences at the University of Florida, shared a wrenching story of how outrage over Monsanto's support of his projects effectively ruined his career.

Monsanto donated to the University of Florida's Foundation, which in part supported Folta's biotechnology outreach and education program. When the public learned where Folta's money came from, and that Folta supported the use of genetically modified crops in agriculture, his reputation came crashing down.

I felt bad for the guy. He teared up on stage, disclosing that the scandal culminated with death threats to him and his family. But he had disclosed the source of his funds, and Monsanto did not seem to be involved in controlling his outreach or research activities. Since the funding agreement between Monsanto and the university upheld operational independence, I probably would have accepted that money, too.

In an interview conducted by David Kroll for Forbes, Folta says, "I've learned one huge lesson about this, as the naïve scientist that says yes to any opportunity — It's not what it is. It is what it looks like." Folta claimed he had "no relationship" with Monsanto, and the discourse devolved into "what is a relationship," if one party's activities are funded by the other, despite not otherwise influencing the project. But Monsanto's actual involvement, or lack thereof, with Folta and the University wasn't what mattered. When money is exchanged, a relationship is always perceived.

And there's the rub. If it looks like there is an ulterior motive, the damage is done, whether there is direct interference by the industry backer or not. And that's a problem, because public paranoia puts scientists between a rock and a brick wall.

We need money to do our research, train our students and buy our equipment, and industry is often willing to provide that, even if they have to stay out of our kitchen. Researchers are further pressured by their own universities to accept grants from companies, because industry funds can often be matched by the government, essentially doubling their money. It's good for the researchers and their institutions, but it's the researchers who are left to grow thick skins.

The Folta scandal is far from the only one where industrial support of an otherwise credible program sowed the seeds of doubt. The Intercept, an online news publication, published a long-form investigative article on January 18, 2020, titled "The Playbook for Poisoning the Earth," by Lee Fang. The article takes a blistering look at Bayer's launch of what Fang calls a "stunningly successful campaign" to keep neonicotinoid pesticides registered and in wide circulation despite a growing number of scientific publications showing that they are not the harmless compounds that Bayer claims.

Fang believes that Bayer cultivated relationships with honey bee scientists to covertly sway research outcomes and discourse. He cites cases where industry provided researchers with financial support that coincided with what he saw as a suspicious shift in rhetoric away from pesticide-blaming and toward varroa-blaming for dwindling colony health. "The greatest public relations coup," writes Fang, "has been the push to reframe the debate around bee decline to focus only on the threat of varroa mites."

He specifically targets Dennis vanEngelsdorp, a professor at the University of Maryland, criticizing him for shifting his research away from neonicotinoids and toward varroa — a diversion, Fang claims, linked to his relationship with Monsanto and Bayer. Dr. vanEngelsdorp was part of Monsanto's honey bee advisory council, and his initiatives have been funded in part by a nonprofit, Project Apis m., to which Bayer is a major donor.

I can't speak to the researchers' integrity for every instance Fang discusses — conflicts of interest do exist, and it's up to each individual researcher to check their bias and uphold the scientific method. There *are* instances where companies like Crop Life have pressured researchers to talk more about varroa and less about pesticides. But using these specific examples to invalidate all research that has been funded by agrochemical companies is overreaching. In most cases, the companies remain hands-off and let the researchers do their jobs.

Fang portrays all bee scientists as puppets, lured by the promise of financial aid. He also calls out Dr. Cynthia Scott-Dupree — a Canadian researcher at the University of Guelph — because she published a landmark field trial concluding that the neonicotinoid pesticide, clothianidin, had no significant effect on colony health when applied to canola.[1] Fang pointed to the fact that Scott-Dupree held a grant from Bayer as a mark questioning her motives.

"In my 34-year career, I've never been asked to change my data," Scott-Dupree says. "I was never told by Bayer what I should be working on, and they never told me what I could or couldn't publish. I'm not willing to lower my standards for any amount of money."

Other scientists, including Dr. Mark Winston — one of the most widely revered honey bee researchers in Canada — don't hesitate to vouch for her scientific integrity. Scott-Dupree's Chair in Sustainable Pest Management, funded by Bayer, did not come with any salary reward nor control over her experimental designs, research methods, or dissemination of results.

Scott-Dupree clarifies. "I could have taken some money as salary, but I didn't. I knew that people would try to insinuate that I was getting some kind of kickback." And while some criticized her experimental methods, that is part of normal scientific discourse. The story is not so simple as "it was funded by Bayer, therefore it's junk science."

"The fact that she [Scott-Dupree] found a result that the pesticide industry might like doesn't mean she was manipulated," Winston argues. He posits that the motivation for agrochemical companies to fund external research is not to manipulate scientists — it's to create a philanthropic image. "They [corporations] care about being seen as good citizens," he says. "I don't think they actually care about the results, or they wouldn't give us all that money." After all, pesticide-pollinator research most commonly unearths negative outcomes, rather than pesticide safety. "If the [pesticide] industry is so good at manipulating us," he points out, "why are there so many papers on the risks of neonics?"

The article in The Intercept makes researchers out to be gullible or spineless for accepting financial support from agrochemical giants. But when I asked Scott-Dupree why she took the grant from Bayer, despite understanding the optics, her response was anything but that. She said that in the beginning, she turned the grant down. However, under pressure from her institution, she decided that "if you do good research, it doesn't matter what anybody does to try to make you look bad. You keep moving forward, you keep making progress."

When he was an active researcher, Winston's laboratory also received funds from Bayer and Monsanto, as well as from government sources, environmental organizations and beekeeping groups. But the grants he agreed to, like most at public institutions, ensured that he held operational independence. Winston says he never felt like he was under pressure, and that communication with Bayer and Monsanto employees was quite useful. "They do know their pesticides," he says.

And, more often than not, studies in his laboratory revealed problems with pesticides and bees. This includes a landmark study, funded in part by Monsanto, conducted by his student Lora Morandin.[2] That study identified a catastrophic loss of plant biodiversity from the use of genetically modified, herbicide-tolerant canola, which harmed honey bees and wild bee diversity by dramatically reducing the variety of available forage.

What Fang fails to acknowledge is the alternate explanation that doesn't involve a complex conspiracy — that most laboratories receiving funds from industry giants *are* operating independently. Research started focusing on varroa as a culprit for colony losses because that's where science led us, and not as a result of a "stunningly successful campaign."

"The community is justifiably ticked off at the damage the chemical industry has caused," Winston says. But Fang's article has "maligned people, work, and research [in a way] that is not reflective of the real situation." Peer-reviewed literature is replete with papers on the damaging effects of pesticides *and* varroa, inconsistent with a research manipulation conspiracy.

Fang even questions the integrity of Project Apis m. — the nonprofit that supported vanEngelsdorp's initiatives. The nonprofit's mission is to fund research that helps enhance honey bee health and improve crop production. They accept research proposals from people like me, then the board of directors (ten accomplished beekeepers from throughout the U.S.) decide what to fund based on their own preferences and recommendations from the scientific advisory board. One of the scientific advisory board members is none other than Jerry Hayes, former Monsanto employee and former author of "The Classroom" in this magazine.

Bayer is a significant donor to Project Apis m. Bayer acquired Monsanto, so now, it looks like Bayer gets a seat at the table, via Hayes, to decide what Project Apis m. funds. But Hayes, as an individual, is well-respected in the field and is one of five advisors who ultimately don't make the final funding decision — that is up to the board of directors, the beekeepers.

I'm a Project Apis m. grant holder myself, and so are several of my colleagues. Nothing I have seen or experienced has made me question the integrity of the Project's conduct or motives. And now the ultra-skeptical reader will think to themselves, "Well, McAfee holds funds from a nonprofit that's supported by Bayer. She can't be trusted either."

Readers are right to be skeptical, but Bayer's money is everywhere and skepticism easily turns into paranoia. If we distrust everything their money has touched, we will strike through a mountain of good science, too. That skepticism needs to be balanced with a willingness to dig a little deeper to see what's really going on in each specific situation.

Would I take the $1 M from Bayer? Yeah, actually, I probably would. I think doing good science and training good scientists would be worth growing the thick skin.

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Alison McAfee has a PhD in genome science and technology from the University of British Columbia, where she studied mechanisms of hygienic behaviour in honey bees. She is now a post-doc at North Carolina State University in David Tarpy's lab, and studies what keeps honey bee sperm alive.

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Re-evaluating Varroa Monitoring

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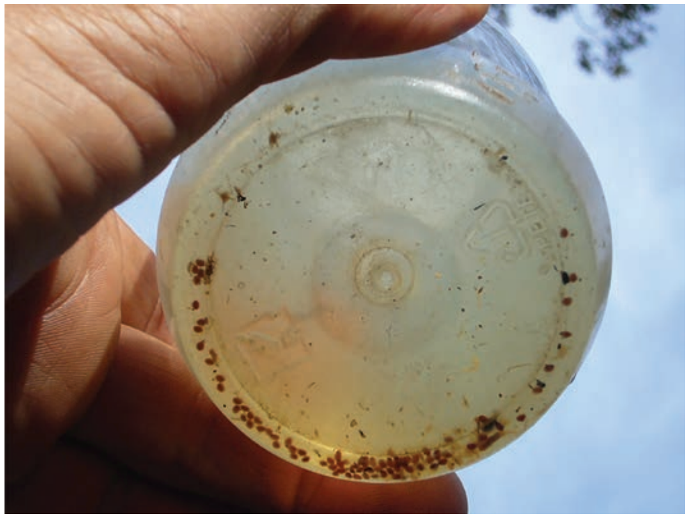

In order to monitor the varroa infestation rate of the adult bees in a colony, one must take a sample of bees from somewhere in the hive. But how to decide which comb to take the sample from?

This is not an easy question to answer, since several questions come to mind:

1. How many bees do you need for a representative sample?
2. Is the sample truly representative of the worker force?
3. Which age class of bees carries the most mites?
4. On which combs are those bees found?
5. Which combs in a hive would offer the "best" *representative* varroa sample?

Yes, some sticky questions. But first, allow me to define a critical term:

Sample: a representative portion of a larger whole group.

Question #1: How many bees do you need for a *representative* sample?

I find that if we limit the varroa infestation rate of our bees to the 2% level (2 mites per 100 bees), that our colonies thrive; but by the 5% level varroa and Deformed Wing Virus (DWV) start to noticeably take their toll on colony health and performance. Thus, early in the season I want to be able to detect an infestation rate should it reach the 1% level.

Practical application: A colony with a 1% infestation level at the beginning of April will reach the point of no return by September if not treated well before then.[1] Colony performance is best if mites are controlled early in the season.

So let's say that a colony was infested at the 1% level. If I sampled a single bee, 99% of the time, I'd see zero mites — which might mislead me into thinking that the colony was "mite free." If instead I sampled 100 bees, I'd still get a zero count 36% of the time (one can use an online calculator to determine these probabilities of sampling success). So what if I sampled a level half-cup of bees (roughly 315 workers)? See Fig. 1 below.

In the second two columns, I ran calcs to find out the chances of seeing fewer than three mites (circled in blue in the lowest row). You'd expect to see at least a single mite 96% of the time, and completely miss a 1% infestation only 4 times in a hundred (in red). So seeing even a single mite in an alcohol wash early in the season might be a call for action.

Probability of success on a single trial	.01	.01	.01
Number of trials	315	315	315
Number of successes (x)	3	2	1
Binomial probability: P(X = x)	0.22429211358	0.21282670202	0.13420282484
Cumulative probability: P(X < x)	0.38920755753	0.17638085551	0.04217803067 False negative
Cumulative probability: P(X ≤ x)	0.61349967111	0.38920755753	0.17638085551
Cumulative probability: P(X > x)	0.38650032889	0.61079244247	0.82361914449
Cumulative probability: P(X ≥ x)	0.61079244247	0.82361914449	0.95782196933

Fig. 1 *At the 1% infestation level, a half cup of bees would, on average, carry 3 mites — but that's not the number that you'd see every time. With an online calculator,[2] I entered the probability of a bee carrying a mite at the 1% infestation level (.01). Then the number of bees in a sample (315), and the number of mites that I'd expect to detect in that sample (upper blue ovals). The calculated probabilities are that although you'd get exactly 3 mites in only 22% of samples (upper left gray box), you'd detect at least 3 mites 61% the time (lower left gray box.*

Practical application: Most of us would rather err on the side of overestimating, rather than underestimating the degree of varroa infestation. Thus, we are more interested in avoiding *false negatives* (underestimating the infestation rate), than worrying about *false positives* (overestimating the infestation). At the 1% infestation rate of the adult bees, a half-cup bee sample gives you 96% chance of getting at least one mite in the bee sample.

The Importance of Technique

Important note: Keep in mind that any of these figures depends upon the degree of mite recovery that you get by your sampling technique. In the above calculations, I assumed 100% mite recovery from the bee sample — a success rate that I suspect is rarely attained in the field. I created the table below based upon my field observations of colony performance vs. varroa infestation rate (Table 1).

Table 1 *Colony health implications related to the number of mites recovered from a sample of a level half cup of bees (approx. 315 bees).*

Infestation level of the adult bees	Colony health implications	Number of mites in an alcohol wash or sugar roll, adjusted for the degree of mite recovery due to technique.*			
		Percent actual mite recovery			
		100%	90%	80%	70%
<2%	Colony not appreciably affected by varroa.	6	6	5	4
3%	Winter survival rate drops.	9	9	8	7
5%	Colony summer performance drops.	16	14	13	11
10%	DWV starts to seriously take hold.	32	28	25	22
15%	Colony typically past the point of recovery despite treatment.	47	43	38	33

*Few beekeepers likely attain even 90% recovery due to poor technique.

Practical application 1: The mite counts above are only expected averages, so obviously half the time you'd see fewer mites in a sample. But when I run the numbers, the counts will be within 10% roughly 75% of the time. So take multiple samples from your hives to get an idea as to where you stand, and keep in mind that roughly a tenth of the hives in a yard will exhibit much higher counts than the yard average.

Practical application 2: Since the threshold for treatment involves relatively few mites in a sample (as low as 1 early in the season), it's important to obtain full mite recovery. Later in this series I will address how to obtain maximum mite recovery in alcohol washes.

Question #2: Is the sample truly representative of the worker force?

To obtain a truly-representative sample of the worker force *of the colony as a whole* would require you to shake ***all*** the bees off the combs into a cage, mix them up, and *only then* to take the representative half-cup sample. Clearly, most of us are not going to do that! So the question then is, where in the hive should we take the bee sample from? One would think, what with all the experts telling us beekeepers that we should monitor our hives for varroa, that there would be well-supported recommendations as to which comb in the hive gives the best representative sample. The common advice is to take the bees from a brood frame "because varroa prefer nurse bees." Is that actually true, and would such a sample indeed be representative?

Practical application: Let's just say that a colony has only a tiny patch of brood, indicating that there would perhaps be a low proportion of nurses in the hive. Would the presumably-high infestation rate of those few nurses then be representative of the colony as a whole? I don't know that anyone has investigated whether the infestation rate of the nurse bees is actually the most biologically-relevant metric for varroa impact upon the colony as a whole.

Question #3: Which age class of bees carries the most mites?

There's no sense in wasting time in trying to reinvent the wheel, so when I have a question about bees, I first search the literature to see if someone's already performed an experiment or study to answer it. So I first looked for the supportive evidence for the claim that "varroa prefers nurses." The original basis appears to be from a trio of in-hive studies performed in the mid '80s — before varroa reached the U.S. At that time, German scientists were engaged in quite of bit of very impressive research into varroa biology.

In the first study published,[3] Petra Schneider collected samples of bees from 10 hives from mid-June through mid-October. One group of hives had low mite levels; the other high mite levels. I've reworked her results in Table 2:

Table 2 *Comparison of varroa infestation rates, in June, of different types of sampled bees. Data reworked from.*[4]

Type of bees sampled	*Mite infestation of bees from low-mite hives, normalized to that of nurse bees.*	*Mite infestation of bees from high-mite hives, normalized to that of nurse bees.*
Nurse bees	*1*	*1*
Foragers	*0.29*	*0.36*
Drones inside the hive	*1.50*	*1.13*
Drones outside the hive	*0.44*	*0.69*

This preliminary study indicated that nurse bees and drones exhibited the highest mite infestation rates. Unfortunately, the brief abstract doesn't detail how they determined which bees were "nurse bees." But Schneider then performed additional studies during winter in a flight room, checking the infestation rate of (presumably marked) bees by age:

The highest infestation rate was found on bees which were 1-day old, further peaks were at ages of 5, 15-20, 20-30 and 42-44 days.

Unfortunately, the paper was only an abstract, so no further details.

But the next year, three heavyweights — Drs. Bernhard Kraus, Nikolaus Koeniger, and Stefan Fuchs — published a study in which they introduced over 2000 paint-marked bees into a hive and then later compared their infestation rates (Table 3):

Table 3 *Infestation rates of marked bees in a hive by age class. Data from Kraus.*[5]

Age of bees (days)	No. of bees sampled	Infestation rate of age group
6	*600*	*5.5%*
12	*640*	*5.2%*
18	*450*	*2.2%*
24	*250*	*3.2%*
Pollen foragers	*370*	*0.3%*

Practical application: This in-hive study confirmed that the mite infestation rate of 6-12-day workers is roughly twice that of older workers. So the question to me then was how workers are distributed by age throughout the hive?

We know that after emergence from her cell, a worker bee typically progresses through a series of different behavioral tasks, adjusted according to the needs of the colony. This phenomenon is referred to as "temporal polyethism" ("temporal" meaning "over time," and "polyethism" meaning "multiple behaviors").

Since these early studies, we've learned that mites tend to quickly abandon the emerging workers that they had developed on (as pupae), and preferentially latch onto nurse bees. Since the mites are blind, they recognize the nurses by their odor, as evidenced by laboratory olfactory preference experiments, well-reviewed by Pernal.[6] This preference makes sense for two reasons:

1. Nurse bees have fully-developed fat bodies, which means that they are a better food source for a female mite, and
2. A nurse bee is the best transporter for a mite to its next host — which occurs when a nurse sticks her head into a cell containing a late-instar larva about to pupate.

So we can justifiably conclude that varroa do indeed "prefer" nurse bees. We might assume then that those nurse bees would mostly be on frames containing brood. But you know how I feel about assumptions. So I looked for hard data.

Question #4: On which combs are the nurse bees found?

In order to determine the usual age ranges at which workers perform each task, several researchers have tracked the activities of age-marked bees in observation or field hives.

A youthful Dr. Tom Seeley[7] took the time to record the activities and location of marked individuals of a cohort of 100 newly-emerged bees over the course of a month. Dr. Seeley granted me permission to include his chart of activities by age (Fig. 2).

Practical application: Varroa would be expected to be mostly found on nurse bees — which according to Seeley's observations would be those from 4-12 days of age, which tend to favor the broodnest.

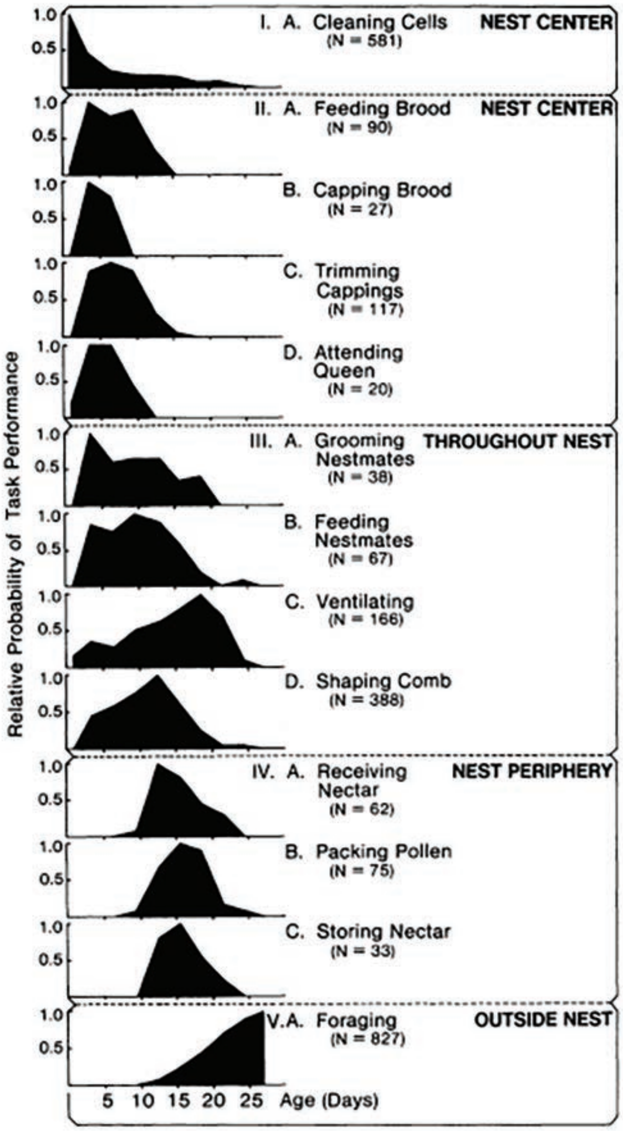

Fig. 2 *The darkened curves show the relative probability of a bee of any age performing one of the 13 listed tasks. Each of the five groups represents an age class, with Groups II and III commonly referred to as "nurses."* Figure from Dr. Thomas D. Seeley, by permission

So I was surprised some years ago when I used fluorescent tracer to track the distribution of pollen-consuming (i.e., nurse) bees within the hive, and found them to be scattered widely throughout the combs. So let's go back to a study by the noted English bee researcher J.B. Free, published in 1960,[8] to see where he found bees of that age to be located. Free introduced newly-emerged marked bees (nearly 4000 bees in 7 replicates) into normal colonies and recorded the numbers of marked bees found on brood and storage combs at intervals afterwards (I graphed his data in Fig. 3).

Practical application: Although we often associate nurse bees with being on brood combs, in actuality, they tend to be distributed on combs all over the hive.

Following up on this earlier research, van der Steen in 2012[9] marked emerging bees once a week in ten one-story colonies for four weeks, and then recorded the distribution of the marked bees on the frames of the hives each

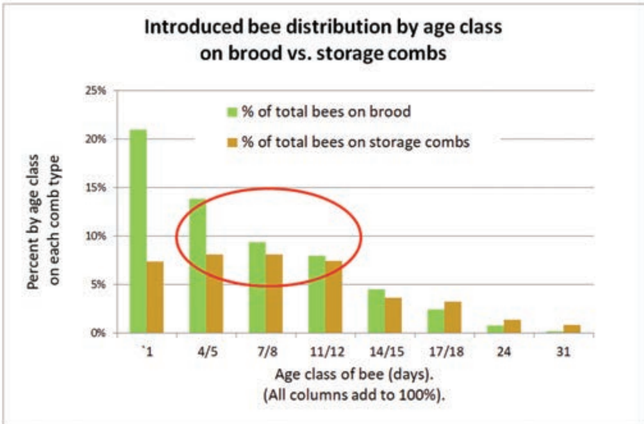

Fig. 3 *J.B. Free recorded the distribution of bees of each age group on brood combs (green) or storage combs (brown). Note that the bulk of a colony's population (during summer) consists of young bees that after 5 days of age are relatively evenly distributed over the combs. Nearly half the nurses (circled in red) were found on storage combs. I'll break down Free's data in greater detail in a later article.*

week from 24 August 'til 20 September. They found no statistical hive-to-hive difference in marked bee distribution among the ten hives, so pooled the data. I've reworked their results in Fig. 4.

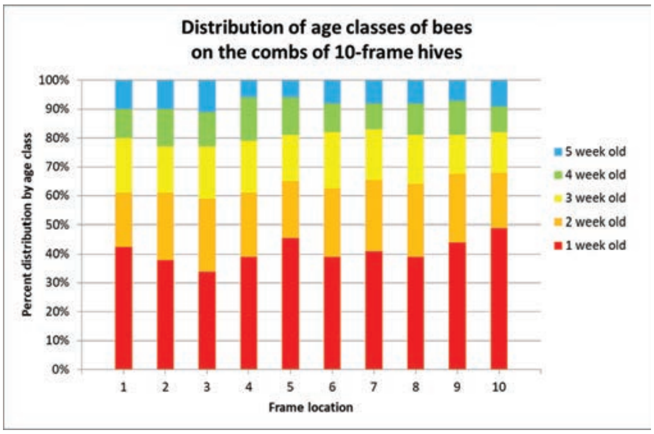

Fig. 4 *I color-coded van der Steen's results. The authors did not specify the contents of the combs as far as storage or brood combs, but they clearly found that the various age classes of bees were relatively equally distributed over the combs, at least in single-story hives.*

They concluded that:

Our study shows that in August it is perfectly possible to sample from the outer brood frames for a standard distribution of age classes, whilst disturbing the colony less. … We did not find a cluster of very young bees in the centre of the colony [as per Seeley], but we started counting from one week old bees onwards, which means that the phase of clustering in the centre of the colony had already passed by that time.

Practical application: The above studies determined the distribution of age classes of the bees, but does that indeed predict where mites were most likely to be found? Since nearly all the mites in a hive emerge from the brood, or are attempting to hitch a ride on a nurse bee in order to reenter a cell, we'd perhaps expect the highest infestation rate to be found on a bee sample taken over emerging or open brood.

Question #5: Which combs in a hive would offer the "best" *representative* varroa sample?

In the same year as Seeley's *observation hive* study of bee behaviors, Dr. Stefan Fuchs[10] published a *field* study, in which he determined the ***varroa infestation rate*** of bee samples taken comb-by-comb from across 10-frame hives. He found that:

The estimates obtained from different bee samples from the same colony fluctuate over a very wide range. In bee samples, infestation was somewhat higher in the central area of the hives, particularly on the brood combs.

However, the infestation rate of bees taken from frames containing brood wasn't that much higher than that of bees taken from outside combs — only about a quarter higher, with only a weak correlation with the *amount* of brood on the comb. But in autumn, as the colonies began to go into winter cluster, infestation rates were roughly 1.5 times higher on the central comb than on outer honey combs.

More recently (2010), Katie Lee studied mite distribution within colonies[11]:

These results indicated mites were distributed approximately at random among bees on brood box frames.

In contrast, [mite] densities on frames with and without brood comb were statistically different … However, the difference was modest, with 1.8 mites per 100 bees on frames without brood comb, and 2.4 on frames with brood comb … for convenience, and to increase sampling precision and chance of detecting mites when they are rare, we recommend beekeepers take a single large-vial sample of 300 adult bees from any frame in the uppermost brood box.

Convincing myself

Years ago I'd also reviewed data given to me by Dr. Frank Eischen for frame-by-frame mite counts from many hives,[12] as well as previously reporting that Dr. Ralph Büchler and I had both found that there didn't appear to be much difference in mite infestation rates of bee samples taken from honey vs. brood frames from the brood nest.[13] I'd also performed a single comb-by-comb comparison myself,[14] and concluded that taking a bee sample from any frame in the upper brood chamber was representative enough.

Practical application: Based upon a review of the literature, it was easy to convince myself that I could take a bee sample from nearly any frame in a brood box.

But that doesn't mean that I don't continually question my own assumptions and conclusions. So since my selection for mite resistant bloodlines is based upon mite counts. I decided to see whether it really made a difference in what comb I took the sample from. I'll share what I found next month (teaser: it changed my mind).

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Randy sees beekeeping through the eyes of a biologist. He's kept bees for over 50 years, and with his sons runs around 1500 hives in the California foothills. He closely follows bee research, engages in some himself, and enjoys sharing what he's learned with others.

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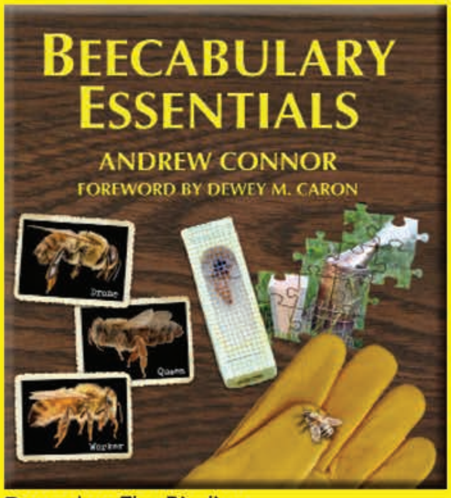

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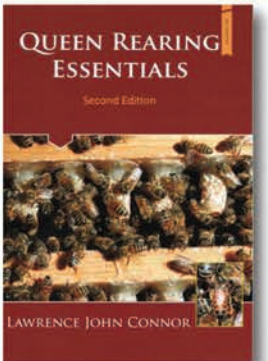

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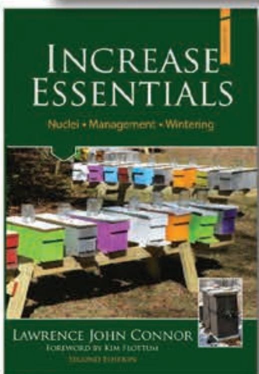

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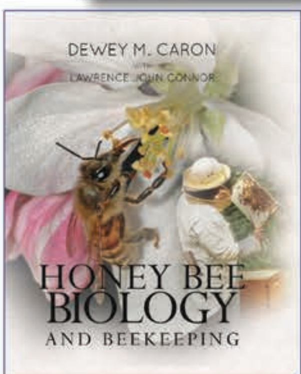

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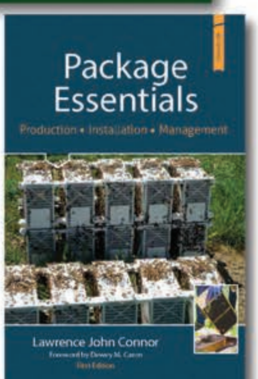

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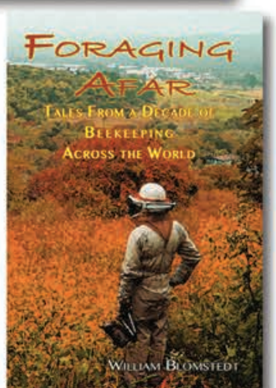

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CRANBERRIES — NOT JUST A THANKSGIVING TREAT

BY KAREN NIELSEN LORENCE

If cranberries were served for the first Thanksgiving at the 1621 harvest celebration at Plimoth Plantation, they most likely appeared in a tart Pilgrim sauce or in some Wampanoag dish that the Native Americans provided. That tells us that cranberries were native to the North American continent and they definitely did not need our honey bees (*Apis mellifera)* to pollinate them.

Cranberry pollination, by nature, is very unique. In fact, the plant itself is exceptional with the flowers pointing downward. Cranberries grow primarily in five states in the United States: Wisconsin produces 62% of the crop, followed by Massachusetts, New Jersey, Oregon, and Washington. Wisconsin has 240 growers and 275 marshes with 21,000 acres harvested each year; the gross profit of cranberry production in the state is $166.4 million. Approximately 900 million pounds are produced, with Americans eating 20% of them Thanksgiving week.

Honey bee on cranberry blossom
(courtesy of Hannah Gaines Day)

In fact, 2.3 pounds of cranberries are consumed per person per year with the majority of them being in the form of juice. Interestingly enough, dried cranberries (widely known as Craisins) are rapidly overtaking juice and fresh berries in popularity. In recent years, the crops produced have been bumper crops, forcing growers to put them in cold storage until they can be sold. Matthew Schultz, a commercial beekeeper in Reedsburg, Wisconsin, runs about 9000 hives near Warrens, WI. According to Matt, there are commercial cranberry producers growing 400 to 500 acres who are often members of the Ocean Spray Growers' Cooperative, as well as other, small and independent producers with ten to fifteen acres.

Cranberries grow in marshes which have been nurtured with acidic peat soil. They are not grown underwater but the bogs are flooded during harvesting season to enable the cranberries to be easily harvested. A successful grower will plant native pollinator-friendly flowers around the perimeter of the field. Most growers realize that the bees need a supplemental supply of food.

Some native bees, including the bumble bee (*Bombus sp.*) are successful pollinators of cranberries as they shake the flowers, causing the pollen to drop down onto the bee. This "buzz pollination" makes them particularly efficient. Honey bees are less efficient at collecting pollen because they do not buzz pollinate but they make up for it by their larger numbers. Pollination by a native bee or by the honey bee insures maximum fruit, more seeds (and thus more weight), larger berry size, and successful ripening. Several of our Wisconsin beekeepers shared the fact that both the bumble bees and honey bees are successfully used for pollination in Wisconsin. Honey bees are delivered, left for the pollination period, and then picked up.

Koppert Biological Systems from Howell, Michigan, has the bumble bees available. They come in quads — four hives packed with about 800 bumble bees (200 per package). They arrive in refrigerated trucks, are left in the bog six to eight weeks, work themselves to death, and are allowed to die, which of course is the natural consequence of their short life.

It is fascinating to think of cranberries being pollinated as they are. The cranberry blossoms are a carpet of flowers, growing densely. The more movement there is, the more pollen transportation that results. When the flowers are rustled, even by wind, pollination takes place. The shape of the flowers encourages buzz pollination, enabling both bumble bees as well as honey bees to do the necessary job of pollination. An old method, according to John Piechowski of Henry's Honey Farm in Red Granite, Wisconsin, is to drag cables across beds to stir up pollen. It is highly labor-intensive but serves the pollination factor well.

About 90% of Wisconsin cranberry growers rely on commercial honey bee pollination, stocking as many as seven to eight hives per acre or as few as two to three hives per acre. A big variance, however, between the likes of almond pollination and cranberry pollination is that bees in almonds command about $225 per hive for pollination service and cranberries command only about $45 to $80. Although cranberry honey is rarely extracted because of the limited supply, it has a rich flavor with a deep red color.

What are some of the conditions that our beekeepers look for when placing their bees in cranberry pollination? Certainly the written contract between beekeeper and fruit grower

Hives brought into cranberry bogs for pollination (courtesy of Hannah Gaines Day)

is important. Hive inspection by a third party, especially if crossing state lines, is deemed mandatory. Timing … from about mid-June to mid-July seems to be desirable.

Chemicals have always been a problem. The timing of the application of sprays of fertilizer, herbicides, or insecticides is paramount to bee health. According to Jon Piechowski, hard chemicals are not particularly hard on the bees but the way they apply them is bad. The chemicals are residual so the plant absorbs the chemicals ahead of time. The poison is supposed to kill the larval stage of the worms on the berries but three days later, bees have died. John is assuming that they are getting poisoned in the larval stage just as the larval stage of the worms is poisoned. One must also be aware of insecticides being applied to neighboring crops.

John goes on to share that cranberry pollination is a different world today than it was thirty to forty years ago. In the 1960s, he pollinated 90% of the cranberry crop in Wisconsin. Marshes were smaller then. Today, the bigger growers have pretty much bought out the smaller growers. His biggest complaint is that the grower does not want to pay for GOOD bees. They don't understand the value of pollination. The big factory corporation owns thousands of acres and pretty much "calls the shots." One of the horror stories that John shared was when a grower went into his flowering cranberry patch and found few bees visiting the flowers. Interestingly enough, cranberries bloom at exactly the same time that Wisconsin's major honey source the basswood (linden) tree blooms. Where were the bees? On the perimeter of the marsh visiting the linden trees that surrounded the marsh. Herein, however, lies the exact reason that many Wisconsin beekeepers do not WANT to pollinate cranberries. They can get 65 to 70 pounds of honey off the linden trees in one week. From the cranberries, they would be lucky to get two to three pounds of honey. And … even worse … the bees may consume three to four frames out of the box, leaving no honey whatsoever for the beekeeper to harvest. Unfortunately, knowing that the bees prefer basswood blossoms over cranberries, some farmers will clear cut the forest of basswood to keep the bees IN the marsh. The good grower, on the other hand, will encourage the wild pollinators as well

ELEGANT FROSTY CRANBERRY PIE

1 ½ cups finely crushed vanilla or lemon wafer crumbs
6 tablespoons butter, melted
1 cup whipping cream
1 teaspoon vanilla
1 - 8 oz. package cream cheese
¼ cup honey
1 - 1# can whole cranberry sauce
Additional whipped cream for garnish

Combine cookie crumbs and butter. Press firmly over bottom and sides of 9" pie plate.
Whip cream with vanilla until thickened, but not too stiff.
With same beater, soften cream cheese. Gradually add honey in a fine stream. Beat until smooth.
Fold whipped cream into cheese mixture. Set aside a few whole berries to use as garnish. Fold remaining cranberry sauce into the whipped mixture. Spoon into crust. Cover with plastic film and freeze until firm.
Remove from freezer 10 minutes before serving. If desired, top with honey-sweetened whipped cream. Garnish with reserved cranberries.

Makes 8-10 rich servings.

Thanks to Ron Fischer for the excellent cranberry recipe.

CRANBERRY DRINK

1 ½ cups cranberries
¼ cup honey
¾ cup water

Mix all ingredients in blender and drink daily!

Thanks to Wally Nass of Wisconsin for his recipe.

as honey bees by nurturing and preserving areas of bare sandy or loamy soil, planted with pollinator friendly flowers. They realize that bees need supplements and there is not enough nectar or pollen to support honey bees successfully in a cranberry bog. Our beekeepers tell us, "You really have to know your grower. She/he has to be very knowledgeable about bees!" Wisconsin sponsors a Cranberry School in January, according to Dr. Hannah Gaines Day, Assistant Scientist at UW-Madison — much like our beekeeper conventions, with two to three days of different research people speaking. This year it was held in Wisconsin Dells. Hopefully the beekeeper is well represented to share his/her concerns with the growers.

Dr. Gaines Day has a PhD in entomology with a concentration in cranberry pollination. She was most interested in the landscape influencing wild bees when she began her studies but added honey bees too after talking to cranberry growers. Using ten years of data from the growers, she determined that the ideal number of hives needed is entirely dependent upon the landscape, including whether there is a controlled environment nearby that the bees are enticed to visit. Cranberry marshes in low-woodland landscapes showed a strong positive relationship between hives and yield. (The more hives the grower had, the higher their yield, and John Piechowski said at that point it is absolutely dependent on what the cranberry grower wants to pay.) But in high-woodland landscapes, there was no relationship between hive stocking density and yield.

Dr. Hannah Gaines Day also emphasized that in 2012, the federal government designated money for farmers to put into pollinator habitat; $100 million was authorized over the five-year life of the farm bill — both to fund research and to subsidize seed for the farmer. This surely enabled the cranberry grower to increase the variety of floral sources that bees on cranberries could visit. As beekeepers, we would like to think that many farmers, including cranberry growers, took advantage of this money to subsidize the planting of pollinator friendly plants in the acreage that provides forage for our bees and to enhance the cranberry pollination season.

Thanks to Lee Heine, Kent Pegorsch, John Piechowski, Hannah Gaines Day - University of Wisconsin Bee Research Person, Thomas Lochner - Executive Director of the Wisconsin State Cranberry Growers' Association, and Matthew Schultz, one of Wisconsin's largest beekeepers and cranberry pollinators.

Karen Lorence and her husband Charles of Aurora, IL have been beekeepers since 1971. At one time they kept 150 hives. As teachers, they had summers free and their hobby turned into a thriving business. Today they manage hobby hives in Wisconsin and Illinois and sell honey and value-added products. They teach classes in beekeeping, offer seminars at community colleges and arboretums, write for a professional beekeeping magazine, and do presentations to garden clubs and special interest groups. Their honey and beeswax products have been awarded special honors on both the state and national level.

Flooded cranberry bog, ready for harvesting (courtesy of Hannah Gaines Day)


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Bees and Beekeeping Past & Present

By Dr. Wyatt A. Mangum

Comb Building: Watch Out for Wrong Turns

With the approach of spring, let's examine some various aspects of comb construction, ending with an example of straight combs destroyed. My top-bar hives and frame hives will provide a wide selection of comb-building situations.

Sometimes comb construction records a nectar flow. In Figure 1, we see a small piece of burr comb. Figure 2 shows a cross section of the same comb. Notice the darker wax toward the middle of the comb. Along the outer edges of the comb, the wax is lighter in color. From the color differences, the bees might have started the comb in an earlier nectar flow, but they could not finish construction

Fig. 1 A small comb built in some extra space inside a top-bar hive

Fig. 2 A cross section of the cells in Figure 1

once the flow stopped. In the intervening time the wax darkened. Sometime later another nectar flow started, and the bees extended the cell walls with new white wax, giving rise to the color pattern in the cross section.

Another way this color pattern could occur is if the bees used some recycled (darker) wax to begin the comb. Bees can build comb in small amounts from recycled wax, just before the beginning of the spring nectar flow. Then once the spring flow began and wax production started, the bees switched to using the newly secreted white wax to finish lengthening the cells. With this last interpretation in mind, it is important to remember not to leave foundation on a colony when there is no nectar flow. The bees might chew up the edges of the foundation and presumably use it elsewhere in the hive.

Before the spring nectar flowers, I watch the bees use recycled wax to repair comb, to build burr comb, and to construct queen cell cups. Figure 3 shows a pair of queen cell cups bearing a change in the origin of wax. The bees made the left queen cell cup from recycled brown wax, as they typically do when the brood nest grows, but before an abundance of spring nectar. In more prosperous conditions, the queen cell cup on the right was built with an addition of new wax. Notice though, the pits at the base of the queen cell cup are brown, suggesting the bees built the newer addition upon an older queen cell cup base.

Fig. 3 Two queen cell cups made from old wax (left) and new wax (right). A colony's changing prosperity is sometimes recorded in the color of its wax.

Now let's assume an intense spring nectar flow has begun. Foundation is in the hive, and the bees are producing wax. The bees, following the hexagonal pattern embossed on the foundation, build the walls of the comb. The bees need a prominent edge to begin their work. That edge on the foundation, sometimes called a sidewall, runs along the hexagons. If the sidewalls are not distinct, the bees might be slow in building comb from the foundation, or they may never use the foundation. Figure 4 shows a close-up comparison between foundations with (upper) and without (lower) well-formed sidewalls. In addition, the impressions are generally a poor quality for the lower foundation.

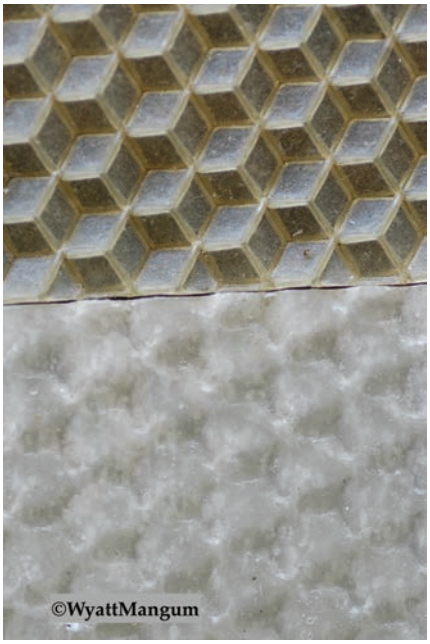


Fig. 4 Comparing foundation: high quality above and poorly milled below. From my international beekeeping work, I always collect and photograph comb foundation.

Proceeding to the more extreme, giving the bees a blank (un-embossed) sheet of wax, not surprisingly, they just walk over it for days without any (normal) comb construction, even during a strong nectar flow. Since the wax sheets are easy to make and no expensive embossing is needed, beekeepers have tried giving bees blank wax sheets, but with little success. Instead of a full blank sheet, others have tried using just a blank strip of wax to get the bees to align combs straight in the frames. In this situation, the bees build the comb mainly from the lower edge of the strip, if they do it at all.

Figure 5 shows an example of comb construction under these conditions. Interestingly, if I make a few unconnected impressions in the blank strip with the head of a heated up small nail, forming little rims of circular impressions, similar to sidewalls in foundation, the bees will try to start building their cell walls (see Figure 6). That idea motivated the following:

Fig. 5 Comb building with an unembossed wax strip. The bees only built a little comb from the side of the wax strip. Instead, they used the wax strip as a comb guide and built comb *under* the strip, not what I had in mind.

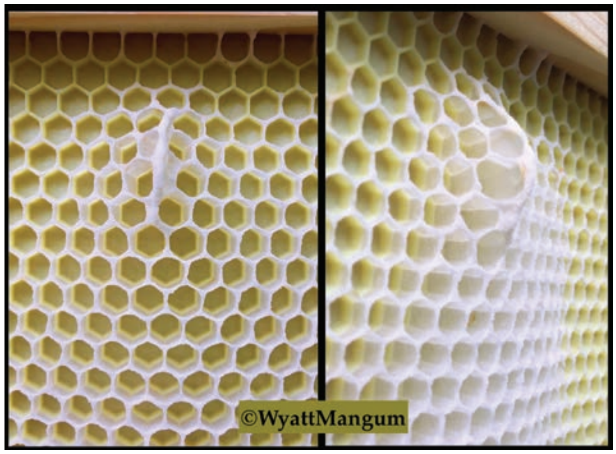
Instead of giving the bees no pattern on the wax sheet, what if the wrong pattern was on the sheet? For example, what if I give the bees a sheet of wax with a pattern of small squares inscribed on it? (That is easy to make.) What will the bees do? Inscribing the pattern can form edges in the wax from which the bees can start their cell walls. But obviously the square shapes are wrong. Can the bees correct the shapes and re-form them into hexagonal cells as they form the cell walls? What this procedure is essentially doing is posing a "problem" to see if the bees can "fix" the situation.

Fig. 6 Wax deposition around wax rims made from a nail head. Bees need an edge to work from. Once they placed some initial wax, there were no more edges to guide their work, and so the bees quit building.

We see their solution in Figure 7. On the face of the wax sheet are numerous irregularly shaped cells. It seems the bees cannot correct the square shape. But the bees do have an unexpected solution. Figure 8 shows a vertical ridge of wax built from the

Fig. 7 Irregularly shaped cells built from squares scored on a wax sheet

Fig. 8 A comb beginning to grow at right angles to the wax sheet



(L) Fig. 9 A typical view of two rogue structures, the beginnings of comb growing perpendicular to the frame **(R) Fig. 10** Comb growth perpendicular to the frame, just starting. I watch for these harbingers of disaster any time my bees build comb. I am showing the initial growing structure from two close-up views and as typically seen (Figure 9) for beekeepers not trained in spotting these structures that can ruin straight new comb.

irregular cells. From the ridge, the bees can build normal comb — but at right angles to the wax sheet. The ridge will essentially become the midrib, the cell floors, of a new comb. So yes, the bees can build a comb — just not parallel to the first one. This unusual occurrence happens in other comb building during regular bee management.

Generally, most of the time, bees build parallel combs. In stark contrast though, bees do build combs perpendicular to each other. In my frame hives when bees build out foundation, usually the combs are straight and uniform as expected. Sometimes the bees web adjacent combs' sides together in a gruesome labyrinth of burr comb. I see this problem occur when the colony strength or the nectar flow weakens, both of which slow comb construction. I see this cross combing with plastic base foundation coated with beeswax, or top-bar combs being naturally built, which are vastly different situations. The structure that seems to precede this comb webbing appears in Figure 9, which is a typical viewing distance from the frame. On the foundation where the bees are extending the cell walls are two small and rather curious "knobs."

Figure 10 shows two close-up views from above (left) and a side view (right) of the upper structure in Figure 9. Observing carefully reveals a midrib of the new comb growing perpendicular to comb in the frame. That perpendicular comb will grow into the next comb. The bees will extend it downward, forming a substantial bridge between the frames. Figure 11 shows the top super turned up vertically to see it from below. On the bottom bars to the right, and especially the rightmost bottom bar, see the cross combs. Those perpendicular burr combs ran all through that side of the super. As best as I can tell, that cross comb had the perpendicular comb structures (of Figure 9) near the beginning of this abnormal growth. This rogue comb growth does not seem to be an artifact of frame-hive beekeeping with foundation.

Fig. 11 A hive with crossed up combs in its top super (on the right side)

In my top-bar hives, the bees build combs with minimal artificial influence. (I mainly want straight interchangeable combs, like with my frames.) Even under these more natural comb growth conditions, Figure 12 shows the beginning of perpendicular comb growth. Without complete sheets of foundation, considerable open space remains around the growing combs. This openness allows a perpendicular comb to begin growing from one comb face and extend

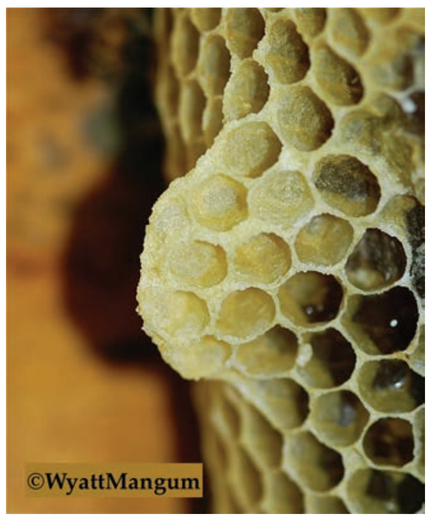


Fig. 12 Perpendicular comb growth, just beginning with a few cells, from one of my top-bar combs. The slightly darker wax reveals the sidewalls of the comb extending out, beginning at almost the edge of the comb.

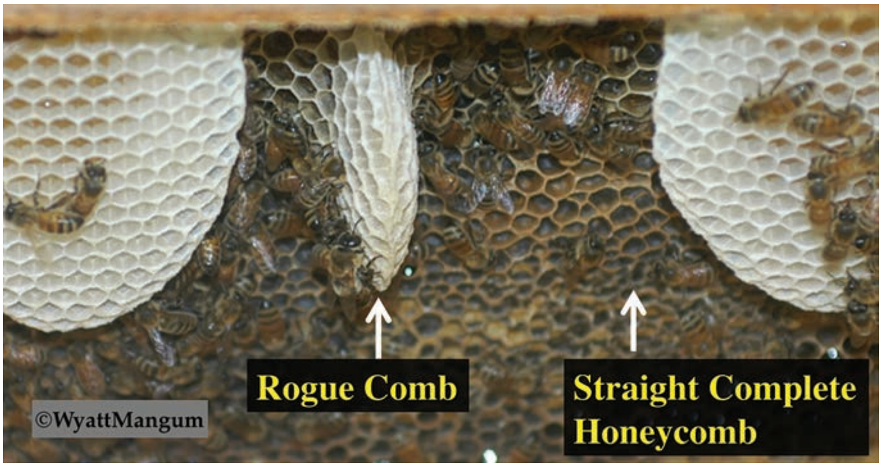


Fig. 13 An easy-to-see perpendicular comb growing from a normal top-bar comb. This perpendicular comb in the middle will interrupt the normal combs growing parallel to the main top-bar comb, which should become the next comb.

across several parallel top bars, the once future sites of normal comb construction. Figure 13 shows the beginning of that situation. A rogue comb has begun from the main comb and will prevent the straight-line connection of the two normal combs closing in from the left and right. This technical photograph is from my book "Top-Bar Hive Beekeeping: Wisdom & Pleasure Combined," where I discussed this unusual comb building.

During times of comb building, like the prosperous conditions when bees bring in nectar like raindrops, I watch their comb building for signs of trouble. It is just second nature now, born from having 200 top-bar hives and dozens of frame hives. When I find the bees just beginning to build perpendicular comb, I cut it out completely from the main comb, leaving nothing to tempt the bees to restart the wrong comb direction again. I also turn the frame or top-bar comb around just to break the old pattern, and reestablish the normal parallel comb-building pattern.

Now as your bees build comb this spring, keep a watch on them. Don't let them take an abrupt turn to burr comb confusion.

ACKNOWLEDGMENTS

The author thanks Suzanne Sumner for her comments on the manuscript.

Visit **TBHSbyWAM.com** and **BeeChildTheBook.com**.

Dr. Wyatt Mangum, author of *Top-Bar Hive Beekeeping: Wisdom and Pleasure Combined*, is an internationally known top-bar hive beekeeper, who started keeping bees at age 10. He switched all his colonies to top-bar hives back in 1986, long before it became popular. He is also an apicultural historian, who blends his knowledge of beekeeping history with his study of honey bee behavior. email: **wmangum@umw.edu. www.TBHSbyWAM.com**

HIVE IRRADIATION –
Another Tool to Combat Disease in Honey Bees

by MARK ANTUNES

I began keeping honey bees in 2001 with equipment my father had used in the late 1930s before he went off to college and then on to serve in the U.S. Navy during WW II. Before I started to learn more about the art and science of beekeeping, I first subscribed to American Bee Journal. My father, who was alive at the time, was reading the second issue to arrive in the mail, and I asked him what he thought about the prospect of me picking up where he'd left off decades ago. He looked up from the magazine and said, "If I was you, I wouldn't even try to keep bees now. They've got more problems that you can shake a stick at. It looks like more trouble than it's worth." Tracheal mites and *Varroa destructor* had arrived by then, and both were already a subject of major focus in beekeeping publications.

I did not dismiss his advice, but I did not let it deter me from trying to make a go of what I decided was going to be the next element of revitalizing the agrarian efforts on the family acreage. So I sought the advice of local beekeepers and ordered three packages of honey bees. My first season was probably typical of a rookie who has more spirit and enthusiasm than a broad base of beekeeping skills and knowledge. But with mentorship and determination, I managed to go into winter with three colonies started from those packages and come out next spring with all three alive.

With that positive outcome and being one who tends to overdo things, I began to expand. I was soon up to eight colonies and enjoying the process very much. Sometime in my second season, I began to notice two of my colonies decline during the peak of the spring/summer nectar flow. I could not figure out why but continued to monitor their decline and eventually called an experienced beekeeper for support. His analysis was that it looked like American foulbrood (AFB) and I should call the inspector. I promptly did so, and upon his inspection my worst fears were confirmed.

For anyone not aware of it, AFB is a highly contagious bacterial disease of honey bee brood. It is the perfect disease to wipe out your honey bees and other colonies within foraging distance. The causative agent, *Paenibacillus larvae*, kills the developing larvae with infectious spores that can remain dormant yet viable for at least 70 years. These spores contaminate woodenware, honey, and the comb. AFB infects larvae in their first and second instar stage of development if their food is contaminated with as few as 10 *Paenibacillus larvae*. As the disease takes hold and each larva succumbs, the spores of *Paenibacillus larvae* multiply wildly to millions, transforming the larva into a sticky, gooey mass. As worker bees clean that viscous, smelly mess out of each cell, they spread the spores throughout the hive. For more information about AFB go to **https://extension.psu.edu/honey-bee-diseases-american-foulbrood**

With the larvae succumbing to AFB, the colony ultimately goes into a state of collapse because there are not enough workers for the colony to function. The now-weakened colony is prone to being robbed out by other colonies within range. What was a problem in a single apiary then becomes a widespread crisis, as honey bees from other colonies take the spore-laden honey back to their hives, spreading AFB out to more and more colonies like a plague.

At that time in my area, the only recourse to stop this disease was to burn the contents of the hives and completely scorch out the boxes with a torch. It was a somber and crushing experience, but I did it, determined to rid my apiary of that scourge. After doing all of that, I settled into the rest of the season with a less gleeful attitude about beekeeping and an apprehensive feeling, keeping a constant eye for trouble. To my relief, I had no further occurrence of AFB that season. The same was true of my third year in beekeeping, and now being on the inspector's watch list, I was fortunate to have a guaranteed inspection every year.

As I continued in beekeeping, I had the opportunity to engage with numerous other beekeepers in the area. At one beekeeping meeting, I vividly recall talking with an older gentleman. Upon learning that I was keeping honey bees in upper Bucks County, Pennsylvania, he exclaimed, "Good Luck. You are in a hotbed of American foulbrood!" That was further borne out when I heard our state apiarist at the time, Dennis vanEngelsdorp, speak on the health of the colonies in PA at the fall Pennsylvania State Beekeepers Association meeting. At that time, he said that with the exception of the Pittsburgh area, Philadelphia and the surrounding four counties had an incidence of AFB that was six times as high as the rest of the state.

Unfortunately Dennis and that old man were both correct. My father later verified that he never had AFB when he kept bees in New England, but once he brought his hive equipment to PA after the war, his apiary contracted AFB two times before he gave up and burned everything that was contaminated. Later he found out that a beekeeper about a mile away had AFB and never properly took care of it. Instead, that beekeeper kept buying new packages of honey bees and introducing them into contaminated woodenware, where they became infected, making his colonies a continuing source of AFB contamination.

My bees came out of my third winter with some losses that I was determined to make up. But during that season, I noticed what looked like AFB-infected brood and immediately called the bee inspector to investigate. To my dismay, some of my colonies had contracted AFB. I again scrupulously followed the protocol and burned all of the frames, comb, and stores in the infected colonies and thoroughly scorched out the boxes.

At the time, I kept thinking there had to be a better solution. And the idea of irradiating infected hives to kill AFB instead of the costly method of burning the hive contents came into my head. So I asked my friend Brian Marcy, a fellow beekeeper who is employed in the pharmaceutical industry, about the idea. He said it should be a viable alternative and would look into it for me. At that time his research revealed that irradiation was being done by beekeepers in Massachusetts and in other parts of the world. Brian's efforts led to connecting with Steris, which has a facility in Whippany, New Jersey, after which I was contacted by Sterigenics and Sterigenics U.S., LLC, which has a facility in Salem, NJ. Both companies have numerous facilities across the nation and Sterigenics currently has over 30 in the U.S. Both companies were willing to treat bee hive equipment on pallets in their New Jersey facilities with gamma irradiation as the physical means of decontamination.

Gamma irradiation has been shown to kill AFB spores.[1,2] The gamma irradiation emitted from the isotope source Cobalt-60 is a penetrating electromagnetic radiation resulting from the radioactive decay of atomic nuclei. It consists of the shortest wavelength electromagnetic waves and so imparts the highest photon energy. The gamma rays penetrate the packaging and hive boxes, harmlessly passing through the frames and comb. That process kills bacteria and possibly other infectious pathogens that harm honey bees by breaking down their DNA, rendering them non-infectious.

It is important to know that the gamma irradiation process does not create any form of toxicity, contamination, or impart radioactivity to the processed hive equipment. So if you are wondering if irradiated hive equipment will be safe for honey bees, the answer is absolutely YES. If you are wondering if your irradiated hive equipment will be easier to find at night because it glows in the dark — the answer is absolutely NO. In fact, this process has been used for decades to sterilize imported leather goods, spices, wine corks, pharmaceuticals, medical dressings and devices, etc. Despite our lack of awareness about it, all of us have food items and other things in our households that have been irradiated.

Pallet delivery on low bed trailer accessible by forklift

Once we got the details figured out we presented the idea of irradiating contaminated hives to the PSBA. Because I was willing to be the unpaid organizer of the effort, the PSBA Hive Irradiation Sterilization Program began in 2008 and has functioned ever since. In the interest of full disclosure, I must admit that I am paid by the appreciation of beekeepers who take part. Plus, on three occasions in the 12 years I have done this, appreciative beekeepers bought me lunch at the Salem Oak Diner where we gather after delivering our hive equipment to Sterigenics.

Beekeepers from all over the mid-Atlantic region, Massachusetts, and as far west as Cleveland, Ohio, have taken part. The beauty of the process is that beekeepers can provide an improved health opportunity for new bees installed in used and dead-out woodenware, and at the same time save the frames, drawn comb, and even some stores in the comb. This eliminates the need to burn the frames and the contents thereof, plus eliminates the need to scorch boxes or boil them in lye water; which is difficult and not without risk to the boil master. (If you want to boil your equipment in lye water, the late Dennis Keeney, who knew as much about beekeeping as anyone I ever met, told me that once you boil hive boxes in lye, groundhogs love to chew up the wood and will eat holes in them quite readily.)

Because irradiation facilities use various kinds of processing equipment, not every facility can handle bulk bee hive equipment on pallets. The system I have encountered most frequently uses a device that looks like a small ski lift with metal cages hanging from a cable or chain that circulates into and out of the irradiation chamber. With that system, the materials being treated are packed in cardboard boxes that fit the dimensions of the cages. In Indiana, Iotron Industries USA has a system that uses a flat conveyer that passes the materials being treated under an electron beam generated by a 10 MeV high energy IMPELA® accelerator that operates with up to 100 kW of output power. The exposure time in this system is much faster than in the Colbolt 60 gamma ray treatment. That shorter exposure time results in less oxidation (breakdown) of the woodenware hive components during treatment. However, that system requires all materials to be enclosed in cardboard boxes.

We are fortunate that Sterigenics, the company we use for gamma ray irradiation service, has a facility in Salem, NJ that accepts full size 40x48" pallets of materials, eliminating the need to box hive components in smaller quantities. We are able to deliver our properly wrapped pallets on low bed trailers, pickup trucks, or full height box trucks and tractor trailers. For us, this is the most cost-effective way to irradiate hive equipment. Regardless of the size or amount of material being treated, Sterigenics and similar companies have a minimum price for treating a delivery from any individual customer. Each such job has a specific manifest detailing the number of pallets, what is on the pallets, and exactly who has ownership and takes responsibility for those pallets of material.

For the hive irradiation program in 2020, the minimum cost to have 1-7 pallets of material treated by Sterigenics in Salem is $1,500. In over a decade managing the PSBA program, I have never had a problem getting enough beekeepers to participate to meet the 7-pallet quantity that gives us the most economical cost per pallet. If we hit that goal again in 2020, the per-pallet cost of our mid-March run of hive equipment will be $214.30.

A 40x48 pallet can accommodate 42 deep and 6 medium 10-frame boxes with frames, foundation and comb. At $214.30 that translates to $4.64 per box. By way of comparison, based on 2019 Mann Lake prices, to buy that same equipment new would cost $2,576. Just the assembled frames with plastic, wax-coated foundation for those boxes would cost $1,444, all without sales tax. Thus, the cost of replacing equipment is a far cry from the anticipated $214.30 per pallet irradiation price.

That same 40x48 pallet will fit 66 medium boxes. That breaks down to a cost of $3.25 per box. That same equipment based on 2019 Mann Lake pricing would be $3,560.70. For the same amount of assembled frames with wax coated plastic foundation it would cost $1,650, again without sales tax.

Transportation to deliver the hive equipment and return to pick it up 4-5 days later is an additional cost, but for any sizable amount of equipment, irradiation is certainly cheaper than the cost of buying new boxes, frames, and foundation plus the time, energy, and food resources the bees need to build comb. To share the cost of transportation for delivering and picking up the hive equipment, I encourage beekeepers to organize within their local and regional associations to combine their equipment and haul as much as possible on one truck or trailer. That way each beekeeper only needs to pay for their percentage of the treatment and transportation costs.

A properly stacked and wrapped pallet of woodenware ready to unload

Having organized the program for this long, we have refined a process that works for as many beekeepers that take part, as well as for our friends at Sterigenics. For complete information about the program and a video about how to properly palletize hive equipment for processing, go to the website of the Montgomery County (PA) Beekeepers Association at: **https://www.montcopabees.org/Irradiation**

For those who have participated in the PSBA Hive Irradiation Program it has proven to be both economically worthwhile and an effective means of preventing used and deadout equipment from being an ongoing source of infection from AFB. With so many new beekeepers in our region and our inspectors able to examine only a percentage of the thousands of colonies that now exist, irradiation may be the ounce of prevention and cure that is worth it to prevent the expense of burning hive equipment from a disease outbreak.

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Mark Antunes is an experienced sideline beekeeper and the owner/operator of Honey Hill Farm LLC producing and selling local raw honey. He currently maintains about 150 colonies in various locations in Bucks and Montgomery Counties, PA. He began keeping bees in the spring of 2001 with hive equipment that his father had used when he kept bees in Wakefield Massachusetts from 1936–1939. He has maintained a variety of bees including Carniolan, New World Carniolan, Russian, Italian, Caucasian, Minnesota Hygienic, Varroa Hygiene Sensitive, Saskatraz, and local feral bees gathered from swarms and removals.

Mark provides public presentations about honey bees and lectures for regional beekeeping associations. In addition, he teaches the beginner beekeeping course for the Montgomery County Beekeepers Association (MCBA) and the Bucks County Beekeepers Association. Mark has also taught for the Pennsylvania State Beekeepers Association (PSBA), and the Eastern Apiculture Society.

From left to right, beekeepers Jeff Barndt, my late friend and mentor Dennis Keeney and I drop off hives at Sterigenics.


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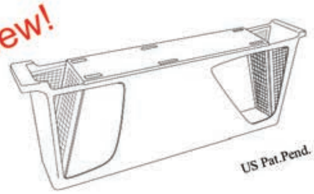

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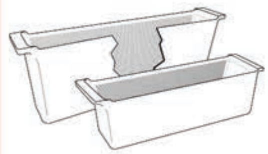

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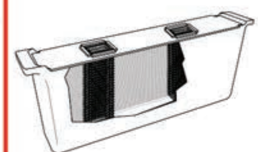

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Notes from the Lab:

The Latest Bee Science Distilled

by Kaitlin Deutsch and Scott McArt

Engineered gut microbes combat varroa and DWV in honey bees

Varroa mites. Viruses. For the past several decades, beekeepers have sought to protect their colonies from these two ubiquitous threats that often come together. Not only do varroa mites weaken individual bees by feeding on their fat bodies, they also transmit diseases such as Deformed Wing Virus (DWV).

As everyone reading this column knows, unfortunately beekeepers have limited tools to combat varroa and viruses. We have a couple acids, some essential oils, IPM practices, and a couple synthetic chemical pesticides. To add insult to injury, we know that varroa is already evolving resistance to the synthetic chemicals. So, it's very exciting news that groundbreaking research was just published on a new genetic approach to combat varroa and viruses. In this month's Notes from the Lab, we highlight "**Engineered symbionts activate honey bee immunity and limit pathogens**," published in the journal ***Science*** and authored by Sean Leonard and colleagues at the University of Texas at Austin. Leonard is a PhD student currently working in Dr. Nancy Moran's lab.

For their study, Leonard and colleagues genetically modified naturally-occurring gut bacteria in honey bees to "teach" the bee immune system to recognize and destroy viruses and the varroa mite. They did this by engineering microbes that, once accepted by the host bees, changed bee gene expression and immunity via the production of RNA interference (RNAi) molecules.

A varroa mite, a common pest that can weaken bees and make them more susceptible to pathogens, feeds on a honey bee. Photo credit: Alex Wild/University of Texas at Austin

What does that mean, exactly? Well, RNAi is an important component of the immune system of most animals, including bees and varroa mites. In short, the immune system detects double stranded RNA (dsRNA) molecules, which are produced by viruses (e.g., dsRNA is produced by DWV). Because the dsRNA molecules are an indicator of disease, an immune response is launched to detect and destroy the invaders. The honey bee immune system "learns" the genetic code of that dsRNA molecule and then targets all other molecules with that same genetic code for destruction.

Your immune system (or a bee's immune system) can also be primed so a more effective immune response can be launched (think about those flu shots you get each fall to reduce your chances of getting sick). It had been previously shown that feeding DWV-specific dsRNA to bees prior to exposure to the virus increased lifespan and reduced virus levels in infected bees — suggesting that RNAi could be effective at "silencing" these viruses (Desai et al. 2012). However, the challenge is providing a *constant* source of dsRNA to honey bees that targets the full range of viruses that infect the bees.

This is where Leonard and colleagues' study really breaks ground. Instead of constantly feeding honey bees dsRNA molecules directly, the authors engineered the naturally occurring bacteria in the bee gut to *create* dsRNA molecules. Specifically, they genetically engineered one gut bacterium, *Snodgrassella alvi* (*S. alvi*), to continuously produce dsRNA molecules that prime the honey bee immune system to target DWV and varroa.

But first, the researchers had to ensure that genetically transformed *S. alvi* could survive in the bee gut and produce molecules that would be taken up by bee tissues. To do this, they fed bees *S.alvi* that had been genetically modified to produce "non-target" dsRNA molecules as proof of concept. They found these dsRNA molecules were present in the head, gut, and hemolymph of bees, indicating the molecules were being circulated beyond where the bacteria reside in the gut. Also, the molecules were detected in bee tissues until the end of the 15-day experiment, indicating the dsRNA-producing *S. alvi* were self-sustaining in the bees. Moreover, the genetically modified *S. alvi* strains were shared through social interactions between co-housed bees. Thus, it is possible that only a subset of bees need to be exposed to the bacteria for it to establish in an entire colony (more on this later).

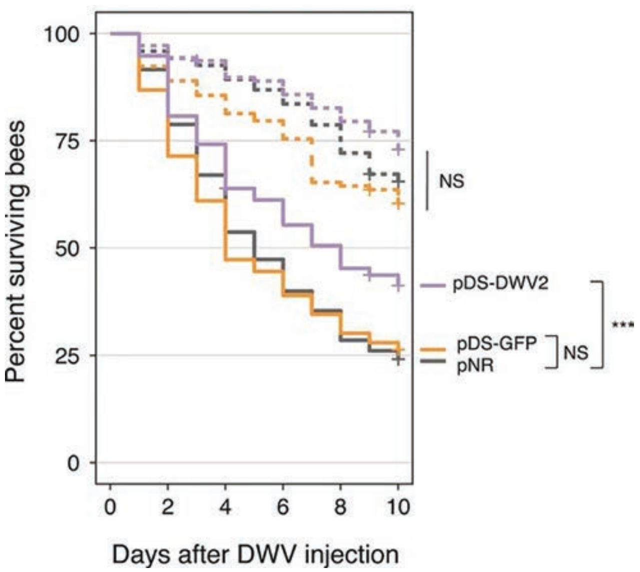
OK, so we've got bees with genetically enhanced gut bacteria producing dsRNA molecules that are able to reach all parts of the bee and remain present for over two weeks. Now, how can this technology be used to protect bees? The next step was using this tool to target viruses and varroa. Deformed Wing Virus is a widespread RNA virus and infections cause wing deformity and reduced lifespans in workers. "Silencing" DWV and other viruses via RNAi has been proven to improve bee longevity and health, but the dsRNA must be continuously provided to the colony for the bees to be protected (see Hunter et al. 2010 to read more about large-scale field application of dsRNA to combat Israeli Acute Paralysis Virus [IAPV]).

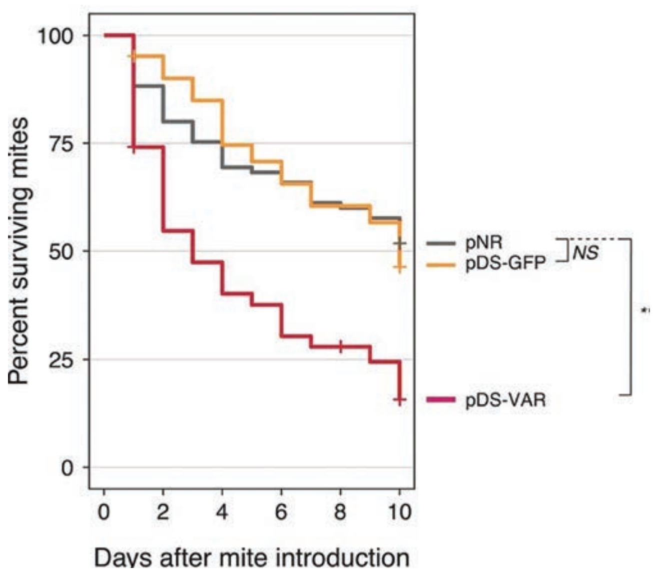
So, the researchers engineered the *S. alvi* bacteria to produce dsRNA molecules that matched the genetic code of DWV. To test its effects, they injected DWV into bees that were previously fed bacteria continuously producing DWV-specific dsRNA, as well as control bees without genetically modified bacteria. The bees with genetically enhanced microbes producing DWV-specific dsRNA were 36.5% more likely to survive the 10-day experiment than control bees (see Fig. 1).

Wow, knocking down specific viruses sounds great. But varroa transmits lots of different viruses, all with unique genetic codes. What about knocking down the mites themselves? Because they harbor and transmit diseases, varroa levels in a colony often predict virus prevalence in a colony. Varroa mites have been associated with not only DWV, but also other harmful viruses such as IAPV and Black Queen Cell Virus (BQCV), among others. So, it makes sense that the authors' next step was trying to engineer bacteria that target not just the DWV genetic code, but the varroa mite itself.

To do this, the researchers took advantage of the *mite's* immune system, as these parasites also rely on RNAi to fight invaders. The researchers created a new strain of dsRNA-producing *S. alvi* bacteria that matched the genetic code of crucial genes in the varroa mite. Because varroa feeds on bees, it ingested the molecules being produced within those bees — including the varroa-specific dsRNA. These molecules triggered the mite's immune system to target all molecules with the same genetic code for destruction — *even though the genetic code was its own*!!

Yes, you read that correctly. The varroa-specific dsRNA successfully tricked the mite's immune system so it





(L) Fig. 1 *Symbiont-produced RNAi can improve honey bee survival after viral injection. Survival curves of bees monitored for 10 days after injection with DWV (solid lines) or phosphate-buffered saline controls (dashed lines). Bees inoculated with pNR (no dsRNA control), pDS-GFP (off-target dsRNA control), or pDS-DWV2 (dsRNA matching the genetic code of DWV) and then injected with phosphate-buffered saline controls showed no significant change in survival (dotted lines). However, when injected with DWV, bees inoculated with pDS-DWV2 (solid purple line) showed 36.5% greater survival compared with bees inoculated with pNR or pDS-GFP (solid black and yellow lines, respectively).* **(R) Fig. 2** *Symbiont-produced RNAi kills varroa mites feeding on honey bees. Survival curves for varroa mites that fed on bees colonized with engineered S. alvi for 10 days. Varroa that fed on bees inoculated with pDS-VAR (dsRNA matching the genetic code of varroa, red line) showed greater mortality than bees inoculated with pNR (no dsRNA control; black line) and pDS-GFP (off-target dsRNA control; yellow line).*

attacked and destroyed itself. Indeed, the effects on mite mortality were striking. In experiments where mites were allowed to feed on honey bees with varroa-specific dsRNA, the mites were 70% more likely to die than the mites fed on control bees (See Fig. 2)!

Alright, let me pick my jaw up off the floor. This sounds too good to be true. What's the catch? And what does this mean for beekeepers? As with all genetically modified organisms, there must an extended period of further testing and regulatory review to determine its safety before it is used outside the laboratory. So, don't expect there to be packets full of genetically engineered bacteria for sale tomorrow. Of key importance is determining if the bacteria can survive outside the honey bee gut, and if there's risk of transmission to non-target organisms. The dsRNA produced by the bacteria have been specifically designed to target the genetic code of either the virus or the varroa mite, limiting the potential for non-target effects. And as far as we know, this strain of *S. alvi* can only survive and colonize the digestive tracts of honey bees — not any other bee or insect. But further work must be conducted to assess this possibility before the technology leaves the lab.

Leonard and colleagues' study potentially places an exciting future tool in a beekeepers' arsenal for the ongoing battle against the varroa mite and the diseases it transmits. (See Fig. 3 for a summary of the key findings described above.) Perhaps bees can be protected for long periods of time once genetically engineered bacteria are established in the gut. That possibility is particularly exciting, since all current treatments for mites are short-term and require repeated applications that come with their own costs to bees (and beekeepers).

In addition, another exciting aspect of the technology is its adaptability (pun intended). Indeed, because of the way in which the protection works, resistance in the viruses or mites is rather unlikely to evolve, or if it does evolve, is easily overcome by just changing the target sequence to match the new virus/mite strain.

Finally, because honey bees are eusocial organisms that interact closely with each other, it may be possible to feed genetically modified bacteria to a subset of a colony and have it shared among workers so the entire colony is protected. The authors point out that their study does not address this yet;

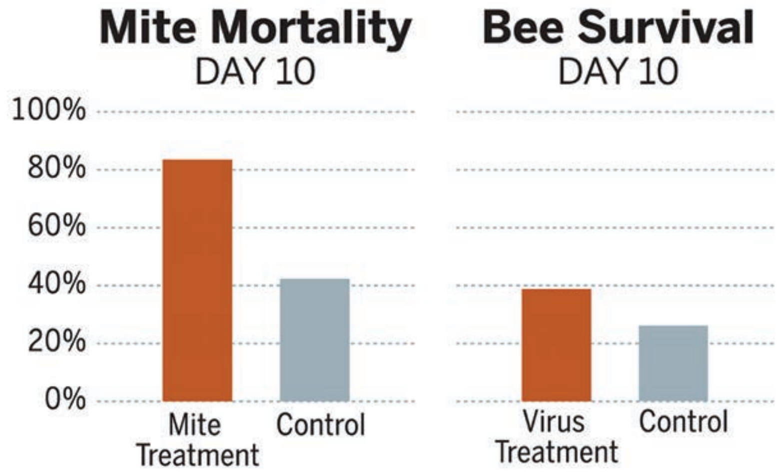


Fig. 3 *Varroa mites feeding on bees treated with the mite-targeting strain of bacteria were about 70% more likely to die by day 10 than mites feeding on control bees. Meanwhile, another set of bees treated with the strain of bacteria targeting the deformed wing virus were 36.5% more likely to survive to day 10 after exposure to the virus compared to control bees.* Credit: University of Texas at Austin

more research is needed to determine whether the genetically modified bacteria can be shared among bees and persist for longer than two weeks.

Overall, this new study by Leonard and colleagues is tantalizing — and maybe not just for honey bees. There is ample evidence to suggest that honey bee viruses are "spilling over" into native bees and other pollinators. Recent work demonstrates that wildflowers and bumble bees near apiaries have higher prevalence of viruses, including DWV, compared to locations without a nearby apiary (Alger et al. 2019), indicating that honey bees may be driving disease patterns in the broader pollinator community. By protecting honey bees against varroa and its associated viruses, it is possible that the genetically engineered bacteria may also provide protection for wild pollinators as well. We're excited to see how this technology continues to develop in the (hopefully not-too-distant) future!

Until next time, bee well and do good work,

Kaitlin Deutsch and Scott McArt

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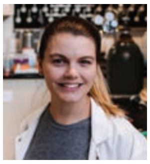
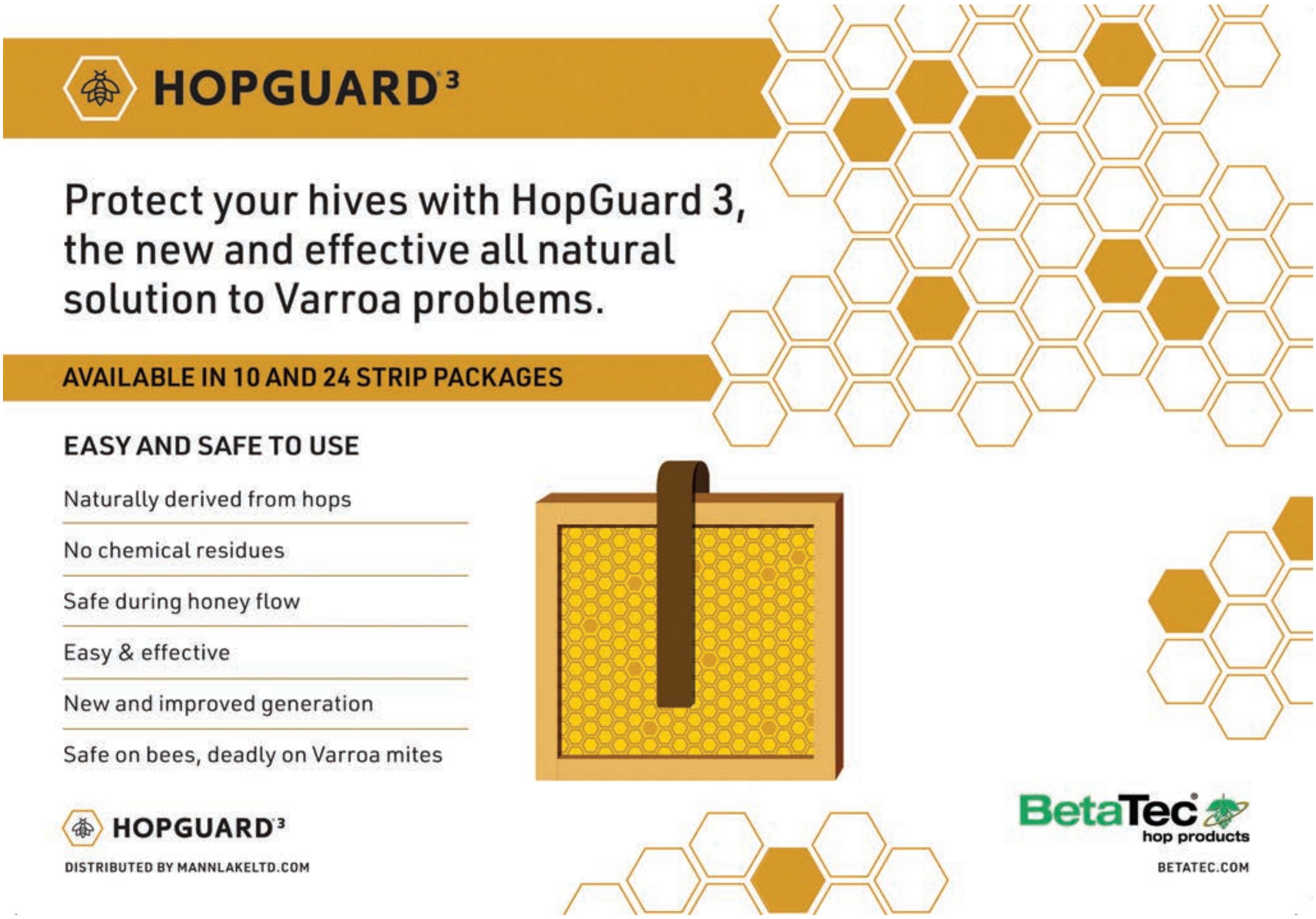


Kaitlin Deutsch is a PhD student in the McArt Lab and Entomological Society of America (ESA) Science Policy Fellow. Her research investigates disease in wild pollinator communities, with a focus on non-bee pollinators. She is particularly interested in working at the interface of science and policy, with the aim of connecting research on pollinator health to related conservation policy and management.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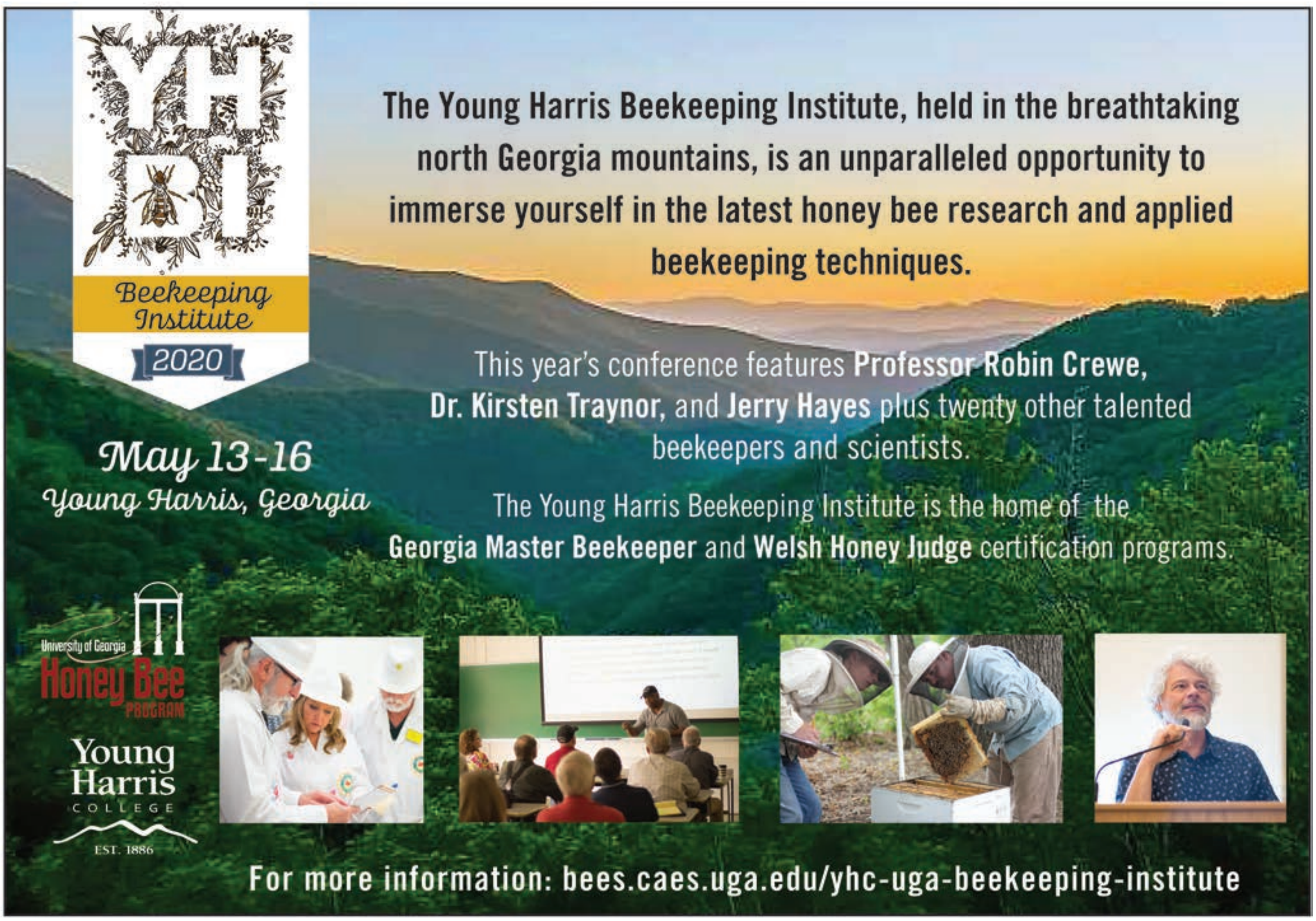
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NICOT: THE GOOD, THE BAD, AND THE POSSIBLE

by GRANT F. C. GILLARD

When I started keeping honey bees in 1981, the small group of experienced beekeepers who guided my progress bought mail-order queens from the large, commercial queen breeders. When queens were needed, they made a long-distance call from the rotary-dial phone that hung on the wall in the kitchen, mailed a check, and in about a week, the postal service delivered a thick envelope with caged queens ready to be introduced.

As a young beekeeper, I thought I could do it better and pondered raising my own queens. The price of a queen in those days ran from $5.00 upwards to $7.00, which we all thought was expensive, but the shipping charge, particularly on small orders, was the harder pill to swallow. My first thought focused on the money I could save, but any inquiry asked of my mentors was summarily dismissed. "Why raise them when you can buy them? Just leave it up to the professionals." Convenience became our default option.

As my apicultural horizons broadened, my need for new queens was hampered by their lack of availability. I found the commercial queen breeders highly seasonal, meeting the greatest demand in the spring and tapering off during the summer. If I needed a queen in July or August, I needed to make several phone calls to find someone who still had queens banked and ready to ship. The supply of queens dwindled as summer lingered.

My fantasy of raising my own queens was further triggered by the inconsistency of these mass-produced, commercial queens. Some worked out well, but the majority did not live up to my expectations, which may be an indictment of my expectations. Some queens arrived dead and I was told to take it up with the local post office where I was instructed to file an insurance claim. Then I had to incur the delay with a replacement order hoping for better luck.

As my interest in beekeeping expanded, both in quantity and in scope, I began attending conferences and searching out books specific to queen rearing. My first queen rearing book was the 1979 edition of "Contemporary Queen Rearing" by Harry H. Laidlaw. This book would supplement my classroom textbook from Iowa State University, the 1976 edition of "The Hive and the Honey Bee," which still bears the price tag from the Student Union Bookstore of $9.35 (an outrageous sum in those days).

Truthfully, the process detailed in these books was intimidating. The idea of grafting larvae was overwhelming. When the mood struck me to raise some queens I found a pile of frames ravaged by wax moths that desperately needed my attention. I filed my queen rearing aspirations under "Someday I'll get to this," but we all know where those plans go.

Then one day in January, my mailbox produced a beekeeping supply catalog from Mann Lake. Like my good buddy John Timmons, I peruse these catalogs looking not for what I need, but for what gadget I don't yet own. My eyes came to rest on a new entry into the realm of beekeeping in the United States: the Nicot Queen Rearing Kit. It was graced with a most magical word: non-grafting.

Dopamine surged through my brain as the queen rearing process now looked magically effortless. I felt like I'd just found the equivalent of the Golden Ticket, as if Willy Wonka had opened a chocolate bee hive factory.

I placed my order that afternoon as soon as I located my checkbook and a first class postage stamp. Spring could not come early enough.

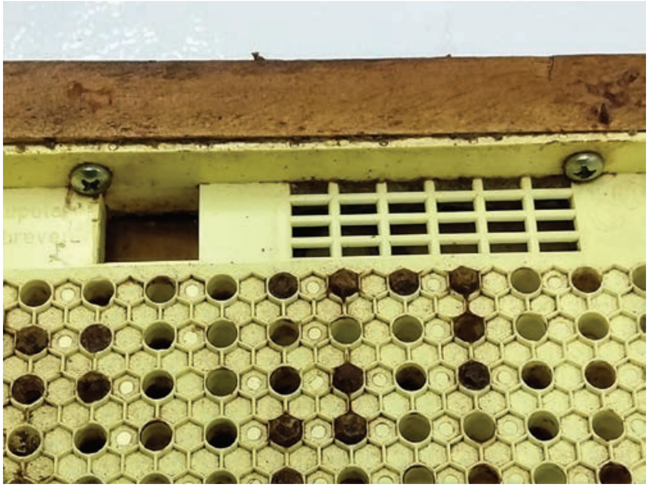
My kit arrived in short order, but did not contain any instructions. This omission would delay my initiative for another year or so. The fearful perception of the learning curve only further enabled my procrastination. Then one spring, another batch of marginal, mail-order queens arrived and forced my hand. I knew it was time to revisit my purpose for ordering the Nicot kit.

The first six or eight attempts failed miserably. It would still take me several seasons to master the idiosyncrasies and find the success I hoped for. I can easily say the Nicot system may not be the best way to raise queens, but it opened an incredible door in my continuing education to become a better beekeeper.

What is a Nicot?

Nicot is a brand name. The heart of the Nicot system is a plastic box, often called a cell grid, with holes for a queen to slide her abdomen into to lay eggs. The queen is constrained in the front half of the cell grid. On the back side of the cell grid, the beekeeper places brown cell cups to close off each hole and receive the queen's egg.

When the eggs hatch, the cell cups with the young larvae are removed from the cell grid and fixed into the yellow cell cup holders. Each cell cup holder fits onto a brown cell cup fixture, and each cell cup fixture attaches to the top bar of a regular, Langstroth frame. The frame is then placed into a queenless, cell builder colony where the young nurse bees construct queen cells.



The cell grid front at left. At right I am inserting cell cups on the back of the grid.

Once the queen cells are constructed and capped, they can be protected with roller cages in the event a virgin emerges prematurely and tears down the competition and destroys all your hard work. The capped cells can be placed in mating nucs around the twelfth to fourteenth day of development. The queens emerge on the sixteenth day in the cycle.

The whole process is described in great detail in my updated book, "Nicot Queen Rearing: The Non-Grafting Method for Raising Local Queens," available on Amazon.com

So What's Not to Like?

I've used my Nicot queen rearing kit to raise countless batches of queens. When people ask me my opinion of its benefits, I tell them, "This kit was a game changer for me and elevated my hobby to that next level. It worked quite well, once I figured out how to make it work for me."

First, I think the best feature of the Nicot system is the ability to transfer larvae without physically disturbing the larvae. They rest comfortably in the brown cell cups and the beekeeper places (grafts) the entire cell cup into the cell builder colony without ever touching the larva. I use a small, needle-nose pliers to pull the cell cups off the back side of the cell grid. Nothing could be easier.

Second, the visual confirmation of the age of the larvae is uncontested when you remove the back of the cell grid after four days. One can easily confirm when the newly hatched larvae are ready to transfer. Even with aging eyes aided by a cheap pair of "readers," one can discern the difference between an unhatched egg and the young larva by the presence of the first milky deposit of royal jelly.

Knowing the age of the larvae takes the guess work out of knowing when the virgins will emerge from the queen cells. This knowledge helps plan the timing of when one needs to make up the mating nucs.

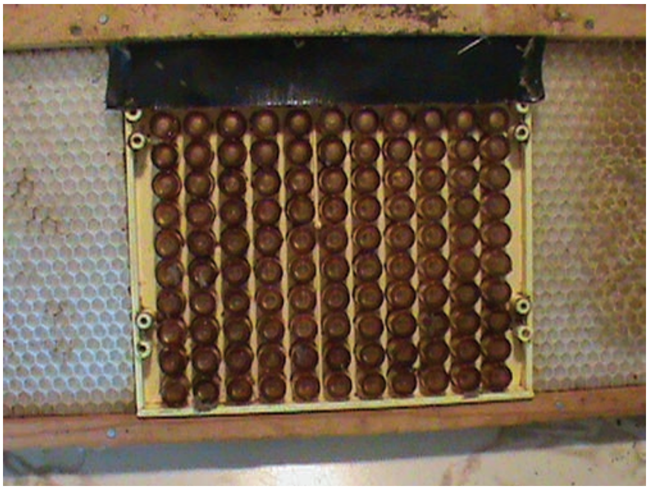
So What Makes Me Less Enthusiastic?

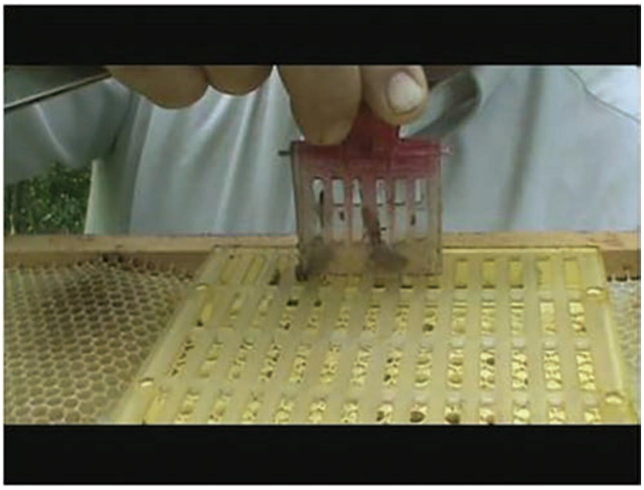
The Nicot system is cantankerous and persnickety. One must acquiesce to a handful of idiosyncrasies or the process will spontaneously come to that proverbial screeching halt … except it won't make a sound, unless you count your sighs of exasperation for buying this plastic contraption in the first place. Skip these steps and your efforts are doomed to failure.

First, when the cell grid is loaded up with brown cell cups, and before the queen is constrained for egg laying, the cell grid must be placed into the middle of the brood nest so the young nurse bees can polish the cells and make them acceptable to the queen. Some people refer to this as "conditioning" the cell grid.

This is best accomplished by removing the front grate of the cell grid. Since the cell grid is slightly wider than a normal frame, I find it advantageous to remove an extra frame from this hive body and space out the remaining frames to improve the access to the cell grid for the workers. This is especially true when the front grate is in place to keep the queen constrained.

(L) *A cell cup holder next to a brown cell cup.* **(R)** *The three stages of the Nicot assemblage for the cell builder: From left, the cell cup fixture attached to the slotted/grooved top bar (the ones without the removable wedge), then the addition of the cell cup holder, then the insertion of the brown cell cup.*





(L) *Here is the fully loaded cell grid, which I highly recommend as the queen is pretty random when it comes to laying eggs, when she eventually gets around to laying eggs. Even though one may not want 110 cell cups with larvae, the queen won't lay in all of them so one might just as well give her every chance to fulfill her duty.* **(R)** *Releasing the queen into the conditioned cell grid with a gentle request to get with the program and lay eggs ASAP!*

Bottom line: The cell grid needs to be conditioned prior to placing the queen in it to lay eggs.

Second, once the queen is released into the cell grid with the front grate in place, she may not lay eggs that first day. She may not lay eggs the second day. She may not lay eggs the third day. Somewhere along her confinement, she will lay some eggs. Her delay in laying eggs will correspond to a delay in transferring the cell cups with the young larvae.

If eggs take three and a half days to hatch, one might reasonably assume to find fresh larvae on the fourth day of the queen's confinement. Don't bet the farm on this one. I have seldom found fresh larvae on the fourth day as the queen didn't lay eggs on the first day she resided in the cell grid. Getting the queen to lay eggs in this plastic box is a test of patience. You'll just have to check the back of the cell grid on the fourth day, the fifth day, the six day … well, you get the point.

Bottom line: One must continue to check the cell grid until fresh larvae are found by inspecting the back of the cell grid.

Third, a rather insidious idiosyncrasy is found in the requirement to only transfer the brown cell cups with fresh larvae. Transferring cell cups with unhatched eggs will not work. For some unknown reason, the workers in the cell builder colony are almost guaranteed to cannibalize eggs in the brown cell cups. I don't know why. I understand the logic of thinking a step might be saved in the process, but this short-cut of transferring eggs instead of waiting for the fresh larvae will get you nowhere.

Bottom line: You must wait until the eggs hatch before moving the larvae to the cell builder colony.

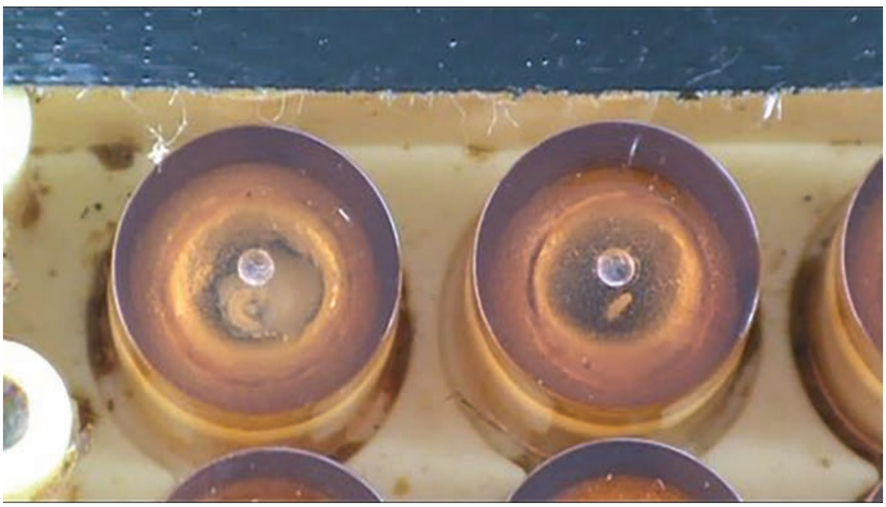
Fourth, I am grateful the Nicot system includes the roller cage cell protectors. I refer to them as "procrastinator cages." Because my beekeeping venture also competes with family obligations and work commitments, not to mention weather delays, I like to slip these roller cages over the queen cell as soon as it is capped. I've also moved my cell builder colonies to my back yard to avoid the accessibility issues with foul weather.

Bottom line: Play it safe and protect the capped cells with roller cages.

When I balance the favorable characteristics of the Nicot system with the challenges that keep me on my toes, I find the positive outweighs the negative. But that's the way I roll and your experience with the challenges might create a learning curve that is too steep for your patience. I get that. I tried to make wine, and my first and only attempt was sufficient to open my eyes to the wonderful selection found at the gas station that's packaged in a cardboard box. It works for me.

Three Random Considerations

In giving advice to those who ask and a few who don't, I remind them my advice is just my opinion based on my experience. Their results may vary.



This is my favorite reason for using the Nicot kit. On the right side is an unhatched egg, which I know is redundant as any egg is unhatched, and once hatched it is no longer an egg. On the left is a fresh larva. The larva is hard to see, which is one of the huge obstacles to grafting from comb, but the presence of that first deposit of royal jelly is the indication that the egg has hatched and the larva is the perfect age to transfer to a cell builder colony. Because I'm looking at the back of the cell cup, there are no obstacles with lighting issues.

Roller cages, or as I like to call them, "procrastinator cages." They can also be used with a candy plug to introduce a new (mated) queen into a colony, though my method is to release a newly emerged virgin directly into a mating nuc without worrying about a candy plug.

I encourage beekeepers to learn from their mistakes, or better yet, learn from the mistakes of others, like me.

Once I figured things out, my experience with the Nicot system of queen rearing has been very positive. The path to get to this point, however, was arduous and strewn with pitfalls and potholes. As I move into another year of beekeeping, always trying to hone my skills and improve my efficiency, there are three other thoughts that cross my mind: First, I continue to shift my preferences for setting up a cell builder colony. Presently, I lean toward the Cloake Board method where a queen-right colony is temporarily divided with a solid divider when the time comes to introduce the cell cups with fresh larvae. The grafts are placed in the queenless portion of the divided colony. After the construction of queen cells is initiated, the divider is removed to create a queen-right cell finisher. I find the Cloake Board method is easier and quicker to set up. You can find a plethora of websites dedicated to explaining this method on the internet if it piques your curiosity.

That said, I think this year I'm going to invest the extra energy in following Michael Palmer's method of shaking nurse bees into a box and making them "hopelessly queenless."

Second, as with any queen rearing system, there is an expected attrition to each step of the process. The cell grid holds 110 brown cell cups, but the queen will not lay eggs in every cell cup. My experience informs me I can expect to pull around 60 to 70 cell cups with fresh larvae to transfer to my cell builder colonies. I only plan on placing a maximum of twenty larvae in each cell builder colony, and with an obstinately reluctant queen, I may need to return on four successive days to gather that many cell cups of fresh larvae. My game plan is to make four cell builders and transfer the freshest larvae each day to each respective cell builder colony.

The cell builder colonies will not construct queen cells from all the larvae I give them so I reduce my expectations to 50 to 60 capped queen cells. When the capped queen cells go into the mating nucs, not every newly emerged virgin will find her way back to the mating nuc. I can normally expect 30 to 40 successfully mated, laying queens. Then to take this queen rearing process one step forward, I can evaluate those 30 to 40 mated queens and only keep the best 10 queens for my personal use.

There is attrition in each progression. These figures are rounded averages and estimates. Sometimes you get a few more, other times a few less. Even if you only wanted to transfer ten cell cups to a cell builder colony, there is no reason not to load the entire cell grid with cell cups, as the queen's choice, when she chooses to get around to laying eggs, appears to be rather random.

Third, I have found that if I release the queen from the cell grid once she's done laying eggs and I'm waiting for the eggs to hatch, the workers will cannibalize those eggs. It seems when the queen is in the cell grid, the workers allow those eggs to hatch. My practice is to leave the queen in the cell grid until I finish transferring the quantity of cell cups I think I need.

This extended confinement appears to create another problem in the hive. The queen's perceived absence as she languishes in the cell gird, cursing my insistence that she lay eggs in plastic cell cups, sometimes prompts the workers in the rest of the colony to start supersedure queen cells.

To reverse the colony's collective assumption that their queen is defective is difficult to achieve. To simply cut out these supersedure cells may prove to be insufficient to convince them to accept their present queen who was merely vacationing in a plastic cell grid at my behest.

To get around this quirk, when I find supersedure cells, I release the existing queen from the cell grid into a nuc box with a couple of frames of brood and allow the rest of the colony to nurture those supersedure cells and trust the bees to follow through. It's the cost of going with the Nicot system.

One last thought. As with so many gadgets in our culture, Chinese manufacturers have found ways to duplicate many of our innovations. The Nicot queen rearing kit is no exception. The Chinese versions are vastly cheaper, in price and in quality. As I hear from a handful of beekeepers around the country, the Chinese versions are not machined to the exacting measurements as the original Nicot kit. As an example, the brown cell cups are slightly smaller. The small difference will cause the brown cell cups to slip out of the yellow cell cup holders and fall down to the bottom board.

What's Next?

The Nicot system is far from perfect and not without a few obligatory necessities. When I consider the two days of warming up the cell grid prior to placing the queen in the cell grid, adding on the four to seven days of waiting for fresh larvae, I am beginning to see how I can save time by learning how to manually graft larvae.

Nine-year-old Jade Stevens grafts larvae.

The value of the Nicot system is in the hardware. This kit can be repurposed to receive manually grafted larvae and move beyond the tortuous containment of the queen. While switching to the Doolittle style of queen rearing entails challenges of its own, I'm hoping to side-step a lot of the tedious nonsense associated with the Nicot system. This transition, obviously, will challenge my repulsion with learning how to graft the age-appropriate larvae.

I tried grafting, once, a long time ago, and gave up for a number of flimsy reasons. To gain that level of improvement, it's time to put on my big boy bee suit and set aside the excuses. This past year, several events and people have conspired and inspired me to renew my commitment and start down this path of grafting larvae.

One of these people is Jade Stevens, daughter of Cory and Jamie Stevens, of Dexter, Missouri. Jade started grafting on her own, at age 9, simply by watching her father do it. But when you have an example like Cory, it's no wonder she picked it up so fast. You can find Cory's work at **www.stevensbeeco.com** or Stevens Bee Company on Facebook.

Grant Gillard is a beekeeper now living in Holden, Missouri. He speaks at a number of conferences around the country and is the author of "Nicot Queen Rearing: The Non-Grafting Method for Raising Local Queens," available with his other books on amazon.com. You can contact him at **grantfcgillard@gmail.com** or find him on Facebook.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The Curious Beekeeper

by Rusty Burlew

Beekeeping as a Competitive Sport

After months of study, you finally take the plunge and buy your very first wooden hive. You sand the sweet-smelling boards until they feel like silk beneath your fingers. You browse the paint aisle of your local home improvement store and spend far too much money, buying colors that spark your imagination, colors with names like Peony, Key Lime, or Meyer Lemon. Once it's complete, you place your gleaming hive on the lovingly built stand and install your first colony. Everything is perfect until your mentor says you really should have two hives, just in case you need some brood or want to raise a queen.

The two-is-better-than-one advice from experienced beekeepers makes sense, so you buy another hive, another colony, and repeat the entire process. Now your setup is to die for. In fact, you revel in your flawless apiary until the moment you realize your bees are about to swarm. Quickly you buy two more hives. You decide they really don't need sanding, so you just paint them to match the others. Just in time, too. You manage to catch the first swarm and split the second colony proactively. You're already up to four colonies in your very first year!

In a few days, you notice that the swarm trap hanging in your old maple tree is attracting a lot of attention. You run right out and buy a fifth hive just in case, slap on a coat of partially congealed paint, and balance the hive on some cinder blocks. Just in time again. Your trap enticed a swarm on the run, so now you're up to five.

Bees Happen

We constantly read the bad news. Headlines remind us that honey bee Armageddon is just around the corner, and we try to stay apprised of the burgeoning panoply of new threats. We read anxiously about each novel combatant poised to take down our bees. We attend lectures and classes, surf the net, and buy books, forever trying to prepare for the next assault.

But despite the naysayers, bees happen. No matter how you try to control the number of hives, it continues to multiply. We watch our little backyard apiaries expand, regardless of the news. Those who promised their partners "just a hive two" to pollinate the vegetable garden and make a little honey for the family find themselves with more hives per acre than a California almond orchard.

When our backyards become overly intimidating, when we begin wearing veils to take out the trash, we seek friends and family who might be will-

Here is the first of my permanent hive stands. I was sure it was the only one I would ever need. All photos by Rusty Burlew

The more hive stands I needed, the simpler they became. This one was made from scrap wood.

ing to park a hive on their property. We promise them honey and they agree. As soon as we can buy a pickup, we deliver a hive or perhaps two — if they said yes to one, certainly they wouldn't mind two — to their homes. Now we have an outyard! How cool is that?

Does it stop there? Of course not. It never stops. In fact, it gets completely out of hand before we realize what's happening. Like the delicately swaddled infant that morphs into an insolent teenager, the tiny backyard apiary evolves into an albatross, hindering our every move. It requires monitoring, maintenance, surveillance, healthcare, equipment,

The swarm on the inside moved in on the prior day. I was preparing to remove it when the second one coalesced beneath.

and heaps of dollar bills. Days off are spent not with the family but with bees, vacations are scheduled around swarm season, and the retirement nest egg is raided for mite meds and electronic monitoring devices that can measure everything from colony weight and humidity to sound and temperature.

Outgrowing Reason

Most of us have been there. Like so many others, I began beekeeping with one hive and quickly added a second. At that point, I coerced my engineer husband into building the hive stand of my dreams, a structure that holds my hives 18 inches off the ground and includes a roof to protect them from some of our heavy Northwest rainfall. It's anchored in the ground with concrete and capable of holding a couple thousand pounds. The best feature was it could accommodate three hives — if for some reason I ever got that many — with three hive perches bolted to the stand itself so they couldn't slide off. It was a dream come true.

My built-in hive stand was a showpiece — greatly admired by my beekeeping friends. It did everything I needed it to until I wanted a second one to take three more hives, and then a third to accommodate my nine. After that, Rich threw together a few single stands out of scrap lumber, and then a few more out of twisted second-use boards. After that, it was up to me.

Next came my first outyard and, with it, the requisite pickup. And then I needed a couple more bee suits so the friends hosting my hives could mow their lawns on occasion. The time and money to maintain my few hobby hives were becoming an issue. I promised myself that on no account would I ever add up the expenses. Some things are better left uncalculated.

Successfully Undone

This process went on for years. Oh sure, I had some winter losses, but I was able to replace them with little effort. Each year I ended up with more colonies than the year before. Hives cropped up like mushrooms, perched on hillsides, squatting beneath trees, and stilted in the wetlands.

But one spring day, an epiphany struck me like a thunderbolt. I was staring at a swarm trap high in a tilty alder tree, wondering how to get it down. It contained a swarm that had moved in the day before. And as I watched — unsure of my next move — a second swarm began collecting on the underside of the trap. I muttered unseemly words as it coalesced into a venomous mass.

Suddenly I realized I didn't like beekeeping all that much. In fact, I began to dread the whole idea. I went inside and began making detailed lists of everything I had to do, materials I had to collect, and hives I had to set up. I outlined every step and then reordered it all. I was overwhelmed and the annotated list was a sure sign of procrastination. I figured if I tweaked the details long enough, I might actually avoid the whole two-in-one thing.

My dislike of beekeeping had nothing to do with the bees, of course. I love bees. I can spend whole afternoons chasing them through the flowers. I like to watch them build comb, tend brood, and do other bee things. Their mystical lives easily hold me in thrall.

The Mites Tipped the Scale

For me, varroa mites were the last straw, the stubble that took down the camel. I hate treating mites. For many years I consoled myself that it only needed to be done once a year, and I could live with that. Then it was twice a year. And then three times. Last year it was four and I still had losses. I began to loathe taking samples, calculating mite drop, assembling treatments, and recording it all with actuarial precision. I lost sleep, wondering if the treatment would work, or whether I would need to do it yet again. I never envisioned a hobby as an amateur exterminator, but that's where I landed. Killing was a way of life, killing in increasingly novel and complex ways. Whacking wasps. Murdering mites. Poisoning parasites. Waxing moths.

The kicker for me was boredom. I can treat one hive, fine. Two hives, still okay. But when it comes to repeating the same action over and over, I resent it. Tedious repetition reminds me of pushups and musical scales, both of which I endured in high school. It reminds me of ironing my dad's white shirts and pulling dandelions and washing dishes. If you think I have some kind of personality disorder, you're probably right, but I have to deal with it nonetheless.

I Am Not Alone

I know I'm not the first person to mindlessly acquire too many bees. Many unpleasant aspects of beekeeping are not about honey bees themselves — those creatures we know and love — but about the peripherals. It's easy to love bees and still have too many. For some folks, it's the spiraling expense; for some, it's the heavy lifting; and for others, it's the constant battle with predators such as bears and skunks and hornets. For still others, it's the hassle of harvesting, bottling, marketing, and selling.

And we haven't even addressed the stickies. Everything about bees is sticky — the honey, the propolis, the beeswax, the feces. If you touch something on my property, you run the risk of remaining attached to it forevermore. In an act of supreme desperation, my husband changed all the household door handles, inside and out, to levers so I can open them with my elbows. Even at this very moment, I'm forbidden to touch a handle of any type.

The paradox within beekeeping is simple. When we are successful we invariably acquire more and more colonies, which translates into more and more work. Too much work, especially the kind we don't enjoy or don't have time for, can lead to unhappiness and frustration. Time and time again, I've seen people get in too deep before they've really decided how deep they want to go, or before they understand the commitment it requires. I think many people leave beekeeping not because of failure but because, at some level, the work isn't enjoyable or it isn't the type of work they imagined.

Reduce and Endure

In my own case, reducing the number of colonies had a positive effect on my attitude. For example, I found making seven candy boards much more conceivable than making 15, partly because it required lifting fewer fifty-pound bags of sugar. Administering 28 mite treatments a year was better than 60, and it minimized the number of heavy boxes I had to lift.

In the past, I would panic over such a low number of colonies, but a few years ago I consciously decided not to replace losses until I got down to a reasonable number. At first, it was difficult because making up losses and increasing our stock is ingrained in our collective beekeeping psyche. I still go through moments of panic, wondering what I will do if I lose them all. Will I immediately restart? Take a year off? Write a memoir? I have no idea, but I've decided to cross that bridge when I come to it.

Once I remembered why I kept bees, I was able to shrink the apiary. Since I didn't want to sell honey, combs of it were taking over the house.

Despite the uncertainty, the decision to go smaller greatly enhanced my enjoyment of beekeeping. I can now remember what I need to do without spreadsheets, software, and cell phones. I can treat for mites when I have a few minutes, instead of setting aside days for a despicable task. I can buy sugar when I'm in town instead of making special excursions for fifty-pound bags and having strangers stare and ask what I'm planning to bake.

All the time saved leaves more moments to enjoy the bees, watch them, play with them. Instead of starting the day with a to-do list of items I detest, I now have time for observing, learning, considering, and questioning.

Honey, I Shrunk the Apiary

Like many beekeepers, I once thought that shrinking the operation was a type of failure. After all, when people ask how many colonies you have, they are impressed with big numbers. Tell them you have three, five, or seven and they say "oh," their voice falling in disappointment. The pity in their eyes is a not-so-subtle insinuation that you can't do better, that you're not a *real* beekeeper. But say five hundred and they say "Wow!"

I was finally able to shrink my apiary by remembering why I started. My foray into beekeeping had nothing to do with saving the bees or pollinating crops or selling honey. It had nothing to do with being with nature or curing allergies or making candles. None of that. All I wanted was a dependable supply of ethereal comb honey for the table.

I did that and I still do, but I don't need dozens of colonies to meet that goal. I realized that I, like so many others, had forgotten my vision and fallen into the "more is better" mindset until the bees that once brought me peace were bringing angst instead.

Beekeeping is not a competition

We live in a supremely competitive society. We compete in sports, academics, salary, and job titles. We compete for friends, likes, page views, and possessions. We reach for ginormous houses, outsized cars, and fancy vacations. Do we really need to compete in the bee yard, too?

Beekeeping should never be a competitive sport. I don't need more bees than my neighbor, or more honey, or the tallest hive. What I do need is a sense of oneness with the bees, the sense of wonder that only a healthy colony can provide. I want to smell the meaty aroma of an open brood nest, feel the softness of freshly secreted beeswax, and taste the confusion of nectar in a newly harvested comb. "How many colonies?" just doesn't matter.

The perfect number of hives is the number that is right for you, be it two or ten thousand. A life with bees is well-lived, but don't let other beekeepers drive your train. Decide on the number that makes you happy and hold the line. In the end, you will be a better and happier beekeeper. You will be the winner.

Rusty Burlew has studied agriculture, honey bees, and environmental science for over 30 years. She is a passionate advocate of native bee conservation and founded the Native Bee Conservancy in Washington State. **https://honeybeesuite.com** or email her at **rusty@honeybeesuite.com**.

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Beekeeper-Funded Research
An Experiment to Improve Pollen Sub
Part 1

by RANDY OLIVER
ScientificBeekeeping.com

In my location, we may not see a drop of rain all summer long, so our colonies become pollen-starved. In order to prepare strong colonies for almond pollination, I used to move them to better forage out of state, but now instead feed pollen sub to build them up before winter. Today's pollen subs are really good, but I'm always looking for ways to improve them.

Introduction

With the demand for strong colonies of bees for almond pollination, coupled with landscapes that are offering less and less bee forage, we beekeepers are feeding more and more artificial diet in the form of pollen subs. Not only is forage being affected by changes in agriculture, but temperature and rainfall are changing with the climate. Of serious concern is a finding brought to our attention by USDA researcher Lewis Ziska,[1] who found that during my lifetime, in response to rising levels of CO_2 in the atmosphere, that the amount of protein in goldenrod pollen has apparently decreased by a third, thus forcing our bees to work even harder to obtain critical nutrients. Thus there is huge interest by beekeepers as to what are the "best" pollen subs.

Practical application: There is a crying need for someone to perform the service for beekeepers that Consumer Reports does for other consumers — to test products on the market one against the other.

With that intent, in 2013 I ran a field trial to compare the performance of various pollen sub formulations on the market[2] — testing to see how well they supported colony growth over the six months prior to almond pollination. The results clearly demonstrated that the feeding of protein patties resulted in far greater colony strength. I also found that although some of the pollen subs initially outperformed natural pollen (on a pound-per-pound basis), that over time, they appeared to lose the lead (Fig. 1).

Practical application: At this point, allow me to make it clear that for short-term colony buildup, some artificial diets performed as well as or better than natural pollen. It is only under conditions of sustained artificial feeding that any nutritional deficiency may become apparent.

Full disclosure: This article is about a follow-up pollen sub trial that I ran in 2018. I had to decide whether to name the commercial product that I used for the test, since I knew that beekeepers would ask me. I left it up to the manufacturer, who granted me permission to do so. That said, I pride myself on my objectivity, and have no wish to endorse any product. In our commercial beekeeping operation, we *do* use commercial products, but our use does not constitute endorsement or favoritism. In the case of pollen subs, a number of us California beekeepers prefer to chop pollen sub into chunks for feeding, rather than purchasing it in preformed flat patties (since we can place more of a soft chunked patty *within* the cluster). One manufacturer offers such a patty for sale, thus eliminating our need to mix our own. That product is Mann Lake's Ultra Bee Bulk Soft Patty (hereafter called the Control sub). Since I was familiar with the field performance of that product, for this trial I approached the manufacturer to see if they were willing to prepare a custom batch to my specifications. Since they would benefit from knowing the results, I asked them to donate the feed for this trial, which they did. I received no other compensation from the company, and all other costs were funded by donations from beekeepers. The results of this trial do not constitute endorsement of any product, but rather information of use to anyone producing pollen subs. FWIW, since new pollen subs have come on the market since my 2013 trial (notably Dadant's AP23 and HealthyBees spirulina patty), I'm planning to run another comparative trial this summer.

My experimental objective

I wondered whether there was something missing or in short supply in the best-performing subs — that could be considered as "limiting nutrients." So I ran this experiment to see whether I could improve the performance of the Control sub by supplementing it with two nutrients that I hypothesized in which it may have

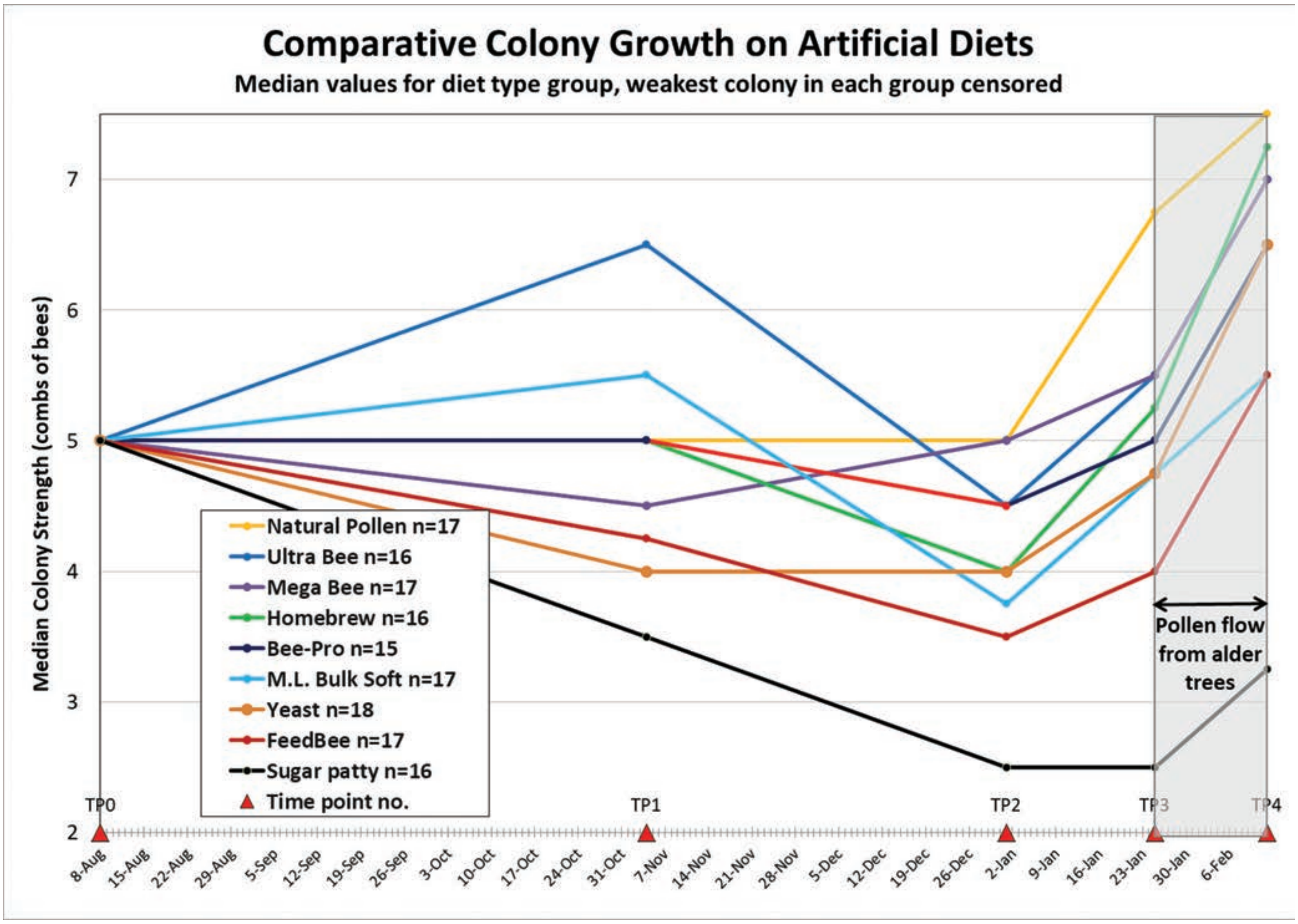

Fig. 1 *The results of the 2013 trial (product formulations may have changed since then). I shaded the plots of colony growth after 25 January, since that growth was sustained by worker emergence resulting from a natural pollen flow from alder, which began three weeks earlier. Note that two of the artificial diets initially outperformed the natural pollen patties. This may have been due to the higher protein content of the artificial diets. My question was whether those diets were deficient in a limiting nutrient that eventually prevented full utilization of the protein.*

been deficient. Allow me to walk you through my rationale for the experimental design.

The concept of a limiting nutrient is commonly illustrated by the barrel analogy of "Liebig's Law," shown in Fig. 2.

Keep in mind that honey bees grow at an incredible rate — faster than any other livestock species.[4] In order to do so, they require a well-balanced, nutrient-intense diet of nectar and pollen. Any deficiency in an artificial diet (pollen sub) will limit its overall utilization by the bees for colony growth.

Practical application: Beekeepers, researchers, and manufacturers tend to focus upon the protein and amino acid contents of pollen subs, but I wonder whether those are actually the true limiting nutrients in artificial diets. There is an economic reason to see whether this is so, since protein is the most costly component of a pollen sub. But that costly protein may be wasted if some other limiting nutrient prevents its full utilization by the bees.

Based upon my reading of the literature, two potential limiting nutrients in pollen subs came to mind: the first a plant sterol.

24-METHYLENECHOLESTEROL

Let me start by quoting Dr. Allen Cohen, the author of the textbook Insect Diets:[5]

Because insects, unlike vertebrates, cannot make sterol to support their needs, they must get it from their diet, thus making sterols, by definition, essential nutrients.

Sterols are essential components of cellular membranes, the molting hormone ecdysone, and other fundamental biological processes. Back in the '60s through '80s, researchers at the USDA ARS labs delved deeply into the sterols of honey bees,[6] concluding that one specific sterol — 24-methylenecholesterol (24mCh) — was a major component of the jelly produced by nurse bees. More recently, Tian[7] found 24mCh to be a component of Major royal jelly protein 1 (MRJP1).

Each plant species produces pollen with different relative proportions of sterols, of which only a few appear to be utilized by bees. Stone and pome fruit tree pollen is notable for having high levels of 24mCh,[8,9] but what is especially of interest is that in colonies foraging upon low-24mCh pollens, such as blackberry or goldenrod, that the nurse bees concentrate 24mCh to levels much higher than it is in the pollen that they're feeding upon, as evidenced by analyses by Svoboda.[10]

Note in Table 1 how the proportion of 24mCh increases dramatically from the amount in the pollen, to that in the adult bees, and then especially in the prepupae that had grown on a diet of jelly produced by the nurses.

Experimental question: The big question for those of us trying to understand bee nutrition is **just how important it is for bees to obtain 24mCh directly from their diet**, or how readily they are able to convert *other* pollen sterols into it. Svoboda[11] concluded that they were indeed capable of sterol conversion to some extent:

> *… previous studies with chemically-defined diets have demonstrated the capacity of the worker bees to provide 24-methylenecholesterol, as the major sterol in the brood food when no pollen is fed to the brood and even when no sterol is added to an artificial diet. These results indicated that the nurse bees could readily cycle certain sterols from their endogenous pools to maintain high levels of 24-methylenecholesterol, sitosterol and isofucosterol in the brood food for the developing larvae. In addition, bees from free flying colonies were found to produce brood in which there were high levels of these three sterols even when their pollen source contained low levels of these sterols.*

Practical application: Although bees appear to possess the ability to convert some other plant sterols to 24mCh, I was curious as to how much 24mCh there was in the Control sub.

I had long looked for an inexpensive commercially-available source of 24mCh. Ten years ago, I couldn't find one, since few vegetable oils contain it to any extent.[12] But nowadays, off-the-shelf borage oil — presumably high in 20mCh — is readily available, but I didn't have any way to confirm that. As luck would have it, in 2017 I heard Drs. Ramesh Sagili and Priya Chakrabarti from Oregon State University present that they had paid thousands of dollars to have a batch of pure 24mCh synthesized, and that the OSU lab could use it as a reference standard to quantify 24mCh in pollen samples. This opened an opportunity for me to see whether I could use borage oil as a source of 24mCh in pollen sub. So I contacted Dr. Chakrabarti to see whether the lab could run analyses for me, to which they graciously agreed. (Disclosure: I was also involved in helping the researchers to obtain funding for their research.)

I sent a sample of the off-the-shelf Control sub, which tested as containing only a trace[13] of 24mCh (compared to a detection of over 4122 mg/100g in a sample of almond pollen). A sample of borage oil tested at 170 mg/100 g 24mCh — far less than almond pollen, but perhaps enough to make a difference in an artificial diet.

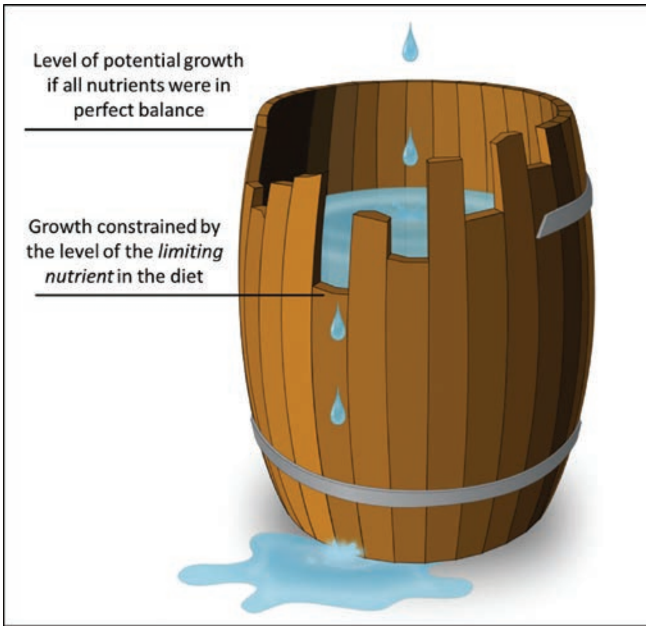

Fig. 2 *Liebig's Law states that the growth of an organism is* ***limited by the nutrient*** *in shortest supply. Using the analogy of a barrel being filled with water, the maximum fill (total growth) is limited by that "limiting nutrient." That nutrient could be an amino acid, a vitamin, a mineral, or perhaps (in the case of bees) a sterol.* Image credit[3]

Experimental design: I would ask the manufacturer to replace the canola oil used in their pollen sub with borage oil, in order to provide a source of 24-methylenecholesterol in the diet.

The second potential limiting nutrient on my mind was a trace element:

Zinc

Zinc is well known to be a necessary nutrient in animal diets, critical for metabolic function, growth, immunity, and appetite. It is typically supplemented in animal diets to the 50-75 ppm level.[14] But natural bee-collected pollens typically contain only from 24-50 ppm zinc,[15] from which nurses pro-

Table 1 *Relative percentages of sterols isolated from pollen, adult bee, and prepupae from field colonies foraging predominantly on a single pollen source. After Svoboda 1983.*

Sterols	Blackberry colony		
	In pollen	In adults	In prepupe
Cholesterol	ND	0.8	0.5
Desmosterol	2.9	0.4	0.6
24-methylenecholesterol	5.1	17.0	43.0
Sitosterol	47.3	38.3	26.0
Isofucosterol	32.4	37.9	16.9

Sterols	Goldenrod colony		
	In pollen	In adults	In prepupe
Cholesterol	0.6	2.0	1.0
Desmosterol	ND	ND	ND
24-methylenecholesterol	1.5	34.6	52.6
Sitosterol	5.7	12.4	9.8
Isofucosterol	5.6	21.8	12.6
Δ7-Stigmasten-3β-o1	66.2	20.4	13.2

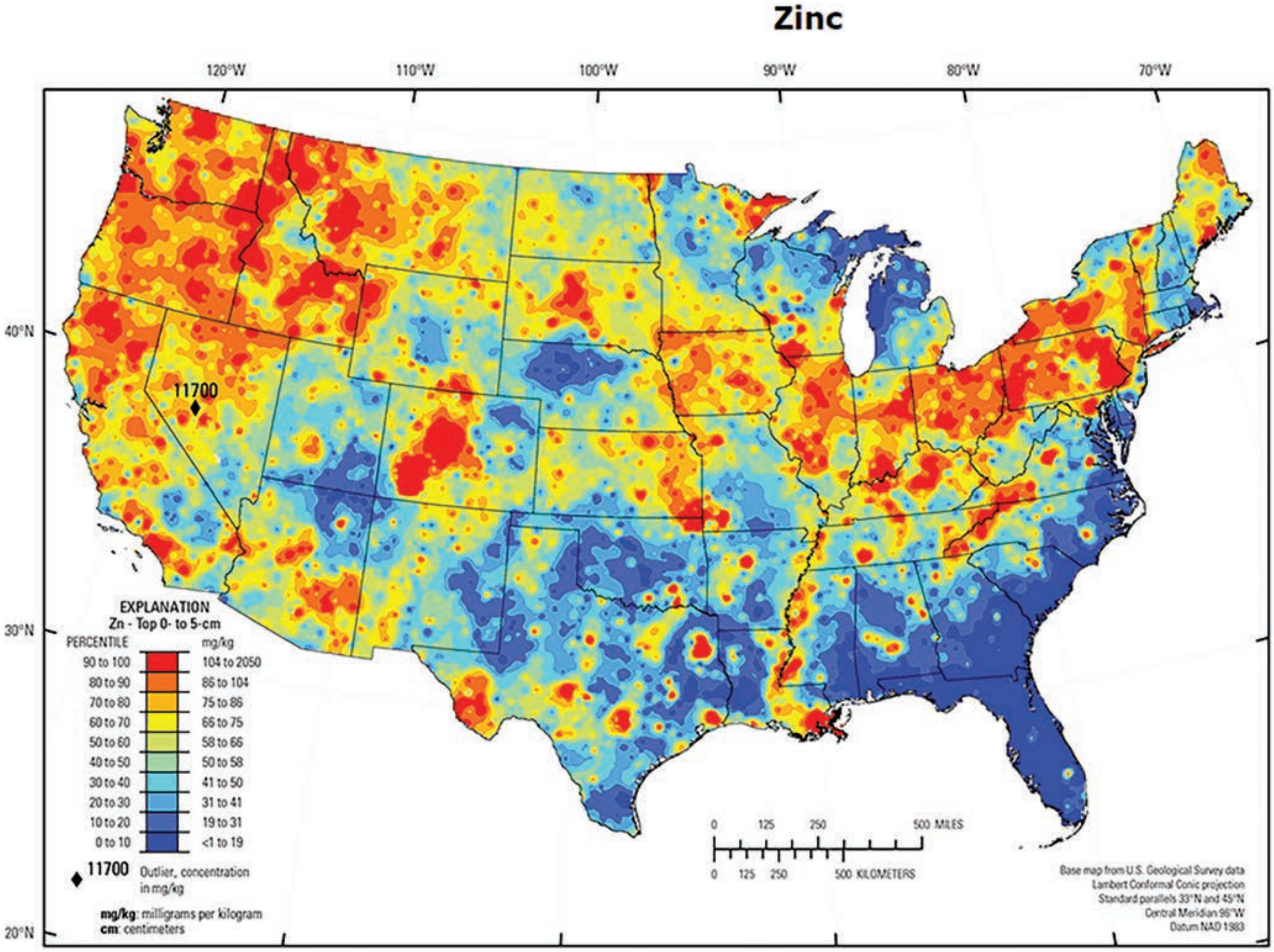

Fig. 3 *The availability of trace elements in the soil varies greatly across the country. The map above is for the concentrations of zinc in the upper soil level, with red indicating the highest concentration, blue a deficiency.* Map credit[20]

duce royal jelly with zinc in a narrow range of 20-25 ppm.[16] Zhang[17] fed colonies during a nectar and pollen dearth sugar syrup supplemented with zinc, and found that it took at least 60 ppm zinc for the nurses to produce jelly with a normal zinc content.

Practical application: The zinc content of natural pollens[18] is often below that considered optimal for animal nutrition, so it's possible that zinc may be more of a limiting nutrient than is the protein content of incoming pollen. Of concern is that even that potential deficiency may be being exacerbated by plant response to the elevating level of carbon dioxide in the atmosphere.

Loladze,[19] in reviewing multiple studies, found that the levels of zinc greatly decreased in plants grown under conditions of elevated CO_2. And that's not to mention that in some regions (notably the Southeast) that zinc would be *expected* to perhaps be a limiting nutrient in pollen, due to the deficiency of the element in the soil (Fig. 3).

Practical application: Although my experiment was run where zinc is relatively abundant in the soil, beekeepers in the blue areas of the map above may consider zinc supplementation of their colonies. To view maps of trace element contents of the soil in your area, go to [21].

So zinc was clearly on my radar as possibly being the limiting nutrient in the pollen sub that I've been using. I asked the manufacturer for analysis of the Control sub, and it came back at only 20 ppm — perhaps less than optimal.

Experimental design: I would supplement the Test batch of pollen sub with zinc to 75 ppm, by adding 25% as zinc sulfate, and 75% as zinc proteinate, based upon a recommendation from an animal nutritionist.

With the object of efficiency in mind, I decided to kill two birds with one stone, and simultaneously test another potential limiting nutrient on my radar in the same batch.

Practical application: Running a controlled trial of pollen subs is costly in labor and materials. My thought was that if the double-supplemented batch exhibited increased performance, then I could later tease out which of the nutrients was responsible.

At this point I was ready to write up a protocol for a field trial. To be continued …

Acknolwedgements

I thank Mann Lake and Drs. Priya Chakrabarti and Ramesh Sagili for providing chemical analyses of products involved in this experiment.

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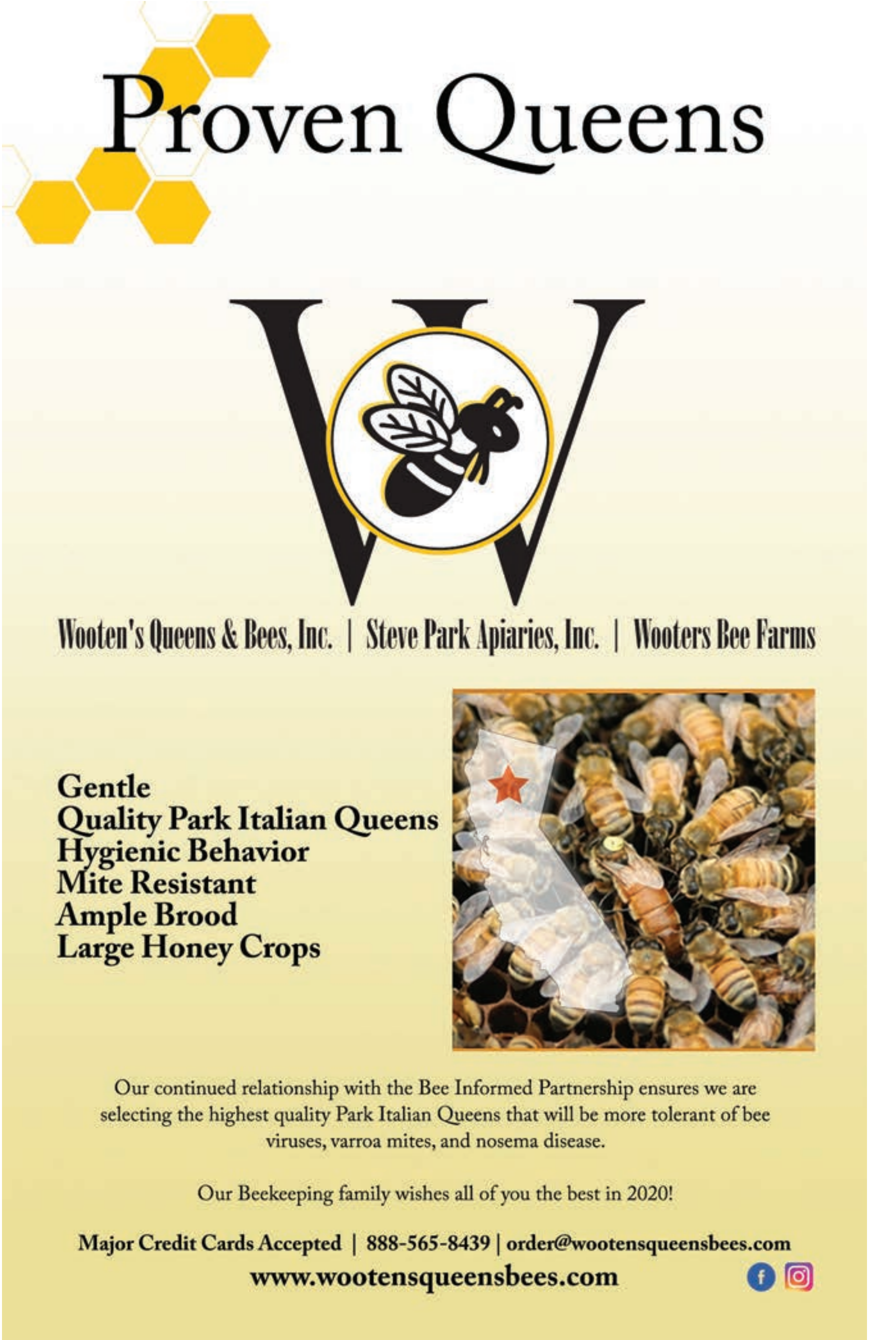
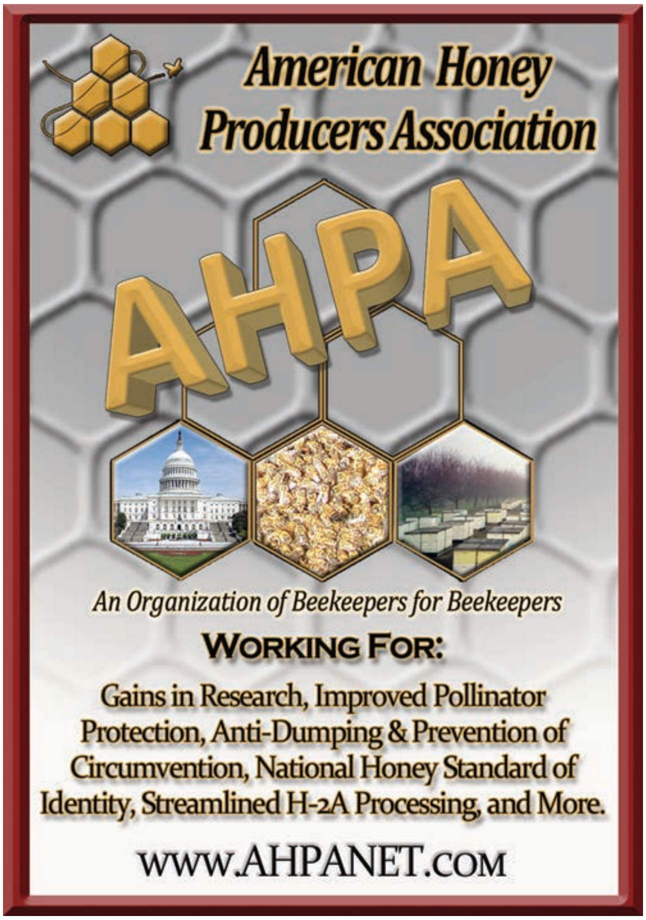
Randy sees beekeeping through the eyes of a biologist. He's kept bees for over 50 years, and with his sons runs around 1500 hives in the California foothills. He closely follows bee research, engages in some himself, and enjoys sharing what he's learned with others.

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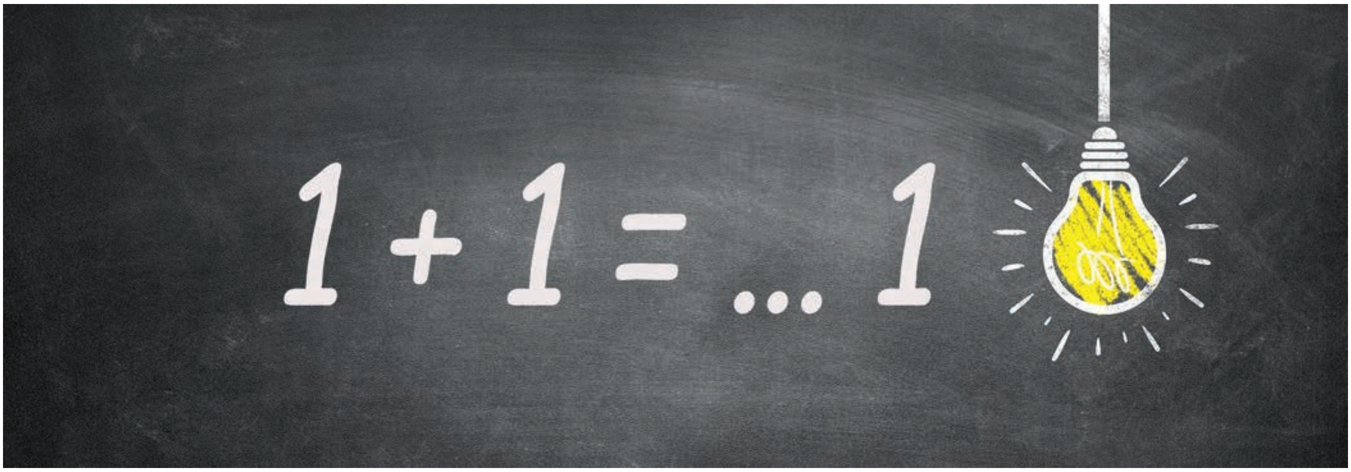

THE SNELGROVE BOARD: — Method II

Part 2 of 2

by SID LEHR, MS, DVM

Last month I wrote about a method of swarm control/prevention described by Louis Snelgrove and first published in 1934[1] that could be applied before bees started constructing queen cells. This method consisted of separating the queen and flying bees from the nurse bees in a vertical split. The queen and flying bees ended up together in the lower section of the split and the nurse bees and most of the brood comprised the upper part of the split. Separation between the upper and lower clusters was maintained by a few honey supers and a "Snelgrove board" or "double screened board" with paired entrances on three or all four edges which are manipulated in a series of "Operations" — as Snelgrove referred to them — to gradually and systematically move bees from one side of the board (the top) to the other side of the board (the bottom). Because the entrances are paired and in close proximity to one another the bees easily mistake one for the other.

At regular intervals the entrances are manipulated so as to trick bees into using the bottom of a pair of entrances after these bees had previously oriented to the top entrance of the pair. For example, bees oriented to opened entrance 1 on the top of the board (see Fig 1) could be tricked into using entrance 2 after entrance 1 is closed and entrance 2 is opened, which would lead them to the bottom part of the split colony below the Snelgrove board. This separation of bees diminished the swarming impulse because it gave the queen ample comb in which to lay in the bottom colony and maintained the nurse bees in the top colony with no queen and thus no ability to swarm. I discussed how this setup can be used to raise new queen cells in the top colony, to set up a two-queen vertical system by later replacing the Snelgrove board with a queen excluder, to eventually split the top colony from the bottom colony completely, or to recombine the top colony with the bottom after the swarming impulse/season had passed. The essential feature of this so-called Method I is that it must be performed before the construction of queen cells. Once the bees begin to construct queen cells it is very difficult if not impossible to quell that instinctual drive to reproduce, and if one were to place the queen and some brood in the bottom box of the split, and the nurse bees and open brood in the top part above the Snelgrove board, the bees in the bottom would continue to construct queen cells and swarm anyway.

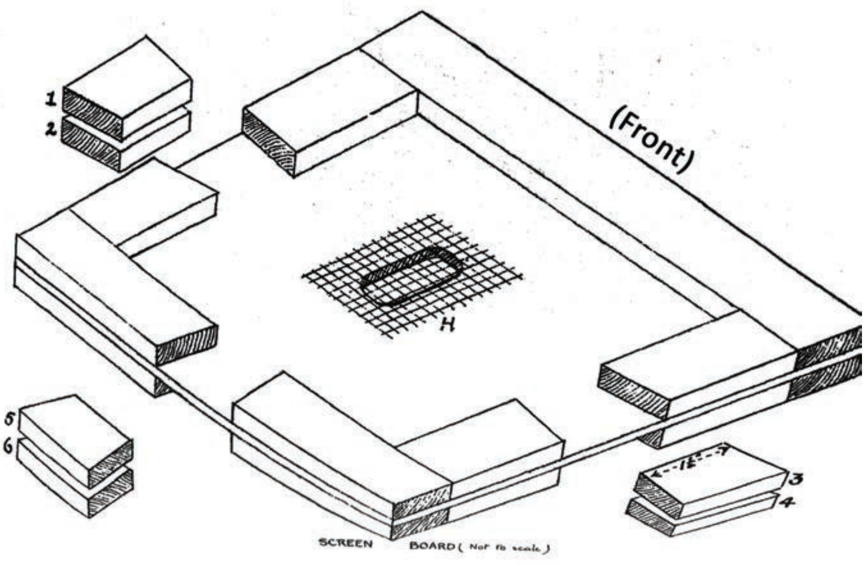

Fig. 1, *showing Snelgrove's original diagram of the board that now bears his name. Note the paired entrances which are systematically opened and closed to move bees from above to below at regular intervals. (Use the Fig 1 from the March issue with "Front" added.)*

Snelgrove carried out his Method I (described in last month's article) on

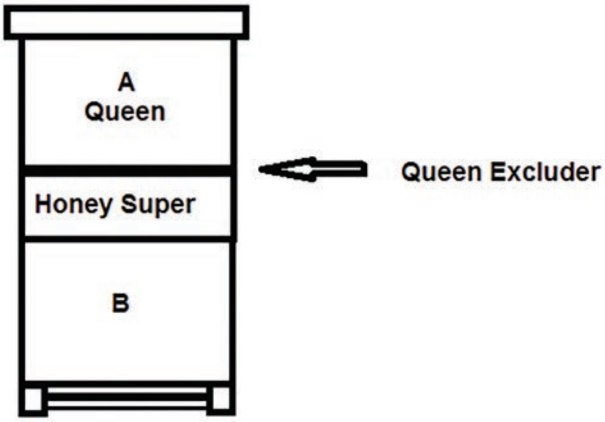

Fig. 2, *showing the order of boxes for Snelgrove's Method II when queen cells are not yet capped.*

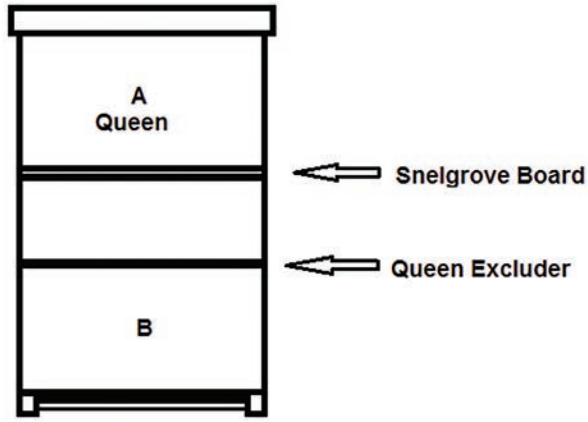

Fig. 3, *showing how to set up the boxes when capped queen cells are present.*

two colonies which had already prepared queen cells (this was when he was in the experimental phase with his board and did not yet understand how this all worked and how the bees would react), moving the queen cells, with the majority of the brood (open and capped), up top without the queen. Before he employed his board, he believed that he needed only to use a queen excluder directly below the upper colony, and a few honey supers between the lower colony and the queen excluder for the first 3-4 days after he created the vertical split. As everyone knows, a queen will not cross a honey super, never mind a few, right? Fortunately for him, and this swarm control method, his bees did not read the same books he was reading, and on a few occasions he came back to inspect a few days after creating the split and found that the queen from the bottom part of the split had traversed the honey supers, squeezed through a gap in the queen excluder, and had moved into the top colony of the split. What surprised him was that not only was the queen laying in the top split, but the workers were chewing down the queen cells he had moved up there.

He thus stumbled upon his Method II of swarm control, to be used after the construction of queen cells had begun. One can see the evolution of the board in Snelgrove's mind, as it is likely that he first separated the top and bottom bees with only honey supers and a queen excluder, but then found the need for a better way to separate the top and bottom bees from one another to prevent the queen from traversing the honey supers and queen excluder and entering the top colony. Maybe if he had kept his queen excluders in better repair and those few queens had not been able to pass through, we might be calling this board by a different name, or not have it at all.

Snelgrove's Method II

As previously stated, this is for those instances when the bees have gotten a little bit ahead of you and have begun to construct queen cells but have not yet swarmed, so it can be used for that 8½- or 9-day period immediately prior to the sealing of the first queen cell and the issuance of a swarm. Prior to this, beekeepers had tried various methods of breaking down queen cells manually, only to find that the swarming impulse was too far advanced and the bees in the bottom split continued to construct new queen cells (sometimes as emergency queen cells) after the first queen cells were destroyed by the beekeeper.

The description of Snelgrove's Method II is as follows:

Proceed as in Method I[2] but place all the brood and queen cells, as well as the queen in the top box labeled A in Fig 2. Place the broodless combs with bees in the bottom box B, but with one comb of sealed brood in the center. It won't hurt if there is also some older open brood, but be sure that there are no eggs or young larvae less than 4 days old so that the bees in the box, separated from their queen above, do not raise a new queen and swarm despite all your manipulations. If any of the queen cells are sealed it is important to place the Snelgrove board in position as shown in Fig 3. Open entrance 5 on the Snelgrove board on the side opposite the entrance to the lower colony.

Destroy only the capped queen cells (or move them to another colony in need, or into a mating nuc; it's a shame to waste good queen cells!). If all the queen cells are uncapped, the cells capped during the next 24 hours should be destroyed, or removed and relocated, the following day.

The foragers will now leave the upper box through the open entrance 5 at the back of the Snelgrove board and return to the front entrance of box B to which they had previously oriented. These flying bees now find themselves in a queenless box (B) and cannot and will not swarm. The bees above lose the drive to swarm as there has been a sudden and dramatic reduction in flying bees, and they gradually destroy the queen cells, as some-

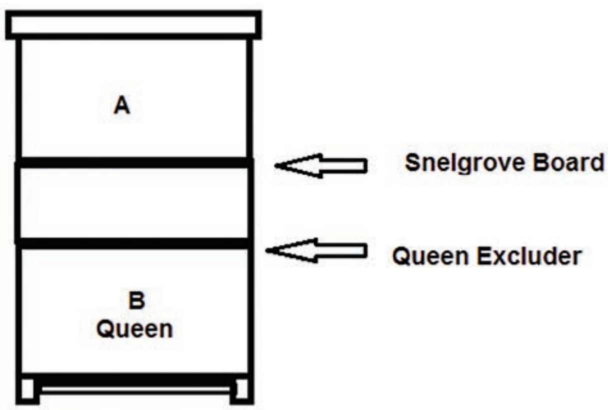

Fig. 4, *showing the final configuration of boxes and bees.*

how, they magically "know" they will not be able to swarm. Five days later close entrance 5 and open entrance 6 of the Snelgrove board to hasten the movement of newly emerged bees from the top to the bottom colony. Open entrance 3 at the side of the hive to be used by the bees up top. On the 7th day, or when the queen cells are destroyed and the queen is again laying in box A (usually within a week), she and the bees on the comb on which she is found should be transferred to the bottom box and the colony takes the form as shown in Fig 4. This should look familiar, as this is how things started in Method I as I described last month, with the queen and the flying bees in the lower box, and the nurse bees and capped brood above the Snelgrove board. The entrances are successively manipulated so as to move flying bees from above to below the Snelgrove board. On day 14 close entrance 3, open entrance 4, and open entrance 1 on the other side of the hive. This moves even more of the newly-emerged bees from the top to the bottom.

This procedure works because it gets the flying bees to leave box A, and a swarm cannot develop without flying bees. Occasionally the queenless bees below discover the queen above the Snelgrove board and return to box A, usually arriving at the entrance to box B and marching up the outside of the boxes to the open entrance of box A, following a route that appears to be marked by the bees' tarsal glands. This difficulty is overcome by removing box A and placing it several yards away for two days, preferably on top of another colony in the apiary, so that when box A is returned to its place above the Snelgrove board the few foragers that will be left behind will join the other colony and not be lost.

Snelgrove went on to describe several other methods of swarm control in his book, none of which involve the use of the double screen board which sometimes bears his name, so I will only mention that these methods and their descriptions exist, and refer you to his book for further reading on the nitty gritty details of the application of these other methods.

The Snelgrove board provides a feasible method of controlling swarming in honey bees provided there are only a few colonies on which it is applied, and these colonies are not too far from the beekeeper's house, as entrance manipulations are frequent and many would consider these swarm control methods labor-intensive. Each colony needs attention every 5-7 days for several weeks. These methods are better suited to the backyard beekeeper, and certainly not to the sideline or commercial beekeeper, who cannot spend the time required to manipulate entrances on such a frequent schedule. If you want to control swarming early in the spring and have some fun working closely with your bees these methods may appeal to you. Snelgrove boards can be found for sale by bee supply houses where they are often advertised as "double screen boards."

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Sid Lehr has been a veterinarian in Palm Beach County, Florida for over 3 decades, and because bees are also animals he is transitioning his veterinary practice from diagnosing and treating disease in cats and dogs to doing the same in honey bees, which he finds much more interesting after 30+ years working with the former. He has post-graduate degrees in chemistry and veterinary medicine and marvels at what goes on in his little white boxes on a daily basis.

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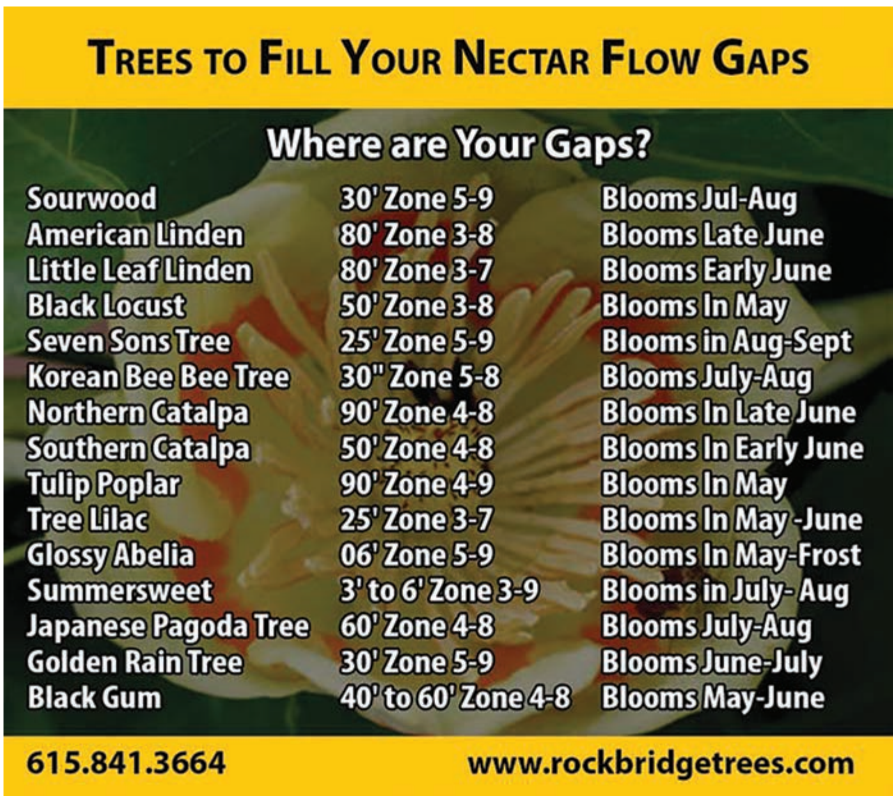

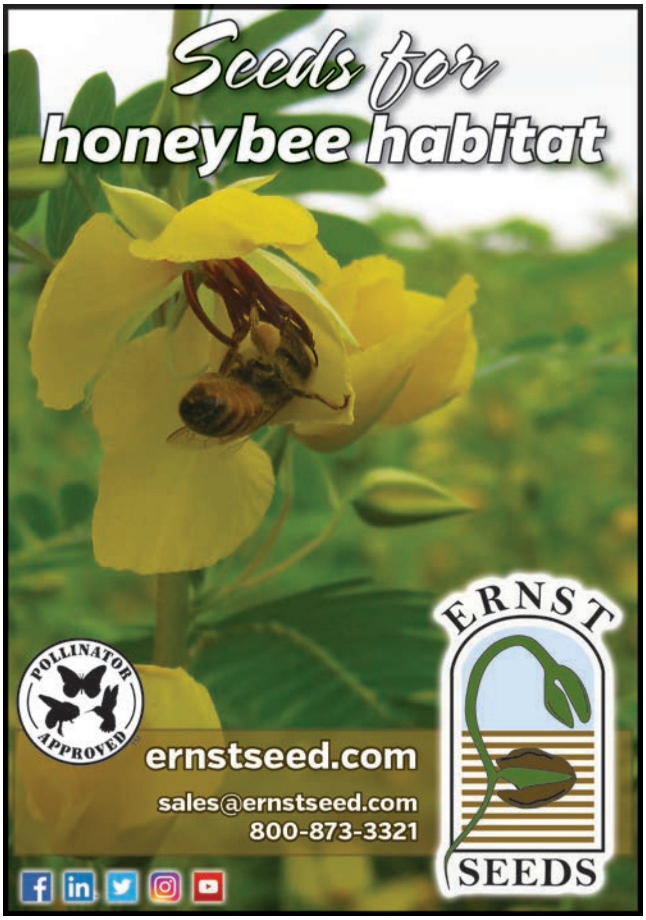
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APIMONDIA STATEMENT ON HONEY FRAUD

Editor's note: Due to the importance of this subject to our industry, we have decided to print Apimondia's position statement on honey fraud in its entirety below. We appreciate the attention this international organization's governing board continues to devote to the issue.

1. PURPOSE

APIMONDIA Statement on Honey Fraud is the official position of APIMONDIA regarding honey purity, authenticity, fair modes of production, and the best available recommended methods to detect and prevent honey fraud.

This Statement aims to be a trusted source for authorities, traders, supermarkets, retailers, manufacturers, consumers, and other stakeholders of the honey trade chain to ensure they stay updated with the current concepts and new testing developments regarding honey purity and authenticity. It is also a guide to promote best practices for the prevention of honey fraud and all of its insidious negative side effects on bees, beekeepers, crop pollination, and food security.

2. RESPONSIBILITY

The APIMONDIA Working Group on Adulteration of Bee Products* is the responsible body for the preparation and review of this Statement at annual intervals or whenever significant new information becomes available that the group becomes aware of.

The Working Group will ensure through consultation with the leading honey scientists, technical experts, specialist honey laboratories, or others with sufficient market and beekeeping knowledge, that the Statement is reflective of the most up-to-date information and collective thinking on the topic.

APIMONDIA Executive Council will publish the Statement on the APIMONDIA website and in other appropriate publications.

3. OVERVIEW OF HONEY FRAUD

Honey fraud is a criminal and intentional act committed to obtain an unfair economic gain by manipulating honey and selling a product that does not meet globally accepted standards for honey.

It is historically well documented that honey has long been subject to fraud (Crane, 1999), however the conditions for honey fraud have never before been so conducive or aligned.

They include:

1. World honey demand seems to be growing at a faster rate than global production of the pure product (Garcia, 2016 and 2018).
2. There is an opportunity for strong profits through fraud.
3. The modes of honey adulteration have rapidly changed and multiplied.
4. Honey is a complex product to test.
5. The official method, EA-IRMS (AOAC 998.12), cannot detect current modes of honey adulteration with C3-type sugars (Zábrodská and Vorlová, 2014) leaving the market exposed to an outdated and inappropriate detection method.

Different types of honey fraud can be achieved through (but not limited to):

1. Dilution with different artificially manufactured syrups produced, e.g., from corn, cane sugar, beet sugar, rice, wheat, etc.
2. Harvesting of immature honey (before the bees have had a chance to transform nectar into a product which has the chemical constituents and composition of authentic honey) as a planned, systematic and purposeful mode of production, coupled with the active dehydration of the extracted immature product by the use of technical equipment including, but not limited to, vacuum dryers.
3. Using Ion-exchange resins to remove/reduce residues and/or constituents of honey such as HMF and/or lighten honey color.
4. Masking and/or mislabeling the geographical and/or botanical origin of honey.
5. Artificial feeding of bees during a nectar flow.

The product which results from any of the above described fraudulent methods shall not be called "honey," neither the blends containing it, as the most widely accepted international standards like Codex Standard (1981) and the European Honey Council Directive 2001/110/EC (2001) only allow blends of pure honeys.

4. THE TRANSFORMATION OF NECTAR INTO HONEY

Honey is a one-of-a-kind product, the result of a unique, complex, and sustained interaction between the plant and animal kingdoms.

The transformation of nectar into honey is the result of thousands of years of evolution by bees to achieve a long-term provision of food for their own use when there is no nectar flow from the surroundings of the colony. The reduced water content, the elevated concentration of sugars, the low pH, and the presence of different antimicrobial substances make honey a non-fermentable and long lasting food for bees. An eventual fermentation of food reserves is an undesirable process for bees since it produces ethanol, which is toxic to

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them and affects their behavior in a similar way than to other vertebrates (Abramson et al., 2000). During the ripening process, bees also add enzymes like invertase, which helps to invert sucrose into more stable simple sugars as glucose and fructose, and glucose oxidase, essential for the production of gluconic acid and hydrogen peroxide, which in turn prevent fermentation (Traynor, 2015).

Honey maturation starts with the uptake of nectar and/or honeydew in the bee honey stomach while the foraging bees complete their load of nectar in the field and in their return flight (Nicolson and Human, 2008). It is inseparable from the drying process, and involves the addition of enzymes and other bee-own substances, the lowering of pH through the production of acids in the bee stomach, and the transformation of nectar/honeydew-own substances (Crane, 1980). Furthermore, a considerable microbial population exists at the initial stages of the maturation process that could be involved in some of these transformations, such as the biosynthesis of carbohydrates (Ruiz-Argueso and Rodriguez- Navarro, 1975).

The transformation of nectar continues inside the hive when non-foraging bees ripen nectar, both by manipulating it many times with their mouthparts and by reallocation. As nectar is passed from bee to bee, more enzymes are added and more water is evaporated (Traynor, 2015). Actually, the allocation and relocation of the content of many cells before final storage is an important part of the ripening process, and needs sufficient space in the beehive for its normal occurrence (Gary, 2015). Bees finally cap the cells when they are full of mature honey.

Eyer *et al.* (2016) provide evidence for the occurrence of both passive and active mechanisms of nectar dehydration inside the hive. Active dehydration occurs during "tongue lashing" behavior, when worker bees concentrate droplets of regurgitated nectar with movements of their mouthparts. By contrast, passive concentration of nectar occurs through direct evaporation of nectar stored in cells and depends on the conditions inside the beehive, being faster for smaller sugar solution volumes, displaying a larger surface area (Park, 1928).

As the nectar is dehydrated, the absolute sugar concentration rises, rendering the ripening product increasingly hygroscopic. Bees protect the mature product by sealing off cells filled with honey with a lid of wax. Therefore, the ripening process finishes when capping has already started, suggesting the possibility of a race against honey dilution (and unwanted fermentation) due to the high hygroscopic nature of mature honey (Eyer et al., 2016).

A colony possesses a division of labor between foraging and food-storing bees, and can adapt its nectar collecting rate by stimulating non-foragers to become foragers (Seeley, 1995). If honey is systematically and purposefully harvested when still unripe, as the mode of production by the beekeeper, non-foraging bees would become foragers earlier, thus increasing the harvesting capacity of the colony. This mode of production violates the principles of honey production, makes human intervention necessary for completing the moisture reduction process, and alters the composition of the final product which does not meet the expectations of consumers.

5. MODES OF HONEY PRODUCTION

APIMONDIA has a role in continually guiding the sustainable development of apiculture globally, and always supporting the production of high quality authentic natural honey containing all the complex properties given by nature.

APIMONDIA supports only those production methods that allow bees to fully do their job in order to maintain the integrity and quality of honey for the satisfaction of consumers, who seek all the natural goodness of this product.

APIMONDIA rejects the development of methods intended to artificially speed up the natural process of honey production through an undue intervention of man and technology that may lead to a violation of internationally accepted standards. Table 1 outlines such practices and how they violate the Codex Standard (1981) and the European Honey Council Directive 2001/110/EC (2001).

6. THE EXPECTATION OF CONSUMERS

The expectation by human beings about honey has been transmitted from generation to generation up to the modern honey consumer, who appreciates

Table 1: *Modes of honey production and processing that violate the Codex Standard (1981) and the European Honey Council Directive 2001/110/EC (2001).*

	PRACTICE	WHAT IS VIOLATED?
PRODUCTION	Harvesting of immature honey as a systematic and purposeful mode of production	- Bees have insufficient time to mature honey and add specific substances of their own by multiple manipulations. - The transformation of nectar into honey is only partially made by bees, and human intervention completes the process in an illicit manner.
	Artificial feeding of bees during a nectar flow.	- Honey must only be produced by honey bees from the nectar of plants or from secretions of living parts of plants or excretions of plant-sucking insects on the living parts of plants.
PROCESSING	Honey dilution with syrups.	- Any additions to honey other than honey are ruled out (including those substances that are contained naturally in honey).
	Dehydration of extracted immature honey with technical devices, such as vacuum dryers, etc.	- Moisture reduction of immature honey is an inseparable part of the maturation process, which must be done exclusively by bees.
	Use of Ion-Exchange Resins to remove residues, offensive aroma, constitutes important for quality control (HMF), and lighten the color of honey.	- Honey shall not be processed to such an extent that its essential composition is changed and/or its quality is impaired. No pollen or constituents particular to honey may be removed.
	Pollen addition to honey with the purpose of disguising the botanical and/or geographical origin of the product.	- Any additions to honey other than honey are ruled out (including those substances that are contained naturally in honey).
	Masking and/or mislabeling the geographical and/or botanical origin of honey.	- Honey may be designated by the name of the geographical region if the honey was produced exclusively within the area referred to in the designation. Honey may be designated according to floral or plant source if it comes wholly or mainly from that particular source and has the organoleptic, physicochemical and microscopic properties corresponding with that origin.

the properties and nature of honey as never before in history. As opposed to other foods, whose manufacturing practices and consumer tastes have mostly changed, honey perception by humans stands quite the same in this era of comprehensive information, of traceability, of the rule of law, of enhanced food safety, and of creative marketing (Phipps et al., 2015).

Stone paintings from prehistoric times (Paleolithic period, 15,000 to 13,500 B.C.) show us that humans were indeed hunters of this natural and sweet food entirely prepared by bees that needs no manipulations by humans to be ready to eat. Honey was the only sweetener for thousands of years, as the use of sugar cane is reported since approximately the 4th century B.C. and restricted to those parts of the world where it was endemic (Warner, 1962). Sugar beet was the result of breeding in the 18th century (Biancardi, 2005).

The product that was accessible to early honey hunters can be assumed to be mainly mature honey (with sufficient time given to bees to fully do their job), instead of an immature product, which would be simply too difficult to handle (lower viscosity, storage) and would not have the desired microbial stability for long-term storage. Consequently, early humans were mainly exposed to ripe honey, giving rise to certain expectations regarding the organoleptic properties of this food.

7. ABOUT THE DEFINITION AND ESSENTIAL COMPOSITION OF HONEY

Codex Alimentarius (1981), the internationally accepted standard for foods issued by the FAO, contemplates the biological aspects of honey production and defines:

"Honey is the natural sweet substance produced by honey bees from the nectar of plants or from secretions of living parts of plants or excretions of plant sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in the honey comb to ripen and mature."

APIMONDIA adheres to the Codex Alimentarius (1981) definition of honey and to its description of essential composition and quality factors:

"3.1 Honey sold as such shall not have added to it any food ingredient, including food additives, nor shall any other additions be made other than honey. Honey shall not have any objectionable matter, flavour, aroma, or taint absorbed from foreign matter during its processing and storage. The honey shall not have begun to ferment or effervesce. No pollen or constituent particular to honey may be removed except where this is unavoidable in the removal of foreign inorganic or organic matter".

APIMONDIA understands that the use of "shall" or "shall not" of Codex Alimentarius (1981) makes it not optional but mandatory.

Codex Alimentarius (1981) rules out any additions to honey (including those substances that are contained naturally in honey such as water, pollen, enzymes, etc.), nor any treatment intended to change honey's essential composition or impair its quality.

Such non-permitted physical, chemical or biochemical treatments include, but are not limited to, the use of ion-exchange resins to remove residues and offensive aromas, and lighten the color of honey.

Honey for table consumption should not be heated (e.g. when processed to avoid crystallization) to such an extent that its essential quality parameters exceed the limits of international standards. These parameters must be met during the whole shelf life of the product, and not only immediately after processing. However, honey used as an ingredient in food may sometimes be heated as part of the manufacturing process of the food.

As defined by Codex Alimentarius (1981), the transformation of nectar into honey must be completely made by bees. No human intervention in the process of maturation, neither any removal of constituents particular to honey are permitted.

A constituent particular to honey is any substance naturally occurring in honey within its typical range of concentration. Interpretation of the term "particular" in the sense of "unique to honey" is not accurate. There are many specific constituents which are inherent in, and universal to, all authentic honey. These constituents include, but are not limited to sugars, pollen, proteins, organic acids, glucose, fructose, amino acids, enzymes, water, chemical compounds which add flavor and color, and other minor substances. None of these substances, in and of themselves, are unique to honey, but as a group they are essential and particular constituents of authentic honey produced according to the modalities described in this APIMONDIA Statement. Water, as well as glucose, fructose, other sugars, proteins, organic substances, and other natural components are definitely considered constituents particular to honey.

Moisture reduction of nectar is an inseparable part of the maturation process of honey and must be done exclusively by bees. For *Apis mellifera*, the process of nectar drying normally continues until the final product has less than 18% of water (Maurizio, 1975). However, very humid areas, seasons, and/or weather conditions may be exceptions since bees may cap honey although its water content is over 18% (Traynor, 2015). According to Buawangpong and Burgett (2019), even under the warm and humid conditions of Thailand, honey from Apis mellifera, if not prematurely extracted through human intervention, is produced with a moisture content under 20% and within recognized international standards for mature honey. In contrast, for some Asian honey bee species, the average honey moisture content of mature honey contained in capped cells may be up to an average of 22.7%, e.g. for *Apis dorsata* (Buawangpong and Burgett, 2019). Honeys produced by other Apis species — different to *Apis mellifera* — should prove its entomological origin in order to be exempted of internationally accepted limits regarding moisture content. A novel realtime polymerase chain reaction (PCR) method with high resolution melting analysis has been developed for the authentication of honey samples produced by Asian and European bees (Soares et al., 2018; Zhang et al., 2019).

Frames with fresh nectar that can be shaken out of the cells like water should not be harvested by the beekeeper (Matheson, 1993; Horn and Lüllmann, 2019). Of course, the beekeeper is not always in the fortunate position to harvest only 100% capped frames. The possibility of harvesting partially capped honey combs normally depends on the ambient humidity conditions of the year and/or the region. Under normal ambient humidity conditions, beekeepers may harvest some frames with different capping percentage, since even uncapped frames may contain mature honey. The beekeeper can assure the maturity of the harvested lot by giving bees enough time to process honey and not harvesting beehives too frequently. Horn and Lüllmann (2019) provide guidelines for harvesting honey with an adequate moisture content. However, it must be emphasized that in areas or seasons where air humidity is high, only fully capped frames should be harvested (Warhurst and Goebel, 2005).

If honey combs have to be stored for a few days in the honey extraction room, the beekeeper should also ensure that the honey does not deteriorate by taking up moisture from the environment (Horn and Lüllmann, 2019).

Considering that honey with a water content over 17% may ferment according to the yeast count (Traynor, 2015), the process of moisture reduction of mature honey, e.g. from 20% to around 18% may sometimes be necessary during processing before bottling in order to reduce the risk of fermentation. The intent of this process is absolutely different from the use of vacuum dryers to remove large quantities of moisture from immature honey.

Extraction of water from extracted immature honey is considered a human intervention that interferes with the natural process of maturation, and transforms a product that may not be called honey according to internationally accepted standards into a product that technically better fulfils some of the criteria for honey, thereby clearly constituting an illegal action (Lang and Schwartzinger, 2020). It also results in a significant loss of honey aromatics and flavonoids which are stable at normal atmospheric pressure (Cui et al., 2008).

APIMONDIA adheres to the maximum moisture content of 20% established by Codex Alimentarius (1981), which constitutes the practical limit to differentiate mature honey from the immature product, Calluna honey currently being the only exemption.

In summary, according to APIMONDIA, honey is the result of a complex process of transformation of nectar/honeydew that occurs exclusively inside the beehive. Honey is unique because of its production process and its composition.

8. THE IMPACT OF HONEY ADULTERATION

Information coming from global honey trade statistics, official surveys, government activities, and private laboratories on the prevalence of honey fraud, allow us to conclude that fraud mechanisms are responsible for the presence of a very important volume of diluted and/or non-conforming honeys into the market (Dübecke et al., 2018; García, 2016).

The current critical crisis of the honey market has an extensive global magnitude, and impacts on both the price of honey and the viability of many beekeeping operations. A situation has been created where the offered quantities of pseudo honey are virtually unlimited with prices that seem to have no floor. The current crisis of the honey market has led Prof. Michael Roberts to introduce the concept of beekeepers as an "endangered species" (Roberts, 2019).

The Executive Council of APIMONDIA has defined honey fraud as one of the two major challenges to the viability of beekeeping globally. APIMONDIA, as the voice that represents beekeepers around the world, aims to play an increasingly important role in driving solutions to honey fraud in the future.

According to the U.S. Pharmacopeia's Food Fraud Database, honey ranks as the third "favourite" food target for adulteration, only behind milk and olive oil (United States Pharmacopeia, 2018). Similarly, the European Union has identified honey to be at high risk to be fraudulent (European Parliament, 2013).

The European Commission (2018) considers that four essential elements must be present in a case of food fraud:

1. Intentionality,
2. Violation of law (in this case, the Codex Alimentarius definition of honey),
3. Purpose of economic gain, and
4. Consumers' disappointment.

Honey fraud in its five different modes has resulted in at least three visible consequences in the international market:

1. A downward pressure on pure honey prices due to an oversupply of product,
2. A disincentive to produce and export pure honeys by several traditional countries, which have shown significant decreases in their export volumes during the past years, and
3. The appearance of new exporting countries, that re-export cheap imports, straight or in blends, as locally produced (García, 2018).

As long as honey fraud, customs fraud, and the violation of national and international trade laws persist, the wellbeing and stability of beekeepers around the world remains in jeopardy. With only some exceptions, current honey prices paid to the beekeeper are not sustainable. If the current situation of low prices persists, many beekeepers will abandon the activity, and those who decide to continue will not be incentivized to keep their current colony counts.

Honey fraud threatens honey's image as a natural product and its attractiveness and appeal to consumers, and harms honest beekeeping. It also happens at the expense of consumers who often do not receive the product they expect and pay for. The overall result is a threat to food safety, food security and ecological sustainability.

In order to better understand the magnitude of the problem, we must remember that honey is the best-known product of bees but surely not the most important one. Bees, throug their pollination work, are essential for the maintenance of the planet's biodiversity, and absolutely necessary for the pollination of crops that represent 35% of all our food. Moreover, bee pollination is not only important in terms of quantities of produced food but also because many of the pollinator-dependent crops are also among the richest in micronutrients essential to human health (Chaplin-Kramer et al., 2014).

9. THE SOLUTION

The strategy to combat honey fraud must include:

- Awareness of the beekeeping community through presentations and publications.
- Awareness of consumers through the media.
- Awareness of retailers and packers on the need to improve testing of honey produced in countries with regulations that do not fulfill the criteria of internationally accepted standards, and whose product could not be exported to countries where those standards apply.
- Awareness and collaboration with national authorities and retailers who should periodically review their honey standards and use the best and most advanced available methods for the detection of honey fraud. The sole use of the official AOAC 998.12 method is no longer sufficient to prevent exposure of consumers and other stakeholders of the honey sector to food fraud. More advanced and powerful methodologies such as Nuclear Magnetic Resonance (NMR) and Liquid Chromatography High Resolution Mass Spectroscopy (LC-HRMS) should be applied to test multiple parameters which are relevant to multiple modes of adulteration.
- Awareness and collaboration with multinational authorities and institutions.
- Full and effective enforcement of all local laws pertaining to food fraud must be encouraged.
- Full implementation of third-party audits in order to verify the compliance of internationally recognized standards, the food safety of the product, the Honey Fraud Management System of the company (which includes a fraud vulnerability assessment and a mitigation strategy), and the traceability of honey back to the apiary and the beekeeper.

10. RECOMMENDATIONS FOR ASCERTAINING AUTHENTICITY OF HONEY

APIMONDIA considers that all beekeepers should strictly follow Good Beekeeping Practices in order to avoid contamination of honey with products used for artificial feeding of beehives. Beekeepers should keep records that document all their treatment and production processes.

Accordingly, each company dedicated to trading, processing, manufacturing, and/or packing honey should have a documented honey fraud management system in place that includes a vulnerability characterization to fraud, a mitigation strategy, and a program for implementation and review.

Some important tools used for the prevention of honey fraud are the traceability of honey, laboratory testing, and auditing systems.

a. Traceability

APIMONDIA recommends that honey should be able to be traced back to the beekeeper, to the botanical floral source from which the bees gathered the nectar, and to the geographic location of the apiary. Traceability should also include transparency of beekeeper's practices. In agreement with HACCP requirements, beekeepers shall keep records that document their production processes and their extraction methods and storage conditions, as consumers demand transparency of the whole supply chain. APIMONDIA considers this an integral part of modern Good Beekeeping Practices. Honey's vulnerability to fraud increases with the complexity of the supply chain, and traceability systems without adequate controls do not preclude the vulnerability to fraud.

Considering the challenges of global trade chains, traceability of honey shall be aligned with standards in the food sector, such as BRC or IFS, which require a Vulnerability Assessment and Critical Control Points (VACCP) be put in place, including organizational as well as analytical measures.

b. Testing

Honey fraud, as other modes of food fraud, is a dynamic phenomenon. Effectiveness of methods to detect honey fraud normally decreases after some time due to the successful learning process on the fraudster's side (Dübecke et al., 2018). Ethical stakeholders of honey trade and processing should always go a step forward, and not a step back, in their commitment to minimize the probability of occurrence of fraud by consistently using the best available method/s to detect it.

Many different kinds of syrups are currently available, some of them specially designed to adulterate honey, i.e. syrups were optimized to match certain testing criteria. These syrups display varying patterns of minor components and trace compounds, which are often used as analytical markers. It is practically impossible to have a single and permanent method able to detect all kinds of honey fraud. By contrast, as fraud involves criminal intentions, variations in fraud practices have to be expected.

The importance of applying suitable testing regimes, and not only the methods required by authorities, has to be emphasized due to the dynamic nature of fraud and the limitations of official methods, e.g. the AOAC official method 998.12 "Internal Standard Stable Carbon Isotope Ratio." It is well known that the AOAC official method can detect reliably and sensitive additions of syrups derived from C4-plants, but fails to detect many other types of syrup. The argument of solely using the AOAC method to reduce the vulnerability to fraud because it is the only official method may be deliberately used to whitewash adulterated honey. APIMONDIA does not endorse such practice because it neglects other certain risks and ignores the requirement of establishing a risk-assessment program with the corresponding mitigation strategies in their operations. Hence, using AOAC 998.12 as the sole testing method has to be considered a violation the principles of VACCP required by IFS, BRC and other standards of food sector.

APIMONDIA highly recommends a choice of method/s tailored to each specific situation making risk assessment (including VACCP) a mandatory first step when deciding about tests. In all cases, a proper honey fraud detection strategy should include a powerful screening method like NMR (Bertelli et al., 2010, Spiteri et al., 2015; Schwarzinger et al., 2015) and/or LC-HRMS (Du et al., 2015; Senyuva et al., 2015). Screening methods have the advantage of monitoring a larger number of parameters in the course of one analysis, thereby addressing multiple aspects of fraud. However, as various methods have strengths and weaknesses, it is advisable to combine methods complementing each other. At the time of preparation of this Statement, this is the case for NMR and LC-HRMS-based approaches in terms of variety and concentration ranges of analyzed molecules, which cover a wide range from traditional quality markers to newly available adulteration markers. For best performance, at this stage all tests shall be carried out in the context of meta information regarding variety, geographical origin, and — if applicable — special purchase specifications. For many modes of fraud, such combinations of complementary screening methods will provide clear results.

In case non-conformances or suspicious results (which cannot be ruled out as a response of ever improving fraud practices) are found, other targeted test methodologies may be useful to complement in order to better clarify the origin of deviations indicative of fraud. Such methods include, but are not limited to, e.g. EA-IRMS, LC-IRMS, honey-foreign enzyme activities, small molecule or DNA-based syrup-specific markers, and honey-foreign oligosaccharides from incomplete starch degradation (see for e.g. Soares et al., 2017).

Pollen and organoleptic testing, along with other honey components, are considered good complementary parameters to determine the geographic and botanical authenticity of honey. However, it should be noted that during the last years, cases of purposeful addition of extraneous pollens used to disguise country of origin and floral source of honey have been found (Phipps et al., 2015). Care should be taken also for some specific regions where some plants are known to secrete nectar but not pollen. In those cases, pollen analysis must be complemented with geographic location of the beehives, with local beekeepers´ knowledge, and with the apicultural value of the different botanical species. As the NMR test is based on the constituent pattern of a honey, which can be correlated with its botanical and geographical origin, this test may be used to verify variety/origin claims even in the case of honeys that have been filtered or where exogenous pollen has been added.

It is interesting to note that, due to the nature of honey fraud, it is not infrequent that the results of a method may need to be clarified by the use of other alternative tests. In the contemporary context the development of multiple modes of detection of fraud is imperative.

The decision taken regarding the best testing method/s to be used shall always be within the frame of a detailed honey fraud management system (or the VACCP), which should consider the supply chain of the product, the relationship with the supplier, the history of honey adulteration cases from that origin and/or supplier, economic anomalies of the region related to honey, and the most usual modes of production and adulteration currently used in the region of origin. It has to be strongly noted that the election of method/s has to be periodically checked in accordance with new scientific insights, change of regulations, etc.

APIMONDIA supports the development of new techniques to detect honey fraud, available at reasonable costs for the majority of stakeholders, and supports the constitution of an international database of original honeys with a more open exchange of analytical information between the different government, academic and private laboratories specialized in honey analysis.

c. Auditing of Food Fraud Management Systems

As previously stated, APIMONDIA recommends that business stakeholders, who import, export, or process honey have a documented Food Fraud Management System in place.

Audits including anti-fraud measures should be performed on-site during the productive season by professionals who have an adequate knowledge of beekeeping, good beekeeping practices, and honey quality parameters in order to detect eventual deviations in the modes of honey production (e.g. production of immature honey, and artificial feeding during nectar flow) and/or illicit processing technologies that may result in a non-genuine product (e.g. ion-exchange resin technology, vacuum dehumidifiers, and presence of sugar syrups in honey processing facilities). As auditing for fraud aspects deviates from regular quality audits, auditors have to receive according training too. Such third-party audits should be conducted with absolute independence, integrity and professional expertise. Audits at the processing facilities should check the Honey Fraud Management System (including the VACCP) of the company, the integrity, traceability, and security of the supply chain. After reviewing raw materials receiving, auditors should inspect the integrity of the process used in processing raw materials (eventual existence of illicit processing technologies), and check mass and financial balances.

Auditors should always take samples at different stages of the production and processing chain for laboratory analysis of honey moisture and purity.

11. CONCLUSION

The crisis provoked by Food Fraud has deepened and broadened. At the same time, awareness of the crisis has grown.

There has never been a period in human history during which the importance of and concern for the world's bees and their keepers has been so widespread. This means the importance and imperative of APIMONDIA's work is acute and encouraging.

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Keeping Time: Using Phenology to Capture a Honey Flow

Part 2 of 2

By MICHAEL DONIHUE

I'll admit that sometimes my imagination gets the better of me, but I could swear that our bees come looking for me when they've got important news to share. More than once I've been at some out-of-the-way location on our property when a few of our honey bees will noisily appear just in time for me to witness a swarm taking off from one of our hives. Last summer I got nailed upside the head by one of our resident *Apis mellifera* foragers as I walked across our back yard. Needless to say, this got my attention and I looked around to see what sort of "message" I was being sent. Sure enough, two of the hives in our apiary looked like they had turned themselves inside out with heavy bearding across the front of both deep supers and around the upper entrance of the medium honey super I'd recently added on.

Temperatures during the first week of July 2019 hovered near 90 degrees here in Central Maine with humidity levels on several days rising above 50%. It had been on my to-do list to return for a look inside our hives following a couple of weeks of intense blossoming on the white clover in our lawn and plenty of bees foraging on the chives, borage, milkweed and flowering perennials. My intuition told me that the honey flow was indeed "on" and that some of our colonies might be ready for an additional super or two.

One hot topic for conversation among beekeepers, and a common question I hear from honey bee-curious friends is "How can you tell when the honey flow is on?" Of course, honey doesn't flow from plants — what we're talking about is an abundance of nectar attracting the bees to make honey. Anticipating a nectar flow and recognizing when it is indeed "on" is perhaps one of the most important seasonal activities for both commercial beekeepers and back yard hobbyists. As I removed the stinger from my temple on that hot July day it got me thinking about the different ways beekeepers tend to answer this question. And as I turned my attention toward our bearded-up apiary I realized that I was standing in a line of honey bees flying low and slow back toward their hives.

Like many hobby beekeepers I enjoy gadgets, but I've resisted investing in the latest technologies for remote internet-based scales to monitor the weight of our hives, internal temperature sensors, inside-the-hive sound recording devices, and thermal imaging cameras. One way to answer the question of when a honey flow is on is to simply open up the hive and see what the bees are doing. It's how quickly things can change in a hive, and simply hefting one end of a super can tell you a lot about the honey flow and strength of a hive. However, sometimes the simple approach to beekeeping just isn't possible.

In our apiary I'm naturally predisposed to a laissez-faire attitude toward our bees. Once well established, I tend to disturb our colonies only when I think there is a need based on what I observe going on *outside* the hive. Plus, it's not easy to inspect a hive when all of the bees are bearded up on the outside of the supers. The disadvantage to the laissez-faire approach, of course, is that it's easy to miss an important event like a swarm or supersedure. Without a careful inspection it's sometimes hard to tell if a hive is suffering from a dearth of food, disease, mite infestation, a laying worker, or a poorly mated queen. So for the beekeeping club I mentor I do recommend regular inspections, but always accompanied by first observing what's happening in and around the immediate vicinity of the apiary.

This got me thinking about phenological activities that might help in answering the question of when a honey flow is on. Specifically, what sort of observable environmental events are going on *outside* the hive that might help answer this question? Temperature changes, rainfall, cloud cover, nearby farming activities, pesticide or fertilizer applications, and persistent lawn mowing in the neighborhood are some easily observable seasonal events that might influence the availability and accessibility of nectar and pollen that can be reflected in honey bee behavior.

I received a copy of "The ABC and XYZ of Bee Culture" as a gift when I began keeping bees some 30+ years ago and it's been an enjoyable resource for a historical perspective on questions like "How to Know When Honey is Coming in?" (page 206 of the 34th edition). Here the authors offer six time-saving "…surface manifestations [that] may show when and where to put on supers," noting that "… at the height of the season it is often impossible to examine a hive." Most of their *surface manifestations* can be found in some form in more modern texts and beekeeping course materials. Recommendations for beginning beekeepers to be on the lookout for heavy bearding of bees working to ventilate a honey-bound hive on a hot, humid day, and to watch how the foragers return to the hive entrance, are standard best practices for mid-summer beekeeping. Whereas early in the season we watch for bees gracefully flying to and from the hive bringing in pollen as a sign of brood development and a healthy queen, in late spring and summer we're looking for large numbers of bees leaving the hive and returning low and slow, sometimes clumsily crashing into the front of the hive or collapsing at the entrance bearing heavy loads of nectar in their honey stomachs.

Anticipating a nectar flow is more difficult. I'm not sure I can say what's "normal" for the weather in our apiary anymore. By my calculations, spring arrived at least two weeks late in 2019 — as of the first week of July we were still about 75 growing degree day (GDD) units behind 2018's total. (See part 1 of this article, "Using Phenology to Keep Bees," in the March ABJ.) Last year we had over 5 inches of rain in June, nearly twice as much as in 2018. As a result, the nectar flow exploded in early July as temperatures suddenly rose to typical mid-summer levels and all of the local flora experienced rapid growth. Sure enough, when I opened up our hives after receiving the "special delivery" message from a resident forager the supers were wall-to-wall full of honey. Much of the honey was uncapped but there were enough sealed frames for me to extract 4 gallons and return the wet frames to give the bees some space to work.

It's not hard to find good online resources about how and why plants produce pollen. Things get a bit more complicated, however, and much less clear, when you want to know about the science of nectar production. I have a friend who is a biology professor and I asked him for help in trying to put together my observations on this year's honey flow with my intuition about observable environmental factors related to honey bee behavior. He provided me with the following mini lecture on some preconditions for plant growth and the chemical reactions that characterize photosynthesis.

Plant growth requires many chemical reactions, and since chemical reactions proceed faster at higher temperatures, plants will grow faster (and produce more nectar) on warmer days. Glucose and other simple sugars found in nectar are produced through photosynthesis, a process that requires the input of energy from the sun. In photosynthesis, plants take in carbon dioxide and water molecules from their surrounding environment and use them to build carbohydrate molecules. Oxygen is given off as a waste product from this process. Since nectar is mostly sugar dissolved in water — warmer temperatures, sunnier days, and abundant water will provide plants with everything they need to produce more nectar.

Last year's wet June produced an abundance of available moisture. Cooler temperatures meant fewer growing degree days and slower plant growth for most of the month until things warmed up in early July when just about all the plants on our property began growing rapidly and synthesizing that moisture into nectar. This coincided with the regular seasonal buildup in the number of bees in each of our colonies. Lots of bees … lots of available nectar … a flight path that was low and slow … the honey flow was indeed on! The high water content of last year's nectar flow meant the bees had to work harder to get the moisture content down to the roughly 18% that characterizes honey. Strong hives, combined with the warmer temperatures and humid conditions, explained the bearding I observed on the fronts of my hives.

A subsequent hive check at the beginning of August revealed that there hadn't been much additional accumulation of honey during July and we opted to head into the fall leaving each colony with a medium super full of honey and another half-full medium on top for the goldenrod and aster flow that usually arrives by early September. The arrival of these early fall food sources, with the distinctive smell of goldenrod nectar in particular, is the signal we use for doing another mite check and treatment if necessary, as the flowering of fall asters typically coincides with a spike in varroa mite populations and the beginning of a drop-off in brood production in our colonies.

For more information…

On photosynthesis, visit the Wikipedia entry at **https://en.wikipedia.org/wiki/Photosynthesis**

On growing degree days visit **www.canr.msu.edu/news/understanding_growing_degree_days**

Kim Flottum's "The Backyard Beekeeper" has a good overview of how flowers produce pollen and is generally a good source of current information on beekeeping practices for both novice and experienced beekeepers.

"The ABC and XYZ of Bee Culture" is currently in its 41st edition and was last updated in 2007. The first edition, titled "The ABC of Bee Culture" was published in 1877.

A version of this article first appeared in the newsletter of the Maine State Beekeepers Association. ABJ thanks "The Beeline" for permission to reprint it.

Michael Donihue has been a hobby beekeeper for a little more than three decades. In addition to their day jobs, he and his wife maintain their apiary along with vegetable and perennial gardens adjoining their small woodlot in Central Maine.

GO NATIVE

Wildflower Plots for the Pollinators and the Planet

by KEN SIKORA

Few can deny that global warming exists. There are obvious changes taking place. I don't believe it's all manmade, but much of it is. Regardless, I think that we should be **better stewards** of our planet. It's no secret that we are losing many of our pollinators, such as bees, butterflies, birds, many insects, etc. And it's not all because of global warming. Much of it is because of habitat loss.

Global warming is said to be mainly because of carbon overload in our atmosphere. Therefore, we need to sequester the released carbon we've created, back into our soils. And it won't happen by maintaining expansive lawns. I can't believe the size of some of the corporate, residential, government (parks) and church lawns. What are we thinking? These are all sterile environments, requiring chemicals that contaminate our waterways, kill the early sources of pollen for bees, (i.e., dandelions), and require operation of small polluting engines, sometimes on a weekly schedule!!

There are many small things we can do as individuals, corporations, etc., to make a difference. We need to create habitats for God's creatures to survive. These new habitats will provide a twofold advantage: habitat for God's creatures and carbon sequestration plots. The plants will absorb some of the excess carbon in our atmosphere. Every little bit we do will help!!

Backyard trail. Beehives are behind the barn.

Go Native

Therefore, we need to plant more native trees and native wildflowers on our corporate, public, church, government and private properties. Various designs of short grass/wildflower plots, that change their blooming colors monthly, with lawns in-between, will not dress-down the landscape but will make an ecological difference. I can show you, because I "walk the walk" as seen in these pictures. All plots are active with bees, butterflies, and birds. It's very rewarding to see nature pleased and multiplying because of the available forage. It's particularly pleasing to see the honey bees working the flowers.

All native wildflower plants have deep, thick root systems, which the plants concentrate on developing before creating blooming flowers, which may take up to five years with some plants. Because of this, many wildflowers are drought resistant and do not require watering — the roots are deep enough to absorb deep ground water. Some species sequester nitrogen (a natural fertilizer) from the atmosphere into the soils, like legumes (or bean-producing) plants. Of particular importance, wildflowers provide the necessary amino acids, lipids, and minerals that the bees and other pollinators need to be healthy — not so with horticulture plants.

Plant a WildFlower Area

I realize that most people don't like the hard work of gardening, but we have to change our thinking, and our ways, if we want future generations to enjoy what we have now. Remember, too, the physical exercise of gardening greatly benefits you and benefits our planet — think carbon sequestration.

To get started planting, decide whether you want tall or short species of native wildflowers and grasses — which will depend on how big of an area you are working with. Plant selection will be based on the following:

A. Sun exposure: full sun, part shade, or shade
B. Soil moisture: dry (clay, sand, loam), wet mesic (wet after rains but dries out), mesic (water soaks in), dry mesic (well drained), or dry (excessively drained)
C. Height
D. Bloom time.

All this information is listed alongside each plant description in the wildflower catalogs. Buyer beware: If you are not dealing with a reliable wildflower nursery, you could be buying non-native plants and seeds. Some alien plants can be very aggressive and take over an area, and you will have a challenge to get rid of them once they proliferate. All catalogs typically have symbols for each plant designating which creature it will benefit, or which creature is attracted to it, i.e., bees, butterflies, etc., and which are deer-resistant.

Five-year-old prairie in barnyard soil using seed and transplants

Soil Preparation

Don't take on too big of an area initially, because of the work involved. And leave space to further expand. Soil preparation can take many forms:

1. A shallow tilling of the soil requires more than one pass-thru throughout the summer. When disturbing the soil, weed seeds that have been dormant for many years will pop up under the new conditions you've created by tilling.
2. Chemical sprays require more than one treatment, and any runoff pollutes our aquifers, streams and lakes.
3. I like to use smothering. Short pile, jute back carpeting works (rubber-backed carpet will degrade and leave a mess as will deep pile carpeting). Most carpet installation companies will gladly give you the old carpeting taken from jobs. I typically cut the grass/weeds as short as possible and lay the carpet, with the pile down, for one year.
4. A roll of black plastic laid down for one year works as well. You will need to anchor it down — a roll of 6-foot-wide wire fencing works best and can be reused. Wind will lift up the plastic if not adequately anchored down.
5. Another method I use is laying down cardboard over a lawn, and covering it with a 2-3-inch layer of soil — black compost from our village recycling center is free for the taking. Then, for the native potted plants I've purchased, I cut an opening in the cardboard and into the soil below, big enough for the plant, and then water it. The cardboard will eventually decompose.

Soil preparation using carpeting and black plastic to smother ground for one year. Soil is fill dirt, primarily clay.

Starting with Seed

If there is a Wild Ones chapter (a national organization dedicated to planting wildflowers, prairie grasses, and native shrubs) in your area, being a member allows you to collect seeds from plants growing in other member's yards, and they also watch where native plants can be rescued from planned construction sites. Use these for filling in your established gardens. Transplanting is a quick method of seeing results in your garden. This is a very worthwhile organization, especially for beekeepers looking to improve the nectar foraging capacity in and around their apiaries.

After the soil preparation has been completed for one year, scratch the soil lightly and sow your collected or purchased seeds (wildflower catalogs have excellent explanations for methods to be used). Seeds for fast growing cover crops can be included. Lightly rake in both. The newly seeded area will require some watering initially.

Many wildflower seeds will not germinate unless they have been stratified, or have experienced winter conditions, i.e., freeze-thaw, freeze-thaw, for multiple weeks. This can be accomplished by sowing the seeds on prepared ground before winter, or accomplished in your refrigerator, if you choose to sow in seed flats in order to put on some early growth, before transplanting. Again, read the catalogs for instructions.

Maintenance and Burning of Prairies

Some weeding maintenance can be done initially or just let the massive root system of the wildflowers slowly develop and they will eventually crowd out the unwanted plants — which for me are: stinging nettle, Queen Anne's lace, various thistles, creeping Charlie, mustards, buckthorn, Canada goldenrod (it's too aggressive), etc. I like to go on weed patrol and pull them out when the soil is soft like after a rain. Another option I use is not to let the weeds go to seed. Cut them back (lawn mower or weed whacker) after they are done blooming. Leave the remaining wildflowers standing throughout the winter for the birds to eat the seeds. Come spring, cut everything to the ground so the sun can reach the ground and warm the soil. It may be necessary to rake off the accumulated dead vegetation.

Or, if you have large wildflower/grass areas, try to burn them every other year. Time the burning to when the sugar maples begin to bud. This will set back the **cool season** plants like the alien weeds that have already put on some growth, and burning will aid the **warm season** native plants to start growing sooner in the spring. With the ground blackened

Controlled burn of six-year-old prairie

from burning, more solar radiation will be absorbed into the soil and this will kick-start the native warm season plants to spring ahead of the cool season plants.

Prairie Plots

From what I have read, prairie plots are becoming more advantageous around commercial orchards, etc., to hold the bees in that area and to provide an important diverse source of nectar to keep all pollinators healthy. Each fall I collect my own seeds and scatter them in right-of-ways, etc. They can even be broadcast on snow and the freezing of the ground will create cracks for the seeds to fall into come spring.

Pollinator paradise in our backyard. Trails keep it interesting.

Save the Planet

We need to rethink the amount of lawns we maintain in order to stop the loss of all pollinators: butterflies, bees, birds, bats, insects, etc., which are having a hard time finding something to forage on.

Backyard shade garden filled with spring ephemerals, which attract a lot of bees in early spring. Humus soil created using grass clippings, leaves, decayed straw bales, etc.

Ken Sikora - As a hobby beekeeper of 25 years, I keep 4-6 colonies near our Green Bay, Wisc. home. Growing up a Yooper (Upper Peninsula Of Michigan) I spent a great amount of time in the woods, which imprinted a love of nature on me. As a consequence, along with my bees, I love working on creating/improving habitats for pollinators using wildflowers, native grasses, shrubs, and trees. My wife and I maintain five prairie habitats: two properties at home, hobby farm up the road, 1800 church cemetery, and our church property. It can be a lot of work, but it's very rewarding. God knows, the planet needs our help!
I can be reached at kfsikora42@yahoo.com


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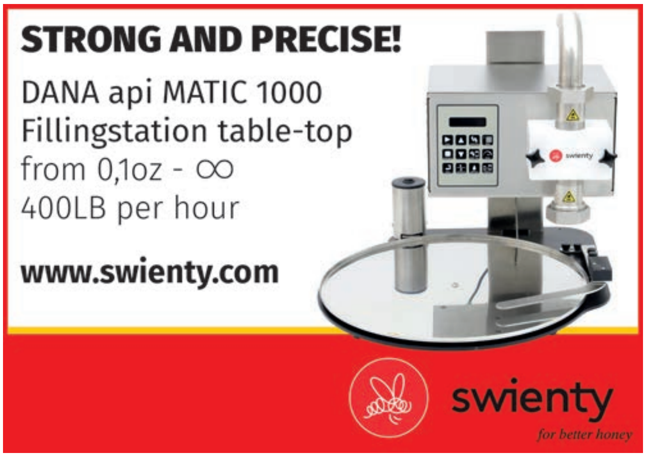

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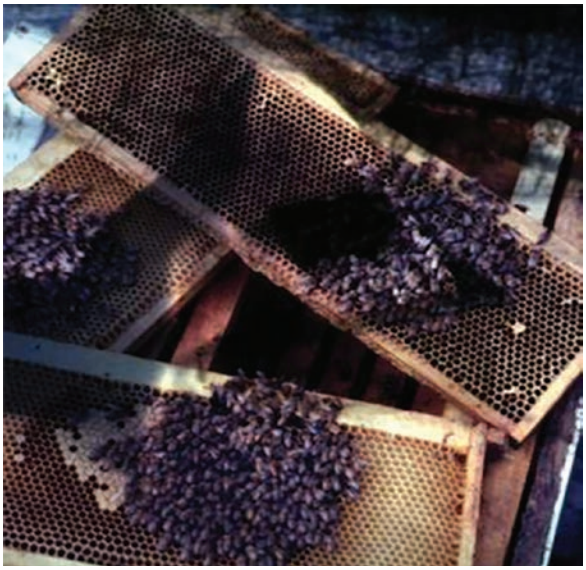


HONEY BEE COLONY MORTALITY — Survey results for the Pacific Northwest

by DEWEY M. CARON

There is an elevated risk for bee colony losses during the winter. L.L. Langstroth in his original "Hive and the Honey Bee," and in subsequent revisions, recommended that beekeepers seek to take losses in the fall, preparing only their strongest colonies to overwinter. Suggestions very widely on what specific fall managements might reduce potential losses.

Following introductions of tracheal and varroa mites, small hive beetle, *Nosema ceranae* and apparent changes in bee virus populations, two major loss syndromes of Colony Collapse Disorder (CCD) and Bee Parasitic Mite Syndrome (Bee PMS — alternatively VMS, Varroa Mite Syndrome) have been described. CCD was first used as a term in fall of 2006; the Bee PMS term was first introduced in the December 1993 American Bee Journal.

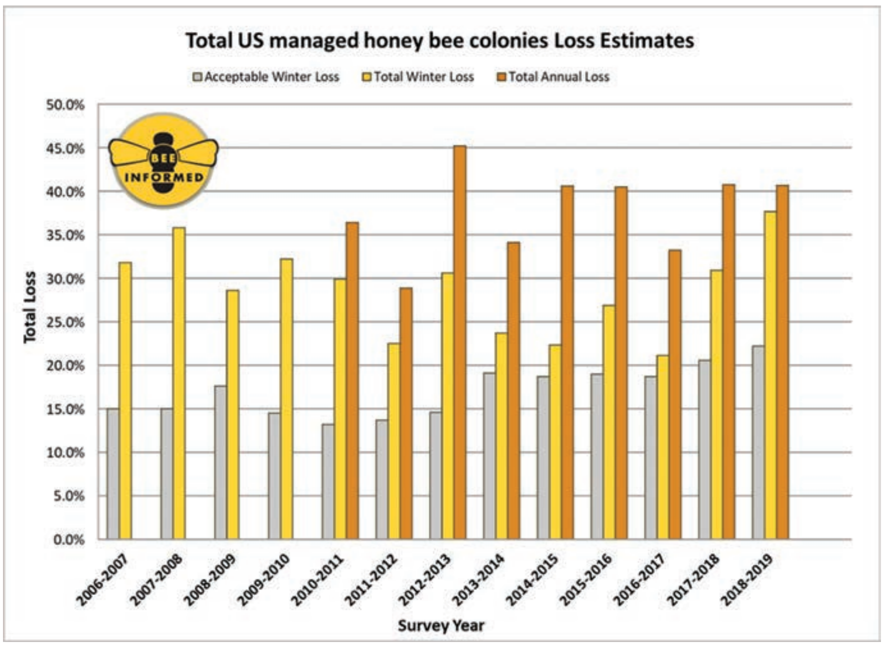
Both syndromes present signs that deviate from the "usual" discovery of remains of a dead overwintering colony (as shown in the above photo). In both CCD and PMS there is a lack of, or only baseball size dead cluster of adult bees and few dead bees on the bottom board or outside the entrance. If there is a remaining cluster, the site is often remote from the original fall brood site. Honey and bee bread stores may be plentiful. Dead/dying brood present unusual symptoms variously termed snot/cruddy or Idiopathic *Brood* Disease Syndrome (*IBDS*).

Despite studies of overwinter losses, no definite factor has been attributed to these syndromes; varroa mites, nosema and viruses have apparent interactive roles, with poor nutrition, pesticides and other possible stressors often implicated as well. CCD and PMS are sometimes used in a general sense for colony loss and original descriptions stretched for any loss event.

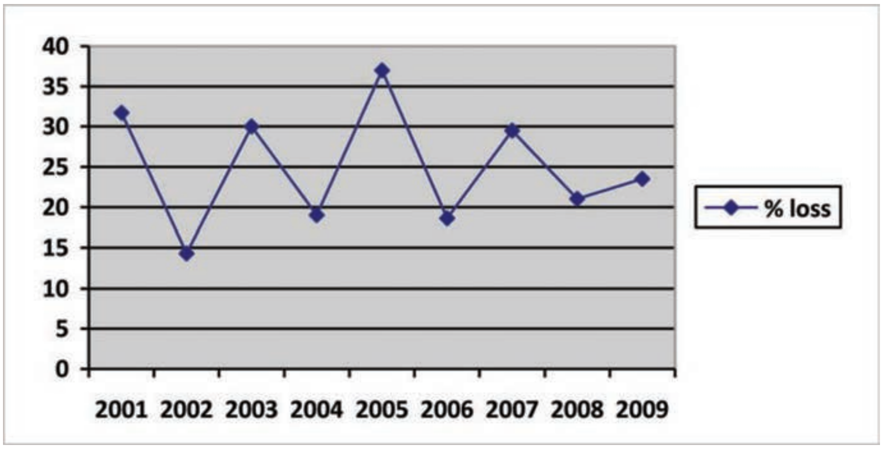
Prior to coinage of CCD or Bee PMS, there were occasional significant bee losses prior to or following the winter period. Such incidences were labeled with a variety of names such as May Disease, Dwindling Disease (for spring events) or Autumn Collapse for a fall colony downturn. One of the well-known loss events was Isle of Wight Disease, initially reported in 1906, with extensive colony losses in Great Britain, Ireland and France for the next 15 years. A mysterious die off of bees occurred in Portland, Oregon and across the southern U.S. in fall of 1915. It was termed Disappearing Disease. Many of the reported instances included descriptions similar to CCD and PMS, with a sudden disappearance/dwindling of large numbers of bee colonies.

Oregon State University apiculturist Mike Burgett reported that prior to the appearance of honey bee tracheal and varroa mites, beekeepers during the mid-to-late 1980s reported average winter losses of 10% or less. Similar loss levels were reported for Canadian beekeepers. A consensus of "normal" losses of around 10-15% over the winter season was the norm.

Following mite establishment, Mike surveyed larger-scale Oregon beekeepers from 1989-1998. Semi-



Graph 1 *Bee Informed Partnership 13-year loss record*



Graph 2 *Delaware/Maryland losses 2001-2009 (from March 2010 American Bee Journal)*

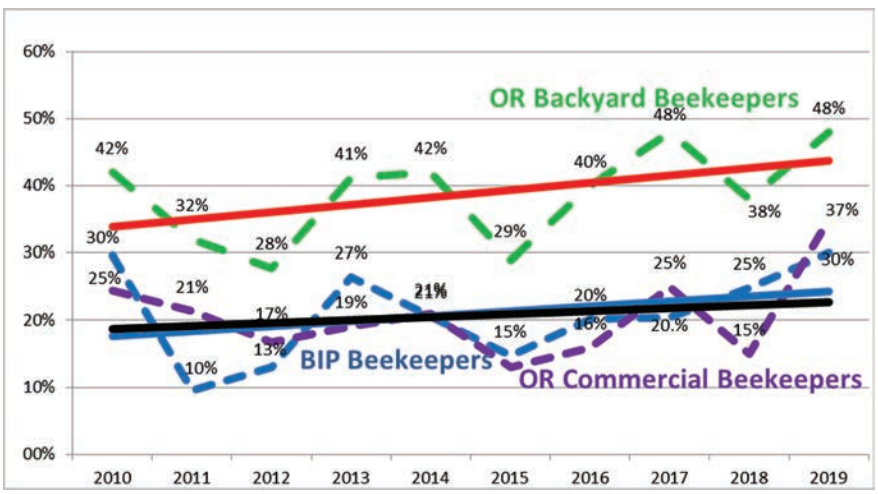
commercial Oregon beekeepers (50-500 colonies) reported an increase in annual loss rate to 13-22% the first four years and to 33-38% the next 4-year period. Commercial beekeeper losses over this same period fluctuated less, from around 20% initially to the higher 20s during later years of survey. Losses were attributed to mites; the CCD term was not yet coined and the PMS label not yet widely adopted.

BIP National loss survey

Bee Informed Partnership (BIP) surveys have thoroughly documented overwinter bee losses over the last 13 years. An initial national survey was conducted by the Apiary Inspectors of America (AIA), in cooperation with a list of beekeepers maintained by the USDA in spring 2007. This survey of beekeepers in 15 states reported a loss rate of 31.8%, confirming what beekeepers were saying — that something was causing heavier than anticipated losses to their bees. The AIA extended this loss survey a second season and losses were even higher at 35.8%; the third annual survey, expanded to 25 states, reported lower losses of 28.6%.

Beginning with the 2009-10 winter season, a national electronic loss survey was initiated by Bee Informed with a grant from USDA, NIFA. That response surveyed 4027 beekeepers managing an estimated 17% of the total number of colonies in the U.S. Loss rate was elevated again to 34.4%. Since that survey, Bee Informed has continued an electronic national loss survey, recently as a nonprofit Bee Informed Partnership. Beekeeper participation has varied from as low as 11% to almost 18%.

The most recent survey, released in June 2019, reported winter losses of 37.7%, which is the highest winter loss reported in 13 years of national loss surveys, 8.9 percentage points higher than the 12 year average (see Graph 1). Total annual losses, a feature of BIP surveys beginning with the 2011-12 survey, was 40.1% of honey bee colonies from April 2018 to April 2019, above the 37.8% average for the previous eight years.



Graph 3 *10-year loss record, PNW and BIP surveys*

Additional to the National survey, there have been occasional surveys of members by several bee clubs over the years. I surveyed Delaware/Maryland beekeepers from 2001-2009 and found losses very cyclic. Losses were higher in odd years and lower in even-numbered years (average 24.5%; range 15% to 37% (see Graph 2).

Pacific Northwest (PNW) Loss surveys

The Bee Informed survey initially included few individuals in the Pacific Northwest (PNW) states of Oregon, Washington and Idaho. A regional survey during the 2007-08 overwinter season of 14 Oregon and Washington commercial beekeepers reported a loss range of 6 to 50%, with average mortality of 29.5%. Eleven semi-commercial beekeepers (50-500 colonies) had a higher average loss of 55% (range of 10-83%, weighted average 30%). In total, these 25 individuals managed an estimated 68% of the colonies in Washington and Oregon.

When I moved to the West Coast, I joined Mike Burgett and economists Randel Rucker (Montana State University) and Walt Thurman (North Carolina State) in a winter 2008-09 loss survey (find report in March 2010 ABJ.) Thirty-four commercial and semi-commercial beekeepers reported a weighted loss of 21%. Once again semi-commercial losses (22 individuals) were higher than the 12 commercials but only by 1.2 percentage points. The BIP national survey included 14 Idaho beekeepers and they had a 33% loss.

An additional 100 returns from Oregon and Washington small scale beekeepers who managed up to 45 colonies (average 6 colonies) reported a loss rate of 25.8%. Self-reported reasons for losses were led by CCD (34% average 2 years), queen failure (22.6%) and mites (21.3%). National losses (BIP survey) were 29%, the lowest loss level found in the first 5 years of the AIA/BIP surveys.

I have continued a loss and management survey of both backyard and commercial beekeepers in Oregon and Washington for the past 10 years. Small scale beekeepers (managing up to a maximum of 50 colonies) are invited to participate in a web-based survey to define overwintering losses/successes (www.pnwhoneybeesurvey.com). Commercial beekeepers are surveyed with a paper survey from Oregon State University. Both surveys are conducted in April, the same time period as the BIP National survey.

I have received anywhere from 112 to over 500 responses from small scale beekeepers, about 80% from Oregon and the remainder from Washington beekeepers. Returns from commercial beekeepers vary from about 50% of estimated colonies represented to over 75%. Annual results are reported in the ORSBA and WASBA newsletters.

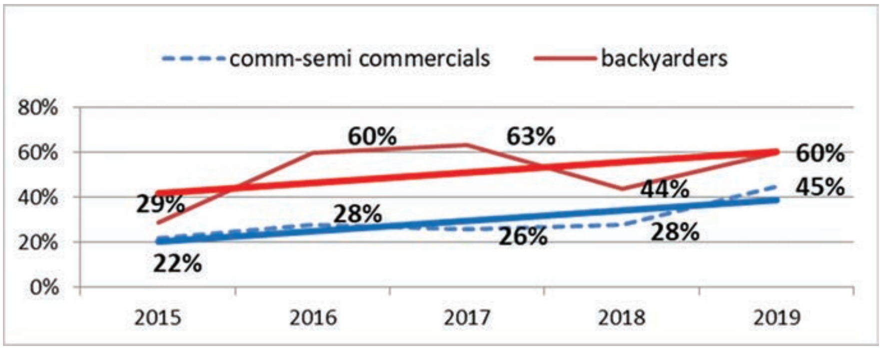
The loss statistic is developed by asking the number of fall colonies (October) and surviving number in the spring (March/April) by hive type, after adjustments for any late/early season additions/removals. Small scale beekeeper loss is also determined for site (to permit future mapping) and by hive origination. Small scale reports include club responses with 15 or more member respondents on the website www.pnwhoneybeesurvey.com. Idaho small scale beekeepers have not been surveyed.

As in the BIP national survey, Oregon and Washington beekeepers this past winter suffered the heaviest losses witnessed in the past 10 PNW survey years. Backyard losses for 416 OR beekeepers with 1-38 colonies was 48% (www.pnwhoneybeesurvey.com). For commercial OR beekeepers, representing about a third of the state's estimated total colony numbers, loss was 37%. Washington small scale (98 individuals) and commercials also had their heaviest loss records, 60% and 45% respectively.

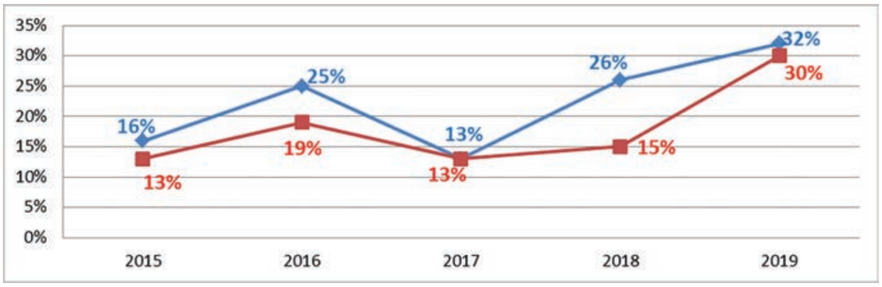
Small scale (backyard) beekeeper losses for Oregon and Washington have consistently ranged from 15 to 20 percentage points higher compared to commercial/semi-commercial beekeepers. Over the same 10-year period, as shown in Graph 3, state losses reported by the Bee Informed survey mirror those of the larger scale survey (see https://bip2.beeinformed.org/loss-map/ for annual losses by state). Trend lines of all three are for increasing losses.

Washington backyard and commercial beekeeper losses, although higher than for Oregon respondents, mirror those of Oregon beekeepers. Small scale beekeepers consistently have considerably heavier overwinter losses compared to commercial beekeepers (Graph 4). As in the case of Oregon beekeepers, the BIP state losses mirror the commercials, not the smaller scale individuals.

Idaho commercial beekeeper losses, as in counterparts in Washington and Oregon are similar to the BIP reported losses for the respective states (Graph 5).



Graph 4 *Small-scale and commercial losses in Washington state, 2015-2019*

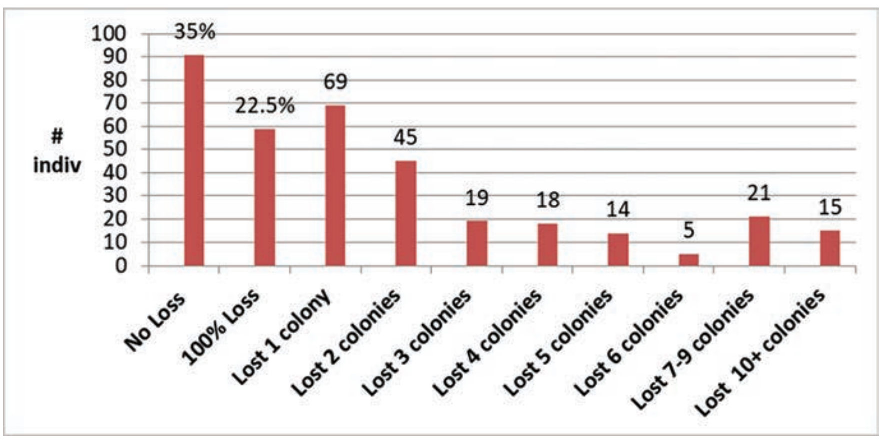


Graph 5 *5-year Idaho loss data from PNW (top blue) and BIP (bottom red) surveys*

It is important to know who are filling in surveys. Each PNW Oregon survey population is characterized by colony numbers and years of experience. In 2018-19, 69 individuals had 1 colony, 109 respondents had 2 colonies (the most common colony number) and 68 had 3 colonies. Fifty-nine percent of respondents entered winter with 1, 2 or 3 colonies. Ninety individuals (22%) had 4-6 colonies and 26 respondents (6%) had 7-9 colonies. Eighty-seven percent of small scale Oregon beekeepers had 1 to 9 colonies, while 13% had 10+ colonies. The highest colony number of 2018-19 Oregon small scale survey respondents was 38.

We also ask the number of years of beekeeping experience for respondents. Forty percent of respondents indicated 1, 2 or 3 years of experience, 132 individuals (32%) had 4, 5 or 6 years' experience and 11% had 7, 8 or 9 years. The median years of beekeeping experience for Oregon beekeepers was 4. Seventy individuals (17%) had 10+ years, and 50 years was the longest. Three and four years were the most common. The 54 individuals with 10+ colonies tended to have more beekeeping experience. Four of them (7%) had 3 years' experience, 20 respondents had 4-6 years, 13 had 7-9 years and 16 (30%) had 10+ years of experience.

Individuals with 1-9 colonies and those Oregon small scale beekeepers with 10+ colonies were separately examined to determine overall loss rate. Loss rate for 54 individuals with 10+ colonies was 42%, 6 percentage points



Graph 6 *Number bee colonies lost overwinter by Oregon beekeepers 2018-19. (First 2 columns are percent of beekeepers with no loss/100% loss; remaining columns are numbers of beekeepers with specific losses.)*

lower than the overall loss (48% in 2018-19) of small scale individuals. Annual participation of small scale Washington beekeepers and for individual clubs have similar representations in number of colonies and years of beekeeping experience (but smaller respondent numbers may show less representation) — see reports on website **www.pnwhoneybeesurvey.com**.

In each survey year there are significant numbers of individuals that have no loss and those that have total loss. In 2018-19, 35% of respondents had no loss while 22.5% lost 100% of their colonies. Heaviest loss was among those with just one colony. Graph 6 illustrates 2018-19 loss numbers for Oregon small scale beekeepers. For the survey respondent individuals with 10+ colonies, four of these 54 individuals (7%) lost no colonies, while 1 lost all their colonies.

Perceived reason of loss and acceptable level

We ask individuals who have colony loss (91 individuals had no loss) to estimate what the reason might have been for their loss (multiple responses were permitted). There were 726 total listings, 2.35/individual. Most commonly checked was "varroa" (40% of respondent choices, 21% of total responses), followed by "weak in fall" (29% of respondents, 15% of total responses) and "queen failure" (27% of respondents, 14% of total responses). Seventy individuals chose "don't know." Among "other," 12 individuals listed "pesticides." NOTE: Table 1 is respondent choice for Oregon small scale 2018-19 survey.

Survey respondents were also asked for a level of acceptable loss. Sixty-seven (17%) indicated zero (no loss) was acceptable. One hundred sixty-seven (42%) of individuals indicated 15% or less was acceptable loss level; 20% was medium choice; 17% said 50% or greater was acceptable. Table 2 shows numbers of individuals; 7 individuals listed don't know. The indication of acceptable loss for survey respondents to the BIP national survey has increased from 15% initially to over 20% currently. There is no effort to define the meaning of "acceptable" in either the PNW or BIP surveys.

Loss comparison to managements

The PNW small scale survey asks Oregon and Washington respondent beekeepers about several managements. Feeding management asks about use of sugar syrup, honey, dry sugars and supplemental protein feeding. Response is a check box; "none" and "other" are response options. The survey does not specifically ask for details such as when or how bees were fed. For the last three years, individuals checking the "fed sugar syrup" option have shown a slight improvement in survival as have those who fed frames of honey and a pollen patty. The feeding of dry sugar, practically hard sugar candy and fondant have consistently demonstrated the best survival rates from among the feeding management options.

Over the past three years no single winterizing management improved survival each of the survey years. However, six managements have marginally improved survival in two of the three years. Those managements are: equalizing colonies in the fall; use of a quilt box/Vivaldi board/moisture trap at top of colony; an upper entrance (most Vivaldi boards have an upper entrance built into the equipment); wrapping colonies; wind/weather protection; and finally the "other" selection (the other items are a large mixture from reduced bottom entrance, reducing number of boxes and some means of reducing moisture). In all three years, those doing no winterizing had heavier losses than overall.

Under "Sanitation" options, providing hives with distinctive "addresses" by spacing hives and/or use of hive colors has improved survival two of the three years. However, in two years, individuals saying they did none of the managements also demonstrated better survival. Screen bottom boards do not measurably improve winter survival — a 3% advantage. However individuals that close (partially or fully) the screen during winter do show a 10% improvement over those who leave screen bottoms open over the winter.

Individual backyard beekeepers performing mite monitoring and practicing mite controls show the greatest survival improvement over the overall loss level. Individuals that monitor for mites (52% use sticky board, less than 20% use alcohol wash while 35% use powdered sugar shake or visual monitoring methods) receive about a 10 percentage point better survival over those who report no monitoring. Last year 18% of Oregon small scale respondents said they did no monitoring.

Three of the non-chemical control alternatives have consistently demonstrated reduced losses over the past three years. Reducing drifting by spreading colonies and/or painting colonies different colors in the apiary has demonstrated a 13% better survival. Brood cycle interruption has demonstrated an 11% better survival rate but drone brood removal only a minor 3% advantage.

Four chemical control options show the greatest potential for better survival in survey results for the past four seasons. Essential oils Apiguard and ApiLifeVar show about a 30% greater survival, and use of Apivar about a 29% better survival. Oxalic acid vaporization demonstrated an 11% better survival over past three years, but survival improvement of Oxalic acid drizzle was minor and in only one of the last three seasons.

The survey reports' correlations of what some beekeepers do and the loss level comparison are related only to single factors. Many Oregon and Washington backyard beekeepers utilize multiple managements to reduce losses; those selecting the "none" choice are under 5% of respondents. Adoption of one or more of these survey options does not guarantee reduction in overwintering losses. It is an opportunity to look over your beekeeping neighbor's fence and to compare your individual losses with

Table 1. *Self-reported causes of loss in Oregon small-scale 2018-19 survey*

	Varroa mites	Poor wintering conditions	Weak in fall	Queen failure	Starvation	CCD	Yellow jackets	Other
Loss (#) Reason (%)	133 (40%)	75 (23%)	96 (29%)	88 (27%)	59 (18%)	18 (4%)	45 (14.5%)	51 (15%)

Table 2. *Oregon beekeepers' selected level of "acceptable loss"*

Don't know	Zero	5% loss	10% loss	15% loss	20% loss	25% loss	33% loss	50% loss	75% loss	100% loss
7	67	15	47	35	53	69	40	54	4	9

those of others. Consult BIP and PNW survey result reports for further details on how individual managements may help reduce losses.

Thanks to all the individuals who have completed surveys the past few years. Thanks too to Jenai Fitzpatrick for her help with data crunching and analysis. Website is hosted by Portland Urban Beekeepers.

Editor's note: The Bee Informed Partnership's annual Winter Loss Survey will once again be live from April 1-30 this year. Your participation at ***beeinformed.org*** *is of benefit to all beekeepers.*

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Just a Spoon Full of Honey

— May Heal What Ails You

by SYLVIA DEKKER

"Good morning, how are you feeling today?" Your nurse has come in to change your bandages. As you exchange friendly chit chat, she unravels some fresh dressings and slathers them with a generous amount of sweet, thick honey. Your wound is sticky, smells like the inside of a hive and is looking much better.

You could be a burn victim in ancient Egypt, a wounded World War I soldier, a dog who got in a fight with a big coon, or a surgery patient in Uganda. Wherever, whenever and whoever you are, you're being treated with HONEY.

When Bees Abroad volunteer Venetia Rist visited Uganda to teach beekeeping and value addition skills to the people of the Batwa Tribe, she learned just how important honey was to the local hospital staff and patients. Anyone scheduled for surgery at the Bwindi Community Hospital in Buhoma, Uganda, must pack some honey in their hospital bag. Whether it's their own or they purchase it from the hospital gift shop, it is local and unpasteurized. If the patient's surgery wound becomes infected, dressings are soaked with honey and applied to the area.

This isn't a new idea. Straight from the hive, honey has been used as a medicine as long as humans have been burgling honey bees. It even has a fancy term: apitherapy. The term apitherapy covers the use of any hive product as alternative medicine, including propolis which has antifungal properties and is effective for treating a wide range of things, such as ringworm in cattle.

The oldest medical writings from as early as 2100 BC mention honey as a drug and an ointment. Aristotle himself said it made a "good salve." Nearly all ancient Egyptian medicines contained honey, and in the First World War the Russians used honey to prevent infection and speed up the healing process.

Abandoned as a medicine in favour of more advanced medical discoveries, honey stayed a humble tea companion for decades. However, using honey as more than a sweetener is making a comeback. As conventional, modern methods and medicines fail and antibiotic resistance erupts, honey steps up to the plate. Soaked into gauze pads, it is an excellent non-adhesive dressing that does more than keep the area moist.

The University of Illinois Veterinary teaching hospital always has a big jar of honey on hand,[1] as do many vets in the U.K. One told me that currently it is routinely used for open wound management. Combined with regular dressing changes, vets believe that the honey kills the harmful bacteria and clears infections. They happen to be right.

Every beekeeper knows honey is essentially bee vomit: a mixture of nectar and enzymes from the bee's honey stomach which is dehydrated down into that sweet thickness we love to steal licks of in the bee yard. According to all the research I combed through for this article, go right ahead and sample that honey. It'll do you good.

Honey has an inhibitory effect on approximately 60 species of bacteria, some fungi and some viruses.[3] Being full of floral, natural goodness and complex ingredients, it is partially the physical properties and partially the

Nurse at the Bwindi Community Hospital in Uganda applying honey to a wound.
(Photo provided by Bees Abroad volunteer Venetia Rist)

Bwindi Community Hospital in Uganda (Photo provided by Bees Abroad volunteer Venetia Rist)

chemical properties that contribute to honey's medicinal qualities.

It's thick, forming a protective barrier to prevent infection.

It's sweet. So sweet that the sugar content is high enough to hinder the growth of some microbes.

It's hygroscopic, meaning it draws water to itself. When applied to a wound, it extracts the moisture from the area to reduce inflammation, plus it dehydrates bacteria.

It's acidic, which gives it extra antibacterial activity.

It produces hydrogen peroxide, the result of a reaction between glucose and glucose oxidase, which is an antimicrobial agent that effectively sterilizes the area.

It contains a plethora of complex compounds such as flavonoids and other polyphenols, peptides, organic acids, enzymes, vitamins, and on and on. Together, these compounds work to give honey an anti-everything quality.

What our ancestors, the doctors at the Bwindi Community Hospital and the vets in Illinois have realized is that honey is an affordable, available, effective catch-all.

Dripping from a humble, sticky week of extracting in the summer, honey can go on to do great things. Recently studies have been finding that at very low concentrations honey seems to be able to stimulate white blood cells, which are our immune cells, and phagocytes, which are a type of cell that engulfs bacteria. In essence, it helps activate and basically hand-feeds bacteria to our immune system.[3]

Beyond helping to keep out and fight infection, using honey on wounds seems to reduce pain, speed up recovery and reduce scarring, even with skin grafts and gangrene cases.[3] Somehow, the fact that honey is good for scars and wounds dropped off medical maps for years but didn't escape the attention of health and beauty gurus. Many DIY face and hair mask recipes include honey.

Maybe it's the result of having multiple modes of action, but microbial resistance has never been reported for honey, unlike so many modern antibiotics. Many major pathogens are beginning to show resistance to antibiotics and it is a huge issue in the modern medical world. Several burn wound bacteria, for example, are showing increasing resistance to commonly used antimicrobial agents.[4]

One paper based on clinical experiences in a university children's hospital in Germany told a story about a young boy who had had an abdominal operation. The site became infected with a type of bacteria that was antibiotic-resistant and was not responding to local antiseptics after almost two weeks of treatment. Medical grade honey was used and two days later the wound was bacteria-free![2]

Over the years I've advised my share of skeptical, hoarse people to use honey. I've claimed that honey has kept me from suffering from many colds. If I get a sore throat, I swallow a spoonful of raw honey before bed and let it slowly sink down my throat, soothing and healing as it flows. After all this research, I have the "why" to back me up.

Wound care is the most common use of honey medically, from amputation to septic wounds to bedsores to leprosy. But honey can also be used for internal infections — for example tuberculosis — and intestinal issues such as gastric ulcers, *E. coli* and salmonella infections. Eat honey, and diarrhea and other gastrointestinal issues can apparently quickly disappear.[4] It also seems to help regenerate healthy levels of mucus in the intestines while keeping inflammation down. When honey is added to rehydration fluids, it helps with potassium and water uptake but doesn't increase sodium uptake.

Most of these issues, both external and internal, stem from bacterial infections, but honey is useful with certain fungal and viral issues as well. Ringworm and dandruff seem to be relieved with honey treatments, and it's not half bad at managing herpes lesions either, apparently.

There are so many studies on honey use in the medical field, concluding and proving a variety of positive effects. These include everything listed above, plus cardiovascular, blood pressure, antioxidant and anti-inflammatory effects.[5]

So why don't we North Americans use it more as a medicine?

One: possible contamination with *Clostridium botulinum,* the reason why honey shouldn't be fed to infants.[6]

Two: concerns about potential pesticide contamination.[6]

Three: Honey can sting on application. This, the U.K. veterinarian I corresponded with told me, makes it difficult to apply to animals. Diabetic patients are especially affected, making the messy procedure of applying honey to an open wound uncomfortable.

Four: The antimicrobial activity of local natural honeys is unpredictable and can be unreliable in medical applications. Bees fly far and collect honey from all sorts of different floral sources. From region to region, the differences in the makeup of honey can be huge.

When people think about using honey for health reasons, they often think about Manuka, a monocrop honey that has very high antimicrobial properties. Studies have shown that your own unpasteurized honey can have the same antimicrobial activity levels. However, because the exact levels and effectiveness of an unstandardized, raw honey is variable and unpredictable, selling your honey to the local hospital isn't going to be your big break.

Medical grade honey is a good supplement in wound care strategies used in some countries, but it hasn't quite taken off yet in North America. Europe and Australia have registered one of the first medically certified honeys which they call Medihoney. It has standardized antibacterial activity and is irradiated in lab-controlled conditions. Medihoney is currently used in professional wound care and both health care practitioners and patients are awed by the results.[2] It was the honey used in the case of the young boy with the infected abdominal surgery wound after all, and those results speak for themselves!

Although promising, honey will likely continue to be a last-resort tactic used when modern antibiotics and antiseptics just aren't cutting it. Meanwhile, where modern methods aren't available — like at the Bwindi Community Hospital in Uganda — honey continues to be an important part of medicine.

*Bees Abroad is an organization that relieves poverty through beekeeping. Find them on Facebook or at **https://beesabroad.org.uk/***

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From the Archives

EGGLAYERS UNION SETS STRIKE VOTE: Mandatory Retirement Age at Issue

by Eugene Makovec

April 1, 2010
St. Louis, Missouri

Editor's note: The following story was posted the morning of April 1, 2010, to the Bee-L online beekeeping community. Within 15 minutes it was re-posted by Bee Culture's "Catch the Buzz" blog. It was subsequently picked up by ezezine.com, numerous American newsletters that we know of (in CA, AL, NC, IA and NY), and at least four publications in the U.K. … mostly without permission.

Members of the International Sisterhood of Egglayers, Local 1851, are set to vote this week on a strike action against SweetBee Honey Corporation.

At issue is SweetBee's new mandatory retirement age of two years for queen bees. The policy was announced on March 1, and drew an ominous hum of indignation from egglayers across the company's 1200-hive operation.

"It's completely arbitrary — it's not even a matter of individual ability," buzzed Myrtle, a 26-month-old queen who declined to give her last name. "They just assume we're too old and can no longer do the job."

Myrtle was summarily dismissed as she reached her second anniversary at SweetBee, just weeks after the new policy took effect. She was able to find work in a nearby observation hive, and while she considers herself lucky, she acknowledges that this is a huge demotion for her. "This used to be where old, worn-out queens went to die," she mused. "I love my hivemates and am treated well by my keeper, but it's not the same as running a full-scale production hive. I need to be challenged."

"It's just not fair," complained Rosie Romano-Ortis-Petrova-Schultz-Bertolli-Bremer-Maggiano-Boehner-Milosevic-Anderssen-Bommarito-Yurovich-Hegel, a 22-month-old single mother of 54,371. "I feel like I'm just coming into prime production age. I've got a lot of mouths to feed, and now I have to worry about one day being plucked out of my work station like some yellow jacket, and tossed out into the grass … or worse."

SweetBee officials declined to comment for the record, citing ongoing negotiations. But one high-level manager, speaking on condition of anonymity, called it "a matter of simple economics. … It is true that you can't put a definitive age on productivity," he said. "But the simple fact is, once they get beyond that two-year point, it's really hit-or-miss." And since the union has consistently resisted the idea of its older members submitting to viability testing, he added, "This was our only option."

Another company official concurred. "Close to 50 percent of queens experience significant production declines in their third year, and the worst part is, it's so unpredictable. You have a queen who looks to be doing a great job, and suddenly she starts producing nothing but drones. It's very difficult, and very expensive, to replace her when that happens in mid-season."

It is widely acknowledged that queen productivity declines with age, often during the third year and almost always by the fourth. The reasons are complex, but experts agree that the largest issue is a decreasing supply of sperm in the egg-layer's spermatheca. This organ is supplied on a mating flight within the first two weeks of a queen's life, and is never replenished. (Sperm is required for fertilization of worker eggs, while unfertilized eggs develop into drones.)

In previous labor negotiations, management has floated the idea of requiring queens to make additional mating flights, possibly annually, in order to circumvent this supply issue. But while drones have generally supported that proposal, the Egglayers union has been vehemently opposed. Some members object on ethical grounds. "It's just not natural," said one queen. "No queen in nature has ever been subjected to this ritual more than once, and we shouldn't have to start now."

Then there is the safety issue. There are occasional reports of virgin queens falling victim to birds or other predators during mating flights. "Foragers deal with this danger as a part of their job," said Myrtle, "but they're also more nimble than we are, and have extensive flight training to boot." After mating, the only time a queen would typically leave the hive is in a swarm, when she's surrounded by a large contingent of workers.

The last time the apiculture industry saw open labor strife was in 1962, when the International Union of Drones (DUI) declared a general strike, protesting the industry-wide policy of releasing drones in the autumn months in preparation for the winter dearth period. But the ill-fated strike occurred in late September, at a time when apiaries had little to gain from negotiations. The action was settled within days in a humiliating defeat for the union. In an effort to save face, and in exchange for a promise not to strike the following spring when a work stoppage would have had more serious repercussions, DUI leaders asked for and obtained an unrelated concession — the free-agent status that their membership enjoys to this day. (Some conspiracy theorists maintain that this was the result the union had in mind at the outset, though most experts agree that drones are just not that intelligent.)

Under the free agent policy, drones are allowed to drift from hive to hive as they see fit. It is not uncommon for a drone to leave his home hive in the morning, visit several drone congregation areas during the course of the day and then follow other drones back to a different hive in the evening. In recent years this state of affairs has been blamed in part for the spread of mites and disease conditions between hives, but there has been no serious discussion about amending the policy.

As far as the impending strike vote is concerned, most believe the motion will pass easily. "It's just too much," said an executive at another apiary. "SweetBee can't expect this big a change to go uncontested. But [a strike] won't last long," he added. "The company certainly can't do without the queens' services this time of year. I'm guessing management will cave quickly — if they let them walk out at all."

Meanwhile, Romano-Ortis-Petrova-Schultz-Bertolli-Bremer-Maggiano-Boehner-Milosevic-Anderssen-Bommarito-Yurovich-Hegel, the 22-month-old soon-to-be retiree, is busy planning for life after SweetBee. She's developing a plan for a pheromone-marketing business, and is looking for consulting work.

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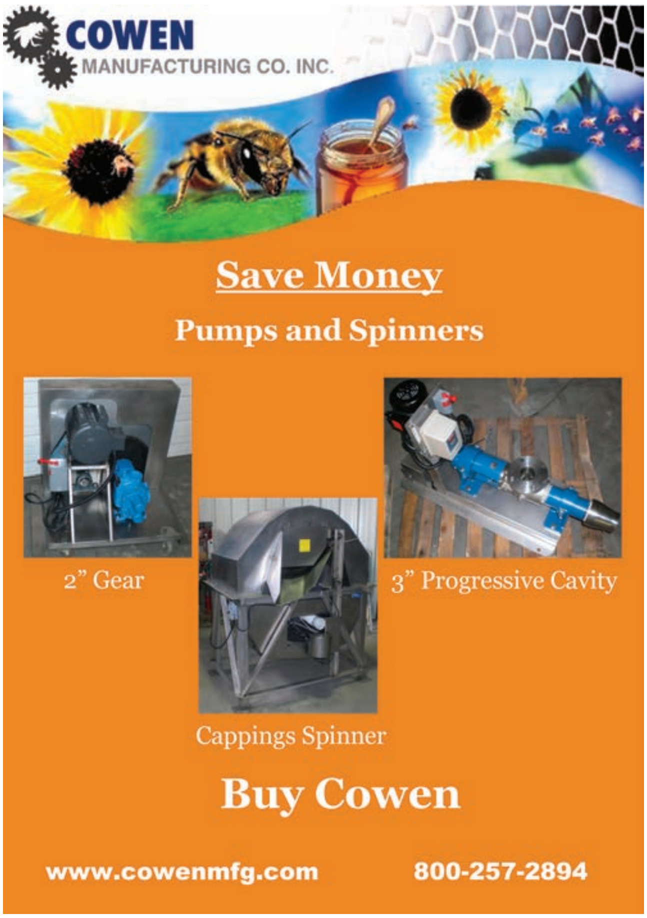

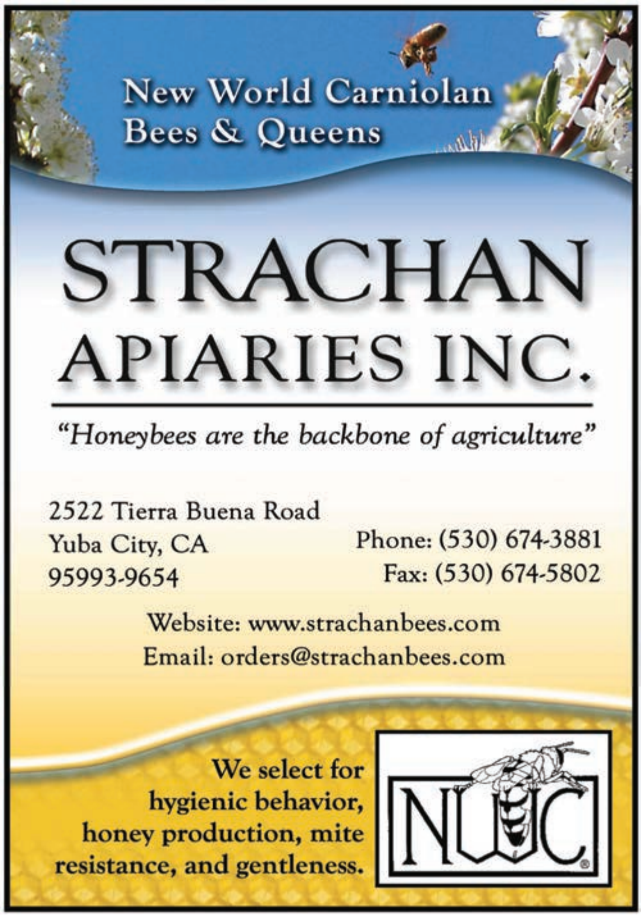

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