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April Features . . .

Watercolor by Susan Holiday, Tuebingen, Germany

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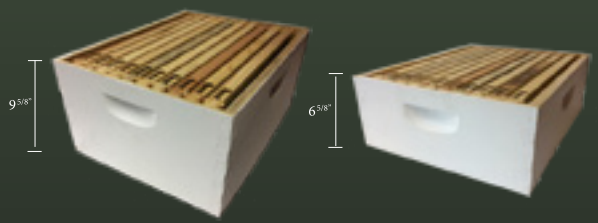

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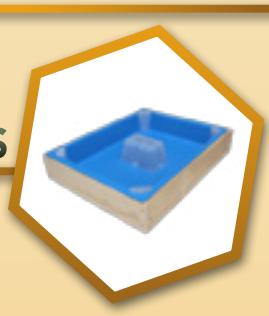

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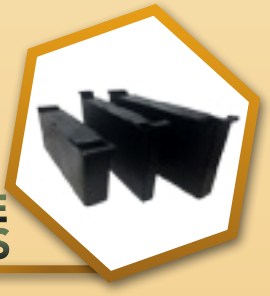

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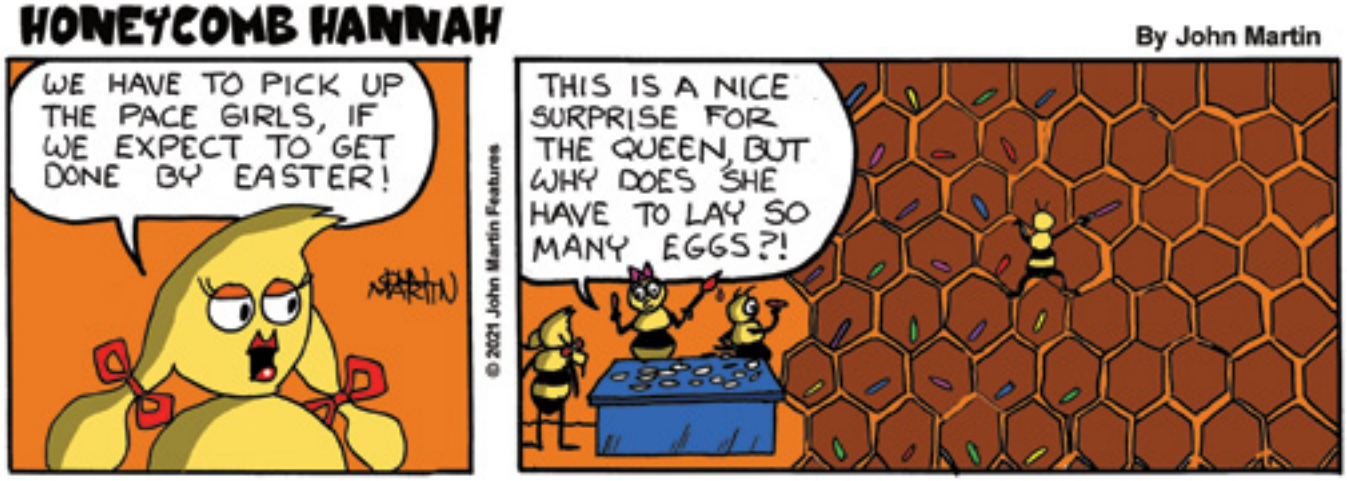
In Every Month –



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Asian Giant Hornet (aka Murder Hornet)

We have all heard of or read about the Asian murder hornet (*Vespa mandarinia*) in recent months. It was first found in the U.S. in Washington state in December 2019. Hornet colonies are eliminated as soon as they are found and WSU scientists and others are keeping close watch to make sure any other colonies don't expand their range. With only one confirmed hornet find in WA and with lots of competent people monitoring the situation I wasn't too concerned about the hornet. French beekeeper John Kefuss's letter in the March *ABJ* gives a sobering look that this pest should be taken very seriously. John writes about a related Asian hornet (*Vespa velutina*) that was introduced in France in 2003: "Today, as it spreads over Europe beekeepers are losing a lot of hives and money. Last year the situation got so bad in our are near Toulouse, France that some beekeepers had beeyards completely wiped out or had to move them. If I was a member of the California Almond Board I would be really worried about the future spread and impact on the hives brought in for almond pollination."

Joe Traynor
Bakersfield, CA

Recycling Old Equipment

Thank you so much for your work on *Bee Culture* Magazine. I have read this magazine all the years I have kept bees since 1999.

In reference to Jim Tew's article in the June 2020 issue I especially want to thank him for giving me ideas for reclaiming my old bee equipment. I was particularly able to use the idea of cutting down old hive bodies into supers and have done so very well as you can see in the photo (a total of 10, not all in picture). But I didn't stop there! I was able to reclaim an old lid, and several hive bodies by gluing tiny pieces of wood on the worn places as well as saving a couple of hive bottoms. Somehow in our disposable society, it never dawned on me that these simple fixes could make something old new again. To some who are clever with woodworking these fixes might have seemed obvious, but until I read the article it never dawned on me that I actually could do this myself!

While I enjoy reading all of the *Bee Culture* articles to keep myself current with beekeeping, I am really glad you include the really simple ideas so people like me who are low budget beekeepers can get ideas that we might not have thought of without a little help from other beekeepers like us.

I want you to know that I was also excited to see that you accepted one of my pictures in your 2021 calendar for the month of May. I am grateful that you sent me extra calendars to share, so thank you.

To all of the *Bee Culture* staff who work so hard on every issue, every month. Thank you!

Sandra Center
Omaha, AR

New For The Beekeeper –

SQUARE QUEEN MARKING TUBE

The round queen marking tubes are ok but I usually have to pick the queen up and drop her in the tube. I don't like having to grab queens –I'm afraid I will harm them. Wanted something better. Push in queen markers don't seem to be much better and they may damage the queen if not careful and will damage the cells you have to push it into. This new square tube works so much better as you can lay a flat side of the tube on the flat comb in front of the queen and push her in with the square foam pusher. If she is running along the frame edge the square tube will fit nicely along the wood frame side, unlike a round tube that leaves a space she can crawl under. Square is just better because comb is flat and frames aren't round. The square printed plastic grid is much more durable that the typical fabric netting glued on many round tube versions.

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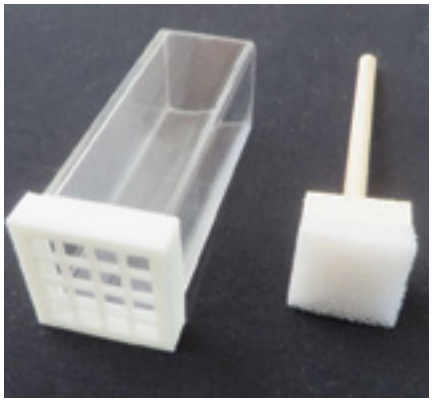

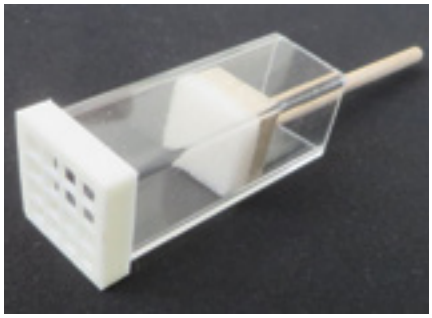

NEW SWARM CATCHER

Millerbees Mfg. has developed a new Honey Bee Swarm Catcher or Bait hive. Notice we do not claim it is a swarm "trap". The bees are free to come and go as they please, which is necessary as scout bees check out the potential new home to insure it is a good size, location, etc. This catcher has been designed with features that beekeepers and bees are looking for. It is made from UV resistant 4mm gray coroplast, with ABS plastic frame rests and vent disc. UV resistant Polypropylene straps hold the top down. Box and all components good for years of service. The best feature is it only weighs three pounds. Yes ONLY three POUNDS. The new catcher holds six Langstroth frames. Adapter pieces are available to hold top bar hive, bars or Warre hive bars. The internal volume is 40 liters, and closeable entrance is two square inches, which has been shown to be exactly what swarms are looking for. Feeder hole is ready to be punched out, to accept a feeder jar to feed your swarm, if a permanent home is not immediately available. Made in USA,

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Forage, Nutrition And Bee Integrated Demonstration Project

In this fourth and final part of my series on the Honey Bee Health Coalition, I'd like to walk through the work that the Coalition has developed to improve forage and nutrition. This includes work done on the Bee Integrated Demonstration Project.

As previously mentioned, the Honey Bee Health Coalition's work is focused around the 4 Ps – pests and pathogens, pesticides, and poor forage and nutrition. The Coalition now involves about 50 organizations, companies and agencies including beekeepers, farmers, researchers, federal government, agribusinesses, conservation groups, and consumer brands. One of the founding ideas behind the Coalition was to bring together all these disparate voices that all have a role to play in improving bee health and start working together instead of separately or even in opposition. Since the Coalition's staff don't have boots on the ground, we need to develop good information and rely on these 50 entities to connect the resources to those farmers and beekeepers who can make changes to improve bee health.

Since the beginning, Coalition members have been active in advocating for and demonstrating the benefits of pollinator habitat. Many members -like Project Apis m, Bee and Butterfly Habitat Fund (BBHF), **https://www.beeandbutterflyfund.org/**, Pheasants Forever, Bayer, Syngenta and Corteva, to name a few – are working with landowners and/or on their own properties to provide seed and technical expertise in establishing pollinator habitat. Many of our members also partner together in the delivery of these programs.

Through the Bee Integrated Demonstration Project **https://honeybeehealthcoalition.org/bee-integrated-demonstration-project/**, the Coalition is bringing together beekeepers and landowners to show how an array of best management practices (BMPs) can be combined in agricultural landscapes to improve the health of honey bees and other pollinators. In our North Dakota pilot demonstration, the Coalition worked with farmers to plant BBHF honey bee and monarch butterfly seed mixes while following the Coalition's *Tools for Varroa Management Guide*, **https://honeybeehealthcoalition.org/varroa/** in demonstration hives and following the North Dakota Pollinator Plan and other best practice guides to enhance communications and stewardship on crop pesticide applications.

Through site visits and pollen collection in our Bee Integrated pilot, research partners have observed higher numbers of native and managed bees at demonstration sites and greater diversity of pollen collected by demonstration hives. This effort has helped to inform U.S. Geological Survey research on pollinator habitat and plant preferences. Importantly, participating beekeepers and farmers also report the benefits of collaborating and providing enhanced habitat and nutrition for bees. In 2021, the Bee Integrated effort is now expanding to create demonstration sites and case studies in other states.

In addition to on-the-ground work, Coalition members have advocated for policies to increase habitat quality and acreage on private and public lands. In partnership with the Keystone Monarch Butterfly Collaborative, the Coalition has developed recommendations to the U.S. Department of Agriculture (USDA) on its private lands conservation programs like the Environmental Quality Incentives Program (EQIP) and the conservation Reserve Program (CRP) and has met multiple times over the years with USDA leadership and staff to promote these concepts. Coalition members have also participated in sign-on letters to support CRP in the Farm Bill and to advocate for multi-use, science and risk-based approaches to support honey bee access and native bees on public lands, including USDA Forest Service Lands.

Beekeepers know that habitat alone is not always sufficient for meeting the nutritional needs of honey bees over the course of a year. The Coalition has supported engagement and research on honey bee nutrition and nutrition supplements through its Nutrition Prize Challenge and through interviews with commercial beekeepers to understand nutrition supplement practices and needs.

Together, the collective efforts of Coalition members to plant habitat, demonstrate best practices, advocate for policies to benefit honey bees and native pollinators, and innovate on bee nutrition – combined with its work to develop tools and resources for farmers and beekeepers on hive pests and disease and crop pesticides -- have helped place the Coalition at the forefront of collective action to advance bee habitat and bee health.

As always, the tools and resources are all free and can be found on the Coalition website.

Jerry Hayes

Learn more at ***honeybeehealthcoalition.org***

From The Editor —

Drumstick Allium

The A.I. Root Pollinator Garden

Alyssum **Flowers**

The A.I. Root Co., and Bee Culture, The 'Magazine of American Beekeeping' will always be connected to the amazing history of Honey Bees and their Keepers. At our company headquarters we recently updated our pollinator friendly garden area in front of the offices along the main thoroughfare into our hometown of Medina, Ohio.

Over the next several months we will share with you how it is coming along and to highlight individual plants in the garden.

NO Garden is complete without one or several species of Allium, with its vivid balls of color standing out in the garden. *Allium spp.* grows from a bulb as do other plants in the Amaryllidaceae Family such as Surprise lilies (Belladona lily), Clivia, amaryllis, daffodil and garlic. Alliums can be used for culinary purposes, cut flowers and for striking contrast in the garden. Its nectar is loved by pollinators and is a good source of pollen for honey bees.

Allium spp. contains over 700 species of bulb forming or rhizomatous plants of varying shades of purple-blue-rose. Alliums may flower from Spring through Summer and vary in size and shape but all produce "balls" of florets on tall spikes. Some cultivars tower over other perennials and produce giant blue balls 4-5" in diameter, while others are shorter, like the "Drumsticks" and mix with other Spring bulbs boasting more oblong flower spikes. All have an "oniony" scent which tends to repel rabbits and deer from eating them.

Allium 'Millenium" is a clump-forming cultivar developed by Mark McDonough as a smaller, mid-Summer bloomer. In early Spring, dark green leaves arise from the soil then a burst of straight 18-20" tall spikes producing 2" round umbels (balls) of fragrant rosey- purple florets arise in July and August. This garden favorite was awarded the 2018 Plant of the Year® by the Perennial Plant Association.

Plant *Allium* "Millenium" in well-drained soil with full to part sun. Although it can tolerate a wide range of soils, it does best in sandy or course textured soil. Plant the bulbs in the spring and split as necessary in early Spring or Fall when the soil is moist. The flower heads will drop viable seeds if allowed, but most people remove the spent seed heads to keep the bulbs strong.

Alliums have very few problems however they can suffer root rot if planted in wet soil. Leaves can be affected by thrips and powdery mildew but it is rarely a serious problem. This cheerful flowering bulb will return every year in Growing Zones Zone 4-8 attracting butterflies, bees and other pollinators. BC

Varieties of allium spp.

https://www.brecks.com/product/Drumstick_Allium?p=0729246&gclid=Cj0KCQiA962BBhCzARIsAIpWEL0dH9VEYaDIYY3Lt8HwaJeJ81-Dup5NUGnWJQktFzR__0RxBptRKe4aAgtpEALw_wcB

https://www.gardeners.com/how-to/growing-alliums/7371.html

https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=263431

https://www.bluestoneperennials.com/ALMI.html

https://www.chicagobotanic.org/plantinfo/alliums

Allium "Millenium" at A.I. Root.

NEXT MONTH

Region 1
- Check Brood Box for Adequate Space
- Sample for *Varroa* to Establish baseline
- Mite Check Alcohol Wash/Treat if Needed
- Put Swarm Traps Out
- Are Hives Ready to Split?
- Is Queen laying well?
- Feed if needed
- Add Supers
- Requeen if needed
- Swarm Control

Region 2
- Is Queen Laying well?
- Try to reduce swarming
- Super
- Make Splits
- Alcohol Wash for *Varroa* check
- Set up Swarm Bait Hives
- Treat for mites if needed after Alcohol Wash
- Check for enough Brood Space

Region 3
- Alcohol Wash and Treat for Mites if Needed
- Add Supers
- Hive Strength/ Requeen if needed
- Check for Swarm Cells
- Feed Splits and Nucs

Region 4
- Splits
- Sample, Sample, Sample for Mites
- Kill, Kill, Kill Mites
- Super Colonies
- Check for Swarm Cells
- Check for Overcrowding
- Equalize Colonies
- Unwrap colonies
- Cull Out old frames/foundation
- Reverse boxes if crowded
- Early Mite control

Region 5
- Control Swarming
- Set out Swarm Bait Hives
- Feed
- Check for Swarm Cells
- Alcohol Wash Varroa check
- Check for crowding/Reverse boxes
- Add Supers
- Have clean water supply available

Region 6
- Alcohol Wash for mites
- Treat for Varroa if needed
- Buy Bees
- Check for Laying Queen
- Feed if needed before bloom
- Check for Colony Crowding
- Check for Queen Cells
- Spring Splits
- Super

Region 7
- Monitor Mite load/Alcohol Wash
- Add Honey Supers
- Treat for Mites if needed after Alcohol Wash
- Is Queen laying Well?
- Feed if needed
- Reverse Hive Bodies/Check for Swarm Cells

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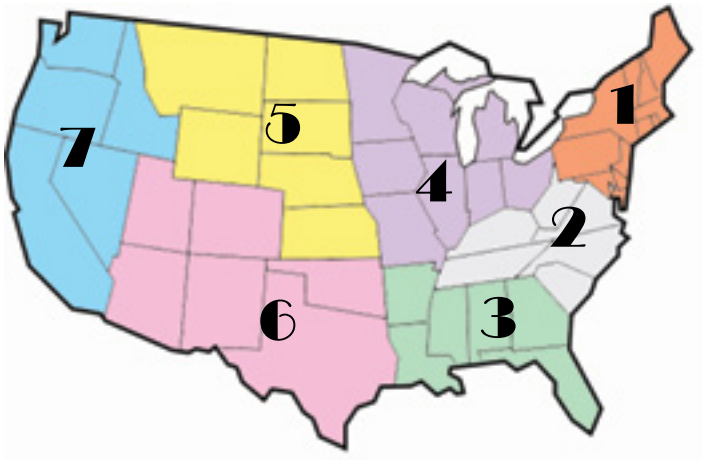

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55 Gal. Drum, Ambr	2.20	2.20	2.55	1.85	2.20	1.89	2.43	1.55-3.00	2.12	2.12	1.77	2.02
60# Light (retail)	208.00	199.00	185.00	192.19	170.00	165.00	232.47	120.00-300.00	206.01	3.43	182.22	204.23
60# Amber (retail)	200.21	198.00	200.21	160.58	200.21	168.33	212.47	120.00-285.00	197.92	3.30	190.55	203.69
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS												
1/2# 24/case	110.65	110.65	105.60	82.00	61.20	110.65	110.65	61.20-194.40	93.49	7.79	106.15	91.93
1# 24/case	163.03	168.00	141.95	106.97	152.50	120.00	144.00	63.00-300.00	144.57	6.02	117.68	131.62
2# 12/case	141.54	141.54	124.77	103.78	111.84	102.00	132.00	66.90-246.00	126.64	5.28	110.14	124.58
12.oz. Plas. 24/cs	130.26	120.00	120.00	90.32	89.88	96.00	108.00	66.00-244.00	105.52	5.86	83.66	99.09
5# 6/case	149.64	149.64	190.50	115.49	113.16	107.00	149.64	71.50-240.00	143.54	4.78	105.45	133.14
Quarts 12/case	187.63	144.00	148.20	145.78	171.36	192.00	183.00	109.20-300.00	170.66	4.74	153.01	143.36
Pints 12/case	98.07	84.00	96.00	88.57	109.50	109.00	96.00	60.00-139.00	96.63	5.37	87.55	90.17
RETAIL SHELF PRICES												
1/2#	6.05	5.50	5.06	4.85	3.87	5.50	6.05	3.25-9.95	5.49	10.98	5.44	5.08
12 oz. Plastic	7.19	6.86	6.33	5.65	5.66	9.49	5.40	3.79-12.00	6.48	8.64	6.29	6.19
1# Glass/Plastic	9.37	9.64	9.06	7.44	7.65	9.43	7.00	3.00-17.00	8.74	8.74	8.39	8.20
2# Glass/Plastic	15.49	17.50	15.40	12.60	12.80	21.99	13.00	7.34-25.00	14.82	7.41	14.53	14.21
Pint	10.94	11.72	12.67	9.77	10.92	10.50	9.60	4.00-18.00	10.88	7.26	10.34	11.05
Quart	21.55	19.67	17.46	19.34	19.32	15.66	17.10	8.00-40.00	19.09	6.36	17.88	18.28
5# Glass/Plastic	54.78	30.00	44.00	50.97	20.44	33.00	54.78	12.80-139.08	33.62	6.72	29.99	28.94
1# Cream	10.26	11.66	10.26	9.70	7.75	13.99	16.00	5.54-16.00	9.75	9.75	10.46	9.99
1# Cut Comb	14.03	14.99	11.50	11.43	13.50	15.55	14.03	6.00-25.00	12.55	12.55	13.49	12.85
Ross Round	12.71	7.00	12.71	13.17	12.00	12.71	13.75	7.00-20.00	11.91	15.89	11.50	11.11
Wholesale Wax (Lt)	7.94	11.00	4.50	4.97	6.00	4.00	5.00	2.20-16.00	6.79	-	6.65	6.70
Wholesale Wax (Dk)	5.76	5.50	2.55	5.66	6.00	2.00	5.76	2.00-10.00	5.52	-	6.43	5.54
Pollination Fee/Col.	109.21	42.50	47.50	163.50	145.00	109.21	110.00	30.00-210.00	98.42	-	69.09	88.97

Over the last many months we have suffered many outcomes of the COVID Pandemic just like you. And hopefully *Bee Culture's* challenges have been much less than yours. Because the Postal Service has been negatively impacted, mail delivery of your magazine has been delayed multiple times. And unfortunately delivery of information from Honey Reporting Regions has also been delayed. As a result this month's Honey Report is not 100% accurate. We do not want to pretend and give you 'bogus' information but rather admit that information is lacking from some regions which impacts the final numbers.

We can always use Reporters so please volunteer a few minutes of your time to share information with *Bee Culture* readers. Go to Amanda@beeculture.com, put REPORTER in subject line, your name, address, phone number and email and we will get you the next Honey Report form.

Thank you for your help.

Dadant

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It's Summers Time –

Spring, Poultry and Random Thoughts –

It's approaching mid-March as I write this and it's the time, at least here in Northeast Ohio, that we all get very anxious for Spring. It's 60 degrees today and will be close to that all week with some rain. But there is snow in the forecast for the weekend. That's March – probably the cruelest month. In the 40+ years I've lived in Ohio our biggest blizzards have come in mid-March.

But the bulbs are peeking through and the sun is shining and if you're lucky enough to have bees alive they might be flying today. So we take a deep breath, go for a walk and just know that there will be more snow before Spring really gets here.

We are having some poultry issues just in the last week. Even as I sit here finishing up the April issue I heard a commotion outside. (Yes, still working mostly from home.) I went to check on things and all of the chickens and the ducks were cowering in the coop. It's a bright sunny day and they had been enjoying their time outside. When the chickens saw me they cautiously came back out. The ducks wouldn't move for awhile. They just sat inside chattering. So something got them scared and running.

We always see hawks and buzzards and if you're lucky an occasional eagle flying over. But usually not this early and usually not up close and personal. Last week we had an up close ad personal with a hawk. I first noticed it sitting in one of our trees fairly close to the house, just sitting there for a long time facing away from the house and the chicken pen. Hadn't seen that before. The next day I saw movement out the front window and that hawk – I'm kind of assuming it was the same one – was on the front porch railing staring down at our bird feeders.

A day later we went out after supper to close up the coop. It had been another nice day and the birds were outside. I went inside to see who was in and Kim went outside to herd anyone that was lagging behind. The birds that were outside were gathered in a corner of the pen, clearly agitated by something. Inside I saw what I thought was a chicken banging at the window like it was trying to get out. and on the floor of the coop a dead duck. It turns out it was the hawk trying to get out of the coop.

It looks like what happened is the hawk chased the duck into the coop, killed it and then couldn't figure out how to get back out. So Kim got in there and took care of getting the hawk out of the coop. That's all I'm going to say about that.

So we're down to four ducks and 14 chickens. We lost a couple of the older hens over this long, cold Winter. We'll keep it at that number for now. Maybe next Spring it will be time to get some young ones again.

The *Bee Culture* team is hopefully optimistic about this year and we're making a tentative plan for our annual event. We had a great title planned for last year so we're going with that. Please take a look at page 29 for some initial information. We plan to start taking registrations on June 1, so mark your calendar and we hope the world allows us to go forward with our plan.

I think it's been the strangest and maybe in a lot of ways the hardest year most of us have had to deal with. We all have experienced hard times and difficult situations we've had to deal with. But never before have most of us experienced this kind of a trial and shared it with the entire world. Every single person has been in some way impacted by COVID. My hope is that life has calmed down for all of you. It's not perfect, but then it really never was. Our family has been mostly safe during this time, but it's been hard being apart from each other. We've had a few members who have had the virus, but thankfully recovered quickly.

As for the staying home part Kim and I have been fortunate in that area. For the last 35 years we've spent 24/7 together anyway, so that wasn't new for us. And with me working from home and being right here in the house I like to think it made things easier for Kim during this time.

I have missed going out to dinner and to the movies. I haven't been to Target – my favorite store – in a year now. On the other hand I've become quite the online shopper and Kim is very familair with the Amazon guy.

But what I've missed most is those casual gatherings. We really enjoy having all of our kids – biological and others – over, especially for the holidays. And we usually have a gathering of friends on New Year's Day. And of course the hugs. We're big huggers in my circle – friends and family.

And of course bee meetings. The last meeting the *Bee Culture* team was at was the big Tri-County meeting in Wooster, Ohio almost exactly a year ago. The talk of 'the virus' had just started and so we went armed with hand sanitizer and wipes and didn't do nearly as much hugging and hand shaking as we normally would have.

COVID has changed that part of our world drastically. And not all in a bad way. Kim, Jerry, Jim Tew and a host of other speakers have mastered the ZOOM meetings. And although it's not up close and personal like we'd like it to be, it has one big advantage. Some folks that just can't get to a meeting physically are able to see the speakers right there at home.

I hope that you are hopeful about the coming Summer. Things seem to be looking up and maybe we'll see you soon. I miss you guys!

Now for some full disclosure. None of us are even close to perfect, whether we want to admit it or not. We all make mistakes and this past year has presented many opportunities for things not to run smoothly. We know that lots of you have had problems getting your *Bee Culture* and we have done our very best to get those to you and appreciate your frustration as much as we hope you appreciate ours.

When we received the February issue in the office and I opened the box there it was staring me right in the face – a typo, right on the cover. You can look at something a dozen times and not see it and then once it's printed – well too late. I decided not to say anything and see who would mention it first. No one has. So hopefully not many of you noticed it. And those who did are just too polite to say anything. Thanks for that.

Well I'm out of room, so I'll save the rest of my thoughts for next time.

I wish you all a wonderful, bright, sunny Spring 2021.

STUDY HALL

Q – I have a northern beekeeping/honey bee question if you have time.

I know it is April but this is a question I have been thinking about for months.

Back in February the sun was strangely out, and my wife Barb and I put on our boots and other paraphernalia to take a loop around our property in the snow. As we looked at the entrances of the few beehives, we have there is the typical bunch of dead bees at the entrances and some a few feet out on front of the colony. But, because of the sunshine and white background of the snow as we walked around, we saw dead bees many yards away from some colonies. We even found a worker probably 40 yards away from the nearest colony that was alive standing on the snow. Barb picked her up and warmed her up in her hands blowing warm breath on her and took her over to the entrance of the colony and let her walk in.

Question(s); Why are these bees leaving when it is in the teens or 20s outside? Are they 'sick' and sacrificing themselves for the potential welfare of the colony/cluster? Are they stupid and it is warm enough in the hive that they are fooled that it is nice outside and going out to investigate for the benefit of the colony? Can I assume that these long-distance flights in poor temperatures are standard but in warmer climates the beekeeper is not being able to see the contrast that we saw between the white snow background and the dark bee?

There it is. As I have said for decades anybody who says they know all about honey bees is a liar. I don't know all about honey bees.

Jerry Hayes

A – Hi Jerry, I suspect that there are two things causing these bees to be dying in the snow.

1. Some probably are sick and are removing themselves for the good of the colony.

2. Some are accidentally crashing onto the snow, getting chilled, and becoming unable to fly home. I think this is a good example of how the housing arrangements that we beekeepers provide for the bees can make life harder for them. Where I live in New York State, the wild colonies almost always have their nest entrances several (15+ feet) above ground level, so when they come out of their nests on sunny days in Winter (to make cleansing flights) they are not apt to crash into the snow. I have done an experiment in which I put two hives on the roof of a shed and two hives on ground-level hive stands nearby. On sunny days in Winter, when there was snow on the ground, I saw dozens of worker bees from the low hives come out, take flight, but then fail to gain altitude quickly and get stuck in the snow, where they soon died. But I saw little or none of this for the bees in the high hives. They too came out on these sunny days to make cleansing flights, but for them the snow was far enough below them that they did crash onto it and get stuck there.

For northern beekeepers, I recommend putting hives in the Fall on hive stands that will get the entrances of their at least a few feet above ground/snow level.

Hope this is helpful. – Tom

Thomas D. Seeley – Horace White Professor in Biology Emeritus Department of Neurobiology and Behavior Cornell University Ithaca, New York 14853, USA

Q – *Mr. MacFawn, I loved your article in the November* Bee Culture, *'Dr. Tom Seeley's Findings'. It filled me in on Dr. Seeley's ideas. They all make sense but one . . . 10-20% drone cells. The biggest production colonies are always the first to collapse, but my theory was that they start drone cells early in the season and are filled with them till Fall. Mites produce like three times as many mites in drone cells as worker. If you remove drone comb, bees will fill between supers with drone cells and try to compensate, but less drone cells as a percentage of the population should limit mite success and population.*

What am I missing? Dale Lesser

A – Dale, Good to hear from you. 17% is the average number of drone cells. Colonies only produce drones when the colony is healthy. When the nectar flow ends, often the number of drones produced are reduced. We have found that drones do not impact honey production to any appreciable extent.

Yes, I have also found the biggest production colonies are the first to collapse. That is why when I produce honey I pull my honey and treat 3/4 to 7/8 of the way into the nectar flow, i.e. about a 1/4 to 1/8 of the flow is left.

If you do not add supers for honey and the colony is space bound, the colony will usually swarm, i.e. the reduced hive size that Dr. Seeley talks about. Dr. Ralph Buchler over in Germany found that after swarming when there is no brood, *Varroa* mites are reduced 1-2% per day. This is significant. If it takes four to six weeks for new brood, that means *Varroa* is reduced 40%-60% at least. The brood break and swarming are the key. See Dr. Buchler's lecture at the BBA National Honey Show.

Does that answer your question?

Best Regards, Dave M.

Q – Greetings Jerry, *Time does fly,,,,Wow!! My hives were neglected by me for the most part. I had pinched nerves in my neck, surgery, and was also removing bees from houses all Summer.*

I lost several hives, but two others are very judicial about treatments and one of them had over 500 hives and lost over 200. This beek is the most go-by-the-book one that I know. Does all treatments religiously.

I started in 1972 and I am at a loss as what is the main cause for all of this mess.

I am wondering if drones are the problem?? Not fertile?? I talked with some breeders that breed artificially said that about five out of 10 were dry of semen.

Have you spoken to others about dry drones??

What do you think? Lionel

A – Good morning Lionel, In everyone's mind it is *Varroa, Varroa, Varroa.* And just treating at X time might not be the best method. Sample using alcohol method, treat if there are more than three mites per 100 bees and then sample again to see if it actually worked is the best method. Know that treating when there is brood with X chemical that 2/3rds of mites are behind capped cells reproducing and generally can't be impacted. The HBHC (Honey Bee Health Coalition) has some great resources at **https://honeybeehealthcoalition.org/varroa/**.

Varroa treatments are necessary but can have collateral damage. Trying to kill a Little Bug '*Varroa*' on a Big Bug, 'honey bee' always has chronic health implications for the whole colony. Some *Varroa* treatments being applied during drone production many times can damage sperm production and sperm stored in the spermatheca. The Drones themselves can still fly to the Drone Congregation Area (DCA) and they can still mount and mate with a virgin queen accessing the DCA but they are 'shooting blanks' so to speak. The sperm is dead or at least cannot move. So, the queen mates and goes back to the colony and none of the sperm can fertilize her eggs. Poof, Dry Drones.

Q – To, Becky Masterman**,** *Last year, I got one OHB Saskatraz queen and a package of Saskatraz's and queen to place in my backyard.*

Both hives were looking strong before I left for 10 days in August. I left the bees with pollen, feeders with sugar water inside both hives, and frames of honey. When I returned, BOTH hives were without bees, still had sugar water, and honey. There were no piles of dead bees inside nor large number of dead bees in front of the hive.

When I read your "Minding Your Bees and Cues, Part 3" in Bee Culture it gave me a possible answer to what happened to my bees in my backyard. and now my question.

If it was viruses that caused the death of two hives, are viruses still present in the hive? I am looking at getting two nucs and placing them back in the boxes containing wax, pollen, and honey. Will that result in the bees dying out several months later?

I am retired and money is limited. I am trying to decide if I will get new bees for both hives or give up on my bees.

Thank you, Richard

A – Hello Richard, Thank you so much for your email and question. It is a good one!

While we have not had the opportunity to study the specific question that you ask, we certainly wonder about it ourselves. We understand that the viruses may well persist in frames (they are everywhere!) but we do not know if they are able to infect new colonies. I will share our protocols with you though.

1. If a colony likely died from viruses/mites, we would reuse the frames that do not have brood on them. If they have sealed brood, the bees will need to clean out the cells and have a higher risk of coming into contact with the infected pupae.

2. We manage mites aggressively if we know that they are a problem in a geographic location (having colonies die from mites/viruses is a good clue). We strongly suggest monitoring and managing for the pesky varroa mites.

Best resource for mites: **https://honeybeehealthcoalition.org/**

3. We actively rotate out frames based on age (usually three years, but some people can go five years).

4. Find other beekeepers in your area who can help you fight your mite problem. Also, please report your mite counts to **www.mitecheck.com**

I hope that this information helps you decide to continue your beekeeping efforts!

Best, Becky

Becky Masterman, University of Minnesota Bee Squad, Department of Entomology
Email ***melto003@umn.edu***

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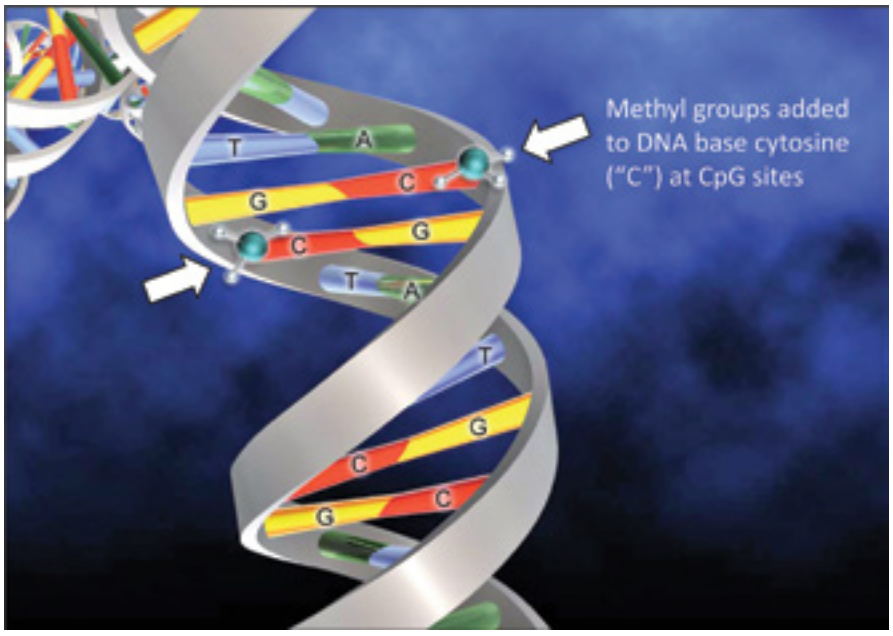
FOUND IN TRANSLATION

Herding Genes With . . . Epigenetics

Jay **Evans**, USDA Beltsville Bee Lab

Knowing the complete genome of an animal, whether human, bee, or worm, can go a long way toward predicting how that animal looks, grows, and behaves. But to really know the source of interesting traits, one must study which parts of that genome are active at key times. Genes that provide the blueprints for individual proteins (a big part of the 'active' genome) are silent much of the time. When triggered, they spin off messenger RNAs, whose message is then translated into strings of amino acids that make up unique proteins. This triggering, or 'transcription', into messenger RNAs can be precise to individual genes or can link tens or hundreds of genes that turn on and off in a coordinated way. Coordinating the arrival of many proteins at once is essential for complex events such as building a limb, enacting an immune response, building a bank for memories, and numerous other needs of even the simplest organisms.

Humans have about 21,000 protein-coding genes and bees have maybe 16,000. These are depressingly average counts for mammals and insects, respectively, and far less than, say, earthworms and potatoes. Our exceptionalism, then, must reflect how well we use the genes we have. This relates directly to how well our cells turn particular genes on and off. When I first studied genetics, we were not given the whole story. Genes were turned on by promoters that hit a cartoonish landing pad on the chromosome just in front of the gene – and protein-building ensued. This view was nuanced a bit by the study of transcription factors that matched to varying degrees sites 'near' key genes, turning them all on at once. Science fans will know that anything with 'factor' in its name still has a bit of mystique (e.g., 'virulence', 'queen', and 'fudge' factors). Transcription factors are now well studied, however, and are validated as good predictors of which proteins need to work together during particular events in the lives of cells.



Many decades ago, discussion began on still more mysterious epigenetic ('above the genome') factors that regulated the activity of larger chromosome regions. Generally, epigenetic controls squash gene activity. One prime example for organisms with sex chromosomes (humans, yes, bees, no) involves the regulation of genes found on the chromosome shared by both sexes (the 'X' chromosome in our case). For many genes, it is healthier if their protein levels are roughly equal in males and females. Since females have two X chromosomes in their cells, there has to be some sort of dosage compensation for the proteins not related to sex differences, so they play well with proteins from the rest of the genome. To do this, genes encoding proteins on the X chromosome in males might be hyperactive to mimic those from XX females – but in reality, it is mostly the female X-encoded genes that slow down to match the boys. In fact, a good fraction of X chromosomes in female mammals is silenced by a process called methylation, an enzyme-driven swap of DNA components that makes these components less likely to be turned on. For you science buffs who remember the four bases of DNA, it is generally the cytosines that get dinged up in this way, neat by itself but also a perfect landmark for scientists to predict which parts of the genome are silenced.

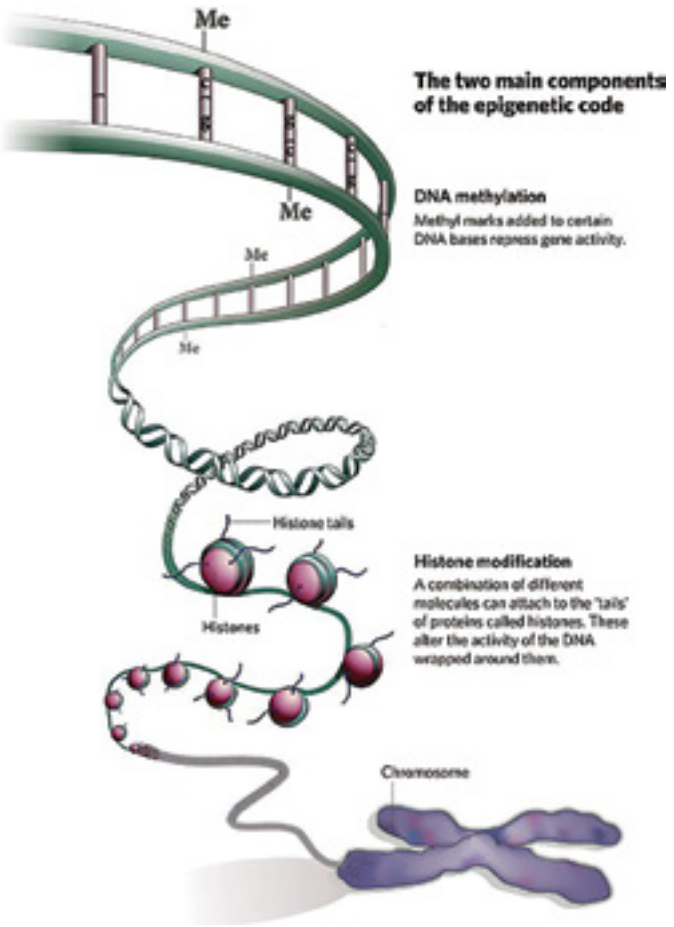
Other than hearing these stories of dosage compensation by a somewhat sloppy brush, I admit to not really thinking much about methylation – UNTIL some fascinating

work by my friend and hero, Professor Ryszard Maleszka from the Australian National University. Prof. Maleszka toiled for years as a leader in the sequencing of the honey bee genome. When it all came together, he was almost giddy to find that the bee genome had a full set of enzymes needed to tag specific chromosome segments with methylation and, importantly, maintain the faithfulness of that methylation tag over time. Soon, he and his team showed that these epigenetic forces were important in one of the most beautiful processes in bee biology, the generation of queen bees.

Queens and workers are indistinguishable at the gene level, a fact known by queen breeders who can graft without discrimination from female larvae to get their future queens. What sets them apart is the coordinated production of caste-biased proteins that, in the case of queen-destined larvae, speed metabolism and development and set the seeds for prodigious ovaries. Worker-destined larvae grow more slowly, and have different brain structures and barbed stingers, among many other differences. While the environmental causes of this split involve larval diet (royal jelly and its queen 'factors'), inside each bee the queen path is set by the epic and apparently epigenetic regulation of hundreds of genes tuned to either a queen or worker fate. In a highly cited paper from 2008, Dr. Maleszka, his scientist wife Joanna, and their team produced clear evidence that silencing by methylation was key for this process. The paper, "Nutritional control of reproductive status in honeybees via DNA methylation" is freely available from the journal Science (**https://science.sciencemag.org/content/319/5871/1827**). Methylation is an imprecise paintbrush, more Monet than Michelangelo, but a critical gene showed shifts in methylation that reflected the queen or worker pathway. Interestingly, worker-destined larvae apparently had a higher rate of methylation for caste-related genes and the proof for the whole story came when the ANU team silenced a key enzyme that drives methylation and successfully pushed more larvae down the queen road, irrespective of diet!

Science moves on and additional epigenetic processes have been discovered since this work, but the message that whole cohorts of caste-biased genes can be tagged in a lasting way to impact their activity has held up beautifully. For a really recent take on it all, Professor Maleszka's group recently teamed up with Marek Wojciechowski, Paul Hurd, and colleagues from England in a fascinating and freely available paper titled

"Phenotypically distinct female castes in honey bees are defined by alternative chromatin states during larval development" (**https://genome.cshlp.org/content/28/10/1532**). These epigenetic changes are undeniable and the signals they leave behind have helped to identify numerous genes products tied to key traits like queen production, disease responses and even stinging tendencies. I will follow up with reviews of those traits in the future, and show how this discovery has been franchised over the past decade to help explain traits like queen production, or perhaps reproduction generally, in species far beyond honey bees. As a teaser, I mentioned that these methylation-related enzymes can repaint the same site even after cells divide. It turns out they ensure that some methylation patterns are faithful from drones or queens to their offspring, presenting great possibilities for a parent's environment to shape the ways their offspring preps for life. Think 'you are what your parents ate', or suffered through, etc. There are also indications that some offspring traits more strongly reflect their dad's versus mom's contribution, a tendency that might either strengthen or challenge colony life. Stay tuned, it will be epigenetic. BC



New Reading For Beekeepers –

Build Beekeeping Equipment – Build your own beekeeping equipment. Ed Simon. Self published. Purchase at **www.lulu.com/shop**, bookstore option. 8.5" x 11", spiral bound, soft cover, color throughout, 207 pages. $24.95.

This is Ed's second book on building beekeeping equipment, tools, devices, things you never thought you would need but do, and some you'll be glad you learned how to build, use and share. I don't think there is anything Ed can't build, make, fix or figure out. And this book is a compilation of his articles from several sources. Some of these are from his first book, *Bee Equipment Essentials*, published, and still available from Wicwas press, some from his many contributions to *Bee Culture* magazine, and many are new. All told, Ed makes 10 pieces of hive equipment ranging from A bottom board to a Migratory top, including feeders, pallets, syrup mixers and dispensers. Most every widget has both diagrams and photos, but some don't need diagrams and the photos are excellent.

When it comes to honey, he produces eight different tools, including an escape board, a drum dolly, a warming box and drip trays. The drum heating pod and the warming box are especially clever, and useful.

For wax, there's a small-scale processor, screener and strainer. All made from materials easy to obtain and assemble.

Queens get some attention, too, with swarm boxes, mating nucs and even queen cages. And sales, that is selling what your bees make get appropriate attention, with displays, traveling observation hives, skeps and a whirligig.

But by far the most useful chapter is at the back of the book, called What Your Mentors Forgot To Tell You. A few examples – attaching wild comb to a frame, going from two to one hive combination, dealing with crystallized honey, cleaning equipment, placing hives in a beeyard, hive stand common sense, marking queens, making mini-nucs, free paint, dealing with pasture gates, hive cover rocks, lighting smokers and on and on – there's over 100 tips, tricks, techniques and solid information every beekeeper can use. Priceless. – *Kim Flottum*

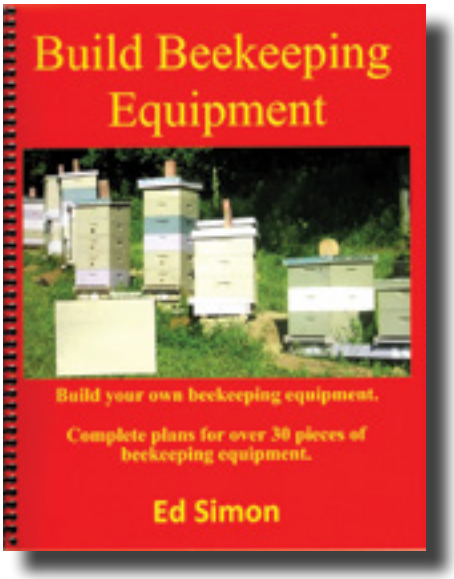
An Annotated Anthology. Graham Kingham. Published by Northern Bee Books. ISBN 9781912271764. 6.5" x 9.5", 143 pgs, color throughout, soft cover, $22.99.

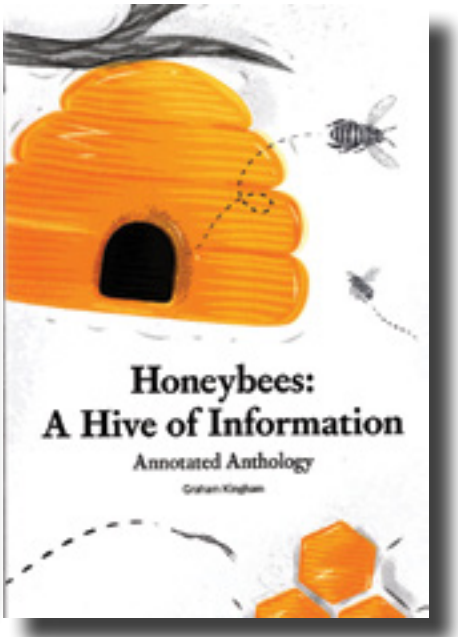
An anthology is a collection of articles, poems, stories and the like made by the author of the book, which is now an anthology. Annotation is when the author supplements the content with photos, diagrams, drawings, notes or charts to help explain the contents of the anthology, and that's exactly what this book is.

The author explores just over 100 subjects all surrounding the honey bee. There are some major headings, like Bits and Pieces, honey, insect classification, seeing with ultraviolet light, a lot about bee plants, pollen ID and pollen coefficients, all about lots of kinds of (British) wasps, viruses and honey bees, morphology, and lots, lots more.

Each of these is short, some less than a page, the longest three or so pages, but there aren't many that long. Some subjects are incredibly detailed, honey for instance has 14 different questions answered, while others are single, or maybe double only questions regarding the topic at hand. Wax moth, a single page. Well, you can see, over 100 topics squeezed onto 143 pages. Each is short, succinct and explained well. It's not a dictionary, nor is it an encyclopedia. It is, as the title says, A Hive of Information, well annotated. It's one of those books that's good to have close at hand when you find something in a much denser book that you don't quite understand. It'll probably be explained here, short, sweet (sorry) and to the point.

It does have a British flavor, but science being science it isn't too influenced by the author's location. But it is just enough to be fun to read, along with explaining over 100 things bees. *Kim Flottum*





It's a good month for pollination and pollinator studies. Two books, both released early this year, study nearly every aspect of the science, the social and the environmental aspects of this most significant, and vitally important event. That we have become aware of what we are doing to the habitats and nutritional needs of all pollinators – insects, birds, bats and more – is satisfying. However, what we are doing to repair the damage we have already done is only now beginning to heal the wounds we have caused. This is especially important now because US farmers will be planting 182 million acres of corn and soybeans this spring. The most ever, and up just over eight million acres from last year. Those eight million acres will not be feeding pollinators. For comparison, the entire

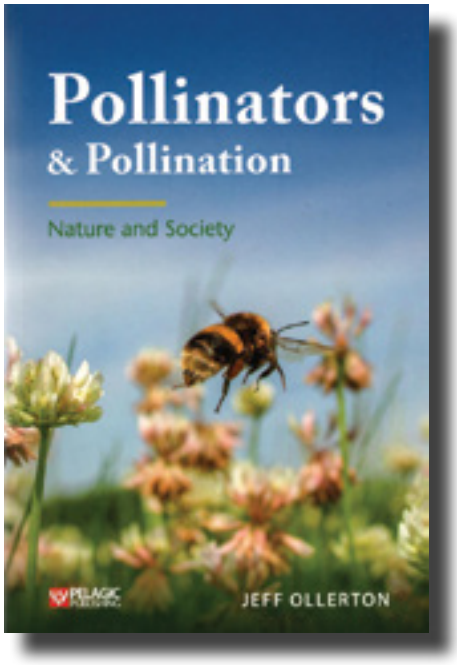
states of California and New Mexico combined total 178 million acres. Throw in Connecticut and you're about even.

Pollinators & Pollination. Nature and Society. Jeff Ollerton. Published by Pelagic Publishing. ISBN 978178272289. 6" x 9", Paper back cover, 289 pgs, color throughout. $31.00.

A unique and personal insight into the ecology and evolution of pollinators, their relationships with flowers, and their conservation in a rapidly changing world.

The pollination of flowers by insects, birds and other animals is a fundamentally important ecological function that supports both the natural world and human society. Without pollinators the world would be a biologically poorer place with an incredible impact on food security, and, obviously, human health would suffer. Absolutely.

Ollerton is an eminent pollination ecologist from the UK and his book provides an introduction to what pollinators are, how their interactions with flowers have evolved, and the fundamental ecology of these relationships. It explores the pollination of wild and agricultural plants in a variety of habitats and contexts, including urban, rural and agricultural environments. The author also provides practical advice on how individuals and organizations can study, and support, pollinators. And he looks at habitat destruction, and then rebuilding it. The importance of urban gardens is especially interesting and useful.



As well as covering the natural history of pollinators and flowers, the author discusses their cultural importance, and the ways in which pollinator conservation has been portrayed from a political perspective. The book draws on field work experiences in South America, Africa, Australia, the Canary Islands and the UK. Many excellent photos, charts and graphs go far in helping define the issues discussed.

For over 30 years the author has spent his career researching how plants and pollinators evolve relationships, how these interactions function ecologically, their importance for society, and how we can conserve, and repair them in a rapidly changing world. This book is aimed at anyone who is interested in understanding these fascinating and crucial ecological interactions.

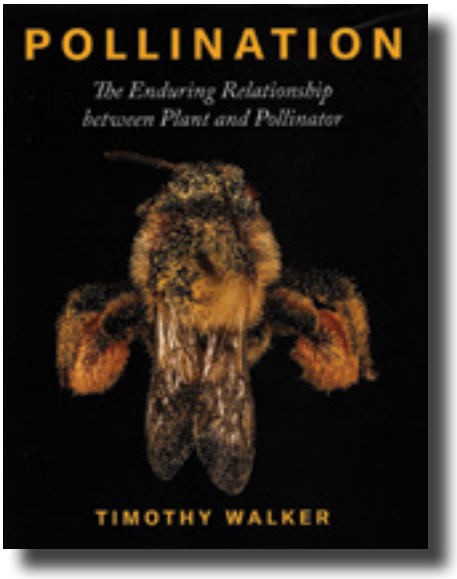
Kim Flottum

Pollination. The Enduring Relationship between Plant and Pollinator. Timothy Walker. Published by Princeton University Press. ISBN 9780691203751. 8" x 10", 224 pgs, hundreds of stunningly beautiful photos of insects, birds, animals and the flowers they pollinate. $29.95.

Pollination is essential to the survival of most plants on Earth. Some plants rely on the wind to transport pollen from one flower to another. Others employ an array of ingenious strategies to attract and exploit pollinators, whether they be insects, birds, or mammals. This beautifully illustrated book provides and excellent look at the wonders of pollination biology, drawing on the latest science to explain the extraordinarily complex relationship between plant and pollinator, and revealing why pollination is vital for healthy ecosystems and a healthy planet.

I thoroughly enjoyed the format of this book. Nearly every page poses a question in big, bold type, and then answers that question, usually on that page, but sometimes on two or three. The author begins his story with a basic, but detailed introduction to pollination biology and explores the many different tactics of plant reproduction. He shows how wind and water can be an effective yet wildly unpredictable means of pollination, and describes the intimate interactions of pollinating plants with bees and butterflies, beetles and birds, and lizards and bats. He even explores the world of managed bees a bit. Walker explores how plants bribe pollinators using odor, colors, and shapes, and how plants rely on rewards as well as trickery to attract animals. He touches on the important role of pollination in ecology, evolution, and agriculture, and discusses why habitat management, species recovery programs, and other conservation efforts are more critical now than ever.

These two books are somewhat similar, but having both on your nightstand would be a wonderful treat. *Kim Flottum*



Bee Culture

The Magazine Of American Beekeeping

BEEing Diverse: Inspiring Leaders in Beekeeping

Mark Your Calendars for October 1-3, 2021

The Return Of Bee Culture's Annual Event

We have an impressive lineup of speakers. The meeting will be held in our Bee Culture Conference Room. Watch these pages and our web page for more details as we firm up the details. We plan to start registration on June 1.

Susan Cobey is an acknowledged international authority in the field of instrumental insemination and honey bee breeding.

Jackie Park Burris was born into the Park Beekeeping Family of Northern California and is owner of Jackie Park Burris Queens

Tammy Horn Potter balances her career as an English professor and hobbyist. She wrote *Bees in America*: *How the Honey Bee Shaped a Nation*, followed by *Bees in America* and *Beeconomy: What Women and Bees teach us about Local Trade and Global Markets*. In 2014, Potter became the KY State Apiarist.

Annette Meredith, Executive Director of BIP (Bee Informed Partnership)

Julianne Grose, Brigham Young University. Associate Professor. Microbiology and Molecular Biology

Maggie Lamothe Boudreau, Fédération des apiculteurs du Québec, Canadian Honey Council 3rd Vice Chairperson

Kathy Summers, Assistant Editor of *Bee Culture Magazine,* involved in the leadership of various local, state and regional beekeeping associations over the years

Kim Skyrm, State Apiarist, Massachusetts

Joan Gunter, one of the co-owners of Gunter Honey Inc. is also President of the American Bee Federation

Barb Bloetscher, State Entomologist at The Ohio Department of Agriculture.

Geraldine (Jeri) Wright is an insect neuroethologist in the United Kingdom. In 2018 she became the Professor of Comparative Physiology/Organismal Biology at the University of Oxford and Tutorial Fellow of Hertford College.

Tracy Farone, Professor of Biology at Grove City College, D.V.M, monthly columnist in *Bee Culture* 'Bee Vet'

Judy Bodenhamer, President of Revenue Resources LLC, Judy is an entrepreneur, business executive, coach, mentor, innovator and community volunteer

We are optimistically going forward with our planning of this event, due in part, to the apparent rapid advances in the public health situation.
We will continue to monitor the situation and make rational/safe decisions going forward.
The way it stands at this time, we will most likely limit attendance based on recommendations as we go forward.
We hope to see you in October!
Be sure and visit www.BeeCulture.com

ROOT PUBLICATIONS

All The Buzzz in...

Hello Friends,
April is national poetry month.To celebrate , send us your bee poems!

Bee B. Queen Challenge

Create your own recipe using fruit.

Bee B.Queen

Do you know what a bee likes to be?

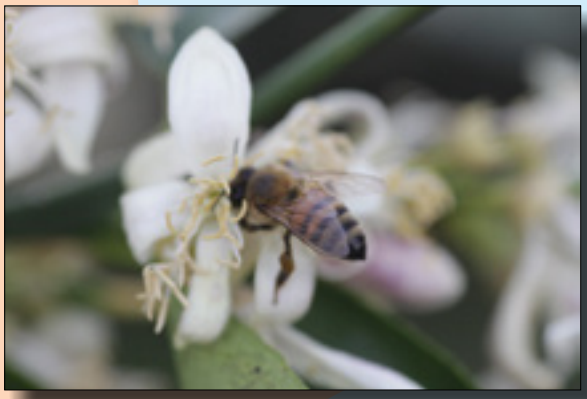
A busy bee
From John Schwartz

Fabulous Fruit Trees

There is almost nothing as delicious as biting into a ripe, juicy peach. The flavor explodes in your mouth. Juice runs down your chin. Thanks to our pollinators, we have nature's sweet treats growing on trees in orchards and if we are lucky, in our own backyards.

Pear Blossoms

The blossoms on fruit trees develop into tasty tidbits thanks to pollination. Pollination occurs when bees, insects, or birds carry pollen from the male part of a blossom (anther) to the female part of another blossom (stigma). Some fruit trees need pollen that is carried from other trees and some do not.



Cross Pollinating

Most fruit trees must be cross-pollinated. They need pollen carried to them from other trees. Pollinators, like honey bees, carry pollen from the flowers of one variety to the flowers of a different variety of the same type of tree. The trees that need cross-pollination are apples, pears, most sweet cherries, and most Japanese plums.

Peach Blossoms

Self-Pollinating

Some types of fruit trees do not need another tree to complete pollination. These self-pollinating or self-fruitful trees are pollinated by pollen from another flower on the same fruit tree or, in some cases, by pollen from the same flower. Even though these fruit trees do not need pollen carried to them from another tree, cross-pollination helps them produce more fruit. Apricots, nectarines, peaches, sour cherries and European plums are examples of self-pollinating trees.

Who Carries the Pollen?

Fruit trees have a number of pollinators that do the work of carrying pollen from one flower to another. Of course honey bees are great pollinators but they are not the only ones. Bumblebees, solitary bees, and flies can also help these trees produce fruit through pollination.

Apricot, Plum, Peach, Pear, Kiwifruit, Sweet cherry, Sour cherry.

Bee kid's corner

Produced by Kim Lehman -www.kim.lehman.com
www.beeculture.com
April 2021

Thank a Bee Smoothie

2 cups pears,
cored and chopped
1 cup cherries, pitted
1 cup apple juice
1/2 cup plain yogurt
1 1/2 cups crushed ice
1/2 tsp vanilla extract

Combine all ingredients in the blender and blend until smooth. Add a little cinnamon or ginger to spice it up.

What is a bee's worst enemy?

A man
From Mose Schwartz

Celebrate Pollinators!

How are you going to celebrate National Pollinator Week June 21-27?

Maybe you could…

- Host a pollinator-themed snack
- Invite your friends over for a honey tasting
- Build native bee houses
- Make seed balls using seeds for pollinator plants
- Join the Million Pollinator Garden Challenge

Register your event at http://pollinator.org/pollinator-week and inspire other to join in!

Great Fruit Tree Sort

Unscramble the letters in each word to discover fruit trees that benefit from having honey bees, bumblebees, and solitary bees pollinate their blossoms. Fill in the numbered boxes at the bottom with the corresponding letters to discover a message. What do you think the quote means?

PAICORT

LUMP

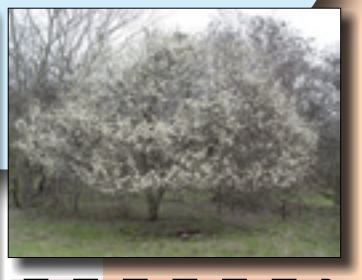
PCHAE

ERAP

IIWRTUKFI

EEYHESWRRCT

UYSHCRRROE



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Quote by Tertullian, a philosopher born in 155 AD.

Beecome a Bee Buddy

Send two self-addressed stamped envelopes and the following information to: Bee Buddies, PO Box 117, Smithville, TX 78957.

Name
Address
Age
Birthday Month
E-mail (optional)

We will send you a membership card, a prize, and a birthday surprise!

Send all questions, photos, and artwork to: beebuddiesclub@gmail.com or mail to the above address.

A Closer LOOK

QUEEN POST-MATING CHANGES

Clarence **Collison**

Mating Is A Lengthy And Complex Process

Mating in honey bee queens is a lengthy and complex process. A queen bee reaches sexual maturity when she is five to 10 days old, at which point she initiates mating flights. She will take one to three mating flights on subsequent days, and mate with numerous drones throughout the course of these flights. The majority of the semen collected by the queen is excreted within 24 hours after insemination, and a proportion of each male's sperm is stored in her spermatheca. A fully inseminated queen retains approximately five to seven million sperm. Once the queen completes the mating process, she will initiate egg-laying behavior within a few days, and then will never mate again during her lifespan (Kocher et al. 2008).

After mating, a queen undergoes massive and permanent physiological and behavioral changes. Her ovaries (previously in a state of arrested development) complete the final stages of maturation as her ovarioles increase in size and the eggs become vitellogenic and reach maturity (Tanaka and Hartfelder 2004). The queen's pheromone profile also changes dramatically (Plettner et al. 1997; Keeling et al. 2003; Richard et al. 2007), causing workers to surround the queen in a retinue response, antennating and licking her. Major changes occur in the brain as well. Fahrbach et al. (1995) found that following mating, the Kenyon cells of the mushroom bodies of the brain decrease by 30% while the neuropil of the mushroom bodies increases by 25-50%. Levels of dopamine and N-acetyldopamine also decrease following mating (Harano et al. 2005). Mating also causes profound behavioral changes. Virgins are phototactic and take mating flights, while mature, mated queens remain in their colonies and lay eggs (Winston 1987).

"In order to disentangle the molecular pathways regulating these various components of the post-mating response, Kocher et al. (2008) correlated changes in gene-expression patterns in the brains and ovaries to behavioral and physiological changes in three distinct types of queens: virgins (n = 6), mated queens that have not yet initiated egg-laying (subsequently denoted as "mated queens", n = 5), and mated queens that have begun laying eggs (subsequently denoted as "laying queens", n = 4). Virgin queens and laying queens are the two extreme cases encompassing the complete post-mating response, while the second group (mated queens) represents an intermediate phenotype. These queens are considered to be "incompletely-mated", because they have not yet completed the full suite of behavioral and physiological transitions associated with mating in honey bees. It is also important to note that queens in this group were heterogeneous in terms of flight behavior; some attempted to take additional mating flights, while others were not observed to do so. Four queens from each group were used for the microarray study. Their results demonstrate that behavioral and physiological post-mating changes can be uncoupled in the mated group, and that these changes can be associated with specific gene expression patterns."

"Research has demonstrated that there are large-scale transcriptional changes in the brain and ovaries that are associated with the mating process in honey bee queens (Kocher et al. 2008). It appears that physiological changes in the ovaries and pheromone production in the mandibular glands may be initiated immediately as the mating process is initiated, but that changes in flight and egg-laying behavior seem to require the completion of the entire mating process or operates on a slower timescale. Consistent with these physiological and behavioral changes, transcriptional changes in the brains and the ovaries appear to be uncoupled as well. There are still several important questions related to honey bee reproductive biology that remain to be elucidated. First, queens mate with several males before they stop taking mating flights and initiate egg laying (Roberts, 1944; Tarpy and Page, 2001; Schluns et al., 2005). However, they still do not fully understand what cues a queen uses to determine that she has successfully completed the mating process."

"To elucidate how queen-post mating changes are influenced by seminal fluid, the non-spermatozoa-containing component of semen, Jasper et al. (2020) injected queens with semen or seminal fluid alone.

They assessed queen sexual receptivity (as measured by likelihood to take mating flights), ovary activation, worker retinue response (which is influenced by queen pheromone production), and transcriptional changes in queen abdominal fat body and brain tissues. Injection with either seminal fluid or semen resulted in decreased sexual receptivity, increased attractiveness of queens to workers and altered expression of several genes that are also regulated by natural mating in queens. The post-mating and transcriptional changes of queens receiving seminal fluid were not significantly different from queens injected with semen, suggesting that components in seminal fluid, such as seminal fluid proteins, are largely responsible for injected stimulating post-mating changes in queens."

"The receipt of drone semen can modulate queen ovary activation, pheromone production, and subsequent worker retinue behavior. In addition, seminal fluid is a major component of semen that is primarily derived from drone accessory glands. It also contains a complex mixture of proteins such as proteases, antioxidants and antimicrobial proteins. However, the specific molecules in semen and seminal fluid that initiate post-mating changes in queens are still unidentified (Brutscher et al. 2019)."

"Niño et al. (2013) used instrumental insemination of queens to examine the role of the insemination substance and volume in triggering post-mating changes. They also examined differences in gene expression patterns in the fat bodies of queens with highly activated ovaries to determine if events during copulation can cause long-term changes in gene expression. They found that the instrumental insemination procedure alone caused cessation of mating flights and triggered ovary activation, with high-volume inseminated queens having the greatest ovary activation. Hierarchical clustering grouped queens primarily by insemination substance and then insemination volume, suggested that while volume may trigger short-term physiological changes (i.e. ovary activation), substance plays a greater role in regulating long-term transcriptional changes. The results of gene ontology analysis and comparison with previous studies suggest that both insemination substance and volume trigger molecular post-mating changes by altering overlapping gene pathways involved in honey bee reproduction."

"Kocher et al. (2010) further uncoupled the changes that occur with the mating process by examining the effects of natural mating versus instrumental insemination and saline versus semen insemination. They observed effects on flight behavior, and vitellogenin expression.

The cues a queen uses to determine when she has completed mating are not well characterized.

They monitored the flight attempts for all queens in each of their treatment groups before and after mating or instrumental insemination. Reproductive status had a significant effect on flight attempts. Virgin queens and queens limited to a single mating flight both continued to attempt to take mating flights, although the naturally mated queens attempted less frequently. None of the inseminated queens attempted to fly following instrumental insemination."

"Vitellogenin (Vg) is a protein that is produced in the fat bodies and sequestered in developing oocytes, and it plays a humoral role in ovary development. The specific role of Vg in the honey bee mating process still remains to be elucidated. Kocher et al. (2010) found that mated queens had the highest levels of vitellogenin transcript, virgin and saline-inseminated queens were intermediate and semen-inseminated queens had the least amount of Vg expressed in the fat bodies."

"To explore neuro-endocrinal changes in the brain of queens before and after mating, Harano et al. (2005) measured the amount of several biogenic amines, including dopamine and its metabolite in the brain of six- and 12-day-old virgins and 12-day-old mated queens. Twelve-day-old mated queens showed significantly lower amounts of dopamine and its metabolite (N-acetyldopamine) than both six- and 12-day old virgin queens, whereas significant differences in the amounts of these amines were not detected between six- and 12-day-old virgin queens. These results are explained by down-regulation of both synthesis and secretion of brain dopamine after mating. It is speculated that higher amounts of brain dopamine in virgin queens might be involved in activation of ovarian follicles arrested in previtellogenic stages, as well as regulation of their characteristic behaviors."

"One of the major post-mating changes in queens is the activation of the ovaries and ovulation. The ovarioles of a newly emerged (0 day) queen have only two regions that may be distinguished: a proximal, short germarium and a very long distal, terminal filament. As the queen matures and gets ready for the nuptial flight, the germarium increases in length, advancing toward the distal end as the terminal filament shortens. The ovarioles of queens ready to mate (six to eight days old) have, already one or two ovarian follicles, i.e. a very short proximal vitellarium, but a real viellogenesis only starts after the fecundation. If the queen does not mate, the ovariole structure is disrupted (12-16 days old). In mated queens laying eggs, the ovarioles present three differentiated regions, from the apical to the basal: a short terminal filament, a medium size germarium, and a very long basal vitellarium. As the eggs are laid, the empty follicle collapses and degenerates (Patricio and Cruz-Landim 2002). Ovaries of laying queens were about eight times as large as those of virgins (Shehata et al. 1981)."

"The number of days from emergence to the onset of oviposition in seven groups of queens was as follows: naturally mated queens, 10·33 ± 0·68; free-flying queens treated with CO_2, 11·00 ± 0·36; queens instrumentally inseminated by the Mackensen technique, 13·8 ± 1·94; virgin queens treated with CO_2, 14·00 ± 0·77; queens instrumentally inseminated, using the washing technique, 14·58 ± 0·53; queens injected with washing fluid, 15·82 ±

1·42; queens injected with Kiev solution, 17·77 ± 1·24. The number of spermatozoa in the spermatheca of naturally mated queens, of queens inseminated by the Mackensen technique, and of queens inseminated by the washing technique, was 4·54 ± 0·7, 3·83 ± 0·47, and 3·02 ± 0·52 million, respectively. Naturally mated queens started laying eggs earlier than the instrumentally inseminated queens (Kaftanoglu and Peng 1982)."

"Manfredini et al. (2015) used next-generation transcriptomics to probe changes in gene expression in the brains of honey bee queens, as they transition from virgin to mated reproductive status. In addition, they used CO_2-narcosis, which induces oviposition without mating, to isolate the process of reproductive maturation. The mating process produced significant changes in the expression of vision, chemo-reception, metabolic and immune-related genes. Differential expression of these genes map clearly onto known behavioral and physiological changes that occur during the transition from being a virgin queen to a newly-mated queen. A subset of these changes in gene expression were also detected in CO_2-treated queens, as predicted from previous physiological studies. In addition, they compared their results to previous studies that used microarray techniques across a range of experimental time-points. Changes in expression of immune- and vision-related genes were common to all studies, supporting an involvement of these groups of genes in the mating process."

Virgin queens are highly phototatic (attracted to light) and undertake one or more nuptial flights before they cease performing mating flights. Once the queen has taken her final mating flight and has stored spermatozoa in her spermatheca, she permanently exhibits reduced phototaxis and sexual receptivity. The queen remains in the hive to lay eggs, unless she participates in a swarming event (Winston 1987). BC

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Bees Eat Meat?

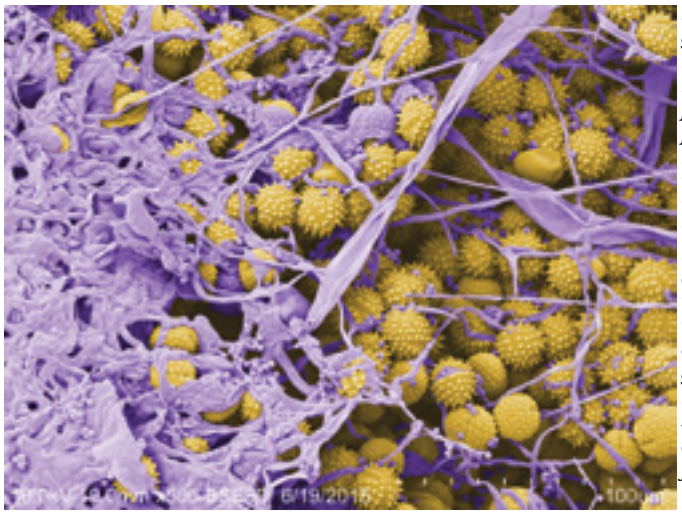
Kirk **Anderson**

The process of science involves new discoveries and continuous revision. The culture of science has placed a premium on novelty, but the revision process is often slow, and hampered by context that is difficult to interpret. Stack this atop the highfalutin' superorganism (AKA: honey bees) and yep, information can become a sticky swarming mess. Reasonable context in science comes from experimental design, statistical application, and the ability of the scientist/author to construct a reality sandwich from the meat of new results and the bread of present knowledge. Scientists learn how to present their findings clearly, and must eventually sell their ideas forward to maintain future funding. When a scientific manuscript is sent for peer-review, the author must target a general science audience by placing the work in context. However, when that same piece of work becomes a news release or popular article, it is typically painted with a more colorful brush. Like an invasion of "Murder Hornets", it must buzz the public ear.

My personal favorite: "Bees Need Meat", explains that microbes in flowers are a crucial part of the bee diet. It goes on to say that microbes are basically "meat", and microbiome changes caused by various environmental and agricultural factors could be starving the insects. While it seems bizarre to consider bees eating meat, this news release aspired to awaken the world to the vital connection between ALL pollinators, agriculture and microbes. As a devout microbial ecologist, I wholeheartedly embrace a future wherein agriculture accounts for microbial factors across the landscape including flowers, water sources, soil, natural systems, and all pollinators, including honey bees. After all, there are thousands of pollinating bee species, and microbes are essential to nearly every life process. However, I recommend that you stop short of replacing your pollen substitute with probiotic hamburger. Although a novel and highly relevant discovery, "Bees Need Meat" was NOT about honey bees. In fact, honey bees were conspicuously absent from these studies, and for good reason. The fact is, honey bees store and process their collected pollen very differently from the bees that eat microbial meat. Moreover, the way in which honey bees control microbial growth and exposure is a hallmark of advanced social life and honey bee success.

First, let's examine the bees that eat microbial meat. These bees are native to the Americas, and mostly solitary or socially primitive. Every female solitary bee must function as a forager, nest builder and queen. They mate, then forage for their own pollen and nectar, and lay individual eggs on nectar-laden pollen balls containing some microbes from flowers. As the larvae develop, it is sometimes a race between microbe and larvae to consume the pollen and nectar provisions. As a result, many native bees end up eating a big load of microbes along with their pollen. These microbes were called "meat" because the measured nutritional value was more similar to a meat eater than a cow grazing grass. Earlier research on native bees detailed how mold growth could devour a large proportion of solitary larvae along with its pollen ball. In response, some bee species return to the nest site to police fungal growth, walling off infected from non-infected larvae. Other solitary bee species developed ways to combat fungal growth, including the application of plant materials and salivary secretions that protect developing larvae. As happens in every microbial ecosystem, various microbes compete for access to the sugary pollen ball including opportunistic pathogens (mostly molds) and potentially beneficial microbes that suppress mold growth (Lactobacillus, Acetobacteraceae and sugar tolerant yeasts). Generally, the microbial function of these sticky pollen balls resembles that of silage production, wherein acid produced by fermentative microbes inhibits mold growth, preserving, and in some cases, altering the nutritional quality.

As a pinnacle of bee evolution, honey bees possess more and better strategies to combat unwanted microbial growth, and advanced social organization has provided some unique modifications. First off, honey bee larvae consume very little if any pollen, so by definition, cannot eat the microbial meat growing on pollen. Honey bees possess a functional subgroup called nurse bees that control multiple aspects of colony nutrition. This group of adult

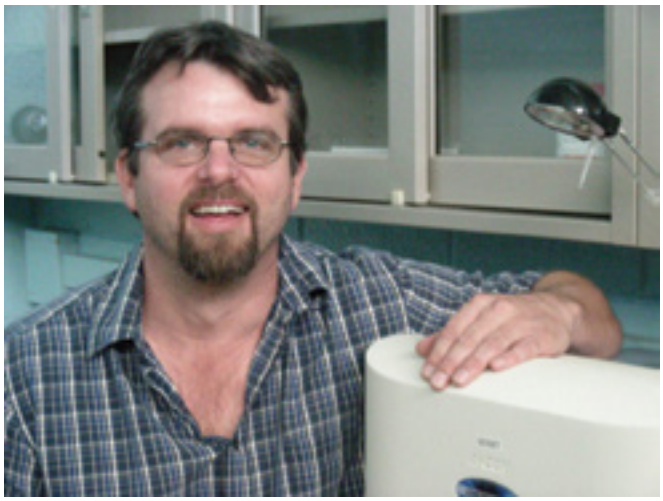


Scanning electron micrograph of beebread (yellow) being devoured by an unknown mold (purple). As part of an overwintering experiment, we removed beebread from its location on the frame and placed it at the top of the hive. Disturbing the natural structure of bee-bread on the frames and exposure to moisture at the top of the hive resulted in extensive mold growth overwinter. Mold did not grow on the undisturbed beebread. The small purple spheres are mold spores, and the purple tubes are fungal hyphae, the major mode of fungal growth.

bees eat and digest the pollen, bulk up their fat bodies, then feed larvae with highly nutritious jelly using special head glands. Secondly, honey bee stored pollen (or beebread) has virtually no microbial meat. Stored pollen is 50% honey by weight and a highly preservative environment that suppresses microbial growth. In fact, both honey and jelly are notorious microbe assassins each containing a devastating variety of antimicrobials. Together, these two substances buffer the effects of environmental change and allow the honey bee to survive extended times with no forage. The perennial honey bee lifestyle would be impossible without honey and jelly. Not only do these substances buffer nutritional dearth but have also evolved to confront the microbial challenges associated with periods of limited nutrition. One might even hypothesize that the evolution of honey bee sociality was continually refined by relentless microbial challenge during the nutritional shift to a perennial lifestyle. But I digress…

Honey bees do not eat microbial meat. The scientific process relies on thoughtful revision, and revision relies on context. As a social insect ecologist who peer reviews 75-100 scientific papers yearly, I'm constantly asking myself three context reliant questions; 1) Am I capable of reviewing this material? Many manuscripts about bees I cannot agree to review because I lack the context (education or experience) to judge them. 2) Are the methods and results valid?, This is difficult to judge and requires an expert versed in the methods and statistics used by the authors. 3) How were the results placed in context? In other words, does the author's tasty sandwich square with hypothesized reality, and if not, do their evidence and arguments convincingly address the inconsistencies? This judgement typically requires a deep knowledge of present and past literature surrounding the subject matter. In short, context is everywhere, it is both theory and hypothesis, hardware and software, tool box and blueprint. Automatically created but rarely considered, the mind quickly imposes context on every situation. At the most fundamental level, it is how you distinguish important things from the background. The space devoted to context can dominate an article, or be largely ignored. Unfortunately, context is complicated, longwinded and often boring. To drive my point home, context is defined as: "the circumstances that form the setting for an experiment, statement, or discussion, and in terms of which, it can be fully understood and assessed". The devil is in the details. Only the science-minded could love context.

Kirk Anderson



In contrast, novelty is fast and fun, and like a new puppy… has sharp little teeth. Context and novelty always compete for space, especially when reducing a scientific article to a twitter blurb, or when sampling select bits of science to support a new product on the market. Presentation of a novel finding requires a dramatic distillation of context, typically producing a short catch phrase that rings the brain bell "wait, what?"… microbial meat? murder hornets? In this age of fast information, novelty is linked inexorably with sensationalism. It's the silver bullet of science. The breakthrough of the century. It's the brush used to paint all advertisement, snake oils, and conspiracy theories. Almost by default, novelty is misinterpreted due to limited or missing context. "Based on science" only works if the context is correct and complete. Returning to our example, "bees need meat", the press release was crafted to highlight the importance of landscape; the flowers and associated microbes sustained by the landscape. The reader was first "hooked" by the scent of sensationalism, satiated by meaty novelty, then for dessert, served a small scoop of context.

But like you, when someone says bees, I see a box with honey supers, a colony on a landscape, an integrated system, a factory in a fortress. I think of beekeeping, honey bee research, whether it happened in a cup, a cage, a nuc, a super, what bees did you sample and why, what time of year, treated for mites, antibiotics, viral load, landscape history…All these factors add variation to the results, some predictable, some stochastic. How do these parts contribute to the collective whole? For the majority of bee publications, much of this variation is either unknown, ignored completely, difficult to attach to the experimental design, or poorly accounted for in the article. Even when you've done your due diligence accounting for these factors, honey bee colonies are famous for behaving in ways you've never seen before. While I'm sure you've experienced this as a seasoned beekeeper, I relearn it repeatedly trying to get bee hives to "beehave" for bee research. Reducing colonies to cages or nukes can yield statistically relevant results, but often does not predict what will happen to full size hive A or B, on landscape A or B, in season A or B, and so on. To understand any complex system, you must approximate many things. Data is piecemeal, and must be stitched together to assemble a gestalt, a platform from which to build novel understanding.

It is in this context that we interpret the biological and statistical reality associated with honey bee microbial ecology. Not easily reduced to individual terms, a colony is composed of physiologically interrelated groups of activities. Colonies can stay in place or move quickly across a highly variable landscape. The colony is a robust and

dynamic social entity, both nurturing and deadly. Colony function relies on the interdependence between groups of individuals performing a variety of different processes in parallel. At the active fringes of the factory, the hive itself is an antibiotic, a prebiotic and a probiotic, populated by a special set of microbes evolved to endure the hive environment. The lion's share of these microbes are not recently transmitted from flowers, but are present throughout the year, and may be considered "native" to the hive environment. Although not convincingly demonstrated in its entirety, this statement about native hive microbiota reflects an educated opinion based on one scientist's microbial understanding of honey bees, native bees, and the pollination environment. More context available on request. BC

Dr. Kirk E. Anderson has conducted research in the ecology and evolution of social insects for 25 years and is recognized nationally and internationally as an authority on honey bee microbial ecology, host-microbe interactions, social insect molecular ecology, trophic and systems ecology. Dr. Anderson designed and built modern molecular and microbiology labs at the Carl Hayden Bee Research Center in Tucson AZ, and attracted and trained a competent research team composed of highly-motivated personnel including graduate and undergraduate students from the University of Arizona. His research achievements are celebrated by industry in the scientific focused ABJ, high-tier scientific journals, top-tier research universities, and various media sources. His work on honey bee microbial ecology has led to invitations to international meetings, inclusion in the world-wide bee microbiome consortium, and consultations with state and national beekeeping organizations. Dr. Anderson has been awarded over $1,300,000.00 in outside funding, including multiple industry grants, an AFRI-NIFA grant, and multiple post-doc grants. In 2015, He was awarded the PWA "Early Career Scientist of the Year" to recognize his ARS microbiome research.

I-CORP FOR BEEKEEPERS, REPORT #2

National Science Foundation (NSF)

Jerry **Hayes**

Back a few years ago when I was young and good looking (well maybe more than a few), I discovered honey bees and beekeeping. Back in the 'good ole days' about the only thing that was of any acute and/or chronic honey bee health significance was the bacterial spore forming disease American Foulbrood (AFB). There was European Foulbrood, Chalkbrood and Nosema (*apis*) but back then these were early season spring issues that popped up and then 90% of the time disappeared as the weather stabilized and flower pollen and nectar came in. These were over relatively quickly. We had wax moths as we do now but wax moths are just opportunists. They are looking for a colony of which the population is dropping for some reason like swarming or Winter death or queenlessness, and they move in because they want to reproduce in the colony as the old comb holds the nutrition that their larvae need to grow to adulthood. As a new beekeeper in the learning stage, I remember going to my first local Beekeeper Assoc. meeting and overhearing the local sideline beekeeper that everybody listened to say, "you set up your colonies and you can go hunting or fishing the rest of the year". Honey bee management was as much as you wanted it to be or as little as you wanted it to be. Other than AFB, pesticide exposure, queenlessness or unexpected starvation, beekeeping was a pretty easy ride in the early 1980s in comparison to 2021.

That is how I started beekeeping. It wasn't particularly stressful or worrying. I became the consummate backyard beekeeper and did all the crazy, yet fun things backyard hobby beekeepers do. I made different kinds of hive equipment, Kenya Top Bar hives, special bottom boards, top feeders and lots more. It was a great learning time because the only pressures on honey bee health were mostly the ones I imposed on these forgiving, patient honey bee colonies as I opened them every day.

We have a Global economy that depends on shipping 'products' including meat, vegetable, fruit with their bacterial, viral, and insect stowaways coming from many countries and going to many other countries. This industrial scale transportation is done by the use of millions of sea-going shipping containers, special containers for air cargo and people traveling the world with a variety of things in their luggage. Things move around the world. COVID is the latest example.

Back in the day, managed and feral honey bee colonies in the U.S. whether they were living in a manmade beehive or a hollow tree, had it pretty easy. Life was good. Plenty to eat and not many pests, parasites or diseases. They had been in effect, quarantined from the rest of the world for hundreds of years. Their survival genetics had not been challenged very much. They were genetically and biologically naïve.

July 3rd 1984 things began to change when the first significant honey bee parasite to come to North America was identified, the Tracheal mite, *Acarapis woodi.* For honey bees in the U.S. and Canada that had never met the parasitic Tracheal mite they took an initial devastating hit. Because of the mostly unrestricted movement of honey bee colonies, nucs, packages and queens tracheal mites spread quickly. Tens of thousands of colonies died and many commercial beekeepers went out of business.

Varroa destructor (and now many other *Varroa* sub-species) the *Varroa* mite which is considered to be the most devastating parasite of honey bees in existence, was first identified in 1987 in the U.S. As a result of global trade in honey bees in and out of Asia, the home of *Varroa*, the mite became established in Africa and Europe before hitchhiking into the U.S. Immediately Canada and Mexico closed their borders to the important lucrative movement of managed honey bees for pollination, queens and packages.

With *Varroa* came a whole suite of new viruses that were vectored/transmitted by *Varroa*. *Varroa* in the process of feeding, chews a hole in the outer membrane of a honey bee abdomen in order to reach the nutrient rich fat bodies of the honey bee. In this interaction and resulting damage done, viruses in *Varroa* are transferred to the honey bee. Immunosuppression occurs which allow these and other viruses to more easily reproduce and even more quickly negatively impact honey bee health and the well-being of the colony.

As the *Varroa* and the Varroa/Virus legacy grew and spread, this became the new norm and the saga continued.

The presence of a secondary predator of honey bees was confirmed in the U.S. in 1996, the Small Hive Beetle (SHB), *Aethina tumida*, previously found primarily in Africa. As colonies weakened from *Varroa*/*Varroa* Virus Legacy, the SHB would move into the colony that did not have the population to defend itself or those stored resources in the hive. The SHB would lay eggs that would hatch into voracious larvae that want nutritional protein from honey bee larvae and pupae and beebread stored in the comb. The SHB also brings along its own introduced specie of yeast, *Kodamaema ohmeri,*

which produces a heavy slime that makes it more difficult for honey bee colony hive access and movement in addition to causing stored honey to ferment. At this point as the colony population collapses, this SHB infestation forces many honey bee colonies to abscond as they are replaced by SHB larvae and slime and driven out.

As a result of all of the above, honey bee health is precarious due to the direct effect of AFB, EFB, things that look like AFB/EFB but are not, Tracheal mites, *Varroa*, SHB, Wax moths, and many times all of these intersecting and appearing simultaneously leading to internal and external immune systems greatly challenged and failing.

Add to all of these introduced pests, parasites and diseases, one of the largest impacts to a colony's health are the products and techniques that we beekeepers subject to the bees to control these problems. Beekeepers like to point their fingers at the use of pesticides by lawn maintenance companies, home insect control monthly sprays, backyard vegetable gardeners, production agriculture, and many others. We beekeepers have to control Varroa or the colony would be totally dead in 18 months. When organophosphates, synthetic pyrethroids, amitraz, caustic acids dribbled or vaporized were approved for use, we all jumped in the circle. We ourselves put pesticides in a beehive to kill a little bug (*Varroa*) on a Big Bug (Honey Bee). The dosages

approved for all of these were such that they killed, hurt or damaged *Varroa* with no apparent immediate acute damage seen in the colony communally or individually. But the chronic long term exposure of these pesticides negatively impact larvae, pupae, workers, drones and the Queen who gets hit every, every time. Ever wonder why Queens don't last as long as in year's past?

Beekeeping traditionally has been a visual sport. The beekeeper to be a successful manager of the honey colony, has to open the hive, take it apart and visually scan the comb and bees, look for eggs, and open brood and capped brood and over time be able to compare and contrast what is seen. Is the Queen there? Is she laying? What is she laying, workers or drones or are Queen cells present? Does the brood look OK or not? If not then what are the issues? How do you know? What is the problem? Can it be ID'd ? How do I address, treat, resolve the problem? Then what?

My guess is that you reading this right now has a Smart Phone, Computer at home and/or work, internet access, home remote protection with cameras and updates, you can start your car remotely and lock it remotely, Siri or Alexa is listening to your every word and responding, maybe even an Apple Watch and ALL THE INTERNET OF THINGS at your disposal. We are all connected. And this digital expansion has taken production agriculture by storm as row crop growers and livestock growers have immediate access to crop and livestock health. Books have been written on diet and nutrition of every livestock animal yet we beekeepers still do not know for sure what nutrients they need at different times of the year, and regions of the world. Why is Beekeeping still a Visual Sport for us when we have so many honey bee management challenges? And honey bees are directly so important to approx. 1/3 of the food we eat plus the gazillions of dollar value honey bees provide to the environment by pollination which helps plants reproduce and birds and animals eat the seeds and grow themselves because of the nutrition provided. Why are we beekeepers so far behind the technology curve to a greater degree than the rest of the world? We could be connected better to honey bee health issues to help honey bees be stronger and healthier as we become better honey bee managers. What is the answer?

Tune into Part III next month. BC

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Clarence H. Collison

Horizontal Two Queen System

Dan **Wyns**

Whether this horizontal two-queen configuration is viewed as two colonies with shared supers or a single colony with two broodnests is debatable, but its capacity to yield large amounts of honey is not in question.
Photo Dan Wyns

One of the first things beekeepers learn, often even before getting bees, is that a colony has many bees but just a single queen. While this is surely true in the vast majority of colonies, I have seen two queens coexisting enough times – and even once found three in a single brood box – to know that the things we beekeepers know as rules may only be viewed as guidelines by the bees themselves. Another thing you learn very early in beekeeping is that a single stack of boxes represents a single colony. The colony is the unit, living in a hive of its own, discrete from the other colonies in the apiary, aside from drifting foragers or robbing bees. Somewhere along the way, inventive beekeepers started straying from the conventional wisdom of "one queen per hive" and exploring two-queen hives with a variety of methods.

In hives where two queens are found occupying the same space, it is not possible to easily determine if one is dominant, laying the majority of eggs. Neither is it possible to know the exact pheromone conditions that result in the toleration of two queens. Beekeepers know if they tried to force a scenario of two queens simultaneously roaming the same brood frames by introducing an additional queen to a queenright colony, the new queen would almost certainly be balled and dispatched by the resident bees. Instead, methods have been developed that allow two queens to coexist in a single hive, as long as they occupy separate spaces and remain separated by employing a queen excluder.

A pair of nuc lids cover the outer portion of each broodnest while a single queen excluder allows bees from both broodnests to access the supers.
Photo Dan Wyns

From a beekeeper's perspective, the primary benefit to two-queen colonies is increased honey production. By having two prolific queens laying simultaneously, the total colony population can reach over 100,000 bees, while the population of a single-queen colony generally tops out around 60,000 bees. This can lead to enormous forces of foragers capable of producing large honey crops when nectar is available.

I have most commonly come across two-queen hives in a vertical configuration. While it seems that the bees fare well in this arrangement, it can quickly become unwieldy for the beekeeper as the height of the colony increases. Productive vertical

two-queen colonies can reach heights that lead to instability and awkward lifts. The abundance of supers on top make even a cursory brood inspection an exercise in heavy lifting.

An alternative to the vertical two-queen system is to arrange two brood nests side by side with supers in the middle. This is generally referred to as a horizontal two-queen system. Looking at the colony, it appears as two separate but adjacent brood nests, just as two regular colonies would. However, there is a stack of shared supers in the middle, instead of each brood nest having its own stack. This configuration intuitively feels like two hives from a management and record keeping perspective, but a single unit from a production and harvest standpoint.

The horizontal two-queen colony is easy to set up, provided you have adjacent hives with brood nests of equal height. Each brood nest will need its own base. It is worth spending a minute to level the bases and ensure the single-queen excluder fits across the top of the interior side of both brood nests. A pair of half-width lids cover the exterior side of each brood nest. The supers are stacked on top of the queen excluder and covered with a single lid.

There are several benefits to the horizontal two-queen colony. Foremost is that the overall stack of woodenware will be twice as wide at its base and not as high, leading to increased stability and decreased lift height. Another advantage is that the brood nest can be accessed without removing all of the supers. By removing the half cover from each side, the beekeeper has easy access to 5 frames from the brood nest, which should provide a quick confirmation of queen status and colony health.

Placing the drone frame at the top and towards the outside of the brood chamber allows it to be removed and replaced on schedule without breaking down the entire colony, making it much easier to practice drone brood removal. Although drone brood removal alone is unlikely to provide sufficient *Varroa* control, when practiced correctly, it can help lower the mite pressure on a colony.

Like most things with beekeeping, there isn't one right or best way to do something, thanks to the malleability of a colony of bees. My early experiences with this two-queen system has shown enough promise to encourage me to keep at it and learn some of the finer points in managing colonies this way. Gaining a better understanding of the nuances of how to manage colonies in this configuration and how they respond to stimuli from both me as a beekeeper and the environment will broaden my understanding of overall bee behavior. BC

Either broodnest can be accessed for a quick queen check without removing the supers. Photo Dan Wyns

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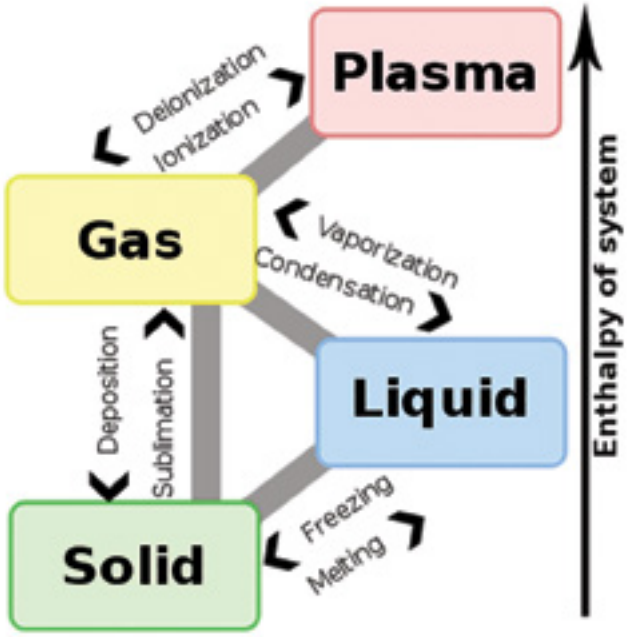
Transitions Continued

John **Miller**

Last month I addressed transitions my fellow beekeepers face. In my case, I join a number of other commercial beekeepers who now transition from outfit owners, to – different.

Some make a clean sale to non-family members. Some of us sell to our families – capable sons and daughters. This is a mix of relief, best wishes, burden lifted; a transition to life's next phase. Some of us are relieved. A few of us are going to be lost for a bit, trying to figure out what next occupies our time, our talents – our energy.

Most of us realize things are changing in beekeeping. I observe that a lot of what is needed to successfully run bee outfits five years from now has not been invented. What is all this techy voodoo showing up in bee outfits? I see tags in beehives I don't understand. I see data showing up on wrist-watches – reporting in-hive conditions. I see hobbyists with the wherewithal to hire hive consultants [a new phrase to me] who will visit a hobbyist to assess hive conditions and make hive recommendations. Who knew hobbyists would embrace the available changes to enhance the health and well-being of their hives. It's a big admission/transition for anyone keeping livestock to seek help . . . or is it? Farmers and Ranchers have for decades [centuries?] sought veterinarian services for troubled livestock.



Last month, hundreds of thousands of hives were strength-inspected by county Department of Agriculture representatives for almond growers. A growing number of private hive inspectors perform strength inspections for growers trusting, yes – but verifying the hives rented to pollinate almond blossoms, do in fact have the strength to do the job. I wonder if the Apiary Inspectors of America, almost exclusively State Bee Inspectors – make memberships available to trained private party inspectors? I wonder if the future includes thermal-camera equipped drones to make hive strength flyovers? If, at 4:00 p.m. a beekeeper removes 1,000 covers from 50 drops of 20 hives per drop in a mile long and mile wide orchard – if upon opening those hives, can a drone, with a pre-set pin drop location log – fly above the tops of the 1,000 hives – scanning the thermal image? Can the inspection be done in a fraction of the time, with a fraction of the bent-over tipped hive looksee labor cost? Will it be accurate? Drone operators have a rule: Drones shall not fly among trees, similar to the U.S. Navy. Is a new era of optimal orchard hive placements about to disrupt hive drops located *within* orchards?

Are expiration dates about to invade everything we do with beehives? Will queens come with expiration dates? We have expiration dates for jars of honey. Drop the idea of warming honey on the back of the stove. When honey granulates: Discard. Go buy a new jar. We don't question the milk jug. Should we question the half-full feeder contents as a source of ill-health for the bee? I'm really keen on clean feeders. Imagine you're a bee. You clean everything with your tongue. Everything. We fret over hives practicing good hygiene. Should we also practice vigilant hive hygiene? Are the tools bursting on the scene pointing to expiration dates for frames? In many outfits, new frames bear a stenciled year. We've long known new frames accumulate fewer pathogens and residue. Frames certainly expire – and not from a hive tool ripping off the top bar.

All this new voodoo tech prompts beekeepers to take preventative actions [far more productive than redemptive actions]. It's a phrase you'll hear Bill Gates repeat: Optimization.

It's all part of a big transition. Fossils like me use a phrase popularized by Malcom Gladwell: Thin-Slicing Data. Upon opening a hive, I thin slice as much information as the hive makes available. It's a lot. How do the bees react to this sudden roof-ripping event? How do they react to the first puffs of smoke? What am I smelling? What am I seeing beneath the top bars – before the digging disruption commences? For me, it's an intuitive assessment – and it takes less than five seconds. I'm often perplexed, but often enlightened by a tic – a sound – a smell – code released by the insects I husband. Bees don't talk Human; I don't speak Bee. But every opened hive reveals, with patience – her wellness or otherwise.

If you're like me – this transition from artisanal/industrial beekeeping is liberating. Those following me employ different devices to improve beekeeping. Change can be jarring. It's part of Letting Go. Commercial beekeepers in transition have decades of bent-back experience. Years ago, a great mentor, Binford Weaver caught me in a hallway. "You're starting to walk like a beekeeper, John. Straighten up." I'm letting go. The voodoo techy stuff will improve Miller Honey operations. I'll probably soldier on like Steve Godlin of Visalia, CA. I've noticed he reminds me of me. BC

Minding Your Bees And Cues

Queen Fandom

Becky **Masterman &** Bridget **Mendel**

Maybe it is her fat, elongated egg-filled abdomen? Or the fact that she survived one or more early-life mating flights to mysterious drone congregation areas and has stored enough sperm to fertilize over a 1000 eggs a day for multiple seasons? Or is it the 'won the lottery' feeling you get finding her among thousands of workers on a frame? Regardless of why, most beekeepers are queen superfans who are thrilled by a queen sighting.

While it's essential to have a young, prolific queen present in your colony at all times, is it essential to find the queen at all times? It is not. In the season-long quest to find their elusive queens, many queen fans are actually disrupting their bees more than necessary, and likely endangering her royal highness. A perfect inspection is efficient and limits disruption to colony organization. Finding the queen should rarely be your goal. While you'll encounter endless resources geared at helping beekeepers learn techniques for spotting queens, protecting her is more important.

Find Your Queen?

First of all, ask yourself why you are looking. Searching for a candid queen Instagram photo opportunity like a member of the paparazzi might not be a good reason to disrupt your colony. Finding a queen in order to split your colony or to replace her are both legitimate reasons to locate your queen.

It is easiest if you separate your hive boxes before you search frame by frame for your queen. Leave one box on the bottom board and move one to sit on the edges of the telescoping cover (see photo). If you separate the boxes first, you do not have to worry about your smoker pushing the bees to the bottom box, crowding the frames with workers and making your search more difficult.

Starting with the end frame, remove each frame carefully and look at both sides. To make it even easier to find her, move each frame into an empty box so that the queen doesn't circle back to frames you've already inspected. Often, you will find the queen on the brood frames with eggs or in close proximity to recently-cleaned brood nest cells.

If you are making splits and just need to know which box holds the queen, you can use the technique taught by the University of Minnesota Bee Lab in their Beekeeping in Northern Climates class (beelab.umn.edu). Place a queen excluder between your brood boxes. Return in 4 days and separate the boxes. In one box you will find eggs (and therefore, the queen is in that one); the other will have neither.

Carefully inspect hive components when inspecting your colonies. This queen was found on the inner cover. Masterman photo.

Checking Your Queen Status

At each colony inspection, ensure your colony is headed by a healthy queen using clues in lieu of the gal herself. The easiest way to ensure that your colony has a functioning queen is to find a solid pattern of eggs in the cells. Once you see a good egg pattern (specifically a single, well placed egg in each of multiple, adjacent cells on a frame), you can be confident that a queen laid those eggs and that she was there in the last 3 days. If you also see larvae of all ages and sealed worker brood, you can be confident that your colony is queenright and your queen is functioning.

In addition to making sure that your colonies are queenright, here are some tips that will help protect your queen:

- During inspections, always check your inner cover when removing it from your hive.
- Move your hive boxes carefully and never place them directly on the ground.
- Move your frames slowly and be careful not to roll the bees on the frames when removing them
- Double check to make sure that the queen is not on a frame used in a sample for varroa.
- Keep your frames above your open hive. If you move around your apiary or yard with frames, you are more likely to lose a queen off a frame. An egg-heavy queen dropped into your colony will be fine. One dropped into the grass will not.
- Remember that a colony will not easily accept a new queen without a proper introduction. The colony must be queenless first (or they will try to sting the new queen to death). A new queen needs to be introduced in a cage for a few days before being released in the colony.
- As a rule, never add adult bees to your colony without a slow introduction (such as a box of bees added above newspaper). You want your queen surrounded by loyal daughters...

While most of us are guilty of gratuitous queen hunting, it is better for the bees if queen status is assessed through egg-presence whenever possible. For the thrill of the hunt, we recommend keeping a stack of "Where's Waldo" classics on hand. BC

Searching for the queen in your hive will be easier if you separate the brood boxes. Note how the top box is placed on the telescoping cover as to not crush any bees. never place your bee boxes directly on the ground. Masterman photo.

Acknowledgement

The authors would like to thank Dr. Marla Spivak for helpful edits and suggestions.

Authors

Becky Masterman led the UMN Bee Squad from 2013-2019 and currently alternates between acting as an advisor and worker bee for the program. Bridget Mendel joined the Bee Squad in 2013 and has led the program since 2020. (Photo of Becky and Bridget from 2014, before social distancing).

BEE VET

If We Only Followed The Directions!

Dr. Tracy **Farone**

The Difference Between a Poison and a Remedy

Most people hate reading "the directions". Who wants to waste all that time when we can jump in and just figure it out, right? Following the directions can be even worse. Just today, I was floating through my lab checking on students who were working on an assignment. When I asked one group how they were doing, they said "Fine, but we started on Exercise 1 and then realized the handout said to start on Exercise 3. So, we've wasted 20 minutes – if we only followed the directions!" Like teaching, medical directions are no exception to poor compliance. Most people do not like taking medications or giving medications to their animals. In fact, studies have shown that medical compliance with doctor's orders is systemically low with up to 75% non-compliance (1). This trend is mirrored in veterinary medicine as well (2). I get it. I would prefer not to prescribe chemicals for my patients if I could avoid it. Unfortunately, many of the disease challenges our bees face do not allow us that utopian luxury.

Let me be clear about the decision of administering any drug, medication, or natural remedy treatments. No matter how they are labeled ("hard", "soft"), they are all chemicals. Antibiotics are chemicals. "Natural" products are still chemicals. Even "soft, natural" products come with a lengthy package insert of their chemical hazards, can kill bees/queens, and harm us, especially if they are not used properly. I do not care to take sides or discriminate based on common treatment categories. IPM is always part of the treatment plan considerations. My goal is to use whatever works with the least number of side-effects based on clinical evidence observed and documented in the bee yard. But if I could encourage beekeepers to follow one direction when administering treatment/s to your honey bees it would be, "Please, use the correct *dosage."*

It is All about Balance: Considerations with Dosage

"All things in good measure" or "moderation" is good advice. In medicine, dosage is defined as the amount of a substance given to a certain patient over a period of time. The purpose of utilizing the correct dosage of a drug/chemical is to maximize treatment efficiency while minimizing possible side effects. Dosage can be further tailored according to the needs of a specific patient in a specific circumstance. Realize no two hives or bee yards are the same and may require different interventions. Since *Varroa* mites are the single, biggest health threat to our bees, I will often use *Varroa* treatments as examples throughout this article, but the principles outlined here can be applied to any medical treatment for any pathologies. The following are important, practical considerations for beekeepers to master in determining dosage:

Timing: Most honey bee treatments are designed to be given during certain seasons and certain weather conditions. Understanding the biological rationale for when and why we use a treatment is critical for success. For example, oxalic acid treatments for *Varroa* mites do not penetrate wax cappings (where most mites reside), can kill open brood, and are thus intended to be used in broodless times. I am a big fan of oxalic when it is used properly. But if a beekeeper is employing oxalic acid multiple times during brood rearing times, (which is most of the main beekeeping season from about February through October in my PA neck of the woods), this treatment is unnecessarily exposing your colony and queen to a chemical that can acutely or subacutely effect bees and brood, and has low effectiveness on the mites at the time (see Box). Please be sure you have a plan as when and why you may use certain treatments during the beekeeping season.

As of February 23rd, the EPA has changed the rules per **Honey Residue and Oxalic Acid**;

https://www.federalregister.gov/documents/2021/02/23/2021-03256/oxalic-acid-exemption-from-the-requirement-of-a-tolerance

Oxalic Acid; Exemption From the Requirement of a Tolerance
A Rule by the **Environmental Protection Agency** on **02/23/2021**

SUMMARY: This regulation establishes an exemption from the requirement of a tolerance for residues of oxalic acid in honey and honeycomb. This regulation eliminates the need to establish a maximum permissible level on these commodities for residues of oxalic acid.

A full discussion of the literature and background on the toxicological profile of oxalic acid can be found in docket number EPA-HQ-OPP-2020-0176 in the documents titled "Oxalic Acid. Label Amendment Regarding Use in Beehives with Honey Supers to Control *Varroa* Mites" and "Oxalic Acid. New Use in Beehives to control *Varroa* mites."

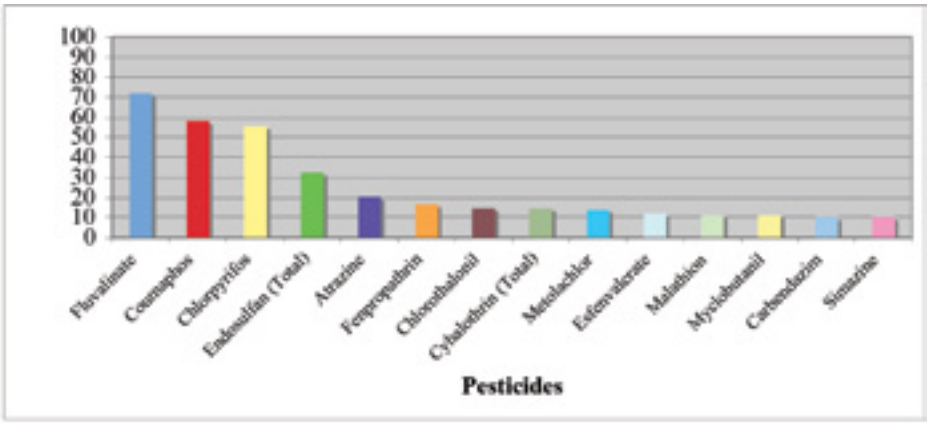
Do not assume that this means that improper exposure to oxalic acid for *Varroa* mites will not harm your colony or leave oxalic acid residues. Beekeepers still need to adhere to label directions.

Amount/volume/formulation: I must admit I am a "to taste" cook. I sort of follow recipes, but I like to add in my own amount of spice or variations. Does this sauce need more wine? Of course, it does!... at least two more "pours"...fun stuff. But in medicine, measuring the actual amount is critical to treatment success. This is the *dose* of medication. It is also critical to understand the concentration of the medication of different formulations of the same chemical may have different compositions and therefore amounts given. More is not better, that approach may be toxic. Less is not better, that approach may cause the medication to be less effective and promote drug resistance. In some cases, after careful evaluation and especially in weaker patients (colonies), veterinarians may adjust doses to the specific need of the hive.

Number of Doses/Frequency: I can remember when I used to make fun of those "old people" pill boxes with M-F designations. Now I have them in my house. Missing doses is a common reason for treatment failure. Remember a treatment is not complete until all the directed doses are given with the correct amount of time inbetween. There are good reasons for this. The number of doses and frequency of medication administration is often based on the lifecycle of the pathogen and/or the half -life of the chemical (essentially how long its effect lasts) in the patient. Be sure you mark the calendar for your bees' meds, too.

Duration: The duration is how long a treatment plan lasts. Some regiments for bee treatments can be long and admittedly annoying – seven days, 21 days , 42 days – but like the number and frequency of doses, the duration is often based on the lifecycle of the pathogen and/or the half-life of the chemical in the patient. The important thing is to be aware of the necessary duration and do the "math" before you apply the treatment to your hives. What your plans are for your hives in a week, a month, two months in the future may determine the best treatment choice.

Application method and distribution: In apiculture, there may be different choices for delivery of a medication to our bees: patties, dribble, vapor, strips, in sugar syrup, sugar dusting, etc. With application four things should be considered: 1. Is this the best treatment delivery to get adequate distribution of the medication to the bees? 2. Is this distribution method the safest/least toxic to the bees? 3. Am I comfortable using this application method, properly? 4. Is this method the most cost effective for my operation? Do some research here to be sure you are on the right track.



Expiration: Using medications that are expired may accomplish three things. Expired drugs are less effective in treatment, may contribute to resistance, and/or they break down and their metabolites can become toxic. Interestingly, many drugs after expiring usually just become less effective and not toxic. However, tetracyclines is one category of antibiotics that are known to increase in toxicity after expiration. Coming from a farm mentality, I get frugality. But believing that using expired drugs is working to treat or prevent disease and/or is economical is a dangerous fantasy.

Withdrawal times: Most drugs we use in animals have a time when food products cannot be used from that animal after a medical treatment. In honey bees, many medical treatments we use can have post-treatment time and some even a pre-supering timeframe, in which we cannot have honey or supers on our hives for honey intended for human consumption. Some of these times can be up to 6 weeks. Again, this takes careful pre-planning of your beekeeping season to be sure you are not contaminating your bee's honey.

Combinations of meds: If you are a horse person or manage any kind of herd animal, you are likely familiar with "strategic deworming". This means we know our pasture animals are exposed to parasites in the environment, so therefore we employ multiple drugs in "rotations" over the season to keep the parasites at a manageable level and avoid drug resistance development. We can monitor the effectiveness of our drug rotations utilizing periodic fecal egg counts. This is becoming our pattern with *Varroa* management. Please do not think that simply treating once for mites with formic acid or amitraz or thymol or whatever, and then you can check the box for varroa for the season. Most beekeepers are now employing multiple treatments over the beekeeping season at appropriate times to keep *Varroa* in check. For example, amitraz in the early Spring or Summer dearth, formic in the Spring/Summer (if it is not too hot), oxalic in the late Fall/early Winter. The only way to determine if your treatment plan is working is to do regular mite counts or other monitoring diagnostic for whatever disease or pest you are managing for. Our goal is still to use the least amount of chemicals for the highest effect. However, that formula may be a treatment plan involving several drugs. Using "more" effective drugs appropriately could mean using less overall.

Evidence of treatment success: Doing regular quantitative mite counts are the best thing you can do for the health of your hive. Learn how to do an alcohol wash correctly. I know, I do not like killing bees either, but 300 bees is a diagnostic sample that could save the life of a hive and tens of thousands of bees.

Many experts recommend doing counts monthly during the active beekeeping season. Personally, I think three counts a year is the minimum (Spring/Summer/Fall). If you have not done mite counts before, start with three and work your way up to what is manageable for your operation. Pre-treatment and post-treatment counts are best for evaluating treatment effectiveness.

Records: All medications with all the above considerations used in your bee yard must be recorded. This is the biggest favor you can do for your bees, yourself, and any other mentor beekeepers or veterinarian coming into your yard to assist you. Develop a system you can understand a year from now.

Purpose: In all these things, beekeepers must consider ultimately what they want to achieve with their bees. Depending on if you are a backyard beekeeper, a commercial beekeeper, a honey maker or migratory beekeeper, your goals, timeline, and environment will all differ and will impact the most effective treatment regimen for your bees.

Consequences of incorrect dosage

Ok, so that is a lot to consider for following "just" the one direction of correct dosage. However, avoiding serious consequences can be reduced or avoided by keeping the above in mind. In summary, these consequences could include:

1. Treatment failure. All that time, money, and chemical exposure for nothing.
2. Queen effects. Death of the queen or sublethal effects that reduces her performance. Remember the queen lives longer that all other casts, so she must endure more treatment exposures.
3. Drug resistance development. Unfortunately, these poor choices end up affecting us all.
4. Death of the hive due to succumbing to the disease (with underdosing) or treatment toxicity (with overdosing).

Keep in mind that all these treatment failures can have significant economic impact on the beekeeper.

One last point I will leave you with to ponder, pesticides. While I am not about to jump into the ring of discussion about how much impact pesticides have on our bees, I will point out that the highest potential concentrations of pesticides and other chemicals in our hives are often the ones we use. Equip yourself with knowledge, pre-plan, and choose wisely. The season is starting. BC

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Pollination In China

Mariann **Fercsik**

It's Not The Bees

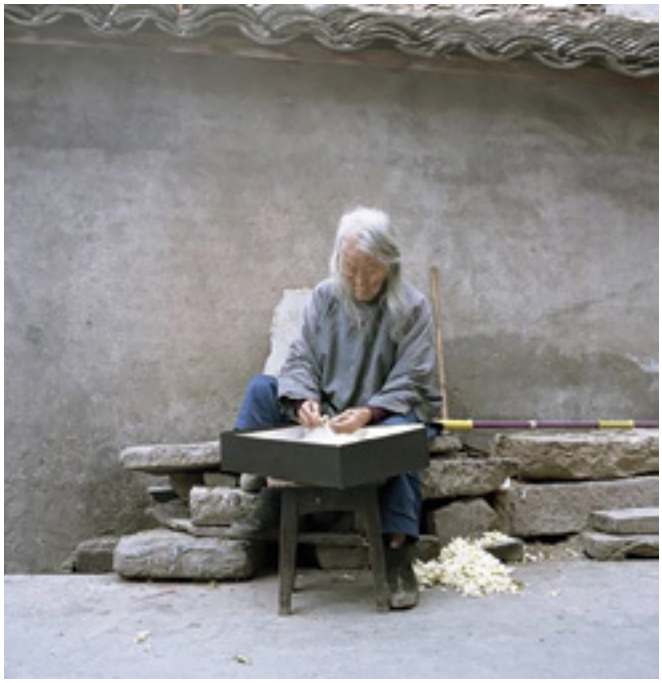
"With the introduction of China's Home Responsibility System in the 1980s, the farmers of Hanyuan County in Sichuan Province found it economically beneficial to replace their rice paddies with fruit orchards.

The mountainous slopes of the region lent themselves well to fruit production, particularly pears, for which Hanyuan County is now renowned.

Any crops grown beyond the quotas of China's collectivized farming program could now be sold on the open market and, in order to maximize their yield, the farmers began to increase their use of pesticides.

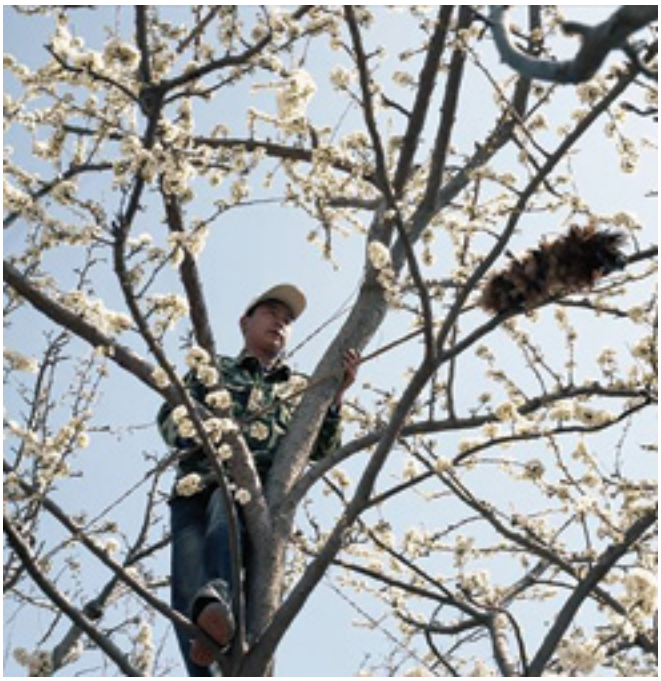
This, in turn, had a negative effect on the population of the natural pollinators, and the local beekeepers were driven to relocate their colonies out of the cultivation areas.

With the disappearance of the bees, along with the desire to control the quality and purity of the pear varieties, the farmers began the labor-intensive task of pollinating their crops by hand.



Every member of the family is involved in the hand-pollination process in some way. Old woman selecting the stamens from the Yali (main pollinizer) flowers. This is a preparation process before the farmers go to hand pollinate. Farmers need to dry the stamens on 20-23°C temperature.

An aged farmer works on his orchard. In Juixiang even the oldest are capable to complete physically challenging tasks such as pollinating each blossom one by one, even in the most difficult and dangerous environment.



Chen Tao pollinating the family orchard in Dalian. He uses a duster made out of chicken feathers. The duster touches pollen mixture, and then shaken over the target pear trees for one to three times a day in order to ensure adequate pollination of the pears."

A farmer prepares a small pollination stick. The feathers are degreased in alcohol before tying on the bamboo stick.

Shiqin Tan stands amongst his pear orchard. He planted the trees 20 years ago. His orchard consists of 45 trees. A person can pollinate 30-40 trees a day.

Flowering pear trees in Hangduan mountains. The average number of pear trees owned by each household is around 80-110. To pollinate these trees three to six polliniser trees are sufficient. A 10 year old polliniser tree can produce flowers enough to pollinate approximately 50 trees.

The transport of masses: motorcycles are the most common form of transport in the mountainous area of Jiuxiang.Young couple on its way to start pollinating their pear trees.

In preparation for hand pollinating. Woman brushing off the stamens from the Yali variety. She collects them into a pot before they start the drying process.

With simple tools such as a bamboo stick and chicken feathers they embarked on a journey of learning, not just how and when to pollinate, but when to collect the stamens, how to dry them, and which varieties respond to which pollinizer.

Additionally, not all the pear varieties are self-compatible, so cross-pollination is needed in order to achieve a desirable crop.

With skill and patience, the farmers can produce high quality, high yield product, albeit with increased labor costs than if they relied on nature alone.

As industrialization continues to push up the cost of hiring a workforce, the farmers must find an alternative way of cultivating their crops in order for them to remain viable. With pear production accounting for 40 to 50 percent of the household income, the stakes are high and adaptability will be key to their success.

The return of the natural pollinators is possible, but this is unlikely without a coordinated approach to limiting the use of agrochemicals.

What the future holds is uncertain and further work is needed to find a successful solution that balances the economy with ecology." BC

A Honey Bee Driven Mid-Life Crisis, Part 2

James **Masucci**

"Men are from Venus, women are from Mars." Or is it the other way around? No matter. The point is, people communicate, and therefore think, differently. I often think differently than others, probably because I'm a science geek. I also appreciate, and take advantage of, the different thoughts of others. If you read my article "A bee-driven mid-life crisis" in the January issue of *Bee Culture*, you know I'm struggling with a lot of questions. I'm newly retired and transitioning into a full-time beekeeper. Questions like, how big do I want to be? Where am I going to put all my stuff? What stuff do I really need? What's my business model? And the list goes on. But the backbone of a bee business is, the bees. The backbone of the bees is their genetics. I've been thinking a lot about that lately. How do I want to handle bee genetics?

Every queen rearing class I've taken, every book I've read and every YouTube video I've watched always talks about selecting the best hive for the queen mother. To me, that sounds like a great strategy for creating genetic bottle necks. Think inbreeding, not good. No one ever talks about what it takes to maintain genetic diversity. Last year, I requeened my 150 colonies with queen cells from two queen mothers. Having the source of my entire apiary traced back to two queens could be a genetic nightmare. What saves me is the queens were mated over two counties. The diversity comes in from the drones. But here's the catch, if you are selecting for traits, the males need to be selected too. By putting the same selection pressure on the drones as you do the queen, you are minimizing diversity.

Why do I care? First, a genetically diverse population is better prepared to handle stressors. As an example, look at Covid. Some people died while others were asymptomatic. A very complex situation, but genetics plays a part. So, my mantra is that genetic diversity is good. I have been contemplating applying to the HILO queen project (**www.HiloBees.com**) to help them develop their mite tolerant trait. But here's the thing. It's a multigenic, recessive trait. In order to be effective, 50% of the drones need to have the traits. If I want to get to a point where I can propagate these queens (getting HILO project permission first, of course), then I must be in an isolated area where the only drones available for mating must be heavily selected for the trait. This situation is a step away from incest. This same argument holds true if I want my bees to be true Caucasians, or true Carniolans. Is this a good thing? In my way of thinking, my mutt bees are better, in the long run, than a highly selected bee stock.

What's In A Queen?

In January this year I got the following text from John Miller of Miller Honey Farms. "I read your piece in BC. It's time to experience almond bloom. I'd love to host you in the Modesto area in late February. Do a day or two there. Then head north to look at a couple of queen operations." Perfect. What better way to figure out my future and address my questions than to spend a week hob-knobbing with the experts. For my genetic diversity question, I go back to the "Then head north to look at a couple of queen operations." This is my chance to get opinions from a couple of the top queen producers in the country. Here's what I wanted to know. First, are today's queens better than the queens from 40 years ago? The premise of this question is simple, are current bee breeding practices making better bees? As an example, look at corn. Yields are higher and pest resistance is better so one could argue that corn breeding programs are successful. Not so obvious with bees and I wanted to hear what the experts had to say. Next, I wanted to know how they selected for traits and how did they insure genetic diversity. My hope was to get into some geeky conversations regarding drone:queen mother ratios and population genetic models. Here's what I learned.

First off, these operations are phenomenal. If you are putting out hundreds of thousands of queens per year, you need a system and you need to know what you are doing. It really put me in my place. I was happy with my 150 queen cells last year. Hah! They are doing a thousand a day and running tens of thousands of mating nucs. This is in the heart of queen production in CA, the so-called golden triangle. Bees are everywhere.

I was a little nervous about asking my first question as it could be construed as an "attack" on their livelihood. But the conversation that ensued was fabulous. "Are queens better now than when you first started or, are we just maintaining quality?" First, it's a difficult question because environmental stressors have changed over time. So, the question resembles the "apples to oranges" comparison. In general, they have been maintaining queen quality. There aren't huge differences. However, improvements have been made. Chalkbrood and foulbrood are much rarer than they used to be. That is likely due to the continued selection for disease-free lines to use as queen mothers. In addition, they've also been selecting for hygienic behavior. Hygienic behavior is a recessive trait, requiring it to come in from both the drones and the queen. So, how do they select for hygienic behavior yet maintain genetic diversity? The key is that there was a "group" decision decades ago to select for hygienic behavior among many, if not most of the queen producers in the region. The result of that decision is that


Open mating with multiple drones complicates the propagation of a trait as simple as body color. It makes breeding for complex traits nearly impossible. Instrumental insemination can make breeding doable in small scale. But traits are soon lost with uncontrolled open mating. How often do you see different colored bees in your hives?

drones from many different genetic sources were selected for the trait. Over time, a large number of genetically diverse drones containing the hygienic traits became available for mating. With mating nucs set up throughout the county, genetic diversity was "maintained" by the drones. So, like my situation where the diversity came in from the drones in different areas, so too in Northern CA, just times a million.

I have not spoken with the breeders of the HILO project, so I don't know their breeding strategy or their plans for genetic diversity. The one thing I do know is that the tools to properly bring this recessive trait quickly and efficiently into the hands of beekeepers are not available. What's needed is a good genetic map of the honey bee and marker assisted breeding. We need to get to a point where the trait no longer defines the line. Instead, the trait is introduced into several lines to increase the quality of those lines. These are the tools used in almost every other agricultural industry, including both plants and animals.

In my opinion, the lag in honey bee breeding has two causes. First, bee genetics are hard. Why? The promiscuous mating behavior of the queen makes it impossible to control which drones mate with her. The drones from a region gather in drone congregation areas (DCAs). This is where the queen goes to mate with 10-20 drones. It has been reported that drones can travel seven km (over four miles) to reach a congregation area. Now, take a map and draw a circle with a four mile radius around your apiary. That's a large area, over 12 square miles. How many colonies other than your own are in that area? Any queen you produce, whether by grafting, supercedure, or on the spot queen rearing will have access to drones from that entire area. Plus, she is mating with multiple drones, each carrying different genetics. This is great for genetic diversity, because it results in several different genetic populations of bees in the colony (have you ever seen different colored bees in a colony?). But, it also means that the likelihood that your queen mated with the appropriate drones is tiny. The inability to control mating in large scale makes true queen breeding extremely difficult. Now, think of the "golden triangle" which is full of queen breeders. Think how difficult it is for them to maintain even the simplest traits because of the diversity of drone population.

For the small-time beekeeper like me, unless truly isolated, breeding for improvement is probably a waste of time. You can, however, maintain good, healthy queen stock. Selecting your best colonies for queen mothers will work because all the queen producers are using similar selection criteria. If you are selecting for chalkbrood-free colonies and those virgin queens go out to mate, it's likely the drones came from colonies where the queens were also selected from chalkbrood-free colonies. However, if you are trying to select for a complex trait like hygienic behavior, you could have the best queen in the world and you won't be able to propagate it. The moment those daughter queens reach the DCA, packed with non-hygienic drones, the trait is lost. This is why it was so important for the queen producers to work together to select for hygienic behavior. Having everyone in the region doing the same selection meant that, over time, the complex hygienic trait was carried by a good proportion of drones. Therefore, the odds of a queen mating with at least a few drones carrying the trait are good.

I believe the second reason why honey bee breeding lags behind the rest of agriculture is because the bee industry is relatively small. There is neither the money nor the people-power to develop the tools. There are groups working on it but developing the appropriate lines to evaluate will take a large, concerted effort. I hope the beekeeping community, its benefactors, and its researchers can come together to develop a large, collaborative effort to reach this long-term goal in as short a time as possible. BC

The Buckfast Bee – Then And Now

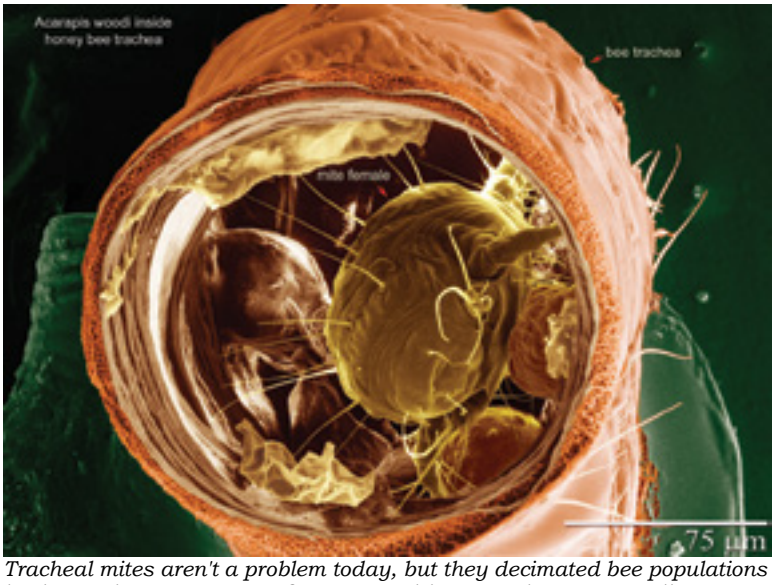
Tina **Sebestyen**

Once his bee breeding program calmed the bees, Brother Adam seldom wore a veil, but the original British Black Bee was so aggressive that he had to kneel beside the hives and spread his skirts around him to keep the bees from walking up his legs and stinging him. Imagine keeping bees while always wearing black! Photo credit **buckfast.org.uk**

Last month we learned about a giant in beekeeping history, Brother Adam, who "created" the Buckfast Bee at his monastery in England over a lifetime of searching for new stocks of bees throughout the world, hybridizing these into his line, and carefully observing the resultant queens with their colonies of bees. It is easy to understand why he was enthralled with other races of bees after the British Black Bee, which was by all accounts quite aggressive, proved also to be susceptible to mites and diseases. They mostly died out when Isle of Wight Disease swept across the continent around 1919, and the Black Bees that had been crossed with Northern Italian bees survived. He subsequently learned about different strains of bees all over the world that had diverse and potentially desirable traits, and the idea of improving bee stock with these different characteristics intrigued him. One thing he learned was that a characteristic not previously noted in a race of bees might become apparent when crossed with his line of bees, so careful observation over time was imperative.

Knowledge of bee mating was in its infancy. Not much was known about how many drones normally mated with each queen, nor about which traits came from the drone as opposed to those which descended from the queen. Some of these things he learned the hard way, through trial and error. Some were discovered by others during those years, and beekeepers shared their hard-earned knowledge with one another. This was facilitated, of course, by Br. Adam's long Summers of travel, and new and old acquaintances in the beekeeping world. To his credit, Br. Adam was one of the first who understood exactly how important the drones were, and this was the basis of his breeding program. Even today, Buckfast breeding associations follow Br. Adam's method of limiting traits from drones while still providing multiple drones for the chosen queen line by using sister queens to head drone production colonies in isolated mating yards. Br. Adam even learned instrumental insemination, a skill just being discovered at that time.

Since he started his career in beekeeping with the British Black Bee, which is so unproductive that it needs to be kept in a single small hive body, is susceptible to not only tracheal mites but also to most other bee diseases, and by all accounts is pretty aggressive, it isn't too hard to figure out why he wanted an improved bee stock. As he sought to produce a bee that could survive the mite and the diseases that were ravaging England, he also bred in traits that he wanted.[1] By the end of his life, the bee named after his home at Buckfast Abbey was known to be very prolific, building up great populations early to produce lots of honey even under harsh conditions, and needing to be kept in the much larger modified Dadant hive. The bees had a very low swarming instinct, which also helps with better honey production, since for most of us, just when the flow is really on, our bees take off for the trees. The bees were very gentle and were extremely resistant to tracheal mites, an important trait that helped many a beekeeper recover colony numbers and made Buckfast queens a good money-maker for the Abbey. The Buckfast Bee over-wintered well, and was frugal with honey stores. Br. Adam didn't like propolis, so he selected for colonies that didn't produce much. Best of all, Br. Adam proved that he could hybridize bees, and the traits he was selecting for would breed true over time with his breeding methods. He claimed that



Tracheal mites aren't a problem today, but they decimated bee populations in the UK in 1919. It was first reported in Texas in 1984. Credit – **commons.wikimedia.org** and USDA

his bees were disease resistant, but one person I corresponded with said this about him, "he never admitted the trouble he had with American Foulbrood."

Times change, and the conditions bees live under change, as well. The Buckfast bee has undergone further breeding, to help them keep up with the demands of the environment and the needs of beekeepers. There is an amazing amount of scientific testing done in recent years using Buckfast bees as one of the races tested. In the 1990s when tracheal mites were decimating our bees here in the U.S., Buckfasts were compared to other races, and Br. Adam's claim of their resistance was proven.[2] In 1999, an Israeli study compared Buckfast bees to Amitraz treated Italian bees and untreated bees. The Buckfast and Amitraz treated bees both produced good amounts of honey, and the Buckfast bees showed declining numbers of tracheal mites with 100% queen survival. The Amitraz-treated bees lost 75% of their queens, while the untreated Italian colonies needed re-queening, and produced almost no honey.

In a study comparing the economic traits of Buckfast bees with hybrid European Black Bees x Caucasians, the Buckfast bee built up faster and had lower swarming tendency, with higher honey production. They were similarly frugal with honey stores.[3] The Buckfast bee is considered very adaptable to various conditions, which shouldn't be surprising, since their ancestors came from so many diverse areas.

Buckfast bees are so different from other races of bees, that they even have different compounds on the surfaces of their exoskeletons. A study in Poland compared Buckfast bees' surface compounds to those of Caucasions[4]. Buckfast bees had fewer lipids on their exoskeletons, which helps explain why they over-winter so well. The role of lipids on the outside of honey bees is to water-proof the bees. That is a good thing in a moist environment, and is why you can pick bees out of your bird bath after a good length of time, and they haven't drowned. However, in the Winter, lipids on the surface of bees also water-proofs them from their insides, too, not a good thing. As

Varroa destructor is currently a big problem for honey bees. Breeding for resistance is underway, but is about as difficult as breeeding sheep for resistance to coyotes.

bees consume honey, they produce liquid waste, which they retain in their intestines until they can get out for cleansing flights. If the bees are less water-proof, some of the fluid inside them can be dehydrated out. If bees can't get rid of the liquid, they just hold it, and eventually get so full of fluid that they are forced to stop eating honey, and then they don't have the energy to keep the super-organism that is a Winter cluster warm, and they die. Being a little less water-proof means that Buckfast bees can survive Winters better. Unfortunately, Buckfast bees also have fewer compounds on their outsides that help keep viruses and fungi from infecting them. Buckfast bees also have fewer alarm pheromones than Caucasians, helping prove their gentler natures.

Of course, the burning question for us today is whether Buckfast bees are resistant to *Varroa destructor*. An Estonian study in 2016 noted that hybrid bees don't fare as well against *Varroa*, but Buckfast is not considered a hybrid. The study concluded that management by a professional beekeeper, treatments synchronized with neighboring beekeepers, and being surrounded by farmland decreased colony infestation.[5] A Norwegian study in 2010 concluded that the race of the bee did not affect *Varroa* resistance[6], agreeing with the Estonian study's finding that bees from any race that undergo selection for resistance do better against *Varroa*, including Buckfast bees.

A study conducted in 2017 investigating *Varroa* Sensitive Hygiene that involved moving brood from VSH colonies to separate them from their own nurse bees used Buckfast bees to raise the brood for the experiment, since they were "apparently free of resistant traits".[7] Another study found that Buckfast brood was more attractive to mites than brood from other races. The take-home from all of these studies is that the Buckfast bee needs further selection and refinement in order to be resistant to *Varroa destructor*, just like every other race of bees. And that is being done by many groups, some of which still call their bee Buckfast bees, and who adhere to Br. Adam's breeding protocol. Others start with

Roy Weaver, Jr. with Brother Adam in Texas. Photo credit R. Weaver Apiaries.

the Buckfast, and call their resultant hybrid by another name, like the Elgon bee.[8] This bee is a follow-up to Br. Adam's last queen-gathering trip to Kenya, in which he finally got to see *Apis m. monticola*, a gentle and resistant bee from the higher altitudes there.

What about the Buckfast bee of today? Are you asking yourself if you want this race of bee? Buckfasts are no longer kept pure at Buckfast Abbey, partly because they only keep 30 colonies now, for teaching and demonstration, and so could not fly enough drones anyway, and partly because they feel that allowing the bees to free-mate with the local survivors gives them a robust, well-balanced bee. And, here's an anecdotal story about how Brother Adam might have answered this question – in 1981, a small-scale beekeeper named Sam from Sweden asked Br. Adam what he should do to improve his bees. Br. Adam did not suggest buying Buckfast bees, nor even bringing his virgin queens to a Buckfast mating station. Rather, he told Sam to choose the best half of his colonies and raise queens from those, and replace the queens in the other half of the colonies. And to do that every year. Br. Adam says in his breeding book that once one has the characteristics one wants in their line of bees, to go back to natural free-mating to maintain genetic diversity. In doing so, we dominate the area with good quality colonies, and good quality drones for your queens. He knew from experience how devastating inbreeding could be over time. The heritage from Brother Adam is not the bee, but the way of breeding bees.

The bottom line is this . . . Buckfast bees are fine. There is no perfect type or race of bee. We need to start with something good, and raise new queens and drones from the best colonies we have. BC

Tina would like to thank Erik Osterlund of Elgon bees in Sweden for his help with this article.

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[8]**https://www.elgon.es/resistancebreeding.html**

Nosema Apis And *Ceranae*

Can Be Difficult To Diagnose

The majority of adult bee diseases are difficult to diagnose in the beeyard (think viruses) as their symptoms can resemble each other, or can mimic non-disease issues like old age and pesticide poisoning. Nosema is a disease that can be both difficult to diagnose, or relatively easy depending on the type.

Nosema is an ubiquitous disease caused by microscopic organisms classified as microsporidia and exists in at least two strains (*Nosema apis* and *Nosema ceranae*) that destroy the lining of the honey bee's gut, affecting the bee's nutrition, shortening its life span and when effecting queens leads to supercedure. Honey, Royal Jelly and bee pollen can all be sources of nosema spores. Nosemosis is caused when the spores are ingested while consuming infected food or water, sharing food with other bees (trophallaxis) or through the cleaning of comb and/or grooming and hive cleaning activities. Studies also suggest that nosema can also be transmitted during the process of mating or through artificial insemination. (Peng *et al.*, 2015; Roberts *et al.*, 2015)

Symptoms

Signs of *Nosema apis* infection can be subtle, but may be observed in the beeyard. They include bees that have disconnected their two pairs of wings (K-wing), disoriented bees crawling around the hive entrance or on the ground in front of the hive, colonies not consuming supplemental feed, bees abandoning brood and clustering elsewhere in the hive while overwintering, and brown fecal streaking within or outside the hive. However, dysentery caused by poor quality food or prolonged confinement may also cause excessive droppings and be confused with nosema. This occurred in my area of Addison County, Vermont, one year during an abnormally dry Summer when the bees collected a lot of honeydew from aphids that produced a dark honey with a taste that resembled brown sugar. Although not a problem in itself, the indigestible matter in the richly colored honey that accounted for its dark hue caused severe cases of dysentery within the hives that particular Winter, which was a hard one for the bees, with long cold periods that kept them cooped up with few opportunities to go on cleansing flights.

Infection confirmation

While not a method that everyone will want to take advantage of, it is said that removing the bee's head and pulling out its guts for inspection can provide a fairly accurate diagnosis of a honey bee suspected of suffering from nosema. The color of a healthy bee's gut will be a translucent pinkish or brownish red, whereas a diseased gut will tend to appear swollen and have a dull gray or whitish color. A more accurate way to identify nosema infection however is to examine the bee's gut under a microscope at 400X magnification and count the number of nosema spores. Nosema spores are oval in shape although the size difference between the two strains is extremely minor making it difficult to differentiate between them through microscopy analysis. The only sure way to diagnose the specific strain of nosema infection is through gene coding of molecular essays.

Colony impacts

Historically, *Nosema apis* was the primary organism of concern primarily during the Winter months, when the bees are confined for long periods without the opportunity to relieve themselves of the indigestible matter that builds up in their digestive systems. More recently investigations have revealed that *N. apis* has been largely if not totally displaced by *Nosema ceranae.* With *Nosema ceranae,* colonies may be weak and slow to build up due to shorter honey bee life spans and less brood production, and high queen supercedure rates. Honey bees also have reduced Winter survival rates, and less honey production when *N. ceranae* is present. Nosema infections of both species negatively impact the immune response at both the bee and colony level making colonies more vulnerable to other pathogens and the effects of pesticides. (Szumoski and Troemel 2015) And to make matters even more complicated, it has been observed that colonies exposed to neonicotinoid pesticides are also more likely to become infected with Nosema and a synergistic relationship exists between *N. ceranae* and many pesticides including neonics that results in higher bee mortality. (Alaux *et. al.* 2010; Vidau *et. al.* 2011; Aufauvre *et. al.* 2012; Petis *et. al.* 2012 & 2013; Doublet *et. al.* 2014)

Since *N. ceranae* has been found to infect certain species of bumble bee and some solitary bee species, the disease has the potential to be spread to managed hives by their native cousins, or be spread by commercial outfits which can intensify the infection rate in native pollinators through the movement of hives, queens and hive products. (Li *et al.*, 2012; Graystock *et al.*, 2014) *N. ceranae* appears to be a more virulent form of nosemosis than *N. apis* since it can weaken and kill hives even during the warm Summer season and the most obvious symptom (heavy concentrations of bee feces) is not present in either Summer or

Winter. Unfortunately this absence of clear clinical symptoms can allow infections to go unnoticed by the beekeeper for long periods of time. It may well be that this lack of attention by the beekeeper is what results in *N. ceranea* ending up being more deadly to hives than *N. apis* since lab tests have suggested that *N. apis* is just as virulent as *N. ceranea* and in some cases more so. (Aronstein *et. al.* 2011)

The old sign of Nosema apis *infection, large patches of honey bee fecal matter in or on hives, can no longer be relied upon to identify nosema infection in honey bee colonies due to the worldwide prevelence of* N. ceranae *over* Nosema apis.

Nosema control options

While the conventional approach and only federally approved control is the antibiotic treatment bicyclohexylammonium known as Fumagillin-B (Fumidil B), which is an extract from the fungus Aspergillus fumigatus, beekeepers would do well to start with resistant stock when possible. Additionally the immunity level of the hives can be kept strong by ensuring proper nutrition. Some studies have found that colonies that feed on pollen are able to resist nosema infection better than those fed pollen substitutes. Other methods that beekeepers can use to help keep colonies free of nosema include frequent comb replacement and ensuring adequate ventilation. Another way to help reduce infection rates of nosema is to leave enough honey on hives to provide for Winter and avoid heavy fall feeding of syrup as this has been correlated with a higher incidence of the disease. Although this is likely the result of nosema spores being passed around the hive during the processing of sugar syrup for storage rather than as consequence of sugar syrup itself being fed to the hive.

Since I began keeping bees in 1992, I have never used Fumagil-B (Fumagillin-B) or anything else to specifically treat nosema, and neither do most of the beekeepers I know. Not only is it an extra expense (and extra labor to provide treatments) but Fumagil-B has been shown to have toxic properties to humans and does not break down readily in honey. For these reasons, the antibiotic is not licensed for use in most European countries and its use is prohibited in the U.S. during the foraging season.

Should the selection of resistant stock, a favorable apiary site, and good management practices fail to keep nosema at bay, there are a number of approaches that can be used to reduce the threat of infection and even some organically acceptable treatments available. First of all, even though nosema spores have been known to live for six to 12 months in infected equipment, both species of nosema have proven to be susceptible to cold, with temperatures of 39°F (4°C) for six months reducing the viability of both species by over 60 percent. (Fenoy *et. al.* 2009; Sánchez Collado *et al.*, 2014) Therefore, beekeepers in northern climates who store their unused combs in an unheated space during Winter may enjoy the benefit of reduced nosema spore survival on their combs. It is also possible that combs located on the outer edges of overwintering clusters may get cold enough to decrease the pathogen's virulence. Despite all this, in cold climates it is suggested that hives be exposed to full sunlight and entrances should face south or southeast to encourage bee cleansing flights.

At the other end of the scale *N. ceranae* has proven tolerant of relatively high temperatures, while temperatures of 140°F (60°C) is enough to kill *N. Apis* within 15 minutes. (Webster 2012) Researchers have observed that nosema appears more deadly in warm areas compared to colder northern regions and theorize this is due to the pathogen's ability to reproduce faster in warmer temperatures. As a result, frames of comb containing nosema spores can be cleaned up and the frames reused by placing the combs in a solar wax melter. Research has also shown that nosema spores exposed to a minimum of two hours of direct sunlight will break the cell membranes of the spores effectively killing them. (Eischen *et. al.* 2011)

Organic acids have also been shown to have a detrimental effect on nosema within a colony. Both formic and oxalic acid can kill off nosema spores in the hive providing an added benefit to the beekeeper who uses acid treatments to control I. (Underwood and Currie, 2009; Eischen *et. al.* 2011; Nanetti *et al.*, 2015) The same may be said for beekeepers who use thymol products for mite control. (Lodesani *et. al.* 2006; Costa *et al.*,

Trials have indicated that emulsified essential oils such as those found in Honey-B-Healthy increase the survival rate of nosema infected bees better than the approved treatment Fumagil-B.

2010) Certain essential oils (like thymol or emulsified lemongrass and spearmint oils such as found in the commercial products Pro Health and Honey-B-Healthy) have the ability to increase the survivability of hives infected with nosema although researchers do not understand how these essential oils increase the lifespan of infected bees, and the essential oils are not registered for the treatment of nosema. (Rhoades and Skinner 2011) Meanwhile, Nozevit, a nontoxic treatment made from oak bark has shown limited success in reducing nosema. (Gajger 2011)

For some reason, nosema disease, which apparently can be a serious problem in some areas of the United States, has not been a major issue in my neck of the woods. Whether most of the susceptible hives around me have died off, leaving only nosema-resistant colonies remaining, the reduced viability of the nosema pathogen when exposed to the long cold Vermont Winter is enough to make a difference, or I have just been lucky I cannot say. Whatever the reason, my experience certainly indicates that, even without using approved medications to control nosema, the naturally inclined beekeeper in the North Country can certainly raise strong, healthy colonies of bees most of the time. BC

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Researchers have found that colonies that consume natural bee pollen are less likely to suffer from nosema than those fed protein supplements instead. (DeGrandi-Hoffman et al., 2015) However when pollen, or combs, are contaminated with pesticide residues this increases the colony's susceptibility to nosema infection. (Pettis et al., 2013)"

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Emily Wine

Emily Painter

Two Upcoming New Beekeepers

Dewey **Caron**

A common lament expressed by beekeeping clubs is where are the youth? Although clubs may have student membership rates, youth scholarships, or other incentives to attract youth, they are not plentiful at most bee meetings.

One recruiting ground to bring in more youth into beekeeping are efforts to support younger beekeepers via a 4-H project or to forge relationships with high school or University bee clubs. Here is a story of two Emilys. Both have been active in founding/serving as officers with student and local bee clubs. They are representative of our youth already passing on their enthusiasm and interest in bees.

Emily Wine

Emily Wine began as Apiary Inspector in Delaware during this covid-19 virus year. This Winter she is teaching in the Delaware Beekeepers virtual beekeeping course and talking to beekeepers at their monthly meetings.

Emily's interest in bees began as a college sophomore environmental sciences major at Cornell University. At that time, she was active in the Dilmun Hill Student Farm. The farm, located in a former orchard close to campus, grows a diversity of crops organically. Emily was on the farm steering committee.

Michael Smith, a PhD student of Tom Seeley, was interested in locating bee colonies on the farm and establishing a Beekeeping Club. Michael was no stranger to University beekeeping club founding, having established one in Wales at the United World College of the Atlantic and another at Princeton where he studied molecular biology before moving to Cornell for his PhD studies. Emily enthusiastically endorsed the idea and volunteered to assist in a cutout to populate bee boxes stored at the farm from an earlier effort. She quickly picked up the basics of colony care.

Emily Wine doing a mite check.

The Beekeeping Club at Cornell, like the Dilmun farm, is and remains entirely student run. The club, using equipment from an earlier beekeeping adventure eventually grew to four hives. Club members gather for hive inspections every two weeks and organize activities such as candle making and speakers on bee topics. Field trips to local beekeepers for honey processing and candle making were arranged. They continue to sell honey on campus. The club maintains both Facebook **https://www.facebook.com/CornellUniversityBeekeepingClub/** and an informative website.

Emily, following graduation served as an Apiary Inspector for the State of PA for one season. She inspected both smaller scale and commercial beekeeper bees in the northern tier of PA. She left to pursue a Master of Science in Entomology in Dr. Doug Walsh's lab at WA State University. Her master's research focused on enhancing habitat for the solitary alfalfa leafcutter (*Megachile rotundata)* and Alkali Bee *(Nomia melanderi)* in the Walla Walla Valley. **https://www.klcc.org/post/native-bees-and-alfalfa-seed-farmers-nw-love-story**

And history repeated. Emily, during her graduate studies, assisted in starting a student beekeeping club at WSU. Club bees were established on the 30-acre Eggert Family Organic Farm. This farm, like the Dilmun Cornell farm of her earlier association, is a hands-on experience for students, mostly in organic vegetable production. The Farm was located adjacent to the WSU honey bee program diagnostic lab facility. Students managed club bees, sold the honey and ran bee related programs on campus.

After graduating with her master's in 2018, Emily worked for commercial beekeepers in the Sacramento

valley area east of San Francisco. She initially had an internship and conducted research on in-hive sensors and pollinator habitat for a medium-sized (4,000-hive) bee operation, Ubees **https://www.ubees.com/.** She moved to Honey Bee Genetics in Vacaville which was subsequently purchased by the large scale (30,000-hive) Tauzer apiaries. Emily participated in their queen-breeding and pollination operations for a little under a year before moving back east as DE Apiary Inspector.

Emily Painter

Emily Painter began with bees on the family farm outside of Dallas, OR in 2009 at age 11. Actually, the bees found her. One day the water meter reader said he could not read their meter because there were bees in the meter compartment. Emily, who discovered bee equipment in one of the family farms, learned that her grandfather had once kept bees. With his guidance, Emily rescued one of the boxes and set it on the water meter. The bees however had a different idea and did not move into the old bee box – they simply took off.

The next year Emily heard that bees had moved into some discarded equipment of a commercial beekeeper who had kept bees at one time on a neighboring farm. The boxes were old but three had bees. Again, with grandfather's help the bees were moved to the family farm. Unfortunately, none survived the winter. But Emily was hooked and was not about to give up.

Her 3rd year was a charm. Driving home from a piano recital, the family noticed bees hitting the windshield just as they were nearing the family farm. Investigating they found a big swarm in a tree alongside the road. Emily raced home, got the box of the Winter dead out and placed it on the side of the road. The swarm marched right in. This colony would survive many years. Emily would eventually manage five hives.

Emily joined the local bee club Willamette Valley Bee Association (WVBA) that second season and took the club short course. At a monthly meeting she was winner of the raffle price of a three-lb package of bees from Glory Bee in Eugene. Emily served as Secretary of WVBA for two years during her Junior and Senior High School years. Following high school graduation, she took a Gap year to live and work at Scotney Castle in Kent, England. The Castle was under renovation and she had a chance to explore the preservation efforts re-sparking an earlier interest in Anthropology. Her interest in bees did not wane as she had opportunities to visit a relative and view backyard bees and talk about the English annual bee cycle with a cousin.

Emily Painter installing a package.

The experience spurred her interest in returning to school to study Civil Engineering to gain background in building structure. She was accepted at the University of VT (UVM). During her undergraduate years she would return as an intern to England (she is dual US and UK citizen, as is her mom) to work for Whitby Wood, an engineering firm in London working on new constructions and to Ireland to work for Carrig Conservation International, a Dublin-firm specializing in preservation of historic buildings.

During her orientation to the University, Emily found the interest desk for the UVM Beekeeping Club. She would serve as Beekeeping Club President the next two years. During this time, the University added a beekeeping course to the curriculum with Dr. Samantha Alger as instructor. The club grew in membership and proactive in educational and outreach efforts. The club apiary was moved from the Hort farm to an on-campus location. The club offered weekly tours for students and sponsored several on-campus speakers. Club honey is sold in the Student Union. **https://www.uvm.edu/cals/pss/student-organizations**

Club members would often carpool to Addison Co Beekeeper events in Middlebury (Addison County slogan is 'Land of Milk and Honey'). Middlebury is home of the Mraz family, including the celebrated evangelist for the therapeutic use of bee stings Charley Mraz (now deceased); another county beekeeper is Kurt Webster, well known northern survivor stock queen breeder and a third is Ross Conrad, regular columnist of *Bee Culture.* In addition to the education, Emily helped make club events fun. Emily would also join the Student Chapter of American Society of Civil Engineers and serve as their Secretary and social media chair.

Now finishing her senior year, she will be graduating spring 2021 Emily is headed back to England to begin Graduate studies at the University of Leeds. She will study structural engineering with an emphasis on restoration of historic buildings. And if they encounter a bee colony living in the walls, Emily will be sure to join in their removal and hiving.

University bee clubs, like colony and regional beekeeping groups, seek to educate the basics of beekeeping. On campus colonies and programs help make the learning fun and relevant for younger individuals. Both Emilys profiled here have been active in training beekeepers and working with new and established beekeepers. It speaks well of our industry to have such youth so active and helping educate others as part of our noble obsession.

Full Disclosure: I was an undergraduate at UVM 2000-2004; our Grange advisor (I was UVM student Grange Master) Enoch Thompkins, was author of a popular New England Beekeeping book. As faculty at University of Delaware 1981-2009 I interacted with the DDA Apiary inspector on a regular basis. Mark Starrett, founder of UVM Beekeeping Club in 2016, was student in my Beekeeping Class at UD. Finally, I was one of the guest speakers of the UVM Beekeeping Club when Emily was President and at WVBA when Emily was secretary. It is truly a small world. BC

The Mystery Of The Haskinville Bee Factory

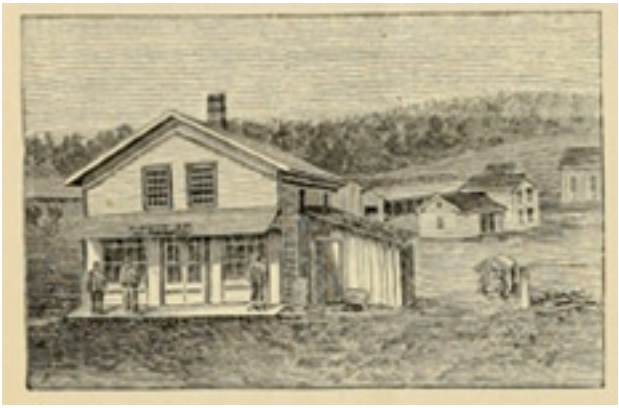
Peter **Sieling**

In 1917, an ad appeared in *Gleanings in Bee Culture* for the M.C. Silsbee Company of Haskinville, NY, a firm that manufactured bee hives, rendered beeswax, and bought and sold honey. Within a year the ad disappeared. Haskinville is a ten minute drive, so I decided to solve the Mystery of the Disappearing Bee Hive Factory. The story that unfolded must have been the scandal of the century.

We first met the Silsbee's in 1890 when *Bee Culture's* roving reporter, John Martin, AKA the Rambler, rambled through Steuben County, New York. He described it as "a land of forests and glens, perfect for bands of brigands". To reach Haskinville, the Rambler traveled up Neil's Creek Rd. which winds through a gorge. Residents live in perpetual twilight, the sun only showing itself for a few hours a day. Traveling the road today by automobile, the natives watch you suspiciously from their porches. It feels like entering the movie *Deliverance*. Haskinville is a cluster of a dozen houses, a church, and a store where Neil's Creek crosses Route 21. But in the late 1800s it was the epicenter of beekeeping in Steuben County. The Rambler stayed for several days, talked with several local beekeepers, visited a wild bee hunting camp, and tarried at the general store, run by postmaster and notary public, George Silsbee. George's brother and business partner was William.

William was a beekeeper. He had two sons and a daughter. Both sons became beekeepers, but Myron dreamed of building a hive manufacturing plant to compete with national companies like the A.I. Root, W.T. Falconer, A.G. Woodman Co., and Leahy Manufacturing. In 1911, by age eighteen, he was managing 160 colonies. In January of that year he laid the foundation of his bee house, a 24x40 foot building which included a bee cellar (for wintering colonies indoors) and a honey processing room. His two storage tanks could hold 9000 lbs. of honey. He soon added a woodshop containing a gasoline engine, saws, and a dovetail cutting machine for hive making.

Tall, good-looking, and a persuasive talker, Myron kept the Haskinville newspaper correspondent and her readers abreast of his activities.



Haskinville Store

In June Myron catches 10 swarms in one day.

In December, Myron buys out another local beekeeper.

In May of 1913, at age 20, Myron diversified. He built a garage and became an agent for the K-R-I-T motor car company.

In 1913, He published a photo and description of his honey operation in *Gleanings in Bee Culture*.

In July, Myron hired a man to manage his bees, and in August he harvested 1800 lbs of honey that was put up by his bees in only six days.

In 1914, aged 21, Myron hired a second bee man. His ambition grew with every achievement. He displayed his auto cars at county and state fairs. The papers report – Myron goes to Corning on Business. Myron goes to Hornell on Business. Myron goes to Big Creek, Elmira, and Buffalo.

Myron's plans continued to expand as success followed success. He advertised in the *Gleanings in Bee Culture* classified section for investors interested in his new beehive manufacturing plant. In 1915 Myron, aged twenty-two, started building a larger addition to his bee house for manufacturing beehives.

More Silsbee news from the Haskinville reporter: In January, 1916 he attended the Canandaigua Beekeeper's Convention, drove to Pennsylvania to buy more bees, and installed a new engine to run his machinery.

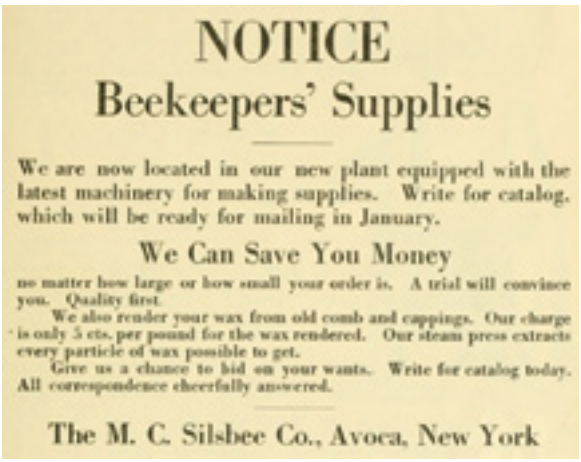
Myron's success came too easily. His first setback came on May 3rd of that year. "Myron Silsbee came near having a bad fire in his bee house Friday. He was melting some wax, which took fire and but from the timely use of a hand fire extinguisher the whole building would have very likely been destroyed" – *Cohocton Valley Times*.

In February, 1917 Myron Silsbee bought a display ad in *Gleanings* for the M.C. Silsbee Company. "Give us a chance to bid on your supplies. We can save you money." He was only 24 years old.

In April, 1917, the United States declared war. Myron registered for the draft but did not become a soldier. The K-R-I-T motor car company filed for bankruptcy and Myron lost his auto business.

By the Autumn of 1917, the

Myron and Louise Silsbee.



United States began sending troops to the Great War to end all wars in Europe. The influenza epidemic that killed an estimated 5% of the world's population was just beginning. Experts were predicting the worst famine in the history of mankind. Europe was already starving. The U.S. government was rationing wheat (1½ lbs. per week per person) and sugar. Because of the sugar shortage, the price of honey was at an all time high. The U.S. government encouraged beekeepers to produce more honey, exempting beekeepers from the sugar rationing, but only for feeding bees.

Ironically, the Winter of 1917-1918 was the worst ever for colony losses. Beekeepers, most likely including Myron, lost 80-90% of their colonies. More people than ever were producing honey, buying bees shipped from the south, and buying bee equipment. Beehive factories were springing up like mushrooms after a rain.

Myron's fledgling company was long on ambition and short on funds. Any setback could be catastrophic. Less than a year later the *Gleanings* editor notified his readers: "A letter from M.C. Silsbee says that their bee house, mill, and total contents, were destroyed by fire the previous night with a loss of $5000, partly insured, and that all orders were burned, and they were left with no records of parties who had ordered supplies." Five thousand dollars in 1918 would be equivalent to about $90,000 today.

The Silsbee Company announced a month later that they would be rebuilding in nearby Avoca, NY. Local history records the existence of a bee hive factory in Avoca, but the plant apparently never opened. Six months later, in June 1918, the M.C. Silsbee Company filed for bankruptcy. The newspaper reports that "while temporarily idle, the plant would soon be in operation, putting a large force of men at work." Two years later, a competitor, the Deroy Taylor Company, bought Silsbee's remaining stock of woodenware and offered it to *Gleaning's* readers at a 60% discount.

Just before the bankruptcy, Myron proposed to Miss Mildred Potter. They were married a year later.

After such a large business failure, Myron couldn't settle down. In 1920, at age 27, he moved to Chicago. A year or two later he returned to his home territory and beekeeping. His display ad states, "… if you want the BEST ask for Silsbee's and accept no substitutes. He also wrote and sold a booklet – Honey as a Health Food.

He moved to Dansville, NY, 20 miles north of Haskinville and opened an insurance agency. A year later he moved twenty miles farther north to Geneseo, NY.

In 1927 at age 34, he returned, settling near Bath, NY, just a few miles southeast of Haskinville. The newspaper reports that he, his wife, and son James Clair spent a few

Lack Of Communication Ruins Everything Because Instead Of Knowing How the Other Person is Feeling, We Just Assume!

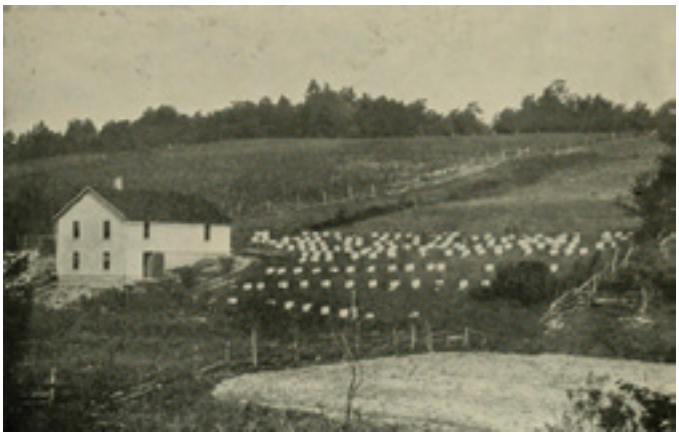
days in Binghamton, on business. The newspaper doesn't mention the name of Myron's wife by name, but seven months later, Mildred had resumed her maiden name and was living with her parents, working as a stenographer at a local business. Mildred made news on July 9th. On her lunch break, she walked to the Avoca Cemetery and swallowed a draught of poison. She was 29.

Shortly after Mildred's suicide, the papers reported that Myron was arrested in Macon, Georgia. He had disappeared with a stolen car. Perhaps Myron "borrowed" it, assuming the owner, who was spending the winter in Florida would never miss it. Someone reported the theft, and the sheriff brought him back.

The papers do not report any fines or jail time, but on this trip or one of his earlier business trips to the south he met and married a girl from Georgia. Louise McLaughlin was eleven years younger than him.

Myron and Louise moved to Babcock Hollow near Bath, NY. Myron worked bees in partnership with his younger brother Lynn. Louise worked at a combination service station and tea room. Autumn of 1928 brought another tragedy. Myron's three year old son choked on a peanut. Efforts to dislodge it failed and James Clair died. The following Spring, Myron's father died.

Myron's second marriage was in trouble. In September 1929, at the start of the Great Depression, Louise accompanied her employer's wife to Pennsylvania. Her brother, without Myron's knowledge, escorted her from there to Florida where she moved into her uncle's hotel. She refused Myron's entreaties to return to Bath. Myron followed her to Florida and confronted her. When she again refused to return with him, he shot and killed her, and then shot himself.



Silsbee Honey House.

Wayland Register, March 6, 1930 – Friends from this place attended the funeral of Myron Silsbee near Bath last Saturday afternoon.

I thought the M.C. Silsbee story would be an interesting 20 minute talk for the local bee club. Instead it turned into an epic tale of success and failure, scandal, tragedy, and murder set against the backdrop of a World War and the Great Depression.

It's easy to look back at an era with no mite bombs, hive beetles, CCD, or neonicotinoids and call it the golden era of beekeeping. But they had black and pickled brood, bee paralysis, Paris green, and lead arsenate. While science and culture progress, human nature remains unchanged. Those halcyon days weren't so halcyon after all. BC

Measuring The Impact Of The Queen

Bradley **Metz** & David **Tarpy**

For philosophers and poets, the public and pundits, and beekeepers and breeders, the queen of a honey bee hive remains the most visible – and perceived to be the most important – member. Described in royal terms, she was originally mistaken to be male by the (extremely) late Aristotle[1]. But the notion of rulership has persisted from its archaic roots to modern beekeeping and industry. Perhaps this notion is increasingly a nominal one, however, as we learn that while she may be (mostly) the sole reproductive, the queen is rarely the one in charge.

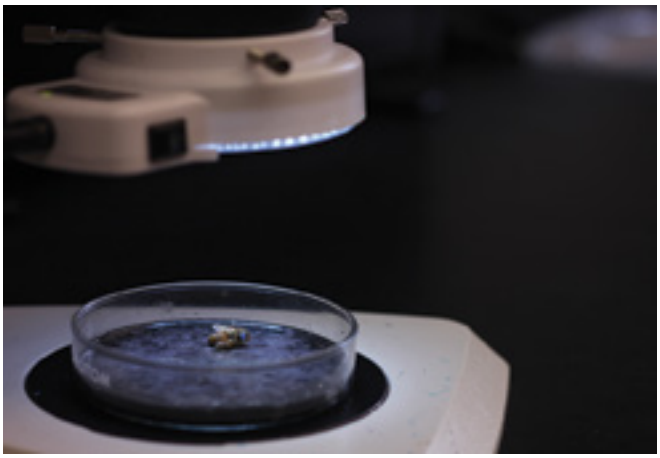
Throughout my time in the NC State Apiculture Program, I've worked with the Honey Bee Queen & Disease Clinic – an extension effort housed within the program designed first and foremost to allow beekeepers and breeders to obtain detailed information about their queens and colonies that is difficult or impossible to measure outside of a research laboratory. This clinic spun out of early efforts to quantify causes of colony failure in the wake of the 2008 "Colony Collapse Disorder" crisis and was founded from a history of work by David Tarpy and colleagues into causes and mechanisms of queen failure and replacement through supersedure. When surveying beekeepers, one of the major self-identified causes of colony failure is a "poor queen," "queen failure," or "loss of queen."[2,3] This places the responsibility on the most visible member of the colony, but not necessarily fairly. Surely, the queen has a massive impact on the growth and health of the colony. Her presence dictates the ability for new female workers to be produced. Beyond that, research suggests that queen size has marked effects on colony growth parameters and honey productivity[4–6], queens that have mated with more partners are more likely to survive a year[7], and that queens with less viable sperm are more likely to be found in colonies that are observing symptoms of collapse[8]. However, it is clear that not all colony problems may be laid at the "feet" of the queen. Brood pattern is a colony trait classically ascribed to the queen, but it has been shown to instead be an emergent property of the *workers* [9] rather than the queen per se. This points to a clear need to separate the *perception* of queen problems from the *reality*, so that management may be directed in the most productive manner.

Our clinic operates with a tripartite mission geared towards helping beekeepers, breeders, and researchers to better understand queen problems, their causes, and the avoidance thereof. All of the Queen Clinic activities utilize similar methods, and all are consolidated into a deliverable report (Figure 1). The most straightforward of these is fertility, mating, and morphological diagnoses of queens themselves. These are the true and obvious "queen problems": drone-laying, poor development and infertility, insufficient mating, and death of spermatozoa. The flip side of this is to provide quality assurance to both bee breeders and their customers, providing evidence of when the queen is *not* to blame for poor performance of a colony. The majority of our clientele use the clinic for these purposes, at least in part because most queen problems are identified after the fact (once she has been replaced, or the colony has itself collapsed).

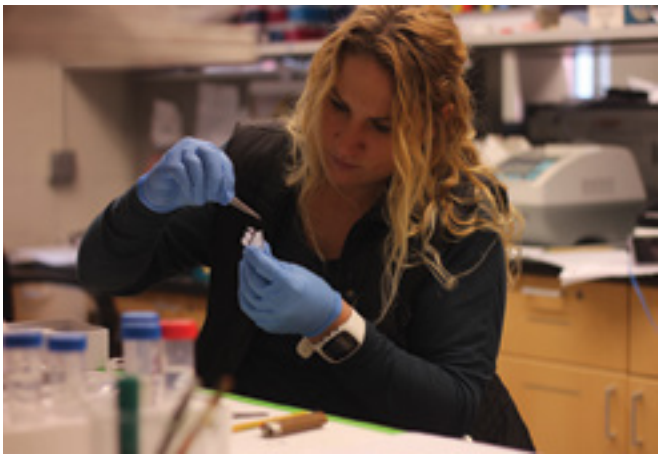
The final arm of our mission is one of collaborative research. In this, we utilize our laboratory expertise and equipment to assist our clients in designing, conducting, and analyzing experiments intended to affect (or, often, to *avoid* affecting) the reproductive or morphological quality of the queen. This can be a helpful first step in evaluating novel treatments, novel management practices, incidental exposures, or – key to our wider research program – mechanisms of queen loss.

Theory of Queen Assessment

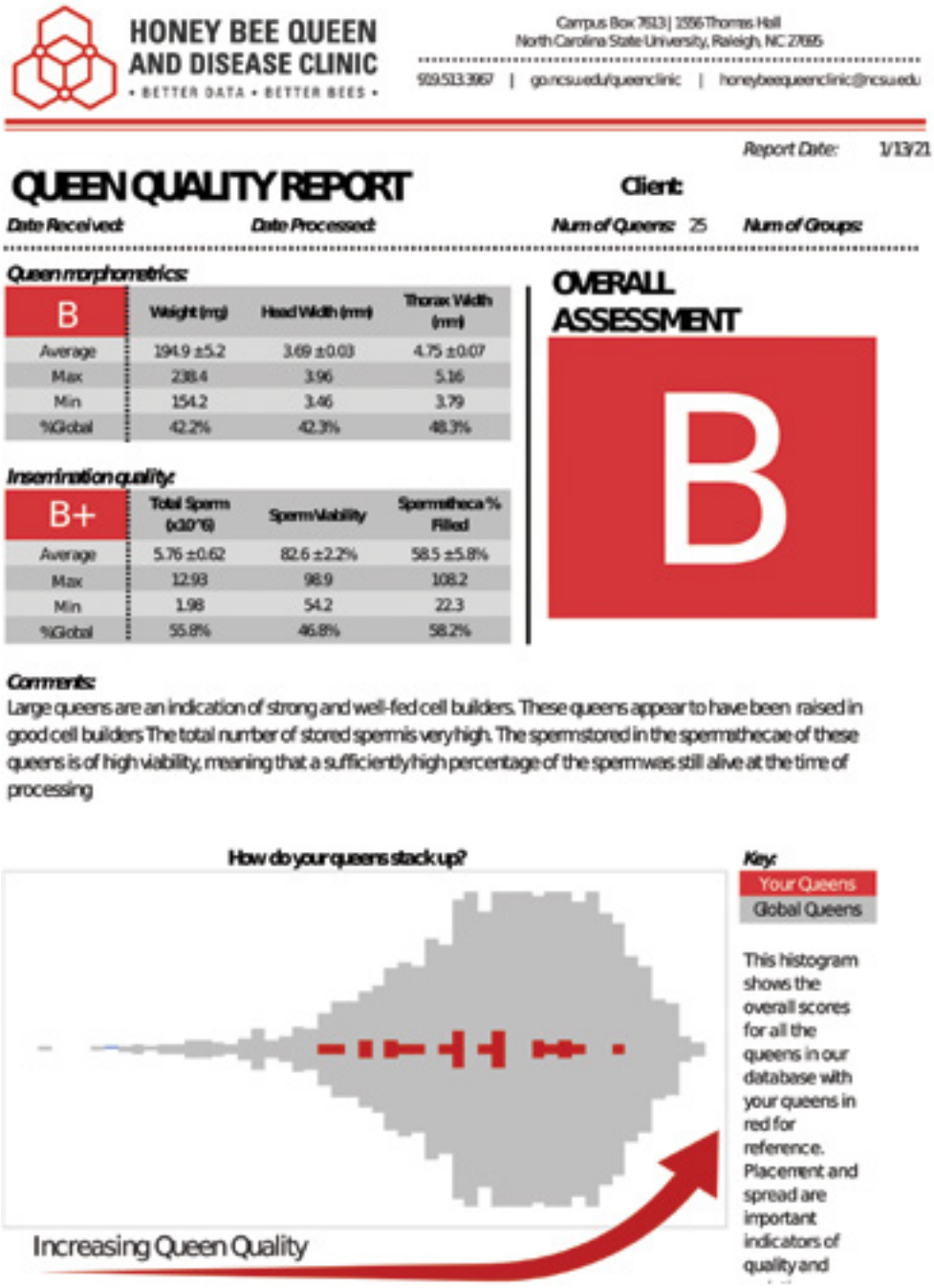
We know that all queens are not equal. As one beekeeper colloquially put it, "My job is to get the bees to



An anesthetized queen placed on the microscope ready to be measured and dissected. Typically this process takes about five minutes from start to finish, after which the clinic will have the photos necessary to compare her body and reproductive measures to the global dataset.



Graduated master's student, Lauren Russert prepares a set of dissected queens for subsequent molecular analyses. Benchwork is rarely glamorous and often time consuming, but critical to gaining detailed insights into honey bee traits, genetics, and stressors.


HONEY BEE QUEEN AND DISEASE CLINIC
• BETTER DATA • BETTER BEES •

Campus Box 7613 | 1556 Thomas Hall
North Carolina State University, Raleigh, NC 27695
919.513.3987 | go.ncsu.edu/queenclinic | honeybeequeenclinic@ncsu.edu

Report Date: 1/13/21

QUEEN QUALITY REPORT

Client:

Date Received: Date Processed: Num of Queens: 25 Num of Groups:

Queen morphometrics:

B	Weight (mg)	Head Width (mm)	Thorax Width (mm)
Average	194.9 ±5.2	3.69 ±0.03	4.75 ±0.07
Max	238.4	3.96	5.16
Min	154.2	3.46	3.79
%Global	42.2%	42.3%	48.3%

Insemination quality:

B+	Total Sperm (x10^6)	Sperm Viability	Spermatheca % Filled
Average	5.76 ±0.62	82.6 ±2.2%	58.5 ±5.8%
Max	12.93	98.9	108.2
Min	1.98	54.2	22.3
%Global	55.8%	46.8%	58.2%

OVERALL ASSESSMENT

B

Comments:

Large queens are an indication of strong and well-fed cell builders. These queens appear to have been raised in good cell builders The total number of stored sperm is very high. The sperm stored in the spermathecae of these queens is of high viability, meaning that a sufficiently high percentage of the sperm was still alive at the time of processing

How do your queens stack up?

Key:

Your Queens

Global Queens

This histogram shows the overall scores for all the queens in our database with your queens in red for reference. Placement and spread are important indicators of quality and

Increasing Queen Quality

Figure 1 *– Sample queen clinic report.*
This random sample of 25 queens illustrates the information provided and the variation within the population. The sample average for each measure is provided along with a percentile comparison to the global (national) database. Each portion, body measures and sperm measures, is also associated with a grade. These each represent a combination of the individual measures in relation to the original calibration set as published by Tarpy et al., 2011. Queens in this database are graded on a curve, owing primarily to the fact that many commercially produced queens are better than the best we can produce empirically, illustrating the value of experience. The overall grade is a weighted combination of the two and again simplifies an underlying numerical aggregation. The actual numbers are presented graphically at the bottom of the report, where the grey field represents all the queens in the database—notice that the bulk of the queens are distributed toward the head of the pack with a small number of trailing queens, the true "duds"—and the focal queens represented in red.

raise them fat girls and then get them good dates." The task of queen rearing involves manipulating colony state and selecting (or allowing colonies to select) appropriate eggs or larvae for queen rearing. Once the queens are reared, it is up to the beekeeper to manage their apiaries to generate a high-quality mating environment, which involves rearing a large number of high-quality drones with desirable traits, and relatively free from disease.

Our analyses combine a number of precise morphological measurements, first of the outside of the body. We measure the mass of the queen, her head width, and her thorax (Figure 2). Mass is largely a function of ovary development and activation, given that much of her body is filled with her reproductive tract. Thorax and head width are functions of development for flight and also a measure of "queenliness," discussed below. These morphological measurements are representative of selection and rearing quality, with higher weights and larger measurements being generally considered higher quality.

Larval selection techniques and basic nutritional management is one of the more heavily taught as beekeepers look to begin rearing queens for their own operations or for sale. Though the industry has not entirely reached consensus as to the optimal methods of larval selection, we know the basic parameters for success: young larvae without a history of nutritional deprivation make the best queens[10,11]. The other aspect – and one that is frequently under less control by the beekeeper – is mating quality. It has repeatedly been shown that

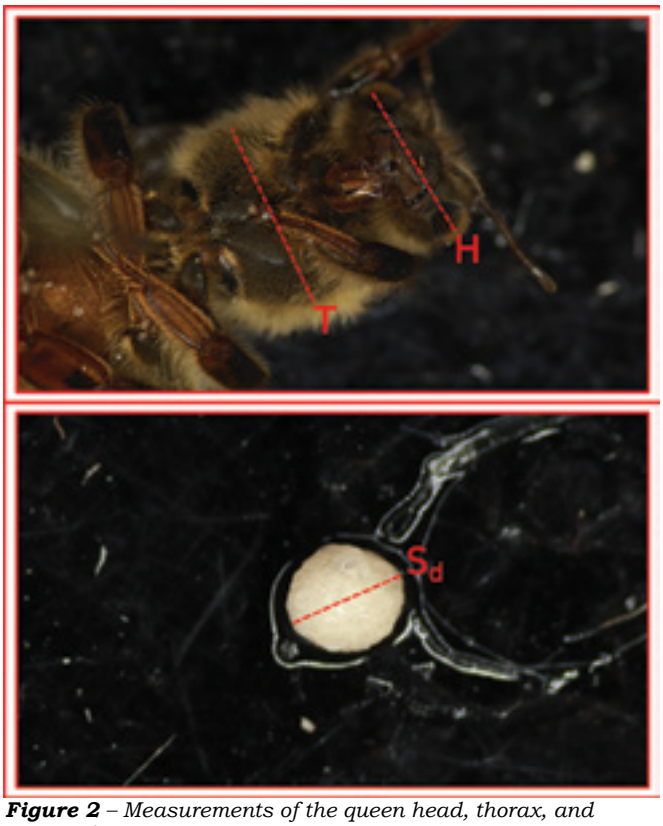


Figure 2 *– Measurements of the queen head, thorax, and spermatheca*
Illustrative of our dissection and measurement process, the head (H) measurements are taken over the face of the queen, measured from eye to eye. The thorax (T) is measured between the fore and middle legs and is taken perpendicular to the body axis. Finally, the spermatheca (Sp), shown here removed from the abdomen, is measured as the diameter of the spherical organ.

Genetics technician and disease clinic head, Erin McDermott happily ushers a boxload of samples collected over a long daytrip to an apiary of a queen clinic research collaborator. Normally, samples are shipped, but occasionally, circumstances necessitate a more rapid response.

higher quality queens, defined morphologically as above, are more likely to be better mated; that is, return from mating flights with more sperm, more *viable* sperm, and more mating partners[10,12,13]. However, these correlations are not perfect, leaving a lot of variation that beekeepers cannot control by controlling queen selection and rearing conditions alone. We therefore use fluorescent microscopy to directly evaluate the sperm for both the number of spermatozoa and the proportion of live and dead spermatozoa found in the queen spermatheca (Figure 3). Since only live spermatozoa are able to make it into the spermatheca[14], any spermatozoa found dead within it have died since mating, either because of an inherent lack of vigor, or because of some environmental stressor. Thus, the sperm count is an effective measure of the queen's success at mating and the viability is a measure of her exposure to stressors since she was mated. Both can be critical to the health of the colony and the life of the queen. In order for beekeepers to control the mating quality, they have to populate their mating environment with a large number of drones, themselves with desirable qualities, relatively disease-free, and (critically) not exposed to any number of chemical agents, a number of which can kill or lead to fragile sperm[15–17]. This is an unfortunate example of yesterday's cures becoming today's problems, as many of the treatments beekeepers rely on for the control of the *Varroa* mite are themselves responsible for partial drone infertility[18–20]. Avoiding non-lethal, but still devastating collateral damage is a major element in the development and evaluation of modern treatment options. Independent testing of novel treatments for effects on reproductive quality is something that both producers, growers, and beekeepers should be ensuring at every opportunity. Certainly, by repeatedly measuring both the body and mating quality of the population of queens over time, we are able to observe when things go wrong, when the correlations between the two breakdown, and when to intervene.

Finding the right way to ask the right questions

The clinic has been performing these analyses for over a decade and has amassed a nation-wide database of over 2000 queens, which provides us with a fairly thorough sense of how much commercially raised queens vary in terms of the measured parameters and the circumstances under which that variance may increase. This enables us to provide valuable insight to both researchers and beekeepers about designing and conducting experiments into factors affecting reproductive variation in queens, and with recent help from California State Beekeeping Association, drones as well. However, I am not a beekeeper, but a biologist. My entire beekeeping experience is linked with that of research. Therefore, my observations and manipulations are often geared towards understanding fundamental questions of communication, behavior, and evolution. Very often my interests and those of the beekeepers are aligned, for instance when I'm asking questions about environmental factors that impact drone fertility. However, I'm not always able to recognize a question that may be important to beekeepers, for instance the effects of long-term banking on queen reproductive health. This is where the clinic really shines, because beekeepers often know the questions they want asked, but without necessarily knowing how or having

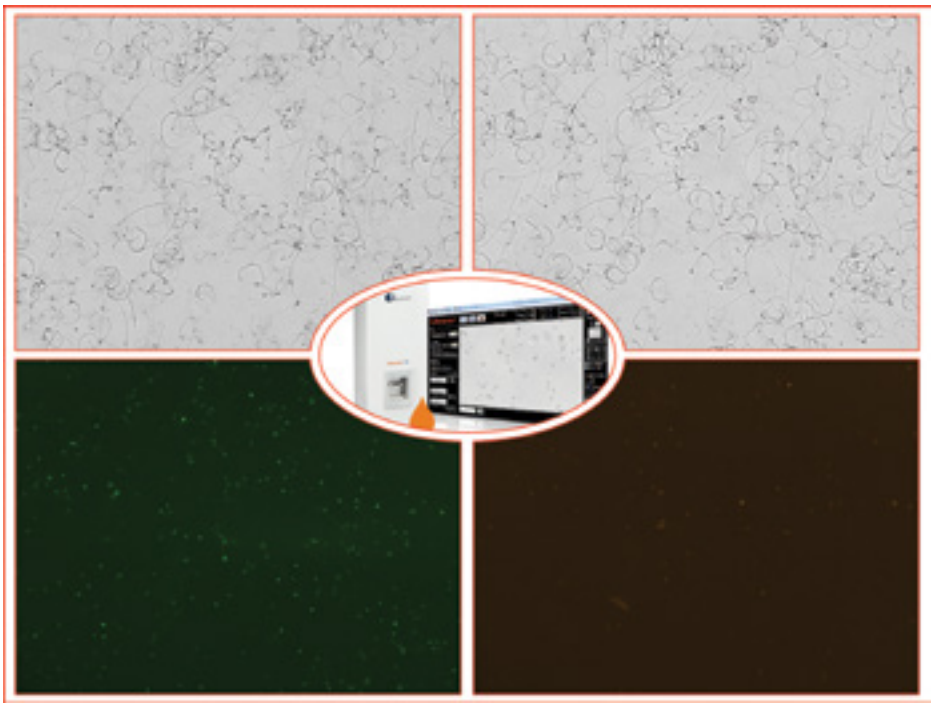


Figure 3 *– Micrographs of live spermatozoa with fluorescent dye indicating live and dead cells*
In the middle is the machine used for these measurements, a Cellometer (Nexcelom), which is essentially an automated fluorescent microscope. The upper panels show a normal light view of the live and dead spermatozoa released from the spermatheca. Below we see a colorized photo of the live (green) and dead (red) cells, which are counted on the same image to provide a measure of sperm viability.

the ability to perform the measurements to answer their questions. Rather than relying on a top-down imposition of knowledge, the clinic is designed to put combined decades of apidological expertise in the service of directly addressing questions that an operation finds important. The NC State Queen & Disease Clinic is intended to ultimately serve as a realization of the mission of the land grant and extension system and build partnerships between industry and academia. BC

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BEEKEEPING LAWS

Ettamarie **Peterson**

Like it or not if you have taken up beekeeping on any scale, you are now responsible for knowing the laws that regulate you and your beekeeping operation regardless of size. If you are keeping bees in a municipality, you need to know if it is allowed. Some cities flat out say beehives are not allowed in the city limits. Corona, California is one. This city is very near the Southern border of California in San Diego County. That county has been officially designated as a county that the Africanized bees have colonized. That may be why this beautiful tourist attracting city does not want bees. My own near-by city (My farm is just outside the city limits.) of Petaluma, California for many years had ordinances against keeping bees.

A few years ago, someone decided that bees were actually beneficial and thought the ordinance should be re-written. My daughter was on the city council and her colleagues knew I was a beekeeper, so I was asked to help write a new ordinance. It is in the section under animal control. That caused my input to be delayed for a couple of years because they were rewriting the whole section. There was a controversy about how many pot-bellied pigs a home-owner could keep (no kidding!) and how strict the rules for owning cats should be. The bird lovers were threatening to sue the city if they did not make strict stay-in-your-yard rules for cats. Anyway, I told them the best ordinance about keeping bees should be kept very simple. It should not go into great detail about how the beekeeper should keep a beehive. My only problem with what was written was the first line of the ordinance states, "Beehives are Prohibited". The reader must continue on to see that is not true. The total ordinance says,

"The keeping of a bee colony or maintaining an apiary in the city is permitted only in accordance with the following:

A. No more than two bee colonies are permitted per household;
B. All hives must be framed and moveable;
C. All hives must be kept a safe distance away from pedestrian walkways and pedestrian traffic, and so as to not constitute a nuisance."

This swarm was reported to me by a motorist that spotted it. She had no idea there was a huge apiary very close by.

Here is another more stringent example of a local code:

In Camas, Washington, the Preservation Beekeeping Council worked with local lawmakers to adopt a progressive bee-centered municipal code. The 2018 Beekeeping Code specifically requires local sourcing of bees, provides expansive options for hive bodies, and prohibits use of harmful pesticides: Hive, apiary management requirements "1. All hives shall comply with Revised Code of Washington (RCW) 15.60. 2. Beekeepers shall maintain an adequate supply of water on their property. 3. Bees should be housed in an appropriate hive body that offers good insulation and protection from weather and predators. 4. Beekeepers must source their bees locally (within a one hundred mile area). Local bees may be transferred as nucleus hives or from swarms. Package 149 CAMAS, WASH. MUNICIPAL CODE, Ordinance 18- 013, § I (2018). 149"

The Puget Sound Beekeepers Association (PSBA) worked with the City of Seattle to establish its ordinance after problems with one beekeeper were found to be difficult to solve. The ordinance now states, "Chapter 23.45 – Residential, Multi-Family Definition in the Seattle Municipal Code 23.45.150 – Beekeeping.

1. No more than four (4) hives, each with only one (1) swarm (Swarm is an older term for colony), shall be kept on lots of less than ten thousand (10,000) square feet. B. Hives shall not be located within twenty-five (25) feet of any property line except when located eight (8) feet or more above the grade immediately adjacent to the subject lot or when situated less than eight (8) feet above the adjacent existing grade and behind a solid fence or hedge six (6) feet high, parallel to any property line within twenty-five (25) feet of a hive and extending at least twenty-five (25) feet beyond the hive in both directions.

(Ord. 110570 Section 3(part), 1982.)

Definition in the Seattle Municipal Code 10.36 – BEEKEEPING

10.36.010 Maintenance and registration of colonies.

1. It shall be the duty of any person, firm or corporation having honey bees, *apis mellifera* on its property to maintain each colony in the following condition:
   1. Colonies shall be maintained in movable-frame hives.
   2. Adequate space shall be maintained in the hive to prevent overcrowding and swarming.
   3. Colonies shall be re-queened following any swarming or aggressive behavior.
2. All colonies shall be registered with the Director of Agriculture pursuant to RCW 15.60.030 prior to April 1st of each year.

(Ord. 108150 Section 1, 1979: Ord. 101531 Section 1 (part), 1972.)

SMC 10.36.020 Nuisances designated.

Bees living in trees, buildings, or any other space except in movable-frame hives; abandoned colonies; or diseased bees shall constitute a public nuisance and subject the owner to the penalties imposed by Section 1 of Ordinance 1015311."

I don't know how the City of Seattle enforces its nuisances designation. I know of lovely old Victorian homes in Petaluma that have had feral colonies in their walls or attics and also know there are bee trees in the city limits. For many years there was a feral colony in one of the crypts at the local cemetery! I know about these colonies because I have been called several times to capture swarms coming from them. One bee tree in a city park was allowed to stay intact after another beekeeper and I re-directed the bees' flight path, so it was well above people's heads.

Beekeepers must notify both New York City and New York State regarding hives kept in the five boroughs. Article 161 of the New York City Health Code, section 161.01(b)(12), requires that persons keeping honey bees "file a notice with the Department, on a form provided or approved by the Department, containing the beekeeper's name, address, telephone, e-mail and fax numbers, emergency contact information, and location of the hive, and they shall notify the Department within ten business days of any changes to such information." Register your hives **here.**

Section 161.01(b)(12) also requires beekeepers in New York City to "adhere to appropriate beekeeping practices including maintaining bee colonies in moveable-frame hives that are kept in sound and usable condition; providing a constant and adequate water source; locating hives so that the movement of bees does not become an animal nuisance, as defined in § 161.02 of this Article; and shall be able to respond immediately to control bee swarms and to remediate nuisance conditions."

Section 161.02 defines a beekeeping nuisance to "mean conditions that include, but not be limited to, aggressive or objectionable bee behaviors, hive placement or bee movement that interferes with pedestrian traffic or persons residing on or adjacent to the hive premises; and overcrowded, deceased or abandoned hives."

If you intend to keep bees inside city limits, go to the city's web site to look for ordinances. If you are not able to determine what the rules are, call the city and ask who would know. Speak to that person to get valid information.

Some counties have bee ordinances as well. Many counties have bee inspectors that enforce them. Here in Sonoma County there is no bee inspector because it was cut out of the budget years ago. In 2019 beekeepers in the county were advised that there is an ordinance to register all bee hives with the State of California. The fee was waived until January 2021. All known beekeepers in our county were sent a letter from the Agricultural Commissioner's Office notifying them of the new fee. To learn what counties in California have ordinances and what they are go to the website **https://beewherecalifornia.com/local-ordinances-by-county/**

One cannot tell who owns or who is responsible for these hives unless they trepass into the field and read the identification on each hive.

Beewherecalifornia.com is also where all California beekeepers register their hives. The fees are sent by the beekeeper to his/her own county agricultural office. This program is fairly new and there are some problems coordinating the collection of the fees. There is no link on the beewhere site to each county. Our county agricultural department says they are working on that problem now. This hive registration ordinance came about because beekeepers were having problems with their colonies being killed by agricultural spraying on nearby properties. The primary goal was to make better communication between beekeepers and commercial farming operations.

The State of Florida has beekeepers sign a compliance agreement. The agreement spells out very detailed best management requirements for maintaining European honey bee colonies on non-agricultural lands. According to the document these guidelines are recommended, but not required for beekeepers keeping bees in areas classified as agricultural pursuant to section 193.461, Florida Statutes. Beekeepers must situate a colony within 15 feet of a property line and maintain a flyway barrier at least six feet in height consisting of a solid wall, fence, dense vegetation or combination thereof that is parallel to the property line and extends beyond the colony in each direction. The property, or portions thereof, where the honey bee colonies are located must be fenced, or have an equivalent barrier to prevent access, and have a gated controlled entrance to help prevent unintended disturbance of colonies. Colonies are not allowed on public lands without a special permit letter issued by the Director of the Division of Plant Industry and written consent of the property owner. Size of land and density of colonies is also spelled out in great detail. Beekeepers are also instructed about providing water and inspecting the colonies monthly for adequate food and colony strength. If the colony is overly aggressive the beekeeper must contact his/her assigned apiary inspector for an assessment. They are directed to re-queen collected swarms, new colonies and maintain colonies with queens or queen cells from European Honey

Bee queen producers. They are also told to practice reasonable swarm prevention techniques as referenced in University of Florida's Institute of Food and Agricultural Sciences extension document "Swarm Control for Managed Beehives", ENY 160, published November 2012.

In Florida feral (unmanaged) bee colonies and swarms can be removed by registered beekeepers. Rule 5E-14.151 states that the removal or relocation of bees, such as a swarm, for the production of honey and related products or pollination purposes, shall not be considered pest control. However, it is considered pest control if the removal is performed by someone who is not a registered beekeeper.

Checking out Vermont's hive registration form I was surprised to discover they not only wanted the location of your apiary(ies) and the usual information but you must also initial a statement that says, "I hereby certify that I am in good standing with respect to any obligations for child support and, under the pains and penalties of perjury, that I am in good standing with respect to or in full compliance with, a plan approved by the Commissioner of Taxes to pay any and all taxes due to the State of Vermont as of the date of this application." So, if you are a deadbeat, don't become a beekeeper in Vermont!

North Dakota claims to be the highest honey producing state in the nation, so it is not surprising that the bee laws there are very strict with harsh penalties for breaking them. The section on Identification of apiary states, 1. "A beekeeper shall identify each apiary for which the beekeeper is responsible by: a. Affixing a three-digit identification number, assigned by the agriculture commissioner, that is prominently displayed and visible upon approach to the apiary's main entrance, provided each digit is at least three inches (7.62 centimeters) high, one-half inch (1.27 centimeters) wide, and weather-resistant; and b. Displaying the beekeeper's name and phone number in a location that is prominently displayed and visible upon approach to the apiary's main entrance, provided the numbers and letter used are at least one and one-half inches (3.81 centimeters) high and weather-resistant. 2. Any apiary that is not identified, as required by this section, may be subject to seizure by the commissioner." The next section goes on to state what will happen if an apiary is not identified and failure to identify the beekeeper responsible. This describes putting notices in the local paper that at a time certain, all of the colonies, the hives, including their content, and all beekeeping equipment present at the apiary, will be seized and sold at auction or destroyed, unless the beekeeper or other responsible person appears to claim the property and pay for any costs incurred by the commissioner under this section.

I can appreciate the need for identifying apiaries for several reasons. In our county we have had beekeepers that left beehives all over the area and then seem to forget them. The hives fall into disrepair and are a nuisance and a health hazard, as well. Many times, I have been called to advise the property owner about what should be done with these abandoned hives. The other problem we have here in our county are the large apiaries put all around by commercial beekeepers between pollination contracts. There will be 50 or more hives set out in fields with no identification that can be seen from the road of the owners that should be notified if there are problems. This last spring, I was called to get a swarm from a fence post near such an apiary. While I was waiting for the swarm to walk onto the comb I had propped up on the post, I walked over to see the many beehives in the field. I was amazed to see seven more swarms in a nearby tree, another swarm all over a fallen over tree and hives that were just beginning to swarm! I called the number on the beehives and got an answering machine. That did not help the situation at all! I called some other beekeepers to help capture these swarms so they would not wind up all over the area in who-knows what buildings! I left the message stating what I was doing and why. I later contacted the owner by e-mail after doing some research. I actually was trespassing to get the information needed to contact the apiary owner. They did forgive me, fortunately.

Honey labels have Federal guidelines to follow. There is a pdf document you can download to your own files at **https://www.fda.gov/files/food/published/PDF---Guidance-for-Industry--Proper-Labeling-of-Honey-and-Honey-Products.pdf**. Ann Harman wrote an excellent article covering this area in the February 2016 Edition of *Bee Culture*. It is available to read at **https://www.beeculture.com/honey-labels/**. Honey label requirements vary from state to state so before designing yours check with your own state.

The tree was covered with at least seven swarms and there were others that landed in near-by spots! Part of the apiary is visible just beyond the tree.

Laws come into existence when problems arise. Researching the various laws for this article made me think about why they came about. When an area is threatened with Africanized bees, laws come to be written to protect the European honey bees we can safely keep. When beekeepers do not maintain their colonies and diseases are spread, more laws are written. Take a responsible attitude towards keeping bees and familiarize yourself with your state and local laws. Your neighbors and fellow beekeepers will have more respect for you when you take this seriously. If you don't like the way the laws are written, work with your state and/or local beekeepers' association to be heard by the government. BC

BIGGER PICTURE

Jessica **Louque**

Winter Food

It might seem like Winter would be a strange thing to think about, now that we're finally (mostly) past the cold months, but the time to plant and throw our overactive imaginations to the outside world has come! You probably know by now what hives made it, and some have most likely swarmed by now if you're in a remotely warm place. Here in NC, one of the biggest things to make a difference in hives surviving the winter is providing pollen during the late Winter when colonies start producing new brood. There's not a lot going on outside, and they don't keep stores of pollen like stores of honey. Pollen patties aren't as nutritious as natural flower pollen, but it can't really be helped at that time of year. In that case, what can you do to try to augment their supply? Obviously, go way overboard and plant more things outside.

Some of it may depend on your green thumb ability, because planting in the Spring means you have to take care of them during the Summer and keep them watered. I prefer this to a little more over planting in Autumn because it gives the roots a better chance of digging in before bad weather. We are really unpredictable here because we can have a 70 degree day turn into a 20 degree day and see-saw all over the place with every weather possible all in 24 hours, basically from September through April. If I really want a plant, I may ignore hardiness zones, but in general I prefer to look for something that can survive one zone down from us because we vary so wildly here. I'll have plenty of suggestions for plants here, but you'll need to do your own research based on your zone to make sure they can survive.

I didn't start thinking about it until I saw an Instagram post by the NC Arboretum on their blooming plants in early January. After seeing their Wintersweet (*Chimonanthus praecox*), Witchhazel (*Hamamelis vernalis*), and Cornelian Cherry (a dogwood species, *Cornus mas*), I decided to go look around outside and see if I could find anything blooming. To my disappointment, I couldn't find anything blooming and barely anything green! After realizing that my bees really don't have much to go for before the maples start to bloom, I went out and made a giant mess with pollen (AP-23 from Dadant) and made a bunch of patties. Once all the bees were fed, the research started on winter blooming plants that would survive here.

There are no nurseries or greenhouses that are particularly close to where we live, so commercial stores are about the only option unless you drive over an hour. I went to get . . . light bulbs? A pot? Who knows . . . but I ended up with not only some random houseplants that were really sad, but some Winter Heath and Daphne. I brought these home before I had looked up a lot, but they were sitting outside in the garden center and blooming quite happily in the cold. Winter Heath (*Erica carnea*) is in the blueberry family and you can tell when you look at the flowers. It likes sun to partial shade unless you live in a warmer zone and needs well drained soil. It's drought resistant after it's established, and it makes a good ground cover. Winter Heath is also deer resistant, can tolerate some salt in the soil if you live closer to the coast, and isn't susceptible to most diseases and pests unless you overwater it and it gets root rot.

Winter Daphne.

Winter Daphne likes a little shade but is usually planted close to a porch or deck because they are fragrant. They are not particularly drought tolerant and need a lot more water than the Winter Heath. It's also an evergreen and typically comes variegated. After I bought these two, bees started coming to the porch on sunny days to visit the blooms.

If you are close to an arboretum, this would be a great place for inspiration for your area. You'll be able to see not only what blooms, but how big it gets and what you can expect when it matures. If you have room to plant witchhazel and wintersweet, I'd definitely go for it. If not, look for smaller shrubs and bushes, or even bulbs that can match your space. A generalized search for winter blooming plants and your zone should give you some suggestions, but contacting a county extension agent or your local arboretum might give you a better perspective on your specific area.

I love bulbs and I think they are overlooked a lot by outdoor plant enthusiasts. Not all of them are attractive for honey bees in particular, but they do attract bumble bees, hummingbirds, moths, and some birds even. My Cana Lilies are always covered by bumble bees, and everything will go to Dahlias. I've seen honey bees on my ginger (I guess technically a tuber, but still bulb-y). For the Spring, it's hard to beat bulb blooms if you do it right. I doubt most of us could ever recreate the picturesque tulip farms created

Winter Heath.

by the Dutch, but you can still have some nice bulb spots around your house. Snowdrop (*Galanthus*) is aptly named because it can be in bloom while snow is still on the ground. Siberian Squill or Early Scilla (*Scilla sp*) are both early blooming flowers that bees love. Some people don't like Siberian Squill because it's considered invasive but I've never honestly been able to get it to take very well here. Crocus and dwarf Iris are both early bloomers as well. Do some research and see what you can reasonably get to grow well for you.

For small shrubs, Winter Aconite, Cyclamen, and Hellebore are good examples of Winter blooming flowers that are reliable. Hellebore is the only one of the three I have tried outside, and it has had bees visit it. My next plan is to make a whole

Making a mess with pollen.

Winter blooming garden with options like these and see what my honey bees will go to. Winter Mahonia and Camellias are fairly large shrubs that have prolific blooms. Camellias are a southern staple and loved by bees around here. They come in a multitude of colors and varieties if you take the time to find them.

To obtain your new coveted Winter garden, your best bet is to go to a local greenhouse or nursery and see what options they have available. A local owned business will be better because the people who work there will be more likely to be knowledgeable about the plants and growth habits than people working in a large chain store. A smaller place is also going to be more vested in the success of their plant and want to help you succeed by choosing plants that will fit your home and abilities. If you are not interested in personal interactions yet, there's always internet ordering.

Plant hoarding has become a new popular hobby during this time of being at home for most of your time, which makes it easier to get plants – in some ways. I am absolutely guilty of ordering ridiculous plants from the internet just because I found it. Since more people want plants, a lot of people are attempting to grow outdoor plants indoors, giving home gardeners a larger variety of plants for their planting pleasure. The problem is that the common shipment comes by way of the postal service, which is only slightly more reliable as a mode of delivery than a dead horse. I cannot stress enough to you how important it is to pay the extra for priority with insurance, even if it's not an expensive plant or bulb. There have been numerous orders that I've had to get reshipped because our Greensboro Distribution Center can't seem to get packages out. It has come to my attention (through my loud ranting about dead plants and lost packages all the way back before Christmas) that the center has had a lot of problems. As with nearly all government organizations, it is a complete jumble of understaffed, overworked, and responsibilities dropped. What this means for you is that if you don't choose to upgrade your shipping, you may very well be the recipient of a box of dead plants. Sometimes your seller will replace, and sometimes they don't have anything to replace it with and you're just out of luck. I have had some bulbs get lost for a while and still survive, and some that couldn't sprout. They kept a cactus long enough to kill it once. Just be careful. On the upside, if you are a fan of a specific plant, like a Caladium, for example, you can find an insane amount of varieties to suit your fancy. If you want to grow some exotic gingers, well let me tell you, you are in luck because you can find all kinds of crazy shapes and colors! If you want to grow your own Hellebore from seed, your options are nearly limitless. Etsy is one of my favorite places to look for unique plants, even if sometimes it's just to see what's the most outrageously priced plant I can find. If you're wondering, it was a $13,500 Monstera that was variegated. The sellers are almost always really helpful and will send growing instructions and help with specific questions. One of my favorite bulb dealers for Caladiums and Cana Lilies is Blue Buddha Farm out of South Carolina. I know Caladiums aren't honey bee plants, but they do add a nice backdrop. If you really connect with a grower or like their shipping skills (some of these people are plant-packaging MASTERS), then you could also ask them about acquiring plants that you want. Keep an open mind, shop small, and feed those bees! BC

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*Visit **BeekeepingTodayPodcast.com** to hear Jessica and Bobby Louque talk about what all they do with their bees, and their role in honey bee and pesticide research.*

CAGE FIGHTER TO BEEKEEEPER

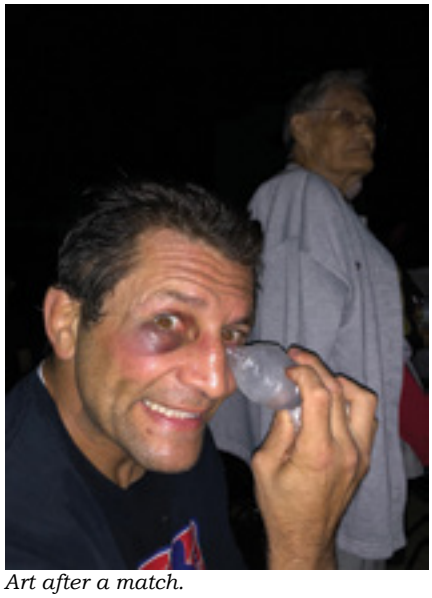
Shelise **Atkinson**

Art and Shelise after a fight in Mexico.

My husband has no idea I contacted *Bee Culture,* the favorite magazine he reads. Let me tell you a little about my husband, Art Santore. He was a licensed professional cage fighter for 10 years. His nickname was El Pachuco. He wore a zoot suit dancing to Big band music before he got in the cage to fight. We traveled the world. He fought in Mexico City, Mexicali, TJ, Tokyo Japan, Quebec Canada, the Hard Rock in Las Vegas, The Orleans In Las Vegas, San Diego California, Upland California, Portland Oregon, and Austria to name a few. He is tough as nails. He did it to provide more for our family and our three children we were raising at the time.

Now let's take it back a bit my husband's mother, grandmother and grandfather had bees. Art used to help take care of the bees when he was young. When we married and had kids, we made it a family affair. The kids and I would work inside extracting the honey by hand, squeezing the comb and making little wax balls that would drain through a strainer. My husband and his mother would do the outdoor work with the bees.

When my husband retired from fighting and we moved to Bakersfield California where he became a sheriff, he got five of his own hives. My husband has been through so much these last 10 years. His sister had breast cancer. His mother and I both got thyroid cancer at the same time. I had surgery a week before she died. I am now on watchful waiting and doing good. My husband on the other hand had an empty heart with his mom now not with us on this earth. He started drowning his sorrow into beekeeping. It helped him still feel close to her like when they worked the bees together at his grandparents' home growing up.



Art after a match.

Then he started teaching my daughter the craft of beekeeping. He got her a full bee suit and she became his assistant. Her and her daddy shared that hard work, that special time together. She loved it as much as her father. We now have a real honey extractor that saves time. He still has some of his original boxes. It's been fun to watch Queen bees be delivered to the house that say live bees! That was a first for me. Art and I have been married 25 years. I do not have all the knowledge Art has. Art reads and watches many videos to learn more each day. He shares his craft with others. He now has two buddies that are beekeeping.

The honey tastes better than any other honey I have ever tasted. I think when you put in the work you appreciate a local, pure honey in a new way. We are able to share it with friends and our family really loves it because they know what they are getting. We have videoed them many times during the whole process of harvesting honey. It is a big job but the end product is the best.

I am so thankful Art has this hobby. He calls his honey Fuzz Buzz. My sister and cousin came up with that. Then my niece drew a honey bee with a officer hat on. My mom printed us some stickers for our jars. It was fun to see everyone involved. My little sister sent us some honey bear containers. Then this past Christmas our family got us bee dishes, t-shirts, signs, socks, jewelry and other fun things all centered on bees. My husband calls me the Queen bee. We laugh that he is the worker bee of course and my daughter is the bee charmer. Our children are all grown now and have moved out but my husband continues the tradition of beekeeping.

Art's father and half-brother also have hives. His uncle and sister on his mother's side also. So, it's fun for them to talk about it when we get together. What a healthy way to spend time as a family making memories that will last a lifetime. BC

Art working his hives.

Monitor Gut Pathogens Of Honey Bees

Hossam **Abou-Shaara**[1] and Mahmoud **El-Kelany**[2]

Monitoring the health of honey bee, *Apis mellifera* L., colonies is very important to prevent prevalence of diseases, and to protect the colonies from sudden collapse. External parasites of honey bees can be identified simply without killing the bees, while the identification of gut pathogens requires the dissection of the bee sample, mostly workers and drones and not queens. Most studies avoid investigating queens, because one queen exists in a normal bee colony. A simple and non-destructive method to monitor gut pathogens in honey bees is described using simple laboratory tools. The presented method can be used to monitor gut pathogens of bees without killing them.

Key words: *Apis mellifera*, Nosema, beekeeping, health.

Introduction

Honey bee colonies suffer from the risk of infection with many gut pathogens, including *Nosema* spp., which can cause many deleterious effects on adult bees (Fries et al. 2013). At the same time, a decline in honey bee colonies has been recorded in the last few years in combination with the phenomena of colony collapse disorder or CCD, and *Nosema* besides other factors have been considered as potential causes (Evans et al., 2009; Paxton, 2010). Other gut pathogens can attack the bees, including some trypanosomes (Runckel et al., 2011; Schwarz & Evans, 2013). The early detection of these pathogens in bee colonies is necessary to protect the colonies from collapsing.

The common method to detect the infection of bees with gut pathogens depends on dissecting or mashing the bee samples, mostly workers, and then analyzing the gut content using a microscopic or genetic methods (Fries et al. 2013; Abou-Shaara, 2018). This method depends on killing the bee sample, and this is a problem in case of inspecting a large number of samples, and also no extra experiments on the same sample of diseased bees can be performed. The available alternatives to this method include detecting the infection in dead bees (Fries et al., 1984), or by expecting the infestation based on the clinical symptoms (e.g. Fries et al. 2013). But these two methods can only be effective after the prevalence of the pathogens inside the colonies, and after causing noticeable damages, and can not be used as early diagnostic methods. Here, a simple, non-costly and non-destructive method for the detection of gut pathogens of honey bees using only modified cages and simple steps is described.

Modified cages:

Two cages can be used to monitor gut pathogens according to the number of bee samples. The first cage is a normal Benton cage, but modified to have two mesh sides as shown in Fig. 1A. This cage is suitable for bee queens either mated or virgin, and for small numbers of workers or drones up to 5 individuals. The second cage is a plastic petri dish with two mesh sides (Fig. 1B) (modified after Abou-Shaara & Elbanoby, 2018). This cage type is suitable when a larger number of bees or drones is needed and up to 15 is used. The height of these two cages is about 1.5cm. It is not preferable to use cages with height more than 2 cm, to prevent the caged bees from defection on the sides of the cages. There is an opening in each cage to allow the insertion and removal of the bees.

Detection of gut pathogens without killing the bees:

First, collect the bee sample; queens, workers or drones, and then place them in the modified cages. Secondly, place the cages above small plates filled with water (Fig. 2). Food, e.g. sugar candy, can be added in the cages based on the study. Then, check the water plates daily to observe the accumulation of feces; mostly drones and queens defect within two days, diseased workers rapidly defecate while healthy ones may take more time. It is possible to press the abdomens of some bees above water plates to rapidly collect the feces, but it is not recommended because it may destroy the abdomens of queens and workers, and can cause death especially to young workers and drones. Then, remove the water plates and inspect some water drops directly under the

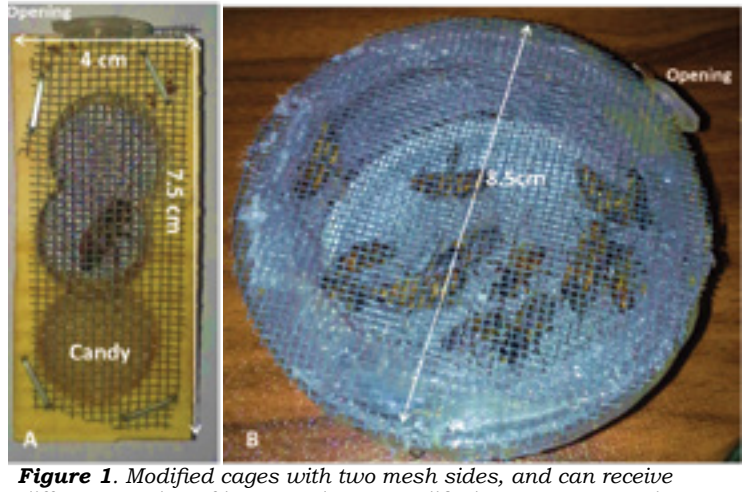


***Figure 1**. Modified cages with two mesh sides, and can receive different number of bee samples. A) Modified Benton cages suitable for bee queens and few numbers of workers or drones (7.5X 4X 1.5cm, LXWXH), B) Modified petri dish suitable for larger number of drones or workers (diameter of 8.5cm, and height of 1.5 cm).*

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[2]Research.

microscope, or alternatively use centrifuge to separate feces and then use PCR analysis to detect the pathogens. The number of times to collect feces from samples can be adjusted according to the purpose from the study, also other parameters (e.g. survival rates, body weight, food consumption rates) can be recorded for the caged bees during monitoring period of abdominal pathogens.

The method presented in this article is not only simple and requires non-costly materials, but it allows performing of various experiments on diseased bees, without killing them, besides monitoring of gut pathogens. BC

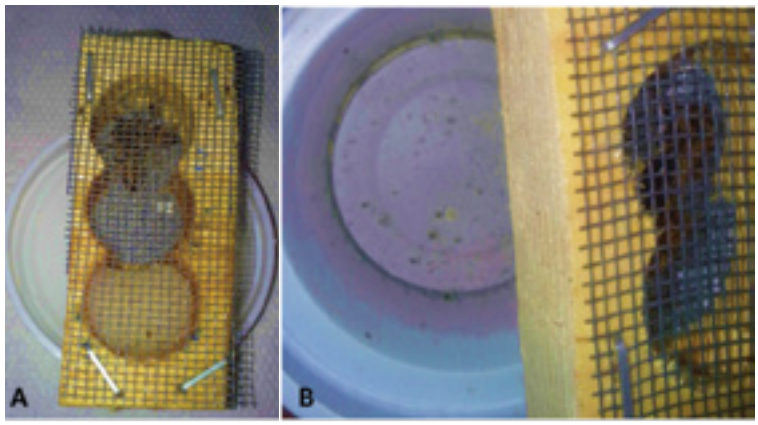

Figure 2. *Modified cage is placed above a small water container (A), and the feces inside the water (B).*

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Sriracha Noodle Time –

Shana **Archibald**

HONEY SRIRACHA NOODLES.
2/3 c. low-sodium soy sauce
3 tbsp. honey
1 tbsp. Sriracha or chili sauce
1 tbsp. lime juice
1 tbsp. vegetable oil
2 chicken breasts, cut into 1" pieces
1 head of broccoli, cut into small florets
2 cloves garlic, minced
1 tbsp. freshly grated ginger
1/4 c. Sliced green onions
12 oz. cooked rice, udon or spaghetti noodles
Lime wedges, for serving (Optional)

Make sauce. In a medium bowl, whisk together soy sauce, honey, sriracha and lime zest.

Meanwhile, heat oil in a large skillet over medium heat. Season chicken with salt and pepper then add to hot skillet. Sauté until brown on all sides and mostly cooked through, about 6-8 minutes.

Add broccoli and toss with chicken until the broccoli begins to turn bright green and tender. Stir in garlic and ginger and cook until fragrant, about 1 minute.

Add the sauce and bring to simmer. Reduce the sauce slightly and simmer until the chicken is completely cooked through and the broccoli tender. Add noodles and toss until completely combined.

Fold in green onions and cilantro. Serve immediately with lime wedges.

Perpetual Queen Management

Seeing ourselves in our bees

We love our queens. We kill our queens. We replace our queens. We worry about our queens. We selectively breed our queens. We clip the wings of our queens. We mark our queens. We write books and make movies about our queens. We just can't get enough queen talk. We have never been satisfied with this whole queen thing.

The beekeeping craft is filled with numerous instances of "humanized" bees. As humans, we just can't help it. Though they never asked for the attribute, we try to give human values to our bees. Beehives are painted white, historically a common house paint color, to ostensibly reflect heat – but I have never been sure that heat needed reflecting. That white hive has a landing board comparable to our front porch. Our bees sting us when they are *"angry"*, or they buzz *"happily"* during a Spring nectar flow. Drones are the goofy boys of the hive, and we smirk when discussing the primary function drones serves. Worker bees are the conscientious laborers within the hive, and we marvel at their *"intelligence"* and *"skills."*

But above all, the queen is the most humanized – more often vilified – member of the colony. She is our colony's "*Mother*" – seemingly the leader of the group. We expect great things from our colony, so we demand that the queen provide the genetic stock to get the job done. Relating to our colonies, we tend to allocate all blame and all goodness of the colony to the queen.

James E. **Tew**

For her, it is ultimately a lost cause. Even the very best queen in the yard will one day soon be a bad queen. Her reign is short, controversial, and violent. It follows that human feelings and attributes will play a part in our decision to requeen and otherwise manage her existence.

Why requeen at all?

"Bees know what's best for them. I let them raise their own queen." That would be a true statement if our bees were not kept in artificial white domiciles with front porches. The beeyard is a very unnatural environment for our bees. Our white hives, sitting in neat, straight rows, contain combs that are too straight. None of this is how the bees would have done it themselves. The beeyard, and the frames of comb contained in the hives, are of human design. In this mostly unnatural world, it becomes somewhat unfair to expect bees to continue to act naturally.

Regular requeening helps us continue to keep bees our way, year-round. Yes, the bees can and will provide for their own queen, but it is frequently not to our human advantage to have them do so. The most suitable queen for a feral bee colony will most likely not be the best queen for a beekeeper-managed colony.

If your goal is productive, overwinterable colonies, you should requeen regularly – at least every other year. If your goal is watch biology in action, as an uninvolved bystander, you can let them raise their own.

Obtaining queens

Numerous detailed books and articles have been written on the subject of raising, shipping, and introducing queens into colonies. My intent here is to discuss the reasons for requeening, including some suggestions and recommendations on the task.

Raising or buying?

Yes, you can *somewhat* readily raise your own queens if that is how you choose to obtain queens, but most of us will simply buy them (and then later complain about them). Apparently, prices for purchased queens are only going to go up. The selling price of a replacement queen has reached a level where requeening must be taken more seriously. The recommendation to regularly requeen is a common one, but that does not make it an automatic process. The requeening process should be taken thoughtfully and with preparation.

From whom to buy?

Sorry, but that is your call. The bee journals are replete with advertisements for queens. Queens are given as door prizes at state bee meetings. Beekeepers talk amongst themselves about queen sources. Sometimes, local beekeepers grow a few local queens and offer them for sale. Spring is the season when most beekeepers want new queens so Spring queens are the most difficult to get. Summer queens and Fall queens are more readily available, but introduction will be a bit more difficult. Ultimately, you the beekeeper, will have to find a source for queens that is satisfactory for you.

What kind to buy?

I can't think of a single beekeeper who ever set out to buy a bad queen. We all want *good* queens, but the question is – how good? Queens of various color and behavioral strains are there for you. Queens with varying claims for resistance to mites are now commonly offered. Most

large-scale queen producers give their queens unique names that actually have little to do with the quality of the queen. Some of you like yellow queens while others are supporters of the darker Carniolan queens. In years past, Caucasian queens were marketed, but that strain has fallen from grace and are not now readily available.

I normally try for the standard *"good"* queen, but there are plenty of you out there who want the very best-bred queen available and are willing to pay for her. Certainly, no harm done there. When you make your decision on where to buy your queens, you will secondarily decide how much you are willing to pay.

The queen – adored by both bees and beekeepers – until she is not.

When to complain?

Need I say that the queens must arrive alive? If they come to you dead, contact the producer immediately. But what if she comes in alive, but she dies while in the cage on your dining room table waiting for the rain to stop, so you can release her? There is not as clear answer to this question. Or how about you pay $30.00 for her, and then find her corpse in front of the hive the day after her release? Again, no clear answer. What if you successfully introduce the queen and she is a low producer? Not a lot of recourse there – buy from someone else the next time. In all areas of queen purchasing, be fair to the producer and to yourself. But before you call with a sad story, you should know that experienced queen producers have heard it all before.

When to requeen?

You need to requeen your colonies ***before*** they need it. In my non-existent idyllic beeyard, I order queens based on the calendar – without even opening the colony. In reality, I and many of you are already standing by the colony looking at a failing queen before we rush to our phone to call for a new queen. With luck, we get our new queens two weeks later. Valuable time has been lost. Alas, better this desperate way of ordering queens than not to requeen at all.

As indicated above, the spring season is the easiest time to requeen. During a good nectar flow, the bees are more amenable to accepting a new queen. Having said that, Autumn requeening is certainly possible and, having said that so is Summer requeening. Winter requeening is obviously not an option. New queens are not available and breaking clusters to find and replace queens would no doubt cause great harm to the clustered colony.

How to requeen?

How to requeen? Let me count the ways. Techniques range from installing a complete nuc to simply rolling the replacement queen in warm water in your hand before dropping her in the colony are in the bee literature. That said, the most common techniques require the colony's reigning queen be removed and a caged queen put in the colony. Everything else is details.

Kill the old queen?

It matters little if you kill the reigning queen and leave her in the colony (humanism again). The bees don't pine in agony and eagerly accept the new queen in awareness that the old queen is dead. Apparently, and strange to us, a colony is nuts about avoiding parasitism and will kill a perfectly good queen – even when no other is available. Killing (or removing) the old queen and leaving the colony queenless for a day or so gives the colony the pheromonal opportunity to "realize" that they are without a queen.

How to manage the caged queen?

Though techniques exist for direct introduction, those techniques were developed during beekeeping times when queens were plentiful and cheap. Not now. Unless you really know what you are doing, and unless you have backup queens available, use the slow release procedure.

After the old queen is removed, the caged queen is put into the colony. The type of queen cage being used will dictate where the cage should go. In any case, the caged queen should be near the colony's brood nest. Just a few years ago, I would have confidently told you to expose the candy plug in order for the bees to slowly eat it, and thereby slowly release the queen. Now, I more cautiously recommend that the queen cage candy plug stay plugged, and you, the beekeeper, actually return to the colony for a second time to evaluate how well the introduction process is proceeding.

Candy plug up or candy plug down? I don't care. That is a detail for beekeepers to argue at meetings. Just be sure that the nurse bees have access to the caged queen in order to feed her. For the past two to three years, I have been directly releasing the queen onto the brood comb, but I'm not prepared to say that you should do that procedure.

What to do with the attendant bees?

If you can, get them out. If you are uncomfortable doing that, leave them in. Caged attendants will undergo the same introduction process as the queen. If the caged queen is to be held outside the colony for several days, be prepared to replace the attendants, with young nurse bees, as the older attendants die.

How to release the caged queen?

Historically, the recommendation was to allow about three days for the caged queen to become familiar

No Matter How Educated, Talented, Rich Or Cool You Believe You Are – How You Treat People Ultimately Tells All

to the colony. I don't mind doubling that time now. Upon returning to the colony on a bright, sunny day when bees are readily flying, using minimal smoke, gently open the colony and observe the cage. No doubt it is covered in bees. Remove the cage and gently brush the bees away. In fact, did they gently brush away? If not, and if they cling to the cage while showing a sting response, do not release the queen[1]. The bees are treating the cage the same way they will treat the queen. If all looks well, release the queen onto a frame of open brood, if available. Use capped brood if open brood is unavailable. If the bees readily show hostility, recage the queen, and try again a few days later.

The actual releasing phase can be dicey. The queen has been in that cage now for weeks and will frequently be reticent about leaving it. When using wooden cages, pry the staple from one end and pull the screen wire back. It is imperative that you carefully watch the queen. She will occasionally abruptly fly away. Gently open the cage on the comb and entice the queen out. Again, watch her. Even if she doesn't fly away, she will nearly always run upwardly. Once you get her turned around and headed into the brood nest, things should be okay. I can't lie. This is a tense moment in the queen introduction process.

Then what?

After releasing the queen and deciding that she is being properly accepted, leave her alone for a week or so. You will want to check the front of the hive each day in case she is rejected. If nothing else in this article stays with you, it should be this: *Queen introduction is not an exact procedure.* Different colonies, different caged queens, different seasons, edited and different beekeepers will all result in different outcomes. Sometimes bad things happen to good queens. Does this story end with the new queen producing a brood nest and becoming the reigning monarch (*there's that human thing again*)? Most of the time – yes – but sometimes the queen will be superseded long after she has established a brood nest. That is just one of the mysteries of the bees. Ultimately, they are the ones who must decide if the queen is right for them.

Just released. Will they keep her – or not?

Requeening – a necessary but iffy task.

As with any other aspect of keeping bees, the beekeeper's ability to assist a colony in requeening itself is an acquired skill. However, you should know that even experienced beekeepers' profit from having a high degree of good luck when undertaking this task. So much of our bee management could be made so much better if we consistently requeened. For a host of good reasons, most of us won't.

Queen management, part 2

The frustration of queen management is in the details and variations. Bee management things have always been this way. Next month, I will take the article presented above and tear it apart – so to speak.

Some possible topics in Part 2 will be:

1. When is the queen truly bad enough to replace?
2. Are you really going to produce queens yourself? How will you do that?
3. Are there instances in queen management when I don't really want a turbocharged queen?
4. So, do you release her quickly or leave her in the cage for days – and days?
5. What do the big, commercial guys do?
6. Do you have any recourse if you pay good money for a bad queen?
7. What should I know about using nucs for introducing queens?
8. So, what about using virgin queens?
9. Whatever else happens to come to mind.

Thank you.

Seriously, thank you for reading. I am always humbled that you took time to read to this point. BC

Dr. James E. Tew, Emeritus Faculty, Entomology, The Ohio State University and One Tew Bee, LLC; ***https://www.honeybeeobscura.com; tewbee2@gmail.com***

https://youtu.be/2Cv1dCdkDw0

[1]Last Spring, upon returning to a package of bees that I had installed, the bees clung to the queen cage and were clearly aggressive. I gave them two more days, but the bees were still unhappy with the caged queen. Upon colony examination, I found a free-ranging queen already in place in the brood nest. The package producer had inadvertently shaken the colony queen in with the package bees.

CALENDAR

♦VIRTUAL♦

Adaptive Bee Breeding April 3, 10:00a - 3p. (MST). Cost is $40.

Speakers include Megan Mahoney, Melanie Kirby, John Jacob, Erik McEwen and more.

To register and for more information please visit h**ttp://bit.ly/nectarnomad**.

♦COLORADO♦

Spring Bee Camps – will be held by Tina Sebestyen near Durango. The beginner's camp will be held June 11-16, geared towards beekeepers with at least one year experience.

May 21-16 – this camp is for beekeepers with at least three years experience.

The cost is $500 ($100 deposit). Camping and outdoor facilities available at the site and hotels available in nearby Durango.

For information please visit **https://beequest.buzz** or contact Tina at **bee.longing@protonmail.com**.

♦INDIANA♦

Michiana Beekeepers Association Annual Meeting will be held May 15 in Nappanee. .

Clarence Collison will speak in the morning followed in the afternoon by a Beekeeping Equipment Auction. Pre-registration is required

For information visit **Michianabees.org**.

♦MINNESOTA♦

MN Honey Producers Summer Meeting will be held July 8-9 in Mankato.

Jim Gawenis, Sweetwater Science Labs, is the keynote speaker.

For information contact **Liz9120@hotmail.com**.

♦WISCONSIN♦

WI Honey Producers Fall Convention will be held November 4-6. at Hotel Mead Wisconsin Rapids.

Sue Cobey is the keynote speaker.

For information contact **Liz9120@hotmail.com**.

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Applications now open for Mann Lake Eastern Apicultural Society (EAS) Youth Scholarship

This scholarship is open to young people ages 18-25 (at time of the conference- July 26-30, 2021)

Veterans ages 18-30.

It pays for most of the one week EAS conference expenses.

Applications are due by April 30.

For info and application: Go to the Eastern Apicultural Society web page, click on "Master Beekeepers", and click on "scholarship".

NOTE; in the event that EAS conference 2021 is cancelled, the successful candidate in 2021 will attend EAS in 2022.

I fished all day Sunday and then, since I was in the neighborhood, dropped off some honey in Aspen. I inadvertently left the rear cargo door of my Subaru open while I made my delivery. On my return, I discovered a young man leaning into the car to pet my gal Marilyn's blue heeler dog Pepper.

"He's not friendly to strangers!" I shouted, and the man quickly backed away. "But he's really cute!" he said.

"Cute but unpredictable," I retorted. "My bad. I never should have left that door open." I picked up a couple more boxes of honey for my delivery, but this time I was careful to close the door.

A short time later, when I reached for my car keys, I found in my left front pocket not my own Subaru keys, but somebody else's Subaru keys. My own keys were in my other pocket. What?! I racked my brain all the way home, wondering how such a thing could happen.

The next morning it hit me: Surely that young man had his keys in his hand when he leaned into my car, and he dropped them when I shouted at him. I must have unconsciously picked them up, thinking they were my own, and put them in my pocket.

I felt like Sherlock Holmes when I put this together, but Marilyn was unimpressed. She cautioned that I should be more mindful.

All-wheel-drive Subarus are very popular here in ski country, but they carry some political baggage. I have a friend who bought a secondhand Honda Civic, when he could have gotten a much better deal on a Subaru Forester. When asked why he opted for the Honda, he said, "I don't want anybody to think I'm a liberal." I think this is just plain silly.

I recently had a row with another dear friend and fellow beekeeper over religion and politics. Imagine that! It started feeling personal. Finally, at my insistence, we agreed to never discuss such weighty matters again, but instead to retreat to the common ground we share in our passion for our favorite insect. Cultivating what we have in common with our neighbors is more fruitful than arguing over our differences, don't you think?

If in the time of Covid you miss those stimulating bee lectures at regional and national bee meetings, you might check out former *Bee Culture* editor Kim Flottum's free beekeeping podcasts at **Beekeepingtodaypodcast.com**. Just click on talks by honey bee rock stars like Marla Spivak, Dewey Caron and Jay Evans, kick back, and learn a lot.

I believe in freedom of speech and all, but there's no shortage of bee BS out there, especially on the internet. That's why it's good for all of us – but especially for beginning beekeepers – to have a reliable honey bee reference like Kim's Beekeepingtodaypodcast.com.

Some years ago, my dear sweet niece told me her friend was writing a book about beekeeping. Could her friend ask me a few questions? I said of course. I did answer some questions, and then I promptly forgot all about it. One day out of the blue Kim called. A copy of this book came across his desk. He didn't speak too highly of it, and he wondered if I knew that I was quoted in the book. "Did I really want to be associated with this?" was the question he posed. I told him accuracy's important, but this was a favor to my one and only niece. Sometimes family has to come first.

You want to be careful when you're filling honey containers and not get tempted to multi-task. When the phone rang the other day, I picked it up in the kitchen. I was still talking a few minutes later, when Marilyn walked into the sunroom and screamed. Honey flowed freely from an open valve on my 15-gallon tank. I figure I only lost a gallon. I spend my whole life on my knees, scraping honey off the floor, and mopping.

Marilyn took this opportunity to confess that she'd been the victim of a much larger honey disaster, one that she'd previously never told me about.

Over at Paul's honey house, an employee once tried to move four 55-gallon drums of honey a short distance on a flatbed truck, but without tying them down. He hit a bump in the road, the barrels tipped over, fell off the truck, and the lids popped off. I'm not sure how you clean up a ton of honey oozing over a dirt road.

The dermatologist wants to cut out a little bit of my elbow – just enough to make me not want to lift a brood super for awhile. I find this very inconvenient! I also have a hitch in my git-along that comes and goes. And a few old-man complaints. Otherwise I'm in perfect health.

Maybe you're young, and you wonder what it's like to get old. I'll tell you. It's not necessarily that you totally fall apart, at least right away. You might still feel like a million bucks – some of the time – except when your damned knee won't work, or you can't pee in the middle of the night. Creaky, worn-out body parts are one reason we seniors can get so cranky.

Tomorrow's our Valentine's Day. Marilyn and I have reservations at the Hotel Colorado in Glenwood Springs. Room service, please! But first, a day of skiing in Aspen -- at Buttermilk -- where the slopes are gentle and the grooming immaculate.

Marilyn's the better skier. She'll surely try to coax this old ski patroller into some fresh crud, but I'm not biting. I have the perfect excuse. I've got a hitch in my git-along.

Ed **Colby**

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