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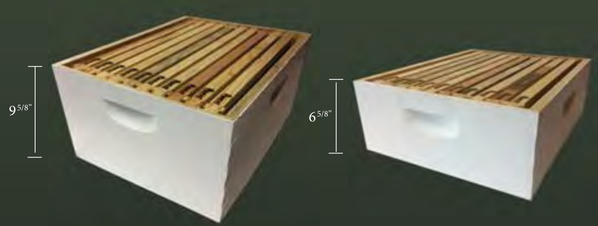

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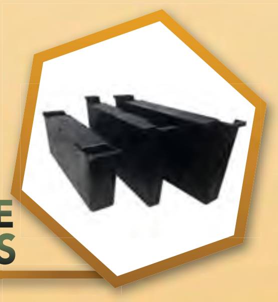

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March Features . . .

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POSTMASTER: Send address changes to
BEE CULTURE, The A.I. Root Co., 623 W. Liberty St., Medina, OH 44256

Subscription Information
U.S., one year, $25; two years, $48. Newsstand price: $4.99. All other countries, (U.S. Currency only), $20.00 per year additional for postage. Digital Edition $15. Send remittance by money order, bank draft, express money order, or check or credit card. Bee Culture (ISSN 1071-3190), March 2021, Volume 149, Issue 3, is published monthly by The A.I. Root Co., 623 W. Liberty Street, Medina, OH 44256. Periodicals Postage Paid at Medina, OH and additional mailing offices.

Subscriptions, Book Orders – www.BeeCulture.com • subscriptions@BeeCulture.com

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Late Winter Ohio beeyard captured by Barbara Bloetscher.


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Bee Culture's Best . . .

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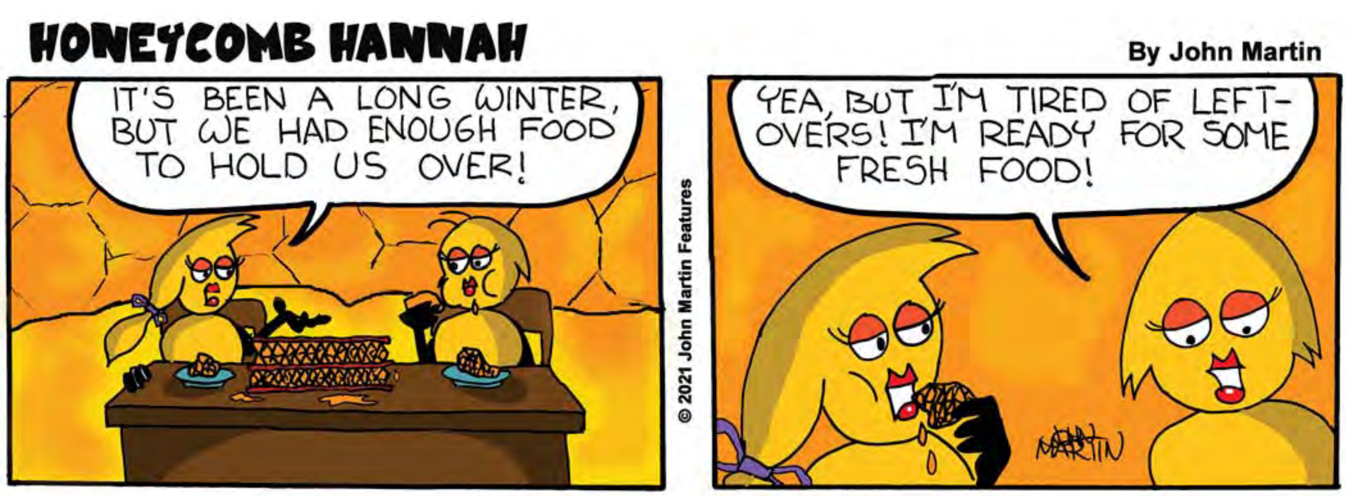
In Every Month –



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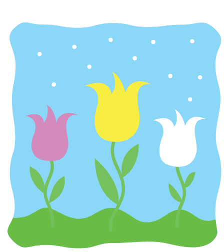
Queen Excluder Cleaning

I have always cleaned my queen excluders with my hive tool and never understood why anyone would buy a special tool for the task. So, I read the recent article on using a heat gun to clean the excluders with a bit of interest. I had always falsely assumed that the uneven heating of the metal with a heat gun would result in warping which might allow the queen free access. The article erased that concern, and I was attracted to the idea of stacking the excluders to take advantage of secondary heat. Since I always wait until it is cool to do this job, I had a stack of excluders to try this recommendation on. I must say that it was a time consuming learning experience, a lesson that will not need repeating. I will never again apply heat to wax on an excluder and will continue with my hive tool as my mentor recommended. If you store your excluders in a cool place, 50° or cooler, the wax and propolis will be quite brittle. It jumps from the metal at the slightest touch of the hive tool and can be swept up with a dust pan and brush for rendering later. The hive tool is my friend.

Greg Carey



From Garage to State-of-the art facility – Mountain Sweet Honey Company

In 2011, Ray Civitts was deep into regional commercial banking as a Vice President of Commercial Lending for a large bank in GA. Ray's family enjoyed honey and cooking with honey. On a whim, he took an eight-week beekeeping class taught by Master Beekeeper Bill Owens. By the end of the class, he was ready to start his adventure in beekeeping with four hives.

Ray lived in a subdivision with one acre of land. He set up his hive stand and within a week had orders for honey from several of his neighbors. Then a few people at his church heard about him having honey bees and they wanted honey. Before he knew it, he had out sold the estimated honey production and it was still early Spring. Ray purchased six more hives thinking this would be sufficient for future honey orders. He eventually expanded to 100 hives.

During the Winter of 2011, Ray launched a website. One week later, he began to get phone calls from the metro Atlanta area beekeepers and beekeepers in SC. These customers wanted to purchase nucs and package bees. So he had to figure out how many hives he would need to start in the Spring in order to supply the bees for the outstanding orders. The figuring resulted in him adding over 100 additional hives to meet the demand. That year he sold 50 nucs and 100 packages of bees.

Mountain Sweet Honey was now up and running and using the garage as a warehouse. Ray looked forward to receiving the UPS order about once a month. People would drive up our driveway and wonder if they were in the right place. Ray would tell them "yes, you are at the right place". Customers saw a beautiful website and thought we were a large company selling honey bees. In the Summer of 2012, I made a decision to start making nucs and scheduled 250 for the Spring of 2013. That Winter he made the hive bodies for all the new hives. By December 2013, the phones were ringing as word traveled around about Ray's honey bees.

Ray continued in his role with the bank. Banker by day, beekeeper by night. In 2014, a commercial building came available and Ray purchased the 5,000 sq. ft. building not knowing how he could utilize this extra space. It soon became evident that Mountain Sweet Honey was just starting their business growth. Before Ray knew it, the business grew and by 2015 the building was completely being utilized which included a honey processing room.

By 2017, Ray saw the need to expand the current product line from honey bees. This would involve adding beekeeping supplies. It was logical that beekeeping supplies be added. We failed miserably the first year. Mr. Civitts then decided to make some marketing changes so that the beekeeping community knew about our beekeeping supplies. The second year was much better with beekeeping supplies sales. During this same time, Mountain Sweet Honey experienced extremely high sales in honey bees. Mountain Sweet Honey expanded their staff by adding two additional staff members to our new call center. The call center is designed to assist beekeepers with questions they have from basic questions to more advanced questions.

In 2019, Mountain Sweet Honey added a 5,000 sq. ft. warehouse to properly stock all beekeeping supplies. Before the warehouse was even completed, Mountain Sweet Honey saw a spike in new customers which exceeded the warehouse under construction. Honey bee sales also continued to spike to new highs. Mountain Sweet Honey added three new staff positions to assure superior customer service.

2020, the COVID year, was a real challenge for us as we saw unprecedented order cancellations because beekeepers could not travel across state lines to pick up their bees. Then, in April 2020, people started to work from home and they had extra time. Ray saw unprecedented sales that easily surpassed the March cancellations. Ray stated, "It was tough on all of us. At times, we did not know if the State of Georgia would go under a total lock down. Georgia deemed us as an "Essential Business" as honey bees pollinate the crops. Ray, went on to say, "every day was a challenge to our domestic suppliers and international suppliers. Mountain Sweet Honey only ran out of a few items during the season."

2020 also required Ray to make more decisions on how to stock more supplies as the business had run out of space once again. Ray knew that he needed room for up to 30 semi-trucks of products. After several months Ray took a step forward in opening a state-of-the-art warehouse that used technology, innovation, and a lot of planning to maximize space.

Today, Mountain Sweet Honey serves over 20,000 beekeepers each year. They ship beekeeping supplies coast-to-coast!

Ray dedicates his success to his staff in offering exceptional customer service, his world class suppliers in offering high quality products, and his wife Cinnamon who understands the stresses of managing a thriving business. Last but not least, the customers who have repeatedly purchased honey bees and beekeeping supplies through the last nine years. Without our loyal customer base, we would not be where we are today, so thank you!

Ray invites you to give his company a try and see customer service in action.

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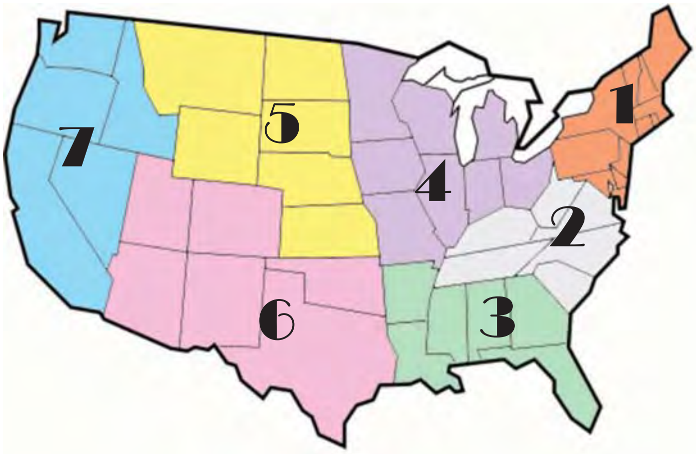
Beginning class – Ray showing a frame.

MARCH – REGIONAL HONEY PRICE REPORT



REPORTING REGIONS	1	2	3	4	5	6	7	SUMMARY Range	Avg.	$/lb	History Last Month	Last Year
EXTRACTED HONEY PRICES SOLD BULK TO PACKERS OR PROCESSORS												
55 Gal. Drum, Light	1.96	2.17	2.15	1.96	1.75	1.90	2.00	1.70-2.17	1.98	1.98	2.21	2.24
55 Gal. Drum, Ambr	1.67	2.14	2.00	1.67	1.67	1.44	1.85	1.00-2.14	1.77	1.77	2.12	2.09
60# Light (retail)	176.86	188.00	190.00	165.00	175.00	168.50	202.50	138.00-205.00	182.22	3.04	207.21	211.90
60# Amber (retail)	188.28	186.00	190.00	188.28	188.28	170.33	212.47	132.00-240.00	190.55	3.18	209.81	209.94
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS												
1/2# 24/case	101.20	74.50	99.75	88.00	75.50	89.75	88.50	72.00-140.55	106.15	9.42	92.31	96.89
1# 24/case	116.34	109.40	100.00	130.00	152.50	106.95	120.00	45.00-185.00	117.68	4.90	140.38	139.60
2# 12/case	111.57	98.00	94.00	123.00	111.57	114.00	132.00	94.00-132.00	110.14	4.59	125.67	125.19
12.oz. Plas. 24/cs	74.08	109.75	80.00	101.00	120.00	53.40	69.67	54.00-120.00	83.66	4.65	103.44	100.86
5# 6/case	109.15	110.50	129.00	110.85	112.51	140.25	174.21	99.00-240.00	105.45	4.55	147.90	131.36
Quarts 12/case	158.01	143.88	125.00	95.00	187.50	157.20	183.00	95.00-231.00	153.01	4.25	162.94	146.56
Pints 12/case	93.28	80.70	65.00	93.28	105.00	108.00	96.00	60.00-138.00	87.55	4.86	99.86	103.72
RETAIL SHELF PRICES												
1/2#	5.50	5.30	4.25	5.00	7.85	5.47	5.60	3.00-8.00	5.44	10.88	5.51	5.27
12 oz. Plastic	6.77	6.87	6.19	6.00	5.50	5.44	6.93	4.50-10.00	6.29	8.38	6.62	6.17
1# Glass/Plastic	8.67	8.40	9.17	8.00	10.00	7.72	8.50	5.89-12.00	8.39	8.39	8.48	8.08
2# Glass/Plastic	14.36	14.50	17.33	14.00	14.36	12.63	14.80	6.89-21.50	14.53	7.27	14.59	13.36
Pint	10.42	9.83	9.00	11.00	12.25	9.60	12.30	6.00-15.00	10.34	6.89	11.29	10.03
Quart	18.19	17.75	16.75	18.00	21.00	15.98	18.58	12.00-25.00	17.88	5.96	18.56	16.72
5# Glass/Plastic	31.97	27.00	42.50	29.00	31.97	27.63	31.97	17.89-50.00	29.99	6.00	31.85	29.27
1# Cream	10.73	8.75	14.00	10.00	10.73	10.73	12.00	8.00-14.00	10.46	10.46	10.92	9.90
1# Cut Comb	14.00	10.25	13.98	20.00	10.00	15.50	17.00	8.00-25.00	13.49	13.49	13.99	11.72
Ross Round	12.25	6.99	12.25	19.00	10.00	12.25	12.50	6.99-19.00	11.50	15.33	11.73	11.33
Wholesale Wax (Lt)	8.07	5.29	7.00	8.07	6.00	4.00	8.33	4.00-15.00	6.65	-	6.91	7.11
Wholesale Wax (Dk)	8.21	5.00	6.00	8.21	6.00	2.75	18.00	2.00-18.00	6.43	-	5.06	6.21
Pollination Fee/Col.	92.05	60.00	52.50	65.00	200.00	92.05	50.00	30.00-200.00	69.09	-	93.57	95.43

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.

NEXT MONTH

Region 1
- Is there enough stored Honey?
- Feed Pollen Sub. And Sugar Syrup
- On a Warm Day check to see if Queen is laying
- Clean out Dead outs
- Sample for *Varroa* using alcohol wash
- Treat for *Varroa* if count is over three mites per 100 bees
- Reverse Brood boxes
- Clean out Bottom Boards

Region 2
- Sample with alcohol wash and Treat for *Varroa* if Counts are above three per 100 bees
- Treat before honey flow
- Feed, Feed, Feed
- Rebuild hives after Bear went through them
- Find the Bear & make a rug
- Early spring splits
- Is there plenty of brood?
- Watch for swarming

Region 3
- Sample and treat, treat and sample (alcohol wash)
- Feed sugar syrup
- Make splits
- Move frames in brood chamber to create more space for the Queen
- Monitor for Swarming signs
- Check for Hive strength and brood production
- Make splits
- Add supers

Region 4
- Total Hive inspection/evaluation
- Move capped brood from strong colonies to weak colonies
- Split strong hives
- Check for *Varroa*, treat as recommended based of %
- Feed Carbs and Protein
- Add boxes or checkerboard to delay swarming
- Unwrap colonies
- Watch for Swarm cells

Region 5
- Hive inspection to see amount of brood
- Feed sugar syrup
- Put on pollen sub.
- Find dead hives, order packages
- Clean bottom boards
- Consider making splits
- Reverse Hive bodies
- If weather permits unwrap colonies

Region 6
- Feed Sugar Syrup
- Sample for mites with alcohol
- Treat for mites if sampling indicates
- Split and requeen
- Combine weak colonies
- Replace winter patties if needed
- Inspect on warm day

Region 7
- Feed and split, split and feed
- Equalize colonies
- Reverse hive bodies
- Check for swarm cells
- *Varroa* mite alcohol wash
- Feed syrup
- Restock Deadouts
- Get excited

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Three Bees I Have Known

Gene **Robinson**

Do you remember Barry B. Benson, played by Jerry Seinfeld in the 2007 film *Bee Movie*? Benson was a honey bee who did not want to do what was expected of him. True, Benson was male rather than female, wore sneakers, and fell in love with a human, but you may be surprised to know that the premise of a maverick bee is not at all far-fetched. Serendipitous observations of three real-life adult worker honey bees my colleagues and I have made over the years suggest that your beehives might just contain a few iconoclasts. Let me tell you about three bees I have known.

Yellow 57 (Y57) was named for the colored numbered tag I affixed to her thorax when she emerged as a one-day-old adult. She was part of a cohort of 150 bees, all sisters, that I studied in an experiment performed in 1982 for my doctoral dissertation at the Dyce Laboratory for Honey Bee Studies, under the direction of the late Roger A. Morse at Cornell University. The main purpose of the experiment was to study hormonal regulation of age-related division of labor. The experiment required that I make careful observations at the entrance of each hive daily for one hour to observe the comings and goings of my tagged bees and determine the age at which they shifted from working in the hive to foraging outside.

Y57's foraging activity was unique; her flights were more frequent and shorter than the flights undertaken by the other individuals in her cohort (Robinson et al. 1984). Y57 took an average of about seven flights per hour compared with one or two, and hers lasted on average only about three minutes compared with about 20 minutes. Moreover, her flights were remarkably constant in duration whereas the flights of the other individuals varied greatly from just a few minutes to almost an hour. My curiosity was piqued.

I discussed Y57's unique behavior with my fellow graduate students Ben Underwood and Carol Henderson, and we reasoned that she must be foraging for something quite close to her hive to have such short flights. The consistency of the flights also suggested to us that Y57 might be foraging for water; once located, a water source should provide a more constant reward than any given patch of flowers. Ben decided to visit a spot in Salmon Creek, which was approximately 0.5 km from the apiary in which Y57's colony was located in Ithaca, New York, where he previously observed honey bees foraging for water. Ben went to the spot, looked down, and believe it or not saw Y57 collecting water. Given that the foraging range of a honey bee colony can be over 100 kilometers[2] (Visscher and Seeley 1982), spotting Y57 was the bee biologist's equivalent of winning the lottery!

We immediately set up a real-time monitoring system--pre-cell phones – aided by walkie-talkies. I continued observations at the hive entrance while Ben set up a chaise lounge in the shallow creek, next to the rock that Y57 was spotted on. I announced Y57's hive departure to Ben, and, sure enough, about one minute later she appeared at the appointed location. Y57 took about a minute to load up with water and then flew off. Alerted by Ben, I was on the lookout for her return to the hive about one minute later, and she never disappointed. The details of these fully mapped trips matched precisely with the observations made during the previous 14 consecutive days, which started on the first day Y57 was seen foraging at 17 days of age and ended when she disappeared and presumably died when she was 31 days old. We concluded that Y57 devoted her entire foraging career to collecting water, apparently from only one single choice location.

To put this behavior into context, bees do specialize by task as a consequence of age-related division of labor; for example, a nurse bee will tend to the brood for a week or more before moving onto other tasks and a forager spends its days collecting nectar and pollen for a similar period of time. But no one had ever observed a bee with the single-mindedness of Y57. A nurse bees cares for many larvae and performs other tasks during this phase of its life and a forager typically collects nectar and pollen from many different patches of flowers. Even scout bees, a subset of foragers that specialize on searching for new food sources or nest sites, visit many different locations. Is Y57 an aberration? My subsequent encounters with two other highly specialized bees suggest that this is not the case.

We discovered Red 93 (R93), an extreme groomer, also during a study on an unrelated topic, the relationship between circadian rhythms of activity and division of labor. The study was conducted in 1994 and by that time, I was a faculty member in the Department of Entomology and the Director of the Bee Research Facility here at the University of Illinois at Urbana-Champaign. The study was led by Darrell Moore from East Tennessee State University, who spent several summers with us as a visiting professor. The study again involved extensive observations of a cohort of individually tagged bees, but while they were inside a glass-walled observation hive rather than at the hive entrance.

Social grooming is widespread in honey bee colonies; it has long been known to have hygienic functions and features prominently in the exciting project initiated by Greg Hunt at Purdue University to breed bees that can resist the ravages of *Varroa* by removing the mites from the bodies of their hivemates (Hunt et al. 2016). A lot of grooming goes on in a hive, but the longstanding assumption was that all bees spend just a little bit of their time doing it (Moore et al. 1995).

Not R93 – she groomed other bees a whopping 84% of the time, 69 out of the 82 times she was observed over a 15-day period. As in previous studies, most other individuals, R93's sisters, groomed other bees infrequently or not at all. And rather than waiting for another bee to perform a "cleaning dance" (von Frisch 1967) to solicit grooming behavior as most bees generally do, R93 simply approached hivemates unbidden and started to groom

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Automated behavioral monitoring of honey bees. Left Panel: Bee with two radiofrequency identification (RFID) tags. RFID readers placed at the hive entrance allow for automated monitoring of flight behavior (Tenczar and Lutz et al. 2014). Image from P. Tenczar. Right Panel: Bees with barcodes. Machine vision and machine learning allow for automated monitoring of in-hive behavior (Gernat et al. 2018). Image from B.M Jones and T. Comi.

them. R93 persisted in her extreme grooming and she never grew up. That is, she never started to forage but rather remained in the hive her entire life, grooming.

The third and final bee I want to tell you about is Yellow 54 (Y54), an extreme undertaker (corpse-removing) specialist. The study that led to Y54's discovery, led by Stephen Trumbo in 1997 as a postdoctoral research associate in my lab and now a professor at the University of Connecticut, was interested in the relationship between task specialization and learning (Trumbo and Robinson 1997). Learning has been clearly demonstrated for foraging (Dukas and Visscher 1994), but not for in-hive tasks.

We thought corpse removal might involve learning because – unlike other in-hive tasks performed by middle-age bees (about 10-20 days of age) such as food storage and comb building – it is a niche job performed only by a small subset of a colony's adult population, and requires impressive strength and agility. An undertaker grabs a corpse, which of course weighs about as much as she herself does, drags it along the bottom board to the hive entrance, and then flies out of the hive carrying her payload before dropping it a few meters away. Like grooming, corpse removal is important for colony hygiene; some individuals do this job over many days but most bees never remove a corpse in their entire lives (Visscher 1988).

Y54 removed 114 corpses over a 13-day period, which accounted for 33.8% of all the dead bees that we experimentally introduced into the hive for this study. By contrast, her sisters removed one to eight corpses during their life. Y54 is the most active undertaker recorded to date in any study.

Y54 also removed corpses significantly faster than the other bees. But she did not improve her performance over time, which means that learning was not involved. Was Y54 just more innately talented at this job than her hivemates, or was there something about her previous experience that set her up for a record-breaking career? We wonder in the same way about the nature-nurture origins of exceptional performance in humans.

As we noted in Robinson et al. (1984), there were a few earlier published accounts of unusually persistent behavior by individual bees from the laboratories of Martin Lindauer, Shoichi Sakagami, and Mark Winston, but nothing as extreme as Yellow 57, Red 93, or Yellow 54. What do we make of them? Why are there so few records of highly specialized bees? Is it because they are genuinely rare, or is it because studies have not been designed to detect them? If they really are so rare they may be little more than curiosities, their "obsessive-compulsive" behavior the product of neurodevelopmental dysfunction that occurs too infrequently to capitalize upon for brain research. But if extreme specialists are actually more common in the beehive, it is important to study how they contribute to colony life, and, yes, such studies might be very useful for neurobiological and genomic analyses of the brain.

It should be possible for bee biologists to answer these questions in the near future because research on bee behavior, like animal behavior in general, is at the dawn of an exciting new era marked by widespread use of automated behavioral monitoring systems. Leaving behind painstaking and hit-or-miss observations of individual bees wearing numbered plastic tags, my lab and other groups are leveraging recent advances in engineering, computing, artificial intelligence, and machine vision to develop new methods of automated behavioral monitoring for honey bees.

Here's a taste of what's to come. First, Paul Tenczar, a citizen scientist in my lab trained as an engineer, developed a radiofrequency identification (RFID)-based system to monitor bee flight activity (above, left panel). He and graduate student Claudia Lutz then used this system to discover that approximately 20% of the foraging workforce accounted for 50% of their colony's total foraging effort (Tenczar and Lutz et al. 2014). Second, computer science graduate student Tim Gernat in my lab (Gernat et al. 2018) developed a barcode-based system to monitor in-hive behavior (above, right panel). The laboratory of physicist and Illinois colleague Nigel Goldenfeld then analyzed data generated with this method for trophallaxis, a behavior that involves an exchange of food and signaling molecules among colony members, and discovered a thought-provoking pattern. Bees have longer trophallaxis exchanges with some hivemates than

with others, and the pattern of these individual differences resembled the pattern for human "face to face" social encounters (Choi et al. 2020). We don't know enough about the function of trophallaxis yet to understand the significance of this similarity, but this result hints at trophallaxis being used as a means for communication among bees.

Automated behavioral monitoring systems provide bee biologists with powerful new tools. If there are iconoclasts like Yellow 57, Red 93, and Yellow 54 yet to be known, these new methods will surely allow for their discovery, enriching our knowledge of bee behavior. BC

Acknowledgments

The research discussed here was supported by grants that I received from the National Science Foundation, National Institutes of Health, and the Christopher Foundation. I also thank M.R. Berenbaum, T. Gernat, C.M. Grozinger, and D.J. Robinson for comments that improved this manuscript, and C.M. Grozinger, whose interest in our work on this topic prompted me to write it.

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I-CORP FOR BEEKEEPERS, REPORT #1

National Science Foundation (NSF)

David **Hawthorne,** Jay **Evans,**
Raymond **Peterson,** Jerry **Hayes**

Vision 2025

Maria has no worries about her colony. It is vibrant. She knows what to look for. She knows what to smell for. And, she has been attentive all year.

But out of habit, she scoops 10 bees into a vial the size of a pillbox. She slips the vial into her flannel jacket, tops the hive, and heads back to the house. On the way, she calls for Roxie, who is off chasing squirrels. In the house, Maria retrieves the vial from her jacket, shakes it vigorously, and sticks it in an old toaster oven.

After a few minutes, the oven dings. Maria takes out the vial and pours the liquid into a test tube. She seals the test tube, shakes it, and puts it in the oven. She sets the timer for three hours. Upstairs, she grabs her mobile, and her car drives her to pick up Alexis from dance.

That evening, at the community center, Carl sets her container alongside of ten others and drips some of each into a flow cell the size of a Snickers bar. He slots the flow cell into a slightly larger device. He starts a software program on his laptop, and turns his attention to the president, who is telling the club a story about how his blood type turned out to be bee positive.

The next day, after church, Maria logs in to view her colony's personalized health dashboard. Much to her shock, given how vigorous her colony looks and the treatment she fed it during the summer, her bees are bursting with Deformed wing virus and are showing invisible signs of stress. Fortunately, the colony is negative for twenty other potential infections. She goes to her workbench, mixes an antiviral drug into sugar water, and drips this into her feeder.

In early Spring, she cracks her hive. Maria is relieved to find it healthy and full of brood. She collects a few young bees. This time, the health report shows a small amount of Nosema. She again mixes a sugar water cocktail, this time with a Nosema treatment, and drips it into the feeder. Come July, and again in September, she harvests a bumper crop of great tasting honey.

Status 2021

We are here to tell you that almost all of this could be done for you today. A technician could initiate a test of your colony for invisible indicators of honey bee stress, and all possible honey bee infections, not just the couple of usual suspects, from a mobile molecular genetics van, using the described Snicker's sized equipment. When the instrument is finished, on the next day, a software system could generate for you a comprehensive colony health report, including action recommendations.

What cannot be done today is for you to perform the testing yourself, in your house, unless you happen to be a molecular genetic lab technician and have a studio lab. The health action plan would not always prescribe a medicine, as there are not medicines for most honey bee infections. Most importantly, the health report cannot YET be generated at a price that makes sense to you.

Purpose of Article Series

The motivation for this article series is to better connect the development of honey bee diagnostics and medicines with the real world needs of beekeepers of all sorts. By way of stakeholder input, the goal is to achieve a product-market fit that benefits the beekeeper, consumers, and society. Towards this end, in April of 2020 our team began an 18-month customer discovery project sponsored by the National Science Foundation. The kickoff for this program was an intense, six-week bootcamp during which we interviewed over 100 people, from honey bee industry leaders to experts in technology, research and development, and commercialization, to hear from them what the market needs, and how we could meet those needs.

National Science Foundation I-Corps Program

The goal of the NSF Innovation Corps (I-Corps™) program is to reduce the time and risk associated with translating promising ideas and technologies from the laboratory to the marketplace. The NSF recognizes that a lack of product-market fit is the overwhelming reason that most new companies or products fail. The I-Corp methodology is to use scientific principles and customer discovery to identify a market opportunity. The team defines hypotheses, tests these hypotheses with customer interviews, and uses the results to reject or refine the hypotheses.

In this way, the team builds a business model canvas that states who the customer is, what value the customer derives from the product, how the customer learns of the product, how the customer buys the product, the way the customer pays for the product, the cost structure of the product, and the key resources, activities, and partners that are needed to get the product to market.

The principal investigator of the present I-Corp Bee Team is David Hawthorne, PhD, Associate Professor of Entomology at the University of Maryland College Park. The technical lead is Jay Evans, PhD, Research Scientist at the USDA-ARS Bee Research Lab in Beltsville, MD. The entrepreneurial lead is Raymond J. Peterson, PhD, of Granite Point Ventures. The industry mentor is Jerry Hayes, editor of Bee Culture Magazine.

We are immensely grateful for the beekeepers, scientists, and businesspeople who openly shared their thoughts, ideas, and financial constraints. We spoke with 75 beekeepers, five vendors, 10 bee inspectors, four veterinarians, and six diagnostics experts to start to get a picture for what is needed and how our research and business efforts might be shaped to meet those needs. In future articles we will discuss more of what we found, in hopes these insights are of interest to the community. For now, we simply offer our thanks for the many people who added us to their Zoom regimes in this challenging year. BC


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FOUND IN TRANSLATION

Dukes Of Hazard Counting

Jay **Evans**, USDA Beltsville Bee Lab

And Duchesses. Professor May Berenbaum captured a new trend for determining the environmental stresses facing honey bee colonies in her 2016 essay 'Does the Honey Bee "Risk Cup" Runneth Over?' in the *Journal of Agricultural and Food Chemistry*. (2016), 64, 1, 13–20; **https://doi.org/10.1021/acs.jafc.5b01067**). Professor Berenbaum, a preeminent entomologist at the University of Illinois, does not claim to answer her own question but instead highlights recent research and thought into how beekeepers and regulators might assess the soup of synthetic chemicals honey bees and other pollinators face. I am not a regulator but I respect those who are, and I was proud to see that the U.S. Environmental Protection Agency has embraced this ethic. In fact, Prof. Berenbaum cites their 2014 Guidance on multi-risk assessment (**https://www.epa.gov/sites/production/files/2014-06/documents/pollinator_risk_assessment_guidance_06_19_14.pdf**) as one way that people are grappling with the complexities of risk as part of a 'risk-cup' approach to bee health (**https://www.epa.gov/pollinator-protection/pollinator-risk-assessment-guidance**). One highlight of Berenbaum's excellent review is a clear explanation for how honey bees, with their advanced societies, differ from other intended or collateral targets of environmental pesticides. A key difference is that with "their ability to find and evaluate multiple types of raw materials, to process raw materials into food that they can allocate to others and store for future use, and to carry out all kinds of activities in human-altered landscapes, honey bees are more like humans than they are like other insects (target or nontarget)". She argues that this fact, along with their importance to plants and humans, justifies a more challenging approach to risks.

Those of us in disease research have long felt that understanding the combined impacts of multiple disease agents can help explain colony losses (and those studying nutrition will say the same about dearths, empty calories, and diverse pollens). In fact, scientists often make nice and actually agree that the many challenges bees face are interconnected. Nathalie Steinhauer and her Bee Informed Partnership colleagues provide a timely review of these interconnections in "Drivers of Colony Loss", *Current Opinion in Insect Science*, 2018, 26:142–148; **https://doi.org/10.1016/j.cois.2018.02.004**). Dr. Steinhauer laments the "difficulty to extrapolate colony level effects from individual effects, and the co-occurrence of (a) web of stressors that can act indirectly, in association, or synergistically." Therein lies a big challenge for knowing when the risk cup is full for your beehive.

ARS Pesticide Spraying. (Heping Zhu photo)

The science behind pesticide risk analysis faces two hurdles. The first is to assess the presence in the field of chemicals or other things that are harmful to bees (this is the 'hazard'). As above, hazards range from pesticides to viruses and bears. Next is to add actual exposure of bees to those threats, from application to persistence, and ultimately to contact or feeding by bees (this is the 'risk'). The latter determines how particular practices impact bees and colonies. Thanks to improved detection methods, it is now possible to directly measure exposure to over 100 environmental chemicals by sampling bees or hive products directly. Kirsten Traynor and colleagues do so in the aptly titled "In-hive pesticide exposome: assessing risks to migratory honey bees from in-hive pesticide contamination in the Eastern United States.", an open-access paper in *Scientific Reports* (2016, 6:33207; **https://www.nature.com/articles/srep33207**. After screening for 171 chemicals in samples of collected bee bread and wax, the authors were able to predict risks to bees and colonies. Ultimately, they showed that these risks reflected reality, with colonies exposed to a higher diversity of chemicals tending to die during the study while those exposed to particular pesticide hazards succumbed to queen loss or other setbacks.

It is also possible to infer exposure levels from public databases that reflect the use of agrochemicals. Margaret Douglas and colleagues did so in "County-level analysis reveals a rapidly shifting landscape of insecticide hazard to honey bees (*Apis mellifera*) on US farmland" (also open access in *Scientific Reports,* (2020) 10:797 | **https://doi.org/10.1038/s41598-019-57225-w**). The authors explored public records including an extensive set of pesticide use records compiled as part of the US Geological Service Pesticide National Synthesis Project **https://water.usgs.gov/nawqa/pnsp/usage/maps/county-level/**). While these top-down analyses are really limited to predicting the hazards, not risk, in the environment, the authors argue that such methods "can be used to test relationships between insecticide use and pollinator populations and to prioritize areas for in-depth risk assessments. Furthermore, these results can inform the collection of data on insecticide use and recommendations to reduce exposure of pollinators to insecticides." As I highlighted at its launch last year, the 'Beescape' project (**www.beescape.org**), led by researchers at Pennsylvania State University, is one way for beekeepers to assess hazards in their own beeyards.

ARS Beekeepers. (Scott Bauer photo)

ARS Pesticide Analysis. (Peggy Greb)

Whether disease, food, chemicals, or a cup containing all three, assessing the risks that cause high honey bee colony losses is an imprecise science. This was not meant to be a disheartening essay (like we need that these days), and bees will still fly and do their miraculous work this Spring. Nevertheless, we need to be aware of the hazards that are out there and limit their entry into bee cups. As many beekeepers and scientists have stated, there are hazards that virtually all colonies face (mite pressure, timely food, impermanent queens) and starting with those is still the best way to know your bees and empty the risk cup a bit. Happy beekeeping! BC

All The Buzzz in...

Hello Friends,

Thinking of you.
Happy Holidays!

Bee B.
Queen

Luca Watson

Looking for the queen is something that fascinates this 5 year old from Pennsylvania. It is always thrilling to catch a glimpse of the queen. He enjoys helping around the family farm but one of his favorite chores is helping to harvest and eat the honey!

Bee Buddies!

I am a Bee
I'm a bee, an actual bee.
A lonely, hurting, native bee.
Humans come to chop up my habitat.
Please
Save
Me.

Wildfires are burning,
My race is scared.
If humans keep this up
We'll be very rare.

We are bees, actual bees.
Sick from pesticide dust.
Without us there'd be
no fruit and no seeds, so
Please
Save
Us.

by Maximus Keilty, 9, TX

Maximus Keilty

This 9 year old from Texas is very active at home and school.

Max is a beekeeper. “Over the summer I researched stuff about bees for my dad. I also help my dad make sugar syrup. We have solitary bees too but honey bees are my favorite.”

Max is interested in many things. “I like migrating birds. Whales and bats have sonar. I like how dragonflies and beetles fly. I’m really interested in chemistry and astronomy. I’m also interested in trains, the Titanic, and being a soccer goalie.”

Not only is a Max a poet but he is also a philosopher. “When you go for something, keep going for it. Don’t stop for anything. Keep your eyes on the prize and just keep going for it. One time I failed. Guess what I did? You think I gave up? No. Even though I was in third grade, I was still talking about the future. I was still talking about what I could do in fourth grade to run for vice president of student council. Now I have a list of supporters!”

Max is an organizer. He organized a school project where students designed artwork for top bar hives. An artist friend copied the designs onto the hives. Not only are they beautiful but they are still in use and very productive today.

... Bee Kid's Corner

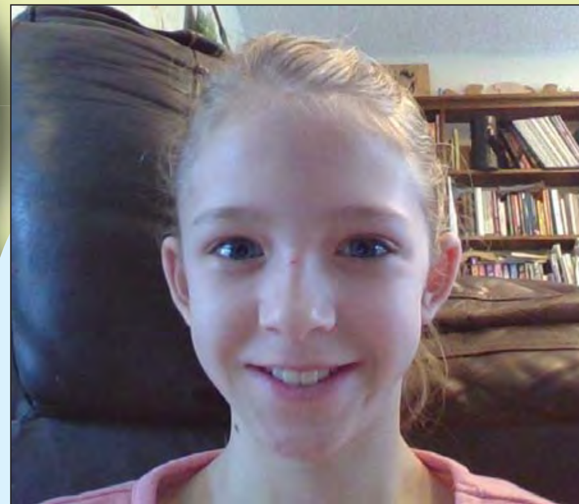
Produced by Kim Lehman -www.kim.lehman.com
www.beeculture.com - December 2020

Jaya McKeown

Jaye, age 10, comes to us from Washington. He loves the process bees go through to make delicious sweet honey. Nectar collecting is interesting but the dance communication bees use to tell other bees where the flowers are is particularly fascinating to Jaya. "I also think it's cool that different people use different types of hives and the bees use them all."

Jaya has many beekeeping experiences including removing a swarm of bees."One time me and my dad made a bee vacuum and used it to get a hive out of a pillar on an old schoolhouse near us.

Not only is Jaya a beekeeper but he also loves nature and the outdoors. You may find him playing baseball, fishing, hunting, farming, traveling, mountain biking, and hiking.



Tirzah Theis

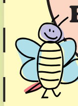
Tirzah, from Minnesota, looks forward to being a future beekeeper! "My family and I love bees. My dad sometimes goes over to my Papa's house to do bees because we're not aloud to have them where we live. Someday I'm gonna get bees of my own."

Jaya McKeown, 10, WA

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 or Phone (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.

Transitions

John **Miller**

A bit of explanation. I am a commercial beekeeper – sort of now retired. I had a great run in the bees. I enjoyed every bent back moment. I rejoice over excellent bees. I mourn over failed bees. I watch beekeeper peers and industry icons make contributions.

Jerry Hayes, *Bee Culture* Editor gives me a great gift & curse of free rein subject selection – a two-edged sword of blocked and creative.

I am the amateur contributor. My point of view is, commercial beekeeping.

I learn much from fellow travelers, the hobbyist, the scientist, the economist. All contribute.

A generation of beekeepers recently entered, or now enter career twilight. We are less youthful, a little bent, tire a little sooner – but death's rattle is still a distant murmur.

This generation faces a familiar test: How to pass on our life's work to others?

Some of us are better at letting go than others. In Vermonter Mike Palmer's words, 'I'd just as soon die in the beeyard.'

So: The Question Is: How do we put a bloodless number to the value of our life's work?

From whom do we seek counsel?

Beekeepers develop different valuation schemes, perhaps based on their experience of buying an outfit – or exactly the opposite based on their experience of buying an outfit.

Some formulate a percentage of the crop for the coming five years.

Some accept a promissory note for 12-15 years.

Some sell the bees, the rolling stock and equipment – but retain the real estate as an income earner.

Some sellers memorialize specific terms in the sales contract, something important to the seller. For example; Annually, 20 five-pound pails of extracted, one-of-a-kind honey known only to the seller – from a specific, treasured spot, shall be the property of the seller for as long as the seller shall live.

How do we know these snot-nosed brats won't return us a ruin in two years with a – Sorry.

It is not lost on me that an aged or departed seller once assessed us with the same dread.

It is so vital for the seller to know the timber of the buyer – or if unsure – sell for cash – enduring a big tax hit – with a big sigh of relief.

Where do we place the re-purposed, un-purposed energy of our former career?

Is this now the time to ride that bicycle across America – before we can't? Is now the time to join the Peace Corps? Can we now fulfill a promise made 40 years ago? What is it like to sleep with our wife instead of our phone? I assure you – there is relief – knowing – when the semi has gone over just outside

Norris, Montana; we are no longer on point for awkward, poorly informed decisions. Less attention is devoted to the P&L and the Balance Sheet. Fewer uncomfortable conversations with lenders are in our future. No longer lying in the dirt, in the dark, looking for the wire now wrapped around the drive shaft. No further log-book fiction writing.

Where do we best focus our considerable experience?

We have, maybe for the first time, financial security. That monthly surprise from Social Security is 'Free Money' magically appearing in my bank account every third Wednesday! We can better support causes or organizations doing work we value. There are over a million non-profits in America. One is devoted to improving honey bee health and crop production. Project Apis m.org. [I am a volunteer Board Member on PAm.] Retiring beekeepers have big reservoirs of beekeeping experience. Project Apis m, & the Bee Informed Partnership Boards benefit from the experience we have. Both organizations are worthy places for financial support. We can support, on a daily basis, with our Amazon purchases – the Bee & Butterfly Habitat Fund.

Signing up is easy. A causal organization. Nice.

The handoff is well under way. I enjoy hearing from my peers as they frame up the transfer of their life's work to other[s]. I'm honored to be included in their muse. Most of us are in love with bees. Decades long love-affairs can end beautifully. Take care with our life's work. Approach the transition by seeking financial advice. Not your cousin's financial advice.

Estate Planning: things everyone talks about, wealth transfer and outliving our money. There is a new task before us: In Pat Heitkam's words: 'Make something about your life more than about your life.' Beekeeping has been good to us. Another new task before us: Mentor the incoming beekeeping generation. Investing a bit of our time with these new gatekeepers of the food supply.

It's been a great run.

It's not yet over. BC

BEE VET

Sentinels

Dr. Tracy **Farone**

It can be amazing how things seemingly unrelated are ultimately connected. Perhaps that is one reason why honey bees continue to fascinate me, as they so often demonstrate the story of One-health relationships.

In January 2019, I had the privilege of visiting Notre Dame Cathedral in Paris – just a few months before the infamous fire of April 15, 2019. In Europe, there are many lovely churches and cathedrals, but Notre Dame is a true standout. Beautiful, awesome, peaceful, and intimidating all at the same time. When I visited, the place was still decorated for Christmas and the organist was phenomenal, especially if you can appreciate a creepy "Phantom of the Opera" type of organ tune. Ironically, at the time, I was also in France for the purpose of studying apiculture.

The cathedral's three honey beehives are now famous in the bee world for "surviving" the fire. The fire, in addition to partially destroying the magnificent building, was also considered to be an "acute pollution event." Among other things, the ancient structure contained considerable amounts of lead. Following the fire, studies were conducted utilizing honey samples from various parts of Paris to measure lead levels. Honey samples directly downwind from the fire had two and a half times the lead of pre-fire levels, three times the levels compared to other parts of Paris, and six times the lead levels comparable to the wider geographical region. The good news is that even though post-fire, downwind, lead levels showed elevation, the levels in the honey were still considered safe for human consumption. Most importantly, the information the honey bees and their honey provided a useful bio monitor of the environmental contamination of the area, helpful in assessing health risks for humans(1).

It is well documented that bees can be utilized as sentinels for various environmental pollutants including various heavy metals (such as lead, cadmium, chromium, nickel), pesticides, and other chemical substances(2,3,4). In medicine, the word **"sentinel"** is a reference to something that indicates the presence of a disease or health threat in an area. We often study various animal sentinels in veterinary medicine and can utilize this information to recognize and analyze human disease risk. For example, testing ticks for various infectious diseases and/or clinical testing of canines for Lyme Disease antibody can indicate disease exposure risk to humans and animals in a geographical region.

In the U.S., there is little found in the literature regarding heavy metal exposure affecting honey bees clinically and acutely. In Europe and elsewhere, there are some studies pointing to heavy metals as having detrimental clinical effects on honey bees, particularly in historically contaminated areas(5,6). It is well established that honey bee bodies can and do pick up metal levels from the environment through air, water, and plants (2-6). On most days, low level heavy metal exposure is one of many environmental pollutants our bees must endure which may factor into difficult to diagnose subclinical manifestations. I would argue however, that if a "acute pollution event" occurred in your area, heavy metal toxicity could be a rare but possible differential consideration.

The take away from all of this is that for many things, from chemicals to infectious agents, it is not so much the "what" but the "how much" that determines effect – the dosage. While we cannot control all the ever-present

Christmas at Notre Dame.

Notre Dame towers.

Notre Dame fire.

contaminants in our bees' foraging range, we can control what is in our beeyards. The place our bees spend the bulk of their life.

The common definition of "sentinel" is a guard who stands and keeps watch. So, while bees can act as a medical sentinel for us, we can act as sentinels, watchful keepers, for our bees. Every chemical, every metal, every substance that you permit in your bee yard, are in the closest proximity to your bees most of the time. Particularly the substances we put on our bees, like medications. Next article, I am going to dive into one thing that is very important for you to keep watch of... the dosage of very common and important chemicals used in our apiaries – *Varroa* control products. BC

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BUILD A DRIP TUB

Ed **Simon**

As a Do-It-Yourself fanatic, you relish the idea that you can create an item you can use and as a side benefit, save some money. A drip tub is one piece of equipment that is made of readily available materials, requires minimum amount of manual dexterity, and is extremely useful. The main use of the drip tub is to contain the honey that drips from the uncapped frames while they wait for extraction. A bonus is that during the off season it can be used to store equipment.

Requirements

- Usable for wood and plastic frames.
- Work with all frame sizes.
- Use readily accessible parts.

Parts

1. Tub - Plastic storage tub (1)
2. Frame rest support rod (2) – 7/16” diameter threaded rod.
3. Nylon lock nut (8) – Sized to fit part 2.
4. Fender washer (8) – Sized to fit part 2.

Tub (storage box) selection

The selection of the size of the drip tub is important. It needs to be large enough to contain the size frames you use. Whichever size tub is chosen, the construction is identical. Here are some things you should consider before deciding on which tub to use.

- Volume – How many frames are you going to uncap in a single session? How many frames does your extractor handle at one time? A wider tub is needed to hold a larger number of frames. But ease of handling should take precedent over the number of frames you will be processing. An unwieldy tub is unusable. The tub I chose can contain eight uncapped frames with easy insertion and removal.
- Sturdy construction – The tub needs to be sturdy enough to withstand continued abuse. The top rim should be substantial. A full tub containing frames full of honey and loose honey from previously handled frames can be heavy.
- Height – If you only use medium frames then a shallower tub may be sufficient. But you should look to the future when you may want it to hold deep frames.
- Minimal inside protrusions and straighter (more vertical) sides is preferred. The less obstacles you need to work around makes the tub easier to build and easier to clean.

Note: I selected the Sterlite® 66 qt. or a 62-liter clear view unit that is 23^{5}/8” high, 16^{3}/8” wide, and 13¼” deep. storage container for my drip tub.

This storage unit is tall enough to contain deep frames (9^{5}/8”) with a minimum of a 1½” space above and below the frames This space allows for:

- A lid to be used without touching the sticky honey that accumulates on the top of the frames.
- Dripped honey can collect without touching the bottom bars. A 1½” space of this tubs dimensions can hold about two gallons or 24 pounds of honey before it needs to be emptied.

Note: Be sure to get the covers that match the unit.

Note: I prefer the opaque or semi-transparent tub so I can see the honey level inside the tub.

Construction

Few dimensions are included with the drawings or this article. Your selection of the tub and the frame rest support rods will dictate the dimensions of the added assemblies and drilled holes.

Note: I selected a ^{7}/16” diameter rod to use as the frame rest. This choice was based on the distance to be spanned. Hopefully, no sagging will occur when the tub is completely loaded.

Hint: When cutting a threaded rod, place a standard nut on it. Position the nut on the good side (to be used side) of the cut. After the cut is complete, remove the nut through the newly cut end. This will restore the threads.

Hint: When cutting a threaded rod, place it between two pieces of a soft wood (pine) in a vice. This will protect the threads from being destroyed up by the vice.

Hint: Unlike standard locking washers, tightening nylon lock nuts can cause the rod will turn. Use a pair of vice grips to hold the rod while tightening the nuts. Remember to protect the threads.

Step 1: Select the tub (part 1).

Take along a deep frame to help with selecting the storage unit. You can set the frame in the unit to see how it will fit. If all you use are medium frames, a shallower unit can be used. Although I recommend a tub that can handle a deep frame. You never know when your requirements will change, and the tub now needs to hold deep frames.

Step 2: Locate the holes for the first frame rest support rod (part 2).

Center the frame on the tub. Leave enough room to the top of the tub to permit a lid to be used without touching the sticky top of the frame.

Note: Use masking tape and a pen to mark where the holes should go. The tape is easier to mark on. If you need to relocate the holes it is easy to remove the tape and add a new piece of tape.

Step 3: Drill the holes for the first support rod.

Use a center punch to mark where the holes will be drilled. A small indent will stop the drill from wandering across the surface of tub.

Step 4: Fit the first support rod (part 2).

Add a fender washer and a locking nut (part 2) to the rod. Slip the rod into the holes from one side and after allowing for an added fender washer and a nylon locking nut on the opposite end, mark the finished length. Cut the rod to this length and smooth the end. After fitting and adjusting the first rod, measure it and save the measurement for use when you assemble the second rod.

Hint: See the **Hints** under the **Construction** heading.

Note: You can always cut something shorter. It is impossible

to cut it longer.

Step 5: Install the first support rod.

Add the support rod to the tub. Use the "Locking nut and fender washer" detail diagram to place the components in the correct position on the support rod.

Step 6: Position the second support rod.

Use a frame to position the holes for the second rod. The rod's position needs to be tight enough to keep the frames in place and at the same time loose enough to allow you to add and remove them effortlessly.

Use the measurement from the top of the tub to the hole for the first support rod to ensure the holes for the second rod are rods are level.

Step 7: Cut and install the second support rod.

Use the rod length you saved in a previous step to cut the second rod. Install this rod as you did the first rod.

Step 8: Tighten all the nuts to finish the **Drip Tub**.

Tighten the outside lock nets first. The ends of the support rods should just be at the outside edge of their locking nuts. Then tighten the

inside lock nuts.

Note: This operation should not distort the tub. In the future you may want to be able to use the lid.

That's it! You're done. Easy wasn't it.

You now have a place to put your uncapped, sloppy, and sticky frames while waiting and transporting them to the extractor.

Conclusion

This is one of the easiest items to build and it is inexpensive and useful. It will help contain some of the mess when you are uncapping and extracting. It can also be used for equipment storage during the non-extracting season. BC

Ed's Second book *Build Beekeeping Equipment* is now available at: **https://www.lulu.com/shop.** Then search for "Edwin Simon" to locate the book.

This book contains 40 "Build a -------" articles along with over one hundred "What Your Mentor Forgot to Tell You" suggestions.

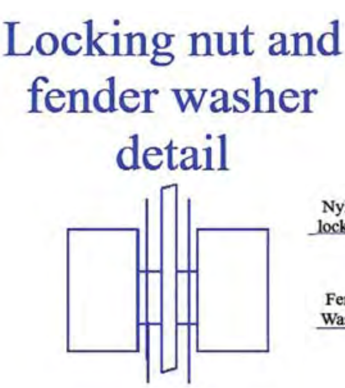
Ed can be contacted through **SimonEdwin41@gmail.com**

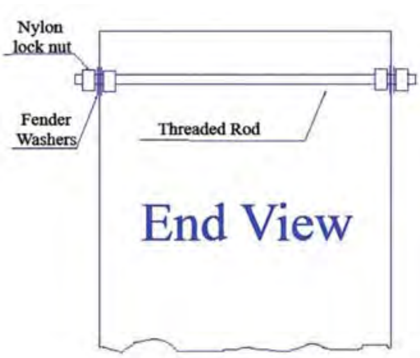
Drawings

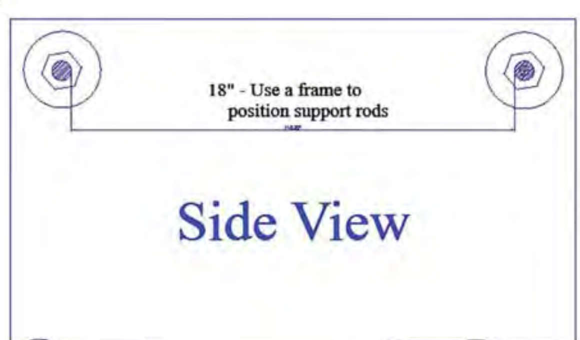
Note: To preserve clarity, not all fender washers are shown on the drawings.

Note: Frame support rods show the end of the rods extended.

This is for illustration purposes only. The ends should be cut even with the outside of the locking nut.





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Quality Beekeeping Suits Made In America

The Story Of Golden Bee Products

Back in 2007 I wrote about what I believe is the finest beekeeping suit made in the United States (and quite possibly the only beekeeping suit still exclusively made in the U.S). The suit made by Golden Bee Products of Metairie, LA comes complete with a built-in veil and is made of two loosely woven layers of fabric that sandwich a thicker third layer. This center layer is a rubbery mesh that provides a thick space between the inner and outer layers of netting fabric. The three loose layers result in a suit that is too thick for a honey bee to sting through due to the space within the mesh (about ¼ inch). Nor does the suit even offer many places that a bee is capable of stinging. The large number of little holes in the outer netting creates a suit with a minimal amount of fibers that are woven tightly enough to allow a honey bee to embed a stinger since the stinger has nothing to catch on, thus preventing the bee from being able to sting the suit. While the person wearing the suit is protected from stings, the only area of the suit itself that is capable of being stung is the pocket areas, which, out of necessity, are made of fabric composed of tightly woven fibers. This airy design also provides plenty of ventilation, which makes the suit a lot more comfortable than conventional suits that are made of cotton when the weather is hot and humid.

Phillip Lamoine

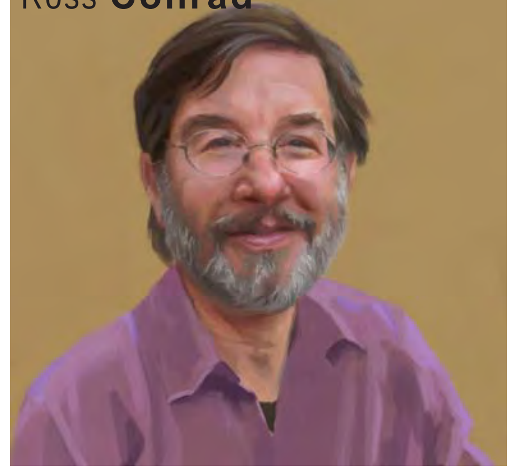
I became intimately aware of the Golden Bee suit's superiority in the early 1990s while collecting honey bee venom: a process that required making two-to-three dozen hives in an apiary very agitated, resulting in tens of thousands of bees filling the air as they all were trying to sting me and anything else that moved within about a hundred yards or so. What is astounding to me in this day and age of commerce based upon cheap imports from over-seas is that the Golden Bee Products bee suit initially invented by Philip Lamoine and patented in 1991, is still being made in the U.S.A. I spoke recently with the owner of Golden Bee Products, Ms. Susie Lemoine who explained the inspiration behind the suit.

"Well, my dad was always working the bees and some days it was so hot he couldn't stand being out with the bees for more than about five minutes so he invented something that was cooler for working in. He kept improving it and even had it tested out by various fire departments and the USDA as they worked with Africanized bees in Venezuela. Over the years he kept improving it and he eventually won investor interest for the bee suit he called 'a radically new way to keep the wearer cool in the heat while providing improved protection against stings.' His patent was approved in 1991 and he sold more than 1200 suits in 49 states as well as Yugoslavia, Africa, Mexico, Guatemala and Kuwait."

Susie began working with her father in the early 1990s cutting fabric and helping with the suit manufacturing work. "My daddy invented it but he was stubborn and wanted everything done his way. I kept working in the business with him and my mom. In fact my ma used to get so aggravated sometimes she used to say 'I quit!' but 15 minutes later she would be back to work. We hired two ladies, and one of the ladies has been working with us for over 30 years, she still sews up suits for us – I have improved the suits over the years. We added a flap in the front so bees can't get through those zippers even when they're not fully zipped and we added a hive tool pocket made of rip-stop nylon."

From my personal experience, Susie's bee suits are the best on the market. Not only are they highly sting resistant but they are made with attention to detail. While she doesn't run a large operation, Susie makes up for her lack of economy of scale by focusing on quality and personalized customer service. When I spoke with her she told me she was backed up with orders. "I recently received an order from the Mission

Ross **Conrad**



Phillip Lamoine

Fire Department in Mission, Texas for 15 suits, and I'm like Wow, you've got to be kidding me. See I'm just a small operation. I operate out of my house. I have a couple women helping me because I don't have a big enough house. Otherwise I would have to go rent a place, and since I just sell suits and jackets and we make aprons, for me to have to rent would not be cost effective since we don't also sell equipment. I would have to raise my prices and I don't want to do that because I'm already the most expensive out there. But if you compare my suit to others you can see the quality in the details. We don't use plastic zippers that tend to tear off. We use metal zippers instead and if you have a problem with a metal zipper you just rub soap or beeswax on it and it will last for a long time. Our suits are thicker than the competition to better prevent stings and the seams are well sewn. The Velcro is heavy duty and man that stuff sticks. And then we custom make our suits to fit your height and weight. Once we get your height, weight, your waist and inseam measurements, the other thing that we do, which I know you're gonna think this is a crazy measurement especially if you're a big guy, I want to know the measurement from the bump at the back of your neck, down between your legs and back up to your Adams apple. People don't understand why, but once I explain it they understand. Let's say a guy has a big stomach or he's got what I call a long torso, if we make that torso too short between the crotch and the neck when he bends over he's going to get a wedgie up the back end. The suit will be too tight. So we make our suits and inch or two longer, because when you raise your arms above your head the sleeve pulls down on you. When you bend over, the pant leg pulls up on you: so you need a couple extra inches so that when you bend over or raise your arms over your head, the suit is not too tight. I have to have all the measurements to be sure the suit fits properly so that you can move in it, "cause this is a working outfit. It's not an outfit you're just going to stand around and do nothing in."

Susie says most of her orders come through word of mouth from fire departments, bee people and bee clubs who appreciate her way of doing business: "Our suits last a long time and we have an unbelievable return policy. If your suit doesn't fit you, send it back and we'll make you a bigger one, or a smaller one, whatever works best for you. I get more business and sell more bee suits from that policy than anything else I do. I have to have all the measurements to fit somebody properly and if I need more information I call them back."

As Susie explains it: "Something like this (buying a bee suit) is a little more personal, it's not like you're ordering a pair of pants or a shirt. This is different. This is a bee suit. And we will custom make it, so if someone wants the hive tool pocket on the right side instead of the left, or maybe they want zippers on the legs, we won't charge anything extra for any of that. I had one guy from a fire department that had bought some suits from me a couple years earlier call and he says 'we've got a screen with a hole in it. Can you fix it up?' and I tell him yeah, send it back. And he asks "What's it going to cost us?" I said 'nothing'. We just ripped off the old one and put a brand new screen in there and sent it back to him free of charge. Now we get the screen for our hoods from a construction company that is heavy duty and tough so it won't easily catch on branches or bushes and tear up."

Susie is a big believer in the quality of American made products and sources all her materials from American companies exclusively. Since the advent of the ventilated bee suit by Golden Bee Products, many other companies have come out with their own versions. These copycats are made in other countries, or at best "assembled" in the U.S., and as a result, often cost much less than the Golden Bee version. This has led some to complain that expecting beekeepers to purchase an American made bee suit that is the most expensive bee suit on the market rather than less expensive versions that are made overseas is elitist. However, as Vermont author Rowan Jacobsen has pointed out, it is in fact just the opposite. It is much more elitist for poor people with minimal education in other countries to be expected to work long hours in often miserable and unsafe working conditions for meager wages, to produce stuff that gets shipped half-way around the world, just so we can pay less money for it when compared to purchasing a similar item made in America by a neighbor down the road or in a neighboring state, who is simply trying to earn an honest living. Given the economic hardships so many people are experiencing in these days of Covid-19, buying "Made in America" is more important than ever. BC

Ross Conrad is the author of Natural Beekeeping: Revised and Expanded 2nd Edition, *and Co-author of* The Land of Milk and Honey: A history of beekeeping in Vermont.

Ravenna, MI High School

$100,000

Olivia **Woodring**

Olivia Woodring is a senior at Ravenna High School in Ravenna, MI. She is an avid FFA member and cross country runner, and she loves reading and all things outdoors. She hopes to attend the University of Michigan next year to pursue a degree in international studies.

I'm sure you're aware that honey bees are single-handedly the most important of all pollinators. The species provides more than 15 billion dollars to U.S. crop production annually, according to the USDA. They're also critical to biodiversity in a vast number of ecosystems. As a member of the Ravenna FFA Chapter (an agricultural education and leadership organization) in Ravenna, MI, I was no stranger to honey bees' impact on agriculture and the environment. However, when my friend and fellow FFA member, Kaia Cooper, researched the risks pollinators face for a public speaking event, we became much more passionate about bees in today's world.

Over the past three years, we continued to research honey bees for FFA events, school projects, and eventually, we asked our agriscience teacher and FFA advisor, Melanie Block, if we could buy and raise bees as a chapter. When Mrs. Block finally consented, we gathered as much information as we could. We started signing up for beekeeping courses, pricing hives and equipment, and then planned to implement our hives in the summer of 2020. Then, along came the COVID-19 pandemic, and all of our plans were put on hold.

Olivia, Kaia, and McKenna (left to right).

Fortunately, Mrs. Block was made aware of the $100,000 Rural Technology Grant, provided by the U.S. Department of Education, from some supporters of our FFA Chapter. When asked about an endeavor she would like to pursue, her first thought was bees – probably because we had pestered her a million times about it. Kaia and I were obviously on board and immediately asked how we could help apply. At this point, Kaia and I were both chapter officers: secretary and president, respectively. Since we were also seniors, we wanted to include a younger member into the project to take the lead when we graduated, so we recruited junior and chapter treasurer Mckenna Morton. The three of us researched how we would utilize $100,000 to integrate commercial-level technology and beekeeping into Ravenna High School's curriculum.

In November of 2020, we prepared and shared a presentation to our district's Board of Education, community members, stakeholders of the grant, and members of our county-wide educational service agency, MAISD. Thanks to loads of behind the scenes work from Mrs. Block, our principal Mr. Wilson, our superintendent Mr. Helmer, and a huge number of community supporters, the grant was submitted to the USDE for consideration. Then, we waited patiently for results. Just kidding, we asked Mrs. Block every other day if she had any news yet, but we tried really hard to be patient!

We were ecstatic to learn on December 17 that we won out of more than 60 competitors from across the country! Not only that, we were one of five finalists who would compete for an additional $100,000 over the next two years. Ever since, bee professionals, news outlets, and others have been asking what we will do next and how they can help us. Our plan is to install honey bees this spring onto our high school campus in an area where the hives will be far from foot traffic. The goal is for the colonies to live in a BeeHome, a solar-powered, autonomous device that houses 24 hives and remotely cares for the bees created by BeeWise.

The BeeHome.

While we are still in the process of securing this system, the hive unit is capable of climate and humidity control, and it monitors pests such as *Varroa* mites and applies pesticides in real-time. Artificial intelligence detects when bees are about to swarm and prevents swarming by adjusting conditions in the colony. The BeeHomes also have the ability to detect when frames are ready to be harvested for honey and harvests them inside the device. This information will all be accessible from the BeeWise computer program. BeeWise currently only works with large operations of over 1,000 hives, but we are hoping they will be willing to work with us for the sake of our project, and we have contacted them to see if they would be interested in helping us with this project.

The project will be completely led by students. Beginning in August of 2021, six to nine students will be enrolled in a course where they will operate the BeeHome technology, share information virtually with other schools, prepare and package honey, and sell products to local retailers. We also plan to rent out our bees to local crop producers. Most farms will require one to five hives per acre, depending on the crop. This hands-on, critical thinking, competency based class will teach students entrepreneurial skills and how to work with commercial-level technologies and will promote agricultural literacy. There are already many students at Ravenna High School who can't wait to enroll in the course and are excited to be part of such an innovative approach to education.

I believe that this project will not only provide irreplaceable skills to students at Ravenna High School, but it will also pave the way for innovative technological and entrepreneurial programs in schools across the country. In a world of constantly changing leadership and technology, today's curriculum is not adequately preparing students to be the leaders our agricultural economy needs upon graduation. Programs, such as the beekeeping project that the Rural Technology Grant has provided to us, are the educational programs of the future. I am so proud to have helped with such an impactful initiative, and I can't wait to see what the future holds for agricultural education. BC

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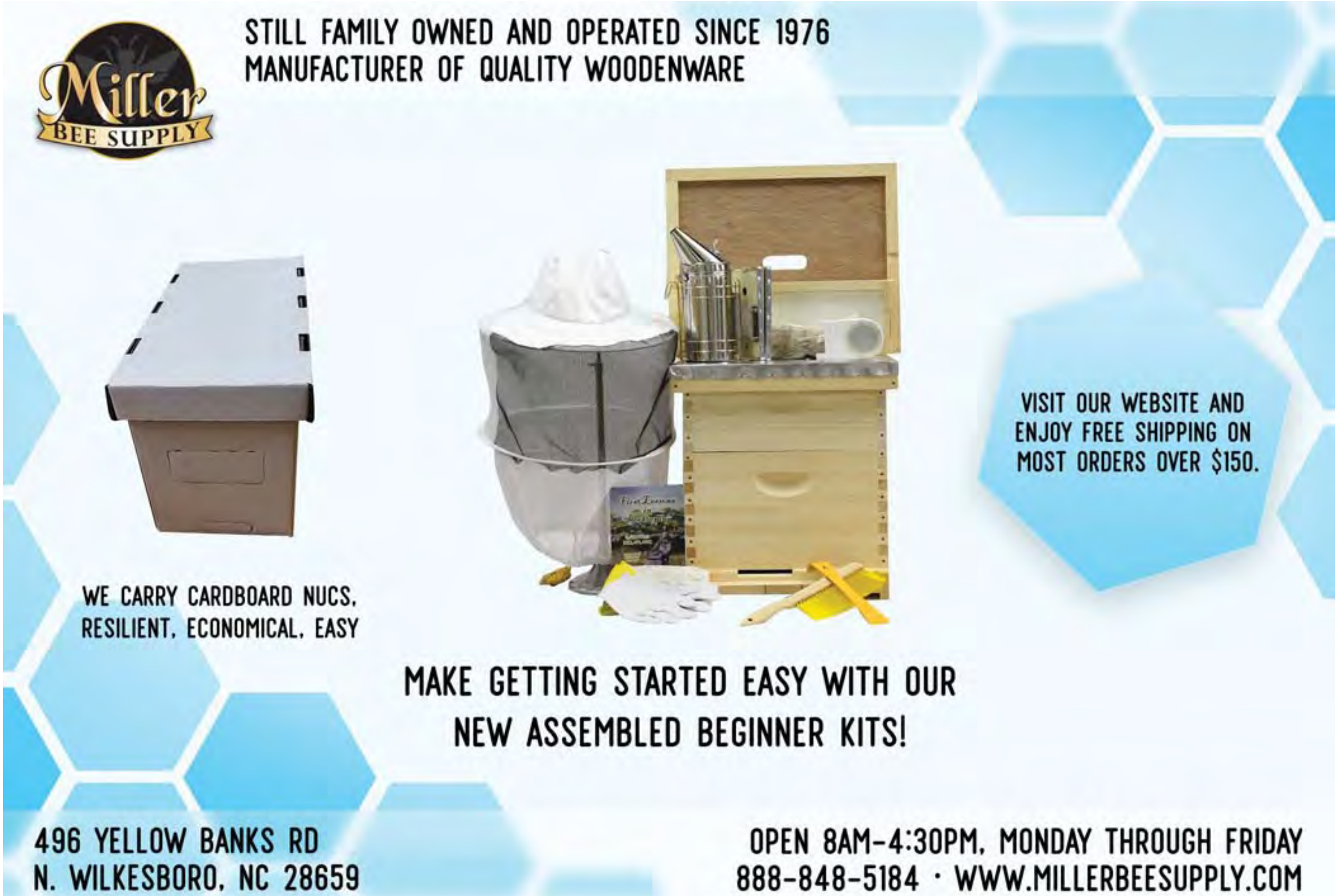
The girls giving their presentation.



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2021 American Bee Research Conference Proceedings

Judy Wu-Smart[1], Shelby Kittle[1], Margaret J. Couvillon[2], Margarita López-Uribe[3]
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[3]Department of Entomology, Center for Pollinator Research, Penn State University

Introduction and Overview

The American Association of Professional Apiculturists (AAPA) is an organization consisting of professors, state apiarists, scientists and students who study and work with honey bees. The goals of this organization are to (1) promote communication within and between industry, academia and the beekeeping community, (2) develop and foster research on fundamental and applied questions to gain a greater understanding of honey bee biology that can assist and improve the beekeeping industry; and (3) create a venue to rapidly share new techniques and current research to advance the field. The AAPA held its annual American Bee Research Conference (ABRC) on January 7th and 8th 2021 virtually over Zoom conferencing due to COVID-19 pandemic travel restrictions. The two-day conference had over 130 participants and showcased 46 oral presentations including research talks from 25 students. Keynote addresses were provided by Drs. Thomas Seeley (Cornell University) and Madeleine Beekman (University of Sydney). Research presented covered current projects and training efforts to address the following four research topics: (1) role of abiotic stressors on honey bee colony health; (2) role of biotic stressors on honey bee colony health; (3) interactions between abiotic and biotic stressors on colony health and survival; and (4) fundamental investigations on honey bee ecology and behavior. The AAPA is pleased to present the submitted abstracts of many of the presentations given over the course of the two-day 2021 conference and 10 unpublished abstracts from ABRC 2020.

Abstracts of Presentations

Session I – Abiotic Stressors

Colony-level pesticide exposure affects honey bee (*Apis mellifera* L.) royal jelly production and nutritional composition

Priyadarshini Chakrabarti[1], Joseph P. Milone[2], Ramesh R. Sagili[1] and David R. Tarpy[2]
[1]Department of Horticulture, Oregon State University
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Honey bees provision glandular secretions in the form of royal jelly as larval nourishment to developing queens. Exposure to chemicals and nutritional conditions can influence queen development and thus impact colony fitness. Previous research reports that royal jelly remains pesticide-free during colony-level exposure and that chemical residues are buffered by the nurse bees. However, the impacts of pesticides can also manifest in quality and quantity of royal jelly produced by nurse bees. Here, we tested how colony exposure to a multi-pesticide pollen treatment influences the amount of royal jelly provisioned per queen and the additional impacts on royal jelly nutritional quality. We observed differences in the metabolome, proteome, and phytosterol compositions of royal jelly synthesized by nurse bees from multi-pesticide exposed colonies, including significant reductions of key nutrients such as 24-methylenecholesterol, major royal jelly proteins, and 10-hydroxy-2-decenoic acid. Additionally, the quantity of royal jelly provisioned per queen was lower in colonies exposed to pesticides, but this effect was colony-dependent. Pesticide treatment had a greater impact on royal jelly nutritional composition than the weight of royal jelly provisioned per queen cell. These novel findings highlight the indirect effects of pesticide exposure on queen developmental nutrition and allude to social consequences of nurse bee glandular degeneration. More information about the study can be found at Chemosphere (2021) Volume 263, pp. 128183.

Superorganism toxicology: Modeling the exposure and effects of metals in the honey bee colony

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The honey bee (*Apis mellifera*) is a textbook example of a superorganism. As such, their responses to environmental chemicals are best understood at the colony level, but due to issues of scale and replicability, are more often assessed from laboratory assays with small groups of caged bees. Consequently, there's high demand for modeling approaches that can extrapolate observations from the lab to the colony context. To do so, models must account for key differences between lab and field conditions: Whereas laboratory assays are typically brief (<4 days) and utilize acute dosages, colonies in the field are exposed to lower levels of anthropogenic chemicals over prolonged periods of time. Besides being important environmental contaminants in their own right, metals offer a variety of promising "model toxicants" that can be used to better understand the movement of food-borne chemicals within colonies and the gradual effects of chronic levels of exposure. Notably, certain metals (Li and Zn) are currently under development as the active ingredients of systemic pesticides to which honey bees are liable to be exposed. Utilizing data from a combination of lab and semi-field assays, I compare two approaches to modeling the time-cumulative effects of metals (Li, Zn, Cd) exposure in honey bee colonies. I show that these approaches can result in contrasting population predictions, depending on the exposure scenario and chemical in question.

The sublethal effects of IGRs on queens, workers, and colony reproduction

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As part of the USDA-ARS Invasive Species and Pollinator Health Research Unit, the new Pollinator Health Lab in Davis, CA is dedicated to performing longitudinal studies related to the health and productivity of managed honey bee colonies in an effort to help inform and develop improved management practices for beekeepers. As a part of this mission, current research efforts are focused on understanding how agrochemicals like insect growth regulators affect honey bee reproduction, behavior and the long term consequences of exposure scenarios. Recently, we have shown that IGR formulations commonly used in almond orchards during bloom can negatively influence queen productivity. Initial findings suggest that IGRs act transovarially, resulting in impaired hatching rates in eggs laid by exposed queens. This phenomenon could have potential consequences on metrics such as colony population stability, the development of surviving embryos, and their performance as adults.

Acute exposure to sublethal doses of neonicotinoid insecticides increases heat tolerance in honey bees

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Climate change is expected to accentuate the effects of abiotic stressors affecting honey bees. We tested the hypothesis that exposure to acute, sublethal doses of neonicotinoid insecticides reduce thermal tolerance in honey bees. We administered to bees oral doses of imidacloprid and acetamiprid at 1/5, 1/20, and 1/100 of LD50 and measured their heat tolerance 4 h post-feeding, using both dynamic and static protocols. Contrary to our expectations, bees fed with insecticides exhibited higher thermal tolerance and greater survival rates. Our study suggests a resilience of honey bees to high temperatures when other stressors are present, which is consistent with studies in other insects. We hypothesize that this compensatory effect is likely due to induction of heat shock proteins by the insecticides, which provides temporary protection from elevated temperatures.

Acute toxic effects of insecticide-fungicide-adjuvant combination on honey bees

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Significant decreases in honey bee (*Apis mellifera*) populations have been reported by beekeepers and farmers over the last couple decades without a clear explanation. This decrease in the honey bee population poses a major problem for the California almond industry because of its dependence on honey bees as pollinators. This research aimed to determine if combinations of "bee-safe" pesticides applied during almond bloom were a possible explanation for this decrease in the honey bee population. In this study, we aimed to mimic the spray application route of exposure by using a Potter Tower to spray adult honey bees with the various treatments. This research determined that the combination of the fungicide Tilt (a.i. propiconazole) and the insecticide Altacor (a.i. chlorantraniliprole) displayed synergistic toxicity that was not observed when the treatments were applied individually. This study also looked at the toxic effects of adding adjuvants to pesticide mixtures. Adjuvants are exempt from bee testing that is required for other pesticides, so this study aimed to determine how these compounds may affect honey bee health. We showed that the adjuvant Dyne-Amic was toxic to honey bees at concentrations slightly above the recommended field applications. Dyne-Amic also showed synergistic toxicity when combined with the fungicide Pristine (a.i. pyraclostrobin and boscalid) and the addition of Dyne-Amic increased toxicity in the Tilt and Altacor combination treatment. These results suggest that the application of Tilt and Altacor in combination with an adjuvant at the recommended field application rates could cause significant mortality in adult honey bees. These findings highlight a potential explanation for honey bee losses around almond bloom and emphasize that adjuvants should receive the same testing as other pesticides.

Integrated Pesticide Management for Beekeepers and Why We Need Another Approach

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The use of pesticides is a complex multi-faceted problem impacting honey bee (*Apis mellifera* L.) health. Research show alarming levels of pesticides from the surrounding environment as well as from beekeeper-applied treatments in bees and hive products such as brood comb and food stores that cause direct and indirect effects from the compound or formulation as well as potential interaction effects with other stressors (malnutrition, mites, and pathogens). Pesticide "kills" leading to acute mortality of bees are noticed immediately, however, chronic abnormal losses often go unnoticed by beekeepers and can lead to stagnant growth or weakening of hives. These pesticide "incidents" where only a small proportion of bees are affected may have cascading effects throughout the colony affecting age-based division of hive tasks (brood care, food processing, and foraging). Currently, there are no monitoring tools for beekeepers to identify abnormal losses due to pesticide incidents. And while recommendations for reducing pesticide exposure to foraging bees exist, management guides to reduce in-hive contamination of nestmates, comb, and food stores is limited. This effort seeks to better understand the sources of hive contamination and to develop integrated pesticide management for beekeepers which includes monitoring using dead bee traps and mitigation steps that will prevent further health decline in affected hives.

Session II – Biotic Stressors: Pest and Pathogens

Brood hygiene-eliciting signal as a tool for assaying honey bee colony pest and disease-resistance

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Despite numerous management and breeding interventions, the ectoparasitic mite *Varroa destructor* and the pathogens it vectors remain the primary biological threat to honey bee (*Apis mellifera*) health. Hygienic behavior, the ability to detect, uncap, and remove unhealthy brood from the colony, has been selectively bred for over two decades, and continues to be a promising avenue for improved *Varroa* management. Although the hygienic trait is elevated in many *Varroa*-resistant colonies, hygiene does not always confer *Varroa*-resistance, as some hygienic colonies still require miticides to limit mite infestations. Additionally, existing *Varroa*-resistance selection methods tend to trade efficacy for efficiency, as those achieving the highest levels of *Varroa* resistance can be time-consuming, and thus expensive and impractical for commercial use. Here we demonstrate that a mixture of synthetic honey bee brood compounds associated with *Varroa* infestation and/or Deformed-Wing Virus infection can be used to trigger hygienic behavior in a two-hour assay. High-performing colonies (colonies exhibiting hygienic response to >= 60% of treated cells within two hours) have significantly fewer phoretic mites, remove significantly more introduced mites, and are significantly more likely to overwinter successfully compared to low-performing colonies (colonies exhibiting hygienic response to <60% of treated cells within two hours). We discuss the efficacy and efficiency of this *Varroa*-specific assay as a tool for facilitating apiary management decisions and for selection of honey bee colonies more resistant to *Varroa*.

The Understudied Honey Bee: A case study exploring the prevalence of viral disease in feral honey bee colonies in San Diego County

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Bees provide important pollination services, but are threatened by many increasingly disruptive stressors, including pathogens. Currently, the majority of pollinator health studies consider the well-known agricultural species such as *Apis mellifera*. Multiple honey bee-associated viruses (HBAV) are implicated in managed honey bee (MHB) colony losses. However, we know little about how these HBAV affect the broader pollinator community. Importantly, we rarely consider the interactions between feral honey bees (FHB) and MHB. Although the ways in which viral diseases manifest in MHB are reasonably understood, the prevalence and effects of viruses in FHB remain a relative black box. These FHB may prove important in considerations of pollinator health, as FHB colonies appear to coexist successfully alongside pathogen-stressed MHB, although FHB are not treated for diseases. This suggests that FHB have some hitherto unexplored strategy that allows them to mitigate pathogen pressure. Such strategies may prove useful in disease mitigation among MHB. In this case study, we show evidence for the notion that FHB and MHB colonies maintain similar viral species, at similar levels. As such, we propose that FHB play a hitherto poorly described, but important role in pathogen dynamics of honey bees and the pollinator community as a whole.

The role of *Varroa* mite (Acari: Varroidae) host selection on forager-mediated mite migration

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Varroa mites represent a serious threat to honey bee (*Apis mellifera*) populations globally through the costs of parasitism and the transmission of virus from mite to host. Although the relatively low reproductive rates of *Varroa* should not allow for rapid population growth, populations are often observed to increase quickly, predominantly in the late Fall. This discrepancy between reproduction and larger than expected mite populations suggests that other factors may be contributing to *Varroa* populations within colonies. We found that forager-mediated migration of mites and a shift in mite host selection behavior were possible mechanisms for rapid *Varroa* population growth in the Fall. GC-MS analysis of cuticular hydrocarbon profiles in nurse and forager age bees revealed differences in cuticular hydrocarbon composition early in the study period, these differences in nurse and forager profiles disappear in the late fall at the same time when populations of foragers with mites increase. In a host selection assay, *Varroa* showed a significant preference for nurse odors over forager odors, in the late Fall there was no preference for either odor. The proportion of time that *Varroa* chose a forager scent in a choice assay correlated with the proportion of foragers with mites captured. These data shed light on the mechanisms underlying destructive seasonal mite titers in honey bee colonies.

The utility of cultured honey bee primary cells to investigate host-virus interactions

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Virus infections contribute to honey bee colony losses worldwide, therefore ongoing research aims to understand the impact of viruses on honey bee health from the colony to the cellular level. However, honey bee virology is limited by a dearth of immortalized cell lines. To address this need, we further developed the use of primary honey bee cells, model viruses, and semi-purified honey bee virus stocks to investigate host-virus interactions at the cellular level. Hemocytes, which are macrophage-like immune cells were isolated from larvae and exposed to a purified Lake Sinai virus 2 (LSV2) stock in either WH2 or Schneider's insect medium. While healthy primary cells could be maintained in either medium for 4 weeks, LSV2 replicated (i.e., 2.5x at 72 hours post-infection) only in cells maintained in WH2 medium. Therefore, WH2 medium was utilized for subsequent viral time course experiments with a model virus (i.e., Flock House virus) which replicated 23x over 96 hours. In addition, we determined that hemocytes isolated from larvae obtained from sacbrood virus (SBV) infected colonies supported ex vivo virus propagation (i.e., 1000x over 96 hours). Together, these data show that honey bee hemocytes support virus infection and are a tractable system for investigating honey bee host-virus interactions. Similarly, cells derived from purple eyed pupae were cultured in WH2 media and used as a more complex cell culture model to study virus infection. We determined that pupa cell cultures supported replication of semi-purified SBV and deformed wing virus (DWV) and thus demonstrate that tissue-obtained primary cell culture is an additional tool to study honey bee host-virus interactions.

Immune response of different developmental stages of honey bee queens to Israeli acute paralysis virus infection

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The honey bee queen's health is crucial to colony survival since reproduction and colony growth rely solely on the queen. Among many environmental stresses, viruses are a major concern since they can infect queens at different developmental stages. Although queens are protected by worker bees and other mechanisms of social immunity, they rely on evolved individual antiviral defense mechanisms to cope with viral infections. To understand the maturation of the queen immune system from before emergence to the onset of reproduction, we investigated how virus infection influences 18 immune genes from different conserved immune pathways including Toll, Imd, JAK/STAT and RNA interference at different developmental stages. We used Israeli acute paralysis virus (IAPV) as an experimental pathogen because it is relevant to bee health, but rarely has been detected in honey bee queens. Our results are discussed in the context of the ontogeny of immunity and regulation of queen immune genes in response to virus infection.

***Varroa destructor* mite decision-making process regarding honey bee worker cell invasion and size implications for developing bee brood**

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Parasitization of honey bees (*Apis mellifera*) by the mite *Varroa destructor* is one of the main causes for the decline of honey bee health. To begin its reproductive cycle, a female mite enters the comb cell of a bee larva just before it is capped, undergoes development and reproduction within the cell, and exits the cell as the adult bee emerges. The main difference between *Varroa* infestations in their original host, *Apis cerana*, and *Apis* mellifera is that in the latter the mites are able to invade and successfully reproduce in worker larval cells. This study examines if worker brood is differently at risk for *Varroa* invasion with proximity to drone brood. This study also measures developmental brood size with *Varroa* invasion and feeding. Understanding distribution of *Varroa* in worker brood and how mite feeding impacts brood development will give us a better picture of *Varroa* impact in our honey bee colonies.

Longitudinal DWV and immune gene expression dynamics in colonies managed under conventional, organic, and treatment-free systems

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Varroa mites and associated viruses are among the most serious stressors to honey bee colonies and are the focus of beekeeping management. Despite efforts to control mites, these parasites are widespread across all colonies in the United States and are a major threat to the industry. Here, we investigated the levels of DWV and immune gene expression in colonies managed under three management systems (conventional, organic, and treatment-free) over two years to determine the role of beekeeping in colony overwintering survival. Our results suggest that high levels of DWV and expression of Defensin-1 are important predictors of colony survival for first-year colonies across all management systems. However, we did not find evidence of an association between DWV and expression of Defensin-1 for established two-year-old colonies. In contrast, higher expression of vitellogenin was consistently associated with higher overwintering survival over the two years. This study highlights the importance of longitudinal studies of disease dynamics and immune gene expression for honey bee colonies to better understand the role of pathogens on pollinator health.

Beekeeping economics: A comparison of the profitability of conventional, organic and treatment-free management systems

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Honey bee colony management is an important factor in bee health, colony productivity, and profits for beekeepers. Parasitic mites are a major focus of management, with most beekeepers applying in-hive chemicals to control them. We followed 144 honey bee colonies for 2.5 years, from colony installation in April 2018 through late Summer 2020. Colonies were managed, with sister queens for genetic consistency, using a conventional, organic, or treatment-free management system (N = 48). Inputs and outputs for each colony were carefully measured to determine the profitability of each system. We found that mites were successfully controlled using chemical inputs and Winter survival was high (over 80%) using both the conventional and organic system, while colonies that were treatment-free (avoiding chemical inputs) had high mite levels and low Winter survival. Honey production was significantly higher in the colonies managed organically in both 2019 and 2020. In addition, both the organic and conventional systems allowed for the sale of excess colonies during Spring splitting, while treatment-free splits had to be kept as replacements for Winter losses. Overall, the organic system was the most profitable, while the treatment-free system was not profitable, due to high colony mortality.

Session III – Interacting Biotic and Abiotic Stressors

Investigating the impact of nutrition and organic compounds on honey bee virus infections

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Honey bees are exposed to diverse environments and multiple stressors. These include close interactions with numerous plant species while foraging for nectar and pollen of varying nutritional quality and collecting oils/resins, and in-hive compounds introduced by beekeepers and agrochemicals used in cropping systems. Bees are also exposed to viruses which are horizontally transmitted via shared floral resources, trophallaxis, and close contact. Recent studies indicate that dietary supplements and plant extracts may reduce the impact of viruses on honey bees, but the mechanisms of mitigation have not been characterized. To further investigate the impact of orally administered organic compounds on the outcome of honey bee virus infections we performed laboratory-based infection assays using deformed wing virus and two model viruses. Virus-infected bees were fed diets of varying composition, including protein and sterol augmented (24-methylenecholesterol) diets, or sucrose containing thyme oil (160 ppb), the antifungal Fumagilin-B (25 or 75 ppm), or the insecticide clothianidin (1 or 10 ppb), and virus abundance was assessed up to four days post-infection. Sindbis and Flock House virus abundance was reduced in bees fed UltraBee®, OSU diet supplemented with 24-mc, or multifloral pollen, and surprisingly clothianidin (10 ppb). SINV, DWV, and FHV abundance was also reduced in bees fed 160 ppb thyme oil, and greater in bees fed Fumagillin-B compared to sucrose-syrup fed bees. The expression of key antiviral genes, including dicer and ago-2 was upregulated in virus infected bees fed 0.16 ppm thyme oil compared to control. Better understanding the outcome of virus infections in the context of diet and chemical exposure may lead to the development of strategies to reduce virus-associated colony losses.

Varroa mites and neonicotinoid insecticides: Effects on drone survival and reproductive health

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The parasitic mite *Varroa destructor* and neonicotinoid insecticides represent important biotic and abiotic stressors, respectively, to *Apis mellifera* honey bees. Despite this, their potential interaction effects, especially concerning male drones, are severely understudied. We employed a fully crossed experimental design to assess potential interaction effects of neonicotinoids and *V. destructor* on drone survival and sperm quality traits. Known age cohorts were obtained from colonies that either received pollen patties containing field-relevant concentrations of two neonicotinoids (4.5ppb thiamethoxam and 1.5ppb clothianidin), or not. Upon emergence, drones were assessed for *V. destructor* infestation, and kept in laboratory cages based on treatment group allocation:

1. No neonicotinoid/No *V. destructor*,
2. No neonicotinoid/Yes *V. destructor*,
3. Yes neonicotinoid/No *V. destructor*, and
4. Yes neonicotinoid/Yes *V. destructor*.

Once drones reached sexual maturity, sperm quality traits were measured. Our findings confirm that neonicotinoids and *V. destructor* individually can significantly reduce drone survival, but also provide novel evidence for a synergistic interaction between the two stressors. Contrary to our expectations, sperm quality traits were not affected by neonicotinoids and *V. destructor*, when pressured alone or in combination. Nonetheless, reduced drone survival until sexual maturity could severely affect honey bee colony and population health given the importance of drones to mating.

Honey bee (*Apis mellifera*) workers prematurely remove themselves from the colony due to developmental stressors

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Honey bees (*Apis mellifera*) provide a tractable system for studying the behavioral consequences of eusociality. As eusocial insects, honey bees live in colonies composed of thousands of sterile female workers with only one reproductively active queen. Therefore, a sterile worker's own genetic fitness is best served by acting in the interest of her colony, even if her behavior curtails her own lifespan. In this study, we tested the hypothesis that developmentally stressed worker bees remove themselves from the hive to protect their colony from the negative costs of an inefficient workforce. To confirm that this self-removal behavior is a reaction to severe stress, and not parasite-driven or a social immune response, we developmentally stressed bees with either cold shock or parasitization by *Varroa destructor* mites. Stressed bees, as well as their control counterparts, were tagged upon emergence and introduced to a common observation hive. We took daily attendance of the focal bees and checked a trap engineered to capture self-removing bees every hour. For both treatments, we found that bees stressed by either mites or cold temperatures lived for significantly less time and self-removed from the hive in significantly higher numbers than their control counterparts. This indicates that self-removal behavior is probably stress driven. Going forward, we plan to measure the hypopharyngeal glands and juvenile hormone titers of the bees that self-removed to further confirm the drivers of this behavior. This will ultimately enable us to model the effects of this behavior on the entire colony.

Dancing honey bees communicate monthly fluctuations in forage availability in a mixed-use landscape in Virginia

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Bees and other flower-visiting insects, which provide critical ecosystem services, face declines in both diversity and abundance that threaten their ability to provide adequate pollination for both wild plant communities and agricultural crops. In response, management efforts have attempted to address pollinator loss through programs that provide supplemental forage or foraging habitat for the hungry pollinators; however, such efforts must consider the temporal and spatial dynamics of foraging and the phenology of flowering species against the nutritional needs of the pollinators. In this study, we monitored the waggle dances of honey bees foraging in a mixed-use landscape in Blacksburg, VA over two foraging seasons (2018-2019) to 1) identify seasonal fluctuations in the availability of honey bee forage, as determined by communicated foraging distance and to 2) determine the types of foraging habitat that honey bees prefer to visit. We decoded and analyzed waggle dances (n=3614) to identify monthly fluctuations in communicated foraging distance and to map the association between land cover type and honey bee foraging dynamics. Our results consistently show an increase in foraging distances in June and October during both years, suggesting that these months likely pose a challenge for locally feeding pollinators and should be the time when aid should be directed in our area. Additionally, our results demonstrate that the honey bee foragers advertised pasture lands with 40.7% of their waggle dances, more than the other available land cover types, despite the pasture land cover category comprising only 19% of the study area. However, foraging rates to the different land cover categories varied across months, with honey bees showing increased foraging to pasture lands and decreased foraging to forests during months with low median foraging distances and decreased foraging to pasture lands and increased foraging to forests during months with higher median foraging distances. These data suggest that local pastures provide attractive foraging resources throughout most of the honey bee foraging season at our field site, while forests provide transitory foraging resources during the early Summer.

Honey bee tolerance to Deformed wing virus infection when fed diets with varying macronutrient ratios

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It has been shown that the health of honey bees infected with pathogens can be improved by ensuring proper nutrition. The purpose of this study was to determine what protein (P) to lipid (L) ratio within artificial diets have a positive impact on the survivorship and overall health of honey bees infected with Deformed wing virus (DWV). We conducted a cage assay where newly emerged bees were assigned to one of three treatments: a DWV injected group, a PBS injected negative control, or a non-injected negative control group. Cages in the three infection groups were further divided into four treatment groups based on whether they were fed a high P: low L diet (40P:10L), a low P: high L diet (20P:30L), an intermediate diet ratio at which non-infected honey bee colonies self-select for in the field (30P:20L), or no diet whatsoever for a total of n=6 cages treatment group. Survivorship and the amount of diet consumed was measured for each cage over a 16 day period. It was found that bees across all three infection groups consumed the intermediate 30:20 the most. It was also determined that bees infected with DWV and fed this 30:20 diet or no diet at all had a higher rate of survival than bees fed one of the more protein/ lipid extreme diets. Pollen and commercially available pollen substitutes vary widely in their macronutrient P:L ratios, and this work will help us better determine what target ratio can help bees better deal with DWV infection.

In vitro effects of fungicides on the susceptibility of honey bee (*Apis mellifera*) larvae to European foulbrood

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Pesticide exposure has been implicated in the immunosuppression of honey bees (*Apis mellifera*) and suspected to increase susceptibility to European foulbrood (EFB). EFB, caused by the bacterium *Melissococcus plutonius*, produces increased mortality in honey bee larvae in colonies under environmental and nutritional stress, particularly in association with commercial blueberry pollination. The effects of exposure to formulated fungicide products commonly used in blueberry production on susceptibility of honey bee larvae to EFB during blueberry pollination is currently unknown. Using an in vitro larval infection model of EFB, we tested the effects of chronic larval exposure to field-relevant concentrations of the formulated blueberry fungicides Captan® and Kenja® on larval mortality from M. plutonius infection. Surprisingly, we found that chronic exposure to Captan® or Kenja® during development significantly (P<0.0001) increased larval survival from EFB by 33% compared to infected control larvae which were unexposed to fungicides. One explanation for this finding could be an inhibitory effect of fungicides on the growth of *M. plutonius*. However, larvae chronically exposed to a combination of Captan® and Kenja® did not experience a significant difference in survival relative to infected controls. These in vitro results suggest that chronic exposure of honey bee colonies to formulated fungicide products during blueberry pollination does not predispose these colonies to EFB. Additional colony-level studies are necessary to verify the field-relevance of these in vitro results.

Evaluation of Active Ingredients for Potential Miticidal Activities Against *Varroa destructor* and Toxicity to Honey Bees

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The *Varroa* mite, *Varroa destructor* Anderson and Trueman, infestation has threatened honey bee survivorship. Low efficacy and development of *Varroa* mite resistance to currently used Varroacides has increased the demand for alternative effective treatment tool options that exhibit high efficacy, while minimizing adverse effects on honey bee fitness. In this investigation, the toxicity of 16 active ingredients and nine formulated products from 12 registered chemical families were evaluated on *Varroa* mites and honey bees. In the laboratory test, we used the vial test for contact surface and topical exposures for 4h and 24h. We found that compounds belong to Pyrazoles (93% mortality) and Tetronic acids (70-84% mortality) had greater toxicity to *Varroa* mites, but high dose rates caused high bee mortality (>60%). The results showed that high toxicity of active ingredients from Quinazolines and Oxazolines against *Varroa* mites caused 92% and 69% mortality, respectively; and were found to be safe on honey bees. These identified products will be further investigated for development of potential Varroacides. To simultaneously test bees infested with mites, a plastic cage was designed to expose a group of 100 – 120 bees infested with mite to three different concentrations of each tested active ingredient for 24 h. Then, the mite mortality and bee mortality were determined in comparison to Amitraz. Out of these tested active ingredients, four ingredients belong to Tetronic acid, Quinazoline, and Pyrazole, showed higher mite mortality rate and variable mortality rates to bees. These vetted products were then subjected to a semi field trial using modified beehives. Each hive had three compartments that had three frames of bees infested with *Varroa* mites in each compartment. Results of field assay indicated that candidates from Quinazoline and Pyrazole miticide classes had greater efficiency and reduced mite abundance by up to 80.12% and 67.71%, respectively, in comparison to 95.88% in positive control (Apivar®) treatment. Our research will continue to further develop an application method that is effective against mites, safe for bees, without resides, and safe for applicators for these products.

A new look at honey bees foraging in the greenhouse: Does early experience matter?

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As the climate continues to change, greenhouse agriculture will be increasingly important to our global food system. Greenhouse crops requiring pollination are mostly limited to bumble bee or hand pollination, but bumble bees are not ideal pollinators for all plants. Using honey bees for pollination would increase the number of viable greenhouse crops. Although there is some evidence that honey bees can be used for pollination in greenhouses, other research suggests that colonies decline in these environments and foraging behavior is altered. This may be because honey bees navigate via environmental cues that are altered in the greenhouse. Other studies show that bees learn to navigate their environments using experience gained during their first orientation flights. Here, we asked how environmental experience affects honeybee foraging activity and learning acquisition in greenhouses. We raised single-cohort hives outdoors or in the greenhouse until bees were several days past foraging age. The colonies were then moved into separate greenhouse or outdoor testing arenas, yielding four treatment combinations: outdoor-reared/outdoor-foraging, outdoor-reared/greenhouse-foraging, greenhouse-reared/greenhouse-foraging, and greenhouse-reared/outdoor-foraging. We observed bee activity at hive entrances and at feeder arrays containing high- to low-value pollen and sucrose resources. In a preliminary analysis, we found that greenhouse-raised bees foraging in the greenhouse collected more pollen and had more foragers visiting feeder arrays. Regardless of their experience, outdoor foraging bees collected more pollen per forager. Further analysis of our data is planned to help us better understand the effects of experience and foraging environment on honey bee foraging behavior.

Session IV – Behavior and Ecology

The grooming and biting behavior of Indiana mite biters and commercial honey bee colonies

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The honey bees (*Apis mellifera*) are the most important managed pollinator for sustainable agriculture and our ecosystem. However, the managed honey bee colonies in the United States experience 30-40% of losses annually. Among all the biotic stressors, the parasitic mite *Varroa* destructor is considered as one of the main pests for colony losses. The mite biting behavior as a *Varroa* tolerant or resistant trait has been selected in Indiana for a decade. A survey of damaged mites from the bottom of a colony can be used as an extended phenotype of the mite biting behavior to evaluate a colony. Our results showed the mite biting rates from both Indiana mite biters and open-mated colonies are significantly higher than commercial colonies from Georgia. Even though we did not detect a significant difference in the number of missing legs in mites between Indiana mite biter open mated colonies and commercial colonies, we noticed a trend of more mite legs are missing in Indiana mite biters open-mated colonies. In addition, the morphology of pollen forager worker mandibles were compared between Indiana mite biters and commercial colonies via X-ray micro-computed tomography. A significant difference was detected in the long edge of the mandible. Our results showed novel scientific evidence to explain the potential defensive mechanism against *Varroa* mites via mandibles providing the significant knowledge of a defensive behavioral trait for mite resistance and efforts in honeybee breeding.

Fluctuating Forage: Honey bee hives located in fruit orchard systems experience boom and bust periods across the foraging season

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Honey bees (*Apis mellifera*) are important pollinators of many foods, such as apples, and their presence in these landscapes is therefore beneficial to crops. However, less is known about the reciprocal of this relationship: are fruit orchards beneficial to honey bees? In particular, how are bees in an orchard feeding themselves, especially when they are located there across the entire foraging season from early Spring to late Autumn? To understand this relationship, we use the honey bee waggle dance, a unique behavior that communicates the location of quality forage, and pollen collection to investigate the foraging dynamics of honey bees in Northern Virginia, a landscape dominated by apple orchards. For two years' foraging seasons, we video recorded for one hour/ day (three or four times/week) the dances of returning foragers from three observation hives. Concurrently, we collected pollen two times/week from returning foragers for plant identification and pesticide residue purposes. We extracted the dance vectors (n = 3540 dances) and analyzed them spatially and temporally, which we also correlated with the pollen data. We found that honey bees are predominantly foraging (85% foraging) outside of apple orchards during the bloom in late April - early May. Pollen analysis demonstrates that bees are collecting pollen from apples very early in the season, but not as a primary protein source.

Honey bee workers fed fatty acid diets exhibit differences in learning and discrimination of brood odors

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Honey bee colonies consume pollen to satisfy their dietary requirements for proteins and lipids. Young worker bees consume almost all of the pollen coming into the hive, while foragers consume mostly nectar. Young bees consume pollen because it provides the nutrients required for the production of food for developing brood. Young bees also play an integral role in hive health by performing hygienic behaviors, such as removing diseased and dead brood. Past research suggests that lipids, specifically fatty acids, impact olfactory learning in honey bees. Thus, we wanted to know how fatty acids affect olfactory learning to colony-relevant odors. We fed young workers diets that were balanced or unbalanced in their ratio of essential omega fatty acids. We then measured their ability to learn healthy and damaged brood odors as well as their ability to discriminate between the two. Workers fed balanced diets exhibited higher learning acquisition to brood odors compared to those fed unbalanced diets. In addition, workers fed balanced diets can discriminate between damaged and healthy brood odors better than workers fed unbalanced diets. These results reveal crucial insight about how diet affects young worker olfactory learning, which could have downstream effects on the hygienic ability of the hive.

Row crops provide mid-summer forage for honey bees

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Insect pollination is necessary for many major food crops and is a vital ecological service. Hymenoptera and Lepidoptera species have faced declines in abundance and diversity due to external stressors including pests, pathogens, pesticides, and poor nutrition. One method of investigating underlying causes of these issues is assessing a landscape's nutritional content. Honey bees communicate their foraging location through the waggle dance, a recruitment behavior foragers use to convey the location of a good resource (i.e., distance and direction relative to the hive). Researchers can observe and interpret these signals to estimate food availability. We placed three hives in a row crop system (e.g., corn, cotton, peanuts, soybeans, wetlands, forest) and filmed bees throughout the foraging season (April - October) of 2018 and 2019. In all, we decoded and analyzed 3459 honey bee waggle dances. We found a difference in foraging distance, as communicated by dance duration, by month in both years (n = 3459, $p < 0.0001$). The shortest median foraging distances were observed in July of both years, suggesting that is when forage is more available. Percent foraging in cotton and soybean fields was between 19-30% and 10-18% respectively during full bloom in Summer. Our findings illustrate food availability within an agricultural landscape and show honey bee visitation to row crops throughout the foraging season.

Factors affecting attractiveness of soybeans to honey bees

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Soybean flowers have the potential to provide a substantial honey flow for beekeepers maintaining apiaries in agricultural regions. However, soybean flowers can be notoriously unreliable sources of nectar. Different soybean varieties display different floral characteristics including nectar production. Weather conditions can also influence nectar production, although some varieties are more sensitive to changes in temperature regimes than others. We monitored nectar production and floral visitation by honey bees in a range of soybean varieties grown in Ohio. A subset of the most and least bee-attractive varieties were grown under pollinator exclusion tents with or without nucleus colonies to assess the foraging preference of honey bees and soybean yield response to honey bee pollination. Data on soybean nectar production could help guide planting choices to maximize benefits to both farmers and beekeepers in areas hosting apiaries and may help inform the timing of pesticide applications to reduce impacts on bees.

Using colony weight monitoring to identify flowers important for honey production in the Ohio agroecosystem

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The Ohio agricultural landscape provides high potential to support honey bee foraging with resources such as crops, weeds, and pollinator enhancement plantings embedded in the landscape. Though many Ohio honey bee colonies are located in this region, there is little definitive knowledge about the flowers that are supporting honey bees in this habitat. This study aims to identify the nectar resources most important for honey production in colonies located in the Ohio agricultural landscape. Colony weight was continuously monitored for 36 colonies at 12 apiaries in central Ohio located on a gradient of agricultural intensity in 2019 and 2020. These weight data not only help us better understand within-colony dynamics, but also indicate periods of nectar flow and dearth on the surrounding landscape. Colony weight data will be analyzed in tandem with pollen metabarcoding analysis of honey samples collected periodically from study colonies over the foraging season. This will allow us to identify the floral resources contributing to periods of colony weight gain and honey production. Preliminary results indicate a period of colony weight gain in many colonies in mid to late July, when soybeans are blooming in Ohio. Metabarcoding analysis of honey samples collected during this bloom period will be analyzed to identify the resources contributing to this weight gain. This study will expand our understanding of honey bee foraging in the Ohio agroecosystem, identifying the flowers most important for honey production in this region.

Lightning Talks

Assessing alternative tools for performing hygienic behavior testing for beekeepers

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Hygienic behavior testing in honey bees is used to assess mite or disease tolerance in colonies. Liquid nitrogen is applied to a portion of brood inside capped comb cells to freeze-killed pupating brood. The rate of removal of freeze-killed brood reflects how quickly workers may detect mite-infested or disease-infected brood and remove the infected brood from the hive before transmission to nestmates may occur. Currently, there are few options for hygienic testing of colonies for non-commercial apiaries due to the challenges associated with access, storage and use of liquid nitrogen. Many hobbyist and small scale beekeepers would like to learn the tools needed to test and select for hygienic behavior in local stock. This research seeks to develop and test novel tools for beekeepers to use in management of their hives for hygienic testing. Comparisons of the current hygienic test using liquid nitrogen will be compared with commercially available alternatives and measured for effectiveness and duration of treatment. Results will be used to inform beekeepers of cheap, fast, and easily replicable alternatives for hygienic testing in the field.

Comparing sample types, and sequencing approaches for the characterization of the honey bee (Apis mellifera) gut microbiome

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The diverse members of the honey bee gut microbiome have a symbiotic and/or pathogenic relationship with honey bees, and they directly impact bee health and immunity. 16S rRNA amplicon and shotgun metagenomics sequencing are used to study microbiome composition of the honeybee gut microbial communities. In this study, we compared the resolution of shotgun metagenomic sequencing and 16S rRNA microbial community profiling for the characterization of bacterial members within the honey bee microbiome. We also investigated the relative representation of gut microbiome reads compared with all classified reads in different sample types. Our sample types included the whole bee and bee abdomen, as well as dissected whole gut and hindgut. We evaluated the impact of sample type and sequencing depth on the taxonomic profiling of the honeybee gut microbiome and compared different databases for bioinformatic analysis. We determined that, at the genus level, one pooled sample can represent a group of 10 honey bees, and all sequencing approaches are able to give an accurate representation of the core microbiota. However, metagenomics sequencing is advantageous at the species level and lower taxonomic ranks. Species rarefaction analysis showed that deep-sequenced samples discover species at a greater rate than shallow-sequenced samples, indicating that taxa abundance information is gained through deeper sequencing. The work presented here will help inform decisions on methodological approaches for bee microbiome studies tailored to specific research questions in bee health and nutrition.

Developing Integrated Pollination Conservation and Research Efforts at Kimmel Orchard

Courtney Brummel[1], Louise Lynch-O'Brien[1], Susan Weller[1,2], Judy Wu-Smart[1]
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Beekeepers are facing increased challenges, from honey bee population loss to the spread of misinformation in management guidance. As the diverse audience of hobbyist beekeepers grows, innovations are essential, particularly as the reasons for keeping bees have also diversified. Beekeepers today are not just interested in honey production but also providing pollination services, producing value-added products, and offering educational opportunities to new beekeepers. This research examines how beekeeping management differs with alternative hive structures or the hive boxes that are used to house each honey bee colony. Data on various functional measures, such as honey production, brood rearing, thermoregulation and overwintering success will help elucidate advantages and disadvantages of each alternative hive structure compared to the traditional Langstroth hive. Results from this project may facilitate successful management of bees for educational purposes which will enhance external partnerships, increase educational opportunities, and further promote engagement with local communities regarding the importance of pollinator-friendly landscapes and practices that support healthy bee communities.

Effects of amitraz and amitraz+thymol acaricide treatments on *Varroa destructor* in *Apis mellifera* honey bee colonies

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More than 30 years after the arrival of the ectoparasitic mite *Varroa destructor*, American beekeepers still struggle to manage this damaging pest of honey bees (*Apis mellifera*). While it is preferable to maintain low *V. destructor* levels throughout the year, it is also important to bring mite levels down rapidly if they reach a damaging level prior to the critical Winter season. During the Fall in Alabama, 32 colonies with high levels of *V. destructor* (mean infestation of adult bees 11.3%) were used to test if concurrent treatment with two registered active ingredients (amitraz and thymol) could improve the management of *V. destructor* compared to an amitraz only based treatment. This was achieved by allocating colonies in late September to two treatment groups that received: 1) Four Apivar® strips (amitraz 3.3%) per colony; and 2) Four Apivar® strips and 51 mL of Apiguard® (thymol 25%), all applied at one visit. Full colony assessments were performed before treatment application, mid-treatment (21 days post-application), and upon completion of the 42-day treatment period. This included visual estimation of the number of adult bees and the area of sealed worker brood per colony. At the same time, *V. destructor* abundance on adult bees was also assessed by an alcohol wash method, as was percent brood infestation, which allowed an estimate of the total *V. destructor* population per colony. Sealed worker brood area was also estimated on Day 10. Preliminary analyses indicate that both treatments reduced the *V. destructor* population in the colonies by Day 42, and that the regimens were similarly effective. There was no treatment effect on the number of adult bees, but estimation of sealed brood area on Day 10 was suggestive of a reduced brood area in the Apivar®+Apiguard® treatment. This and the pieces of pupae observed on the bottom boards in the combination treatment point to brood removal in this group in the first days of the treatment. Of the 27 colonies that remained at the end of the trial, 10 still had *V. destructor* abundances on adult bees that exceeded 3.0%; 7/14 for Apivar® and 3/13 for Apivar®+Apiguard® treatments. The colonies will be monitored through the winter to detect any delayed treatment effects.

Reusing equipment from dead outs and the potential impacts on queen rearing capacity

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This study evaluates the potential impact of reusing combs from colonies that have previously died. Consistently high losses of colonies within apiaries may be the result of environmental or abiotic stressors (such as pesticide exposure or malnutrition) or biotic pressure from high mite or disease loads. Reusing combs from previous dead colonies to restock new hives is a common beekeeping practice that may adversely affect survival of subsequent colonies. Exposure to pesticides through contaminated comb and food may impact queen development, mating, and egg viability, thus impairing a colony's ability to replace their queen if necessary. This research examines the role old "deadout" comb plays on requeening success and the viability of replacement queens reared by queenless microcolonies. We established two treatment groups that used, 1) combs from good performing apiaries, or 2) combs from "deadout" colonies originating from an apiary suspected to have chronic pesticide exposure and contaminated food stores. The number of queen cells formed, adult emergence success rate, and measures of virgin queens (weight, wing length, head length, and head width) will be compared among treatments. A separate subset of reared queens will be observed for timing of egging laying, and egg laying behavior, to determine if colonies are able to successfully rear viable, functional replacement queens.

Plausibility of novel honey bee semen cryopreservation methods

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Cryopreservation of germplasm is used in several livestock species to accelerate artificial selection of desirable traits. Recently, semen cryopreservation has been successfully introduced to honey bees, bolstering trait selection for bee breeders and aiding conservation efforts for threatened bee populations. The leading cryopreservation method uses slow-programmable freezing to achieve long-term storage of honey bee germplasm; however, this method is costly and time consuming, making it less accessible to bee breeders and researchers. Additionally, the success of this method is inconsistent, producing inseminated queens with variable fertilization success, prompting the need for an alternative freezing method. Here we test two freezing devices, the CryoLock and microdialysis tube, with varying levels of cryoprotectant (20%, 40%, or 60%). Each device was either plunged directly into liquid nitrogen (vitrification) or submerged in liquid nitrogen vapor (vapor immersion) before being stored. The post-thaw sperm viability and subjective motility of these techniques were compared to those of slow-frozen semen and non-frozen controls. In general, semen frozen in dialysis tubes produced higher motility and sperm viability than those frozen with the CryoLock. The same trend was observed between vapor immersion and vitrification, with vapor immersion proving superior. Compared to slow-programmable freezing, only dialyzed semen immersed in vapor with 20% cryoprotectant produced comparable sperm motility and viability. Future brood evaluation studies on queens inseminated with dialyzed semen immersed in vapor with 20% cryoprotectant should be performed to determine if this method can effectively replace slow-freezing and alleviate financial barriers imposed on bee breeders.

Introducing the Bee Health Collective

Grace Kunkel, Nathalie Steinhauer[2]
[1]Project Apis m.
[2]The Bee Informed Partnership

The Bee Health Collective is a collaboration of stakeholder organizations to gather and share current, credible information about honey bee health. Founded by Project Apis m. and the National Honey Board in 2019, the mission of this project is to provide a 'one-stop shop' resource with information about honey bee health, honey bee research, and the beekeeping industry. This information is presented as infographics, images, and narrative, and focuses on how these topics relate to important things like agriculture, resource management, and food. In addition to the general information, there are two other main features of the site: A comprehensive research database, and a bulletin board for bee-related opportunities. The database is searchable by topic, funding source, researcher, or institution, and contains funded honey bee projects in the United States since 2009. The bulletin board is a free resource where anyone can post or find honey bee related jobs, research funding, and scholarships. In addition to Project Apis m. and the National Honey Board, The Bee Health Collective is supported by the USDA, the Almond Board of California, and the Bee Informed Partnership.

Abstracts from ABRC 2020

The physiological effects of oxidative stress in feral honey bees

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Honey bees are the most important managed pollinator in agriculture but the long-term survival of their colonies is seriously threatened. Oxidative stress is closely related to the lifespan and ageing of honey bees. Many synthetic pesticides and herbicides are thought to increase oxidative stress in honey bees. More work is needed to determine the impact of increased oxidative stress on honey bee health and survival. Feral colonies have displayed higher mite resistance comparing to commercial package bees. However, it is unknown whether there is any difference between the aging and levels of oxidative stress between these two populations. We sought to determine the impact of oxidative stress of forager workers by collecting them from paired colonies (a feral colony and a managed commercial colony) with similar foraging resources. Results exhibit a significant difference of survival time and oxidative stress via lipid damage between feral and commercial honey bees. Our study provides new evidence of the difference physiology and oxidative stress between feral and commercial stocks.

Neonicotinoid pesticides are more toxic to honey bees at lower temperature: implications for overwintering bees

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The honey bee (*Apis mellifera* L.) is an important pollinator and the best model for pesticide effects on insect pollinators. The effects of agricultural pesticides on honey bee health have consequently raised concern. Honey bees are suffering from eminent colony losses in the northern and eastern hemisphere possibly because of a variety of growing problems, with which pesticides may interact to exacerbate their impacts. Effects of various pesticides have been measured for multiple responses such as learning, memory performance, feeding activity, and thermoregulation. These studies were conducted at many different temperatures (11-35°C), however, few studies compared the toxicity of the same pesticide to bees at different temperatures. It is possible that the same pesticide might show different toxicity to honey bees at different temperatures. To reveal such potential interactions, we administered low doses of two neonicotinoid insecticides (imidacloprid @ 250 ppb and thiamethoxam @ 125 ppb) at three different temperature scenarios (35°C, 24°C and a varying temperature) and determined the effects on honey bee survivorship. We discovered that honey bees are much more sensitive to the neonicotinoid pesticides imidacloprid and thiamethoxam at a constant 24°C or at a varying temperature (night at 13°C and day at 24°C) compared to bees at 35°C. These results suggest that honey bee colonies during wintertime will be more sensitive to pesticides. Doses of neonicotinoids that are safe to colonies during Summer might kill them during the wintertime.

Extended-release Oxalic Acid in Virginia

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Extended-release oxalic acid Scott shop towels seem an effective method of treating *Varroa* mites in beehives in the Summer in California. These shop towels were soaked in a 1:1 mixture of glycerin and oxalic acid and applied to the hives. We repeated Randy Oliver's study in our high humidity climate of Northern Virginia and found mixed results. Four hives were responsive, two hives were neutrally affected, and two hives had high increase in mite count. The response to extended-release OA might be to multiple factors. The bees could be hygienic and resistant to mites, the high humidity might affect the chemistry of the glycerin, the bees behavior might affect the rate of shop towel removal and thus their exposure to the oxalic acid. Further studies are needed to elucidate reason(s) for varied responses.

Honey bee queen flight ability negatively impacted by Nosema infection

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Nosema ceranae (Nc), a fungal pathogen that infects honey bee's midgut epithelial cells, can affect honey bees in many aspects. However, whether infection with this pathogen can affect honey bee queen's ability to fly has not been investigated. We fed each newly emerged queen with 100,000 Nc spores (via 5 ul sugar syrup) and let the queens age inside cages for 10 days. On the age of 11 days (day 1=emergence), we tested their flight performance using flight mills. We found significant negative effects on queen flight distance, flight duration, maximum flight speed, and both the flight duration and flight distance of the longest flight episode. No significant differences were found for other parameters, such as number of stops, stopping time, and the average flight speed. Our results suggest that Nosema ceranae infection can have significant negative impacts on queen flight ability and thus may affect their mating success. The fungal infection by Nosema ceranae thus can have more serious negative impacts on honey bee health, than previously considered.

Effect of various pollen substitute on honey bee worker longevity and size of hypopharyngeal glands

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There are currently many types of pollen substitutes available in the market, which are used to feed honey bee colonies when there is pollen dearth. We tested several common pollen substitutes in the market, including Beepro, Megabee, Nutrabee, and Ultrabee, with sugar only as a negative control, and mixed bee collected pollen as a positive control, and also a yeast extract. All pollen substitutes were mixed with 50% syrup to yield the same soft pliable consistency and provided to caged bees. Longevity was tested at 34.5°C and 50% RH. We measured pollen consumption every five days and on day 10 sampled five bees per cage for the size of hypopharyngeal glands. We replicated the study with bees from five different colonies. In general, pollen yielded the longest survival bees while sugar gave the shortest longevity. Pollen substitutes yielded longevity between these two extremes and their rankings varied among different trials.

Neonicotinoid pesticides are more toxic to honey bees at lower temperature: implications for overwintering bees

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The honey bee (*Apis mellifera* L.) is an important pollinator and the best model for pesticide effects on insect pollinators. The effects of agricultural pesticides on honey bee health have consequently raised concern. Honey bees are suffering from eminent colony losses in the northern and eastern hemisphere possibly because of a variety of growing problems, with which pesticides may interact to exacerbate their impacts. Effects of various pesticides have been measured for multiple responses such as learning, memory performance, feeding activity, and thermoregulation. These studies were conducted at many different temperatures (11-35°C), however, few studies compared the toxicity of the same pesticide to bees at different temperatures. It is possible that the same pesticide might show different toxicity to honey bees at different temperatures. To reveal such potential interactions, we administered low doses of two neonicotinoid insecticides (imidacloprid @ 250 ppb and thiamethoxam @ 125 ppb) at three different temperature scenarios (35°C, 24°C and a varying temperature) and determined the effects on honey bee survivorship. We discovered that honey bees are much more sensitive to the neonicotinoid pesticides imidacloprid and thiamethoxam at a constant 24°C or at a varying temperature (night at 13°C and day at 24°C) compared to bees at 35°C. These results suggest that honey bee colonies during wintertime will be more sensitive to pesticides. Doses of neonicotinoids that are safe to colonies during Summer might kill them during the wintertime.

A Dataset of Varroa Survey

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[2]Biene Österreich (Austrian Beekeepers Association)

Varroa destructor is classified as an ectoparasitic mite and currently poses one of the most serious threats to the western honey bees (*Apis mellifera* L.). This mite has invaded many western honey bee populations throughout most of the world, leading to diminished colonies for hobbyist and commercial beekeepers. This research will utilize survey data on the varroa infestation rates of honey bee colonies in Austria, and examine the potential factors affecting these infestation rates. The *Varroa* survey data is collected from three sources of varying quality by both software and a mix of trained and untrained individuals. The data of factors that we believe is most likely to affect *Varroa* infestation levels was collected and consists of two categories. The first is beekeeping factors which includes the location and elevation of the beeyard (the spatial dimension), and time of the year (temporal dimension). The second is weather factors which include daily values of temperature, dew point, wind speed, and precipitation. The goal of this research is to build a prediction model for *Varroa* distribution, and to enhance the existing models by utilizing this data. Although this model will be limited to Austria, it will be able to be used in other parts of the world with similar climate and elevation zones. By predicting the spatial distribution of *Varroa* on these factors, there might be an opportunity to give beekeepers advanced warning of infestations nearby so they can take precautions and protect their hives from varroa outbreak in the future.

A data mining to validating good beekeeping practices

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As humanity continues to understand and battle the effects of climate change on the world today, pushing research forward in all segments of natural life is critical. The environment and habitat of almost all species around the world are being affected by these changes, and pollinators are definitely not an exception. As part of the United Nations 17 Sustainable Development Goals, the Istituto Zooprofilattico Sperimentale del Lazio e della Toscana (Veterinary Beekeeping Laboratory Office) and affiliated with the Food and Agricultural Organizations took on this global best beekeeping practices project. The first part of this project culminated in a list of 234 beekeeping practices, that are proven to help with key hive metrics like survival and honey flow. In the next chapter of the BPractices project, we were searching to prove a handful of practices legitimacy using data from apiculture integrated software systems. During this iteration of the project we have proven five of the seven original hypothesized practices to be legitimate. Record keeping, treatments, Fall, Spring, and Winter inspections have all been proven as significant factors in the hives survival rates through this study. Further analysis of the queen acceptance and yard address variables would be needed to prove these. The final phase of this project will be transferring the information we have gleaned from the database analysis, to an economic metric for impact. This will be conducted by officials qualified for this analysis at the United Nations. Preparing the data and understanding what the differences are between the groups that survived and those that died is critical to the forward progress of this project in the coming months.

Prospective Advantages of GIS in apiculture

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Geographic Information Systems (GIS) are frameworks designed to capture, store, manipulate, analyse, manage, and present spatial data. GIS integrate combinations of hardware tools such as GPS and remote sensing, and software platforms such as Google maps, and ESRI packages. GIS are used in hundreds of different applications ranging from the daily used car and smartphone navigators to the complicated astronomy issues. GIS have appeared in apiculture almost 20 years ago. This review work has mined the online information about the efforts had done to employ GIS in apiculture; in both research and business. Scientific literature, R&D initiatives, and commercial start-ups that have used GIS in apiculture has been screened. Moreover, the future prospective services that GIS can provide to apiculture are brain-storming here. Finally, we are announcing our proposed "US Bee Map" initiative. The very brief conclusion is that the past uses of GIS in apiculture were extremely less than the potentials. However, the future is promising.

Pathogenic Associations with Winter Colony Loss in Canada

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Canadian beekeepers report that high pathogen/parasite infestation levels, poor queen quality and severe weather conditions are the leading causes of elevated wintering losses. In order to replenish annual losses or maintain their operations, beekeepers in Canada face a unique and difficult situation for purchasing new queens or package bees. Scarce local supply drives local producers to import approximately 300,000 queens and packages each year, predominantly from foreign sources. This large-scale importation of stock may contribute to the introduction of undesirable pathogens or genetics, and supply bees that have not been selected to survive and prosper in northern temperate climates, thereby influencing wintering success. Honey bees act as a host for a multitude of pathogens and parasites. Nevertheless, the interactive effects that many of these pathogens, endoparasites and ectoparasites have on colony wintering success remains poorly understood. In order to better understand these interrelationships, we studied colony health and wintering success as a part of an ongoing national-scale study. In 2016 and 2017, we sampled 1025 and 520 colonies, respectively, across five Canadian provinces. During each experimental year (May through April), we collected pre-winter phenotypic data (Fall colony weight and cluster size), and samples for pathogen analysis (Nosema spp., Lotmaria passim, DWV-A, DWV-B, BQCV, SBV, and phoretic loads of *Varroa* destructor) from colonies in all locations to investigate the main drivers of colony Winter mortality. We also studied colonies wintered outdoors, as well as those wintered inside specialized wintering facilities. Although Winter mortality was statistically similar between 2016 and 2017, indoor-wintered colonies had greater survival than those wintered outdoors (92% vs 77%). Irrespective of wintering method, consistent influences were seen across both experimental years, based on logistic regression modelling. Elevated levels of DWV-A, DWV-B, BQCV and Fall phoretic mite loads increased the risk of colony death during Winter, whereas higher fall colony weights, larger cluster sizes and increased sealed brood areas exerted positive influences on survival outcomes.

Using 48-hour queen cells to study the queen quality of honey bees

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Apiculturists desire to maximize their investment in their apiaries to obtain healthy colonies but often struggle on which source of bees is the best: commercial package bees or feral bees stocks. The fitness of a colony often time depends on the quality of the queen who lays approximately 2,000 eggs per day in the Summer. In addition, virgin queens go out for mating once and store drone sperm inside the spermatheca!. The quality of the queen is measured upon her ability to reproduce in the colony. To ensure that the queen is viable beekeepers have developed an inexpensive way to make virgin queens mobile using 48-hour queen cells. A queen cell of larvae after grafting was built by nurse bees for 48 hours in a queenless colony. Then the queen cell can be moved around into different apiaries for increasing the genetic diversity. It is unknown whether a difference occurs in the quality of 48-hour queen cells between feral and commercial honeybees. We monitored and test the survival rate and development of three queen cells from each population. Comparing to 100% of successful emerging and returning from mating flights in feral colonies, commercial package colonies only had 33% of survival rate. In the coming field season, we will increase the sample size and compare the queen quality in the numbers of eggs laid by each queen. Our research will provide unique information on the quality of queens between feral and commercial colonies.

DRONE BIOLOGY AND BEHAVIOR

Clarence **Collison**

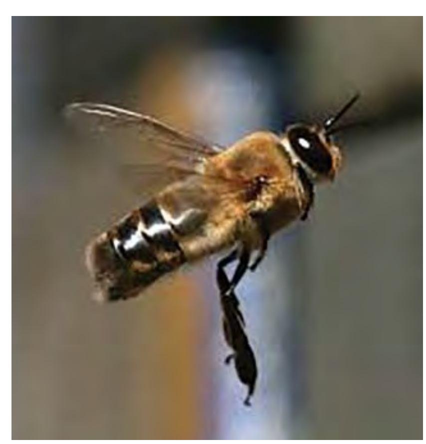
Environmental And In-Hive Conditions Can Affect The Quality Of Drones

"Honey bee colonies are typically composed of one queen, thousands of female workers, and a few thousand seasonal males (drones) that are reared only during the reproductive season when colony resources are plentiful. Despite their transient presence in the hive, drones have the important function of mating with virgin queens, transferring their colony's genes to their mates for the production of fertilized, worker-destined eggs. Therefore, factors affecting drone health and reproductive competency may directly affect queen fitness and longevity, having great implications at the colony level. Several environmental and in-hive conditions can affect the quality and viability of drones in general and their sperm in particular (Rangel and Fisher 2019)."

"Older honey bee drone larvae are fed with a diet containing pollen. It is not known how pollen deprivation during the larval development of drones might affect their reproductive quality. Czekońska et al. (2015) investigated ejaculation ability and semen quality in drones reared in colonies with limited (LP) and unlimited (ULP) access to pollen. Access to pollen was limited by pollen traps. Drone brood rearing was not instantly abandoned in colonies with limited access to pollen. Colonies from the LP group reared drones with smaller mass, which ejaculated in fewer numbers and released smaller amounts of semen. The LP and ULP groups did not differ in semen quality as judged by the concentration, number and viability of spermatozoa in ejaculate. It was found that access to pollen during larval development directly affects the reproductive quality of drones."

"Colonello and Hartfelder (2003) analyzed mucus gland protein content and pattern for drones of Africanized honey bees. The effect of exogenous ecdysteroids on mucus gland maturation was judged against the endogenous ecdysteroid titer. During the first five days of adult life, the mucus protein content increases steeply, whereas the protein pattern becomes reduced in complexity. Subsequently, the protein content decreases, reaching a plateau level at day eight. The protein pattern of mature glands is characterized by three dominant polypeptides. Injection of 20-hydroxyecdysone into newly emerged drones abolished the normal increase in protein content and prolonged the persistence of the protein pattern typical for immature glands. Ecdysteroids thus appear to act as negative regulators in the maturation process of drone mucus glands. This hypothesis received support from analyses of the hemolymph ecdysteroid titer, which was found to rapidly decline soon after emergence."

"Mezawa et al. (2013) determined the neuroendocrine mechanisms underlying regulation of mating flight behaviors in drone honey bees. Both a precursor of dopamine (3,4-dihydroxyphenylalanine: DOPA) and a precursor of octopamine (tyramine) in the brain decreased in an age-dependent fashion before sexual maturation (i.e. eight days of age), whereas the levels of brain dopamine, dopamine metabolites (N-acetyldopamine and norepinephrine) and octopamine were increased. These age-dependent increases of dopamine and octopamine were also detected in the meso-metathoracic ganglia. Injection of either dopamine or octopamine into seven to eight-day-old males shortened the duration for flight-initiation and increased the duration of wing vibration, indicating that both dopamine and octopamine enhance the flight-initiation and -sustaining activities in males. Applications of a juvenile hormone analog (methoprene) enhanced the levels of dopamine in the brains of four-day-old males, but this enhancement was not detected in either brain octopamine or meso-metathoracic dopamine and octopamine. Thus, they found that both dopamine and octopamine in the brain and meso-metathoracic ganglia increase until sexual maturation and could enhance the activities



of mating flight independently; in addition, the increase in levels of dopamine in the brain could be selectively regulated by juvenile hormone."

"Jaycox (1961) studied the sexual maturity of drone honey bees to determine reasons for differences in maturity among drones of equal age. Maturity of the drones was judged by the number of spermatozoa in the seminal vesicles and vasa deferentia. At 93°F., drones caged without worker bees attained maturity at about the same rate and to the same level as those allowed free flight or caged in a nursery colony. Drone maturity was retarded slightly at 88°F. and seriously at 83°F. At the highest temperature the drones matured normally when fed honey syrup containing pollen or royal jelly (4 percent by weight) or on plain syrup. The retarding effect of the 83° temperature appeared to be offset in part by the presence of royal jelly in the diet."

"Reyes et al. (2019) studied the activity of drones during their entire life in Spring and Summer by using an optical bee counter at the entrance of the hive. Drones were active in the afternoon, with most flights occurring between 14:00 and 18:00. Short orientation flights were performed at six to nine days old, and longer mating flights of 30 min were performed from the age of 21 days onward during the spring and from the age of 13 days onward during the Summer. Their registers showed that 50 and 80% of the drones remained faithful to their colony (did not drift) in Spring and Summer, respectively."

"Many environmental factors can negatively impact drone semen quality, but little is known about factors that impact the drones' ability to successfully mate and deliver that semen, or how widely drones vary. Metz and Tarpy (2019) observed the daily variation in honey bee drone reproductive quality over time, along with a number of morphological traits. Drones were reared in cages in bank colonies, and 20 individuals were dissected and measured daily. The number of viable spermatozoa in the seminal vesicles was zero at emergence and reached an average maximum of 7.39 ± 0.19 million around 20 days of life. Decline in spermatozoa count occurred after day 30, though viability was constant throughout life, when controlling for count. Older drones had smaller wet weights, head widths, and wing lengths. They predict that this is likely due to sampling bias due to a differential lifespan among larger, more reproductively developed drones. Their study shows that drones are more highly variable than previously suggested and that they have a significant variation in reproductive physiology as a function of age."

"Czekońska et al. (2013) compared the volume of semen and viability of spermatozoa collected from drones at ages 15, 20, 25, and 30 days. The drones originated from different queens and were reared in different environments. Semen volume was determined by measuring the filled length of a capillary. Percentages of live and dead spermatozoa were determined by SYBR-14/propidium iodine fluorescence staining and flow cytometry. The volume of semen collected from drones ranged from 0.5 to 1.3 µL. The mean volume of semen significantly decreased with drone age. Sperm viability increased significantly with drone age."

"At a natural drone congregation area free-flying drones were attracted by a fast-moving queen dummy and the pursuits of drones were stereoscopically recorded. The reconstruction of 192 flight paths from successfully approaching drones in chronological three dimensional sequences lead to the following results: 1) The alignment of the drone's longitudinal body axis coincides fairly well with the line connecting drone and queen (drone-queen-axis), its mean angular deviation from this line being only 14°. Angles between -5° and 5° occur most frequently. Thus, drones head straight to the queen. 2) Lateral deviations from the drone-queen-axis most frequently lie between -30° and 30° which corresponds to the drone's binocular visual field. 3. The drone's heading was continuously adjusted to the actual target, mean turning speed being 1890°/s. 4) The results lead to the conclusion that honey bee drones choose the shortest way to a fast and not predictably moving mate. A comparison with earlier observations suggests that a drone's mating success depends not only on his skills to win a race but also on his persistence within a group (Gries and Koeniger 1996)."

"The honey bee queen mates during nuptial flights, in the so-called drone congregation area where many males from surrounding colonies gather. Using 20 highly polymorphic microsatellite loci, Baudry et al. (1998) studied a sample of 142 drones captured in a congregation area close to Oberursel (Germany). A parentage test based on lod score (measure of relatedness of two individuals, the likelihood of linkage between genes) showed that this sample contained one group of four brothers, six groups of three brothers, 20 groups of two brothers and 80 singletons. These values are very close to a Poisson distribution (probability distribution that expresses the probability of a given number of events occurring in a fixed interval of time or space). Therefore, colonies were apparently equally represented in the drone congregation, and calculations showed that the congregation comprised males that originated from about 240 different colonies. This figure is surprisingly high. Considering the density of colonies around the congregation area and the average flight range of males, it suggests that most colonies within the recruitment perimeter delegated drones to the congregation with an equal probability, resulting in an almost perfect panmixis (means random mating). Consequently, the relatedness between a queen and her mates, and hence the inbreeding coefficient of the progeny, should be minimized. The relatedness among the drones mated to the same queen is also very low, maximizing the genetic diversity among the different patrilines of a colony."

"Males of the honey bee fly to specific drone congregation areas (DCAs), which virgin queens visit in order to mate. From the thousands of drones that are reared in a single colony, only very few succeed in copulating with a queen, and therefore, a strong selection is expected to act on adult drones during their mating flights. In consequence, the gathering of drones at DCAs may serve as an indirect mate selection mechanism, assuring that queens only mate with those individuals having a better flight ability and a higher responsiveness to the queen's visual and chemical cues. Jaffé and Moritz (2010) tested this idea relying on wing fluctuating asymmetry (FA) as a measure of phenotypic quality. By recapturing marked drones at a natural DCA and comparing their size and FA with a control sample of drones collected at their maternal hives, they were able to detect any selection on wing size and wing FA occurring during the mating flights. Although they found no solid evidence for selection on wing size, wing FA was found to be significantly lower in the drones collected at the DCA than in those collected at the hives. Their results demonstrate the action of selection during drone mating flights for the first time, showing that developmental stability can influence the mating ability of honey bee drones. They therefore conclude that selection during honey bee drone mating flights may confer some fitness advantages to the queens."

"At the beginning of natural mating, the drone becomes paralyzed. However, the muscles in the abdomen continuously contract shrinking the abdomen till mating has ended and the pair have separated. It is not the queen that ends the nuptial flight. The termination of the nuptial flight is determined by the drone, which fails to remove the mating sign of the previous drone from the sting chamber of the queen. The mating sign originates from two or more drones. The queen also does not determine the age at which she starts oviposition. It is the last drone, which tried to mate, but failed to remove the mating sign of the predecessor, that determines the age that the queen starts oviposition (Woyke 2016)."

"Honey bee colonies invest a substantial amount of colony resources in the production of drones during the reproductive season to enable mating with virgin queens from nearby colonies. Recent studies have shown significant differences in the production of sperm cells that are viable (i.e., sperm viability) and can fertilize an ovule among sexually mature drones that are exposed to different environmental conditions during development or as adults. In particular, sperm viability may be negatively affected during drone development from exposure to pesticides in contaminated beeswax. To assess whether sperm viability is negatively affected during drone development from exposure to beeswax contaminated with in-hive pesticides, Fisher and Rangel (2018) compared the viability of sperm collected from drones reared in pesticide-free beeswax with that of drones reared in beeswax contaminated with field-relevant concentrations of the pesticides most commonly found in wax from commercial beekeeping operations in the United States. These pesticides include the miticides fluvalinate, coumaphos and amitraz, and the agro-chemicals chlorothalonil and chlorpyrifos. Sperm from drones collected at 10 and 18 days post emergence were classified as viable or non-viable to calculate sperm viability. For all pesticide treatment groups, drones that were reared in pesticide-laden beeswax had lower sperm viability compared to those reared in pesticide-free beeswax. This difference was especially pronounced among drones reared in miticide-laden wax. Their results reinforce the notion that pesticide contamination of beeswax negatively affects the reproductive quality of drones, which can affect the queens they mate with, ultimately compromising colony health."

"Ciereszko et al. (2017) evaluated the effects of chronical exposure of honey bee drones to environmental (5 ppb) and non-environmental concentration (200 ppb) of imidacloprid (IMD) on sperm concentration, motility, viability and mitochondrial membrane potential measured in semen obtained from 180 drones originating from 18 colonies. The results demonstrate that IMD exposure did not affect sperm concentration; however, there were significant differences in concentration within colonies. IMD exposure was associated with reductions in sperm motility, which also varied within colonies. Statistically significant interactions between IMD exposure and colony were found for active mitochondria and sperm viability. Their results strongly suggest that neonicotinoids can negatively affect honey bee drone sperm quality. It is important to emphasize that IMD actions can be strongly modulated according to the colony."

"Maintaining honey bee drones in the laboratory can be important for the purposes of instrumental insemination of queens and studying the effects of pesticides on drones. Few studies have been performed on the survival of mature drones in the laboratory. Abou-Shaara and Elbanoby (2018) investigated factors impacting the survival of mature drones. Small cages were used to facilitate observation of drones. Their study showed that some factors can impact the survival of drones passively. These factors were sugar candy as a food source, collecting drones from colonies with egg laying workers, and caging drones without attendant bees.

Outcome was improved when the attendant workers were nursing bees either from the same colony from which the drones were collected (preferable) or from another colony. Placing caged drones in complete darkness was better than under light. Avoiding these factors can help increase the survival of caged drones under laboratory conditions." BC

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Minding Your Bees And Cues

Meal Planning – Hungry Bees

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

What do you do if you have no bees, but want bees? Or if you have bees but want more? There are a few options.

1. If you're a do-it yourself type, Constantine VII Porphyrogenitus (a Macedonian Emperor in the 10th century) recommends the following method (we truly do not):
   "Build a house, 10 cubits high, with all the sides of equal dimensions, with one door, and four windows, one on each side; put an ox into it, 30 months old, very fat and fleshy... kill him...let a quantity of thyme be strewed under the reclining animal, and then let windows and doors be closed and covered with a thick coating of clay, to prevent the access of air or wind. After three weeks have passed, let the house be opened, and let light and fresh air get access to it, except from the side from which the wind blows strongest. Eleven days afterwards, you will find the house full of bees, hanging together in clusters, and nothing left of the ox but horns, bones and hair."

2. If you are an adventurous soul, like free things, and are okay leaving things partially up to fate, you can try to catch a swarm. In springtime, when there's plenty of nectar and pollen coming in and overwintered colonies are growing quickly (mid-May for us in northern climates), honey bees will have the impulse to reproduce – called swarming. The bees will raise new queens, and, when those queens are about ready to emerge, the old queen will leave with a slew of workers and settle in a cluster somewhere (like a tree branch) to decide on a new place to live (like a hollow tree, box, or a the eaves of house, ten cubits high). This is where you come in: you can shake the swarm, gentle and distracted by the business of relocation, into a box. Even better, you can find the queen within the swarm, and put her in the box first. The rest of the bees will smell her pheromones and follow her into the box. For a more hands-off approach, you could try setting up a trap or an empty hive, perhaps with a frame of honey, and hope that the swarm decides to move in. Local beekeeping clubs usually have a sign-up for people who want swarm alerts.

3. If you're looking for a quick and reliable fix, order a package of bees. If you order from a local beekeeping supplier, package pickup day is an exuberant day where all kinds of beekeepers converge to pick up their bees. People are glad to see their fellow beekeepers after the long winter. If you ordered through the postal service, pickup won't be quite as festive: maybe a slightly freaked out call from a post office employee and some weird looks when you hustle your box labeled "live bees" out of there.

Installing a new package of bees on foundation gives your colony a cleaner start. Note the mite testing jar in the top right corner. It is easy to do a powdered sugar roll test prior to releasing the queen into the package.
Jody Gerdts photo)

But what are package bees? Where did they come from? Unlike Constantine VII's recipe for brand-new bees, a package of bees is a mix of lots of different bees likely from a few different hives. Large-scale beekeepers with bee yards in warmer climates can make up packages in early spring, and ship them across the country, long before cooler climate beekeepers can raise queens. A package is made by combining a young, mated queen with a bunch of young bees – around two or three pounds. The bees may be "shaken" from many different hives into a wooden or plastic box with vented sides. The queen is added in a separate cage, so that all those random workers have time to get familiar with her scent during the trip to your place.

4. If you don't mind waiting a little bit longer in Spring, you can buy a nuc. A nuc – short for "nucleus colony"– is a small colony that has all the essential components of a full-sized colony: a mated queen, worker bees, drawn combs, and honey and pollen stores. Getting a nuc means your "new" colony will have a head-start (they already have drawn wax, unlike a package) and will grow quickly. With the head-start of drawn combs comes the additional risk of parasites, pesticides and disease. While understanding colony health diagnostics is always critical, you might have to employ your skills sooner if you are a new beekeeper with nucs. We suggest marking and rotating out nuc frames quickly if they are not newly drawn. Look to your beekeeping clubs for nucleus colony sources; there are many great providers out there.

5. If you successfully wintered bees, dividing (splitting) them prior to swarming will increase your number of colonies. Local beekeeper experts will be able to

help you with timing of the divides, introduction of a new queen and managing your growing apiary.

6. If you're the type to always think outside the box, consider hosting bees that don't live in boxes. First step, transform your yard into a refuge where many types of bees, like sweat bees, mason bees, bumble bees, and leafcutter bees will thrive on their own. When your beekeeper neighbor asks what kind of bees you have – perhaps expecting to get into it about the pros and cons of Italian or Russian stocks--you can pull out your phone and show them the leaf-based evidence of your very own adorable leafcutter bees. BC

Impress your friends with your pictures of leafcutter bee evidence. Using her mandibles, a leafcutter bee will make circular cuts in leaves to use for her nest partitions. Look closely to identify the multiple leaf cuts made by bees in this maple sapling. Making sure you have bare ground and plant stems available for bees nesting in your yard.
(Becky 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).


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Jennie Atchley

Largest Queen Breeder In The World!

Peter **Sieling**

In 1878 Emerson Atchley wrote a letter to the editor of *Gleanings in Bee Culture*.

He had read that if you clip the wings of a virgin queen, she would be a drone layer. That one fact more than paid for his $1.00 annual subscription cost.

"Oh and by the way," he added, "My wife can handle bees. One day when I was not at home, she put a ladder into a cedar tree and took a swarm in her apron. You can tell whether she is afraid of bees or not."

That turned out to be the understatement of the decade. Fifteen years later, Emerson's wife was the largest queen breeder in the world. The Jennie Atchley Company of Beeville in Bee County, Texas[1], managed 10 yards and sold a variety of queens including Italians, Cyprians, "Holylands", Carniolans, and Albinos. They shipped queens all over the world, manufactured beehives in their own factory, and published their own periodical, *The Southland Queen*. The Atchley family ran their enterprises without employees except for some occasional labor.

We can piece together the life and career of Jennie through a quarter century of contributions to *Gleanings in Bee Culture* and the *American Bee Journal*, as well as old newspaper accounts.

She was born July 14th, 1857 in Tennessee. Her parents named her Amanda Tennessee "Tennie" Marshall. At age 15 or 16, she married the recently widowed Emerson Jackson Atchley. They moved to Lancaster, Texas, then Lampasas, Floyd, and finally settled in Beeville. Emerson came with a one year old daughter, also named Amanda. Willie Atchley was born a year later. Over the next 28 years, Jennie and Emerson produced the rest of their employees – Charlie, Nicholas Napoleon, Rosalie, Leah, Ives, Thomas York, Jennie Bee, Emma June, and Lottie Queen.

The Atchley's interest in queen rearing appears in Emerson's second letter in August of 1878. A.I. Root gave him his own heading: "Our Original Texan Correspondent". Emerson (or Jennie writing in her husband's name) had accidentally stepped on a queen and needed a replacement. "I have been taking *Gleanings* for nearly a year, and nary a word can I find telling a man how to raise his own queens…After a hive swarms I can go there and get queen cells and hatch them most anywhere, in a nucleus or in a cage under a setting hen." His problem was getting the bees properly fertilized.

A.I. Root's answer, "If you have hatched queens under a sitting hen, you deserve a medal for original experiment, and pushed boldly into the unexplored region of attempting to have queens take their mating flight without being introduced to a colony…"

If hatching queen cells under a chicken works, how about hatching chicken eggs in a beehive? According to 12 year old Amanda Atchley's letter to *Gleanings*:

"Take a wide frame, cover it with wire cloth, fill it with hens' eggs, then place in a strong colony, putting a frame of unsealed brood on either side of it. Lift it out and turn the eggs once in 24 hours…Ma put in 12, and they nearly hatched, but the bees swarmed a week before time, and cool weather came and they died in the shell. We are going to try more this season . . ." (Spoiler alert: don't waste your eggs. It doesn't work)

Learning From Experts

In 1879 A.I. Root wrote that a woman from Texas spent several weeks in the A.I. Root apiary learning how to rear queens. He doesn't mention her by name, but it would almost certainly be 22-year-old Jennie. A.I. Root wrote, "We gave her a small apiary of seven hives, and she went through with the whole operation of rearing queens for these hives, and sending them off to market . . . She did work enough in the apiary to pay for the tuition she received, in the shape of showing and answering questions. We paid her nothing for her work, and she paid us nothing for what she learned, and she was at liberty to leave at any time.

Robbed and Ruined!

In 1882, Emerson Atchley wrote: "I am almost ruined. I collected $500 to buy wax and to pay $200 what I owe (equivalent to almost $17,000 today), and night before last myself and family were nearly killed by chloroform, and my money all stolen – I was also indicted a month ago for selling honey that people pronounced glucose. I bought it from a friend in California and it was so much whiter than Texas honey, they thought it was manufactured – I had rather give up all my bees (90 colonies) to pay my debts, than be called dishonest, or not coming up to my promise . . ."

A.I. Root's response wasn't very sympathetic. He used the Atchleys' troubles as an object lesson:

"When money is paid you, either pay it out again or put it in the bank . . . Why did you not send it, as fast as you got it, to those you were owing, getting it out of your hands. It is an excellent idea to keep money moving, for while it is lying in your pocket or drawer, it is doing no good to anybody."

Letters to the Editor

In 1883 Amanda and Willie, age nine and seven wrote letters to the editor. Amanda reported that her parents had 125 colonies. She did the cooking while her parents were working bees. Children who wrote in to *Gleanings* got a free gift. Amanda asked for the book *Ten Nights in a Barroom*, a book about the dangers of alcohol abuse. Willie added that Jennie's Father helped out in the bee yard.

Jennie As A Public Speaker

In 1892, at the Dallas Texas Bee Association meeting, Jennie read an essay on queen-rearing. "Good queens can be reared by almost any plans given. Failure is the fault of the person, not the bees or the method. Use larvae less than one day old, well provisioned, with well shaped cells

[1] There is no connection to honey bees. Beeville was named after Barnard E. Bee, Secretary of State for the Republic of Texas.

– and I will assure you large, long-lived and prolific queens which are the foundation of the bee-business."

On beekeeping for women: "Most readers of bee-papers have already seen this subject exhausted, so I shall offer no further apology for using it than to say that I have been requested to do so. Between man and woman I see no occasion for a sex line in beekeeping, but let it rest on the adaptability of either of them, whether they are capable of keeping bees – a woman has a perfect right to try any pursuit that men are capable of running, until she diligently tries and fails – I think we should examine ourselves, and see if we possess grit, grace and generosity, as these are the three essential points of a successful bee-keeper."

Jennie didn't hire employees, she begat them.

In 1893, a photograph of the Atchley family was printed in *Gleanings*. It was taken on Jennie's 36th birthday. Willie, age 16, on the left holds frames of queen cells. Willie eventually replaced his mother as the most prolific queen breeder in the world. Charlie, 14, holds a saw, hammer, and plane. He made most of the hives and other appliances used in their queen breeding. Charlie eventually bought the Atchley beehive factory. Leah, age six, stands in front of Charlie holding a smoker. Leah was a beekeeping prodigy, grafting and rearing her own queens. She astonished visiting beekeepers by caging queens "almost faster than the eye can see."

THE ATCHLEY FAMILY.

Next to Leah sits two-year-old Ives, chewing on a frame. Ives could open hives, take out a frame and help himself to the honey, all without smoke or veil. (It was reported in the early papers that bees don't sting little children.) Behind Ives stands father Emerson. He has been in poor health for many years and can't do any heavy work. He handled correspondence and later edited their journal. In the photo he rests his hand on *The ABC of Bee Culture*, which he considered to be the best beekeeping book in print.

Jennie stands next to her husband, one hand on a typewriter and the other on Doolittle's *Scientific Queen Rearing*, her authority on commercial queen-rearing.

In front of Jennie stands eight-year-old Rosalie. She has her own bees, but hasn't taken to the business like her younger sister Leah.

Amanda, 18, behind Rosa, is the eldest. Ma has just mortally embarrassed her by announcing to the world that she is corresponding with her beau from New York. Thanks, Ma.

Napoleon, holding a frame in one hand and the other on his wheelbarrow, does a lot of the hauling of hives for the other family members. Like the rest he has his own colonies.

Behind Napoleon screams two-month-old Thomas York. Two days after he was born, Jennie grafted 200 queen cells from her bed.

There are more children to come. Jennie Bee was born in 1895, Emma June, and Lottie Queen, born in 1902 when Jennie was about 45 years old.

Writing

In addition to producing queens and children, Jenny began writing a column in the *American Bee Journal* in 1891, titled *In Sunny Southland*. At that time the Journal was a weekly paper, so Jenny wrote 52 or 53 articles a year. Her column ended abruptly in April of 1895 with no warning. The terse explanation given: "The Publishers have deemed it best to make this change." Whether she was discharged or quit, Jenny's new publication, *The Southland Queen's* first issue appeared the following month. In her introductory note she explained, "There is ten of our own family and all are being raised and have been raised in the bee yards and we are going to give our readers the benefit of our almost life experience in this work."

Jennie continued to publish *The Southland Queen* at least until 1904. That last issue of *The Southland Queen* reads like an end-of-the-season reality show cliff hanger, with the 1905 season about to be unexpectedly cancelled. Nick (Napoleon) is traveling to Colorado with a railcar load of colonies. Jenny, accompanied by Emerson, Rosa, Jennie Bee, and Emma June will meet up with Nick there. Emerson will be inspecting colonies in Colorado for foulbrood. Willie has started his own honey and queen rearing business. Charlie has just bought the family beehive factory.

To be continued . . .

Whatever happened to the Jennie Atchley Company? I can't find any issues of The Southland Queen after 1904. In 1906, Beeville was buzzing with queen breeders. W.H. Laws and J.W. Taylor also sold queens from Beeville. Competition had increased over the last decade. In 1893, there were 23 queen breeders from 14 states advertising in *Gleanings*. By 1906 there were 39 companies from 19 states and you could even buy Italian queens direct from Italy. Jennie continued to run small display ads selling queens until 1907. By this time her son Willie may have taken over the business. He was reported to have 1600 colonies and was the world's largest queen producer.

That's the last I could find about The Jennie Atchley Company and family until her brief obituary from the newspaper. In 1910 she and Emerson moved to Rialto, San Bernardino County in CA. Jenny died there in 1927 at age 69. BC

It Began With Brother Adam

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**

Brother Adam lived an incredible life, and contributed greatly to beekeeping in several ways, but most of all in creating a line of bees with traits that he selected, and he proved that those traits could remain stable within that line. We all hear about Buckfast Bees all the time, and Brother Adam's name is well-known in beekeeping lore, but what kind of person was he? What life did he live? He taught and wrote widely, and was awarded two honorary doctorates, one by Uppsala University in Sweden, and one by Exeter University in England. He was vice president of what would eventually be the International Bee Research Association. He was also made a member of the Excellent Order of the British Empire by Queen Elizabeth the II. All of that is wonderful and good, but what is really interesting is the adventurous life Brother Adam lived.

He must have had an adventurous spirit combined with strong determination that we see throughout his life in the way he lived it. He joined the monastery at Buckfast when he was just 11 years old. He left his home and family in Germany to move to England, to a monastery that was largely inhabited by French monks. As Benedictines, the monks observed silence. Though the young boys weren't required to observe silence, they also weren't allowed to speak German, only French or English. Named Karl Kerhle at birth, the abbots renamed him Louis while he was a novitiate, and then he took the name Adam when he took the vows that would make him a Brother. From here on, we'll call him Adam for simplicity.

The monastery had fallen to ruin since 1539 when it was closed by King Henry the VIII. Adam worked with the other boys and the monks dressing stone. Making the stones exactly the right shape and size for building use was meticulous work, and the training in attention to detail is apparent in his later work with the bees. Stone work was also arduous, and with his poor health and home-sickness, it proved too much for him, though he did enjoy it. At 16 years of age, he was reassigned to help Brother Columban with the bees, and he also helped in the kitchens, of which Br. Columban was in charge. It is easy to imagine how wonderful the bees were for this lonely boy, so far from home, living in a world of silent men. He grew to love the bees.

A mysterious disease was ravaging the country at that time. Colonies were dying everywhere, and with one in every garden, it was quite communicable. Named Isle of Wight disease for the apparent origin of the malady, it was thought to be caused by tracheal mites. There is some disagreement about the cause today[1], but the fact remains that nearly all of the British Black Bees in that part of England were wiped out. 16 of the 64 colonies at Buckfast Abbey survived, those that had been crossed with *Apis m. liguria*, the leather colored bee from northern Italy. Adam and Brother Columban began rebuilding the apiaries, since the honey and beeswax were an important part of the self-sustaining work at Buckfast. Since all of the local bees had been wiped out, there was no choice but to import queens. They brought in both Italian queens, and Carniolan queens. They also did a great business in the sale of nucs. Soon they had 45 colonies, which made 5000 lbs. of honey that year. The following year the decision was made to sacrifice the honey crop in favor of creating more colonies from nucs.

The commercialization of the beekeeping was too hard on Br. Columban, so he retired from the apiaries to run the kitchens, and after just four years of tutelage, Brother Adam was left in charge of the bees. Though what is well-known about him is his amazing successes at bee breeding, Adam faced difficulties and failures like all of us who raise bees. One of the first things that caused trouble was a sugar shortage caused by WWI, followed by a cold spell. When a warm spell came along and sugar was available, Adam decided to feed sugar water to the bees to get them up to Winter weight. The extra water in their stores caused the bees to get severe dysentery, and all but three of the full-sized production colonies died, leaving just the nucs which had been fed only fondant. Brother Adam had to rebuild again.

Brother Adam's religious duties were very rigorous, but he still found time to read the American Journal "*Gleanings*" (the original name for *Bee Culture* magazine) and the *British Bee Journal*. Some of the authors were to have a profound impact on Brother Adam's ideas about beekeeping. Professor L. Armbruster, writing about the laws of Brother Mendel regarding bee breeding, was a great influence in Adam's early thinking about bee breeding, and they corresponded, eventually met, and became fast friends. Samuel Simmins and F.W. Sladen were two more beekeepers who were making efforts in the field of bee breeding with the White Star line of Carniolan/Cyprian stock. Brother Adam continued his beekeeping career with an appreciation for the scientific ways he had learned and read about, dividing his colonies into groups to try new ideas and keeping a control group. His reading and experience with cross-genetic survivor bees led him to begin his lifelong bee breeding ventures.

With his colony numbers growing, Brother Adam was very motivated to standardize his beekeeping equipment. The hives at Buckfast were in several different styles and sizes of hive bodies, making beekeeping difficult. The hives in common use across England were the Burgess Perfection, which would hold 10 British Standard frames in the brood box. Brother Adam thought this was inadequate for the prolific Ligurian queens he was importing, and so tried using double brood boxes on one colony. It produced six supers of honey, more than any other colony in the apiary. Other beekeepers were moving to the 10 frame Langstroth hive, but Adam felt this was still too small. Again, an article in the journal *Gleanings* would give the inspiration needed. He bought the first six modified Dadant hives to be imported to England. This is a 20" x 20" x 12" hive body which holds 12 frames. This provides 2,050 sq. inches compared to 2,126 sq. inches in a double British Standard hive body, and without the time-consuming separating of two brood boxes. For comparison, double Langstroth brood boxes have 2,742 sq. inches, so the single modified Dadant effectively limits the amount of brood needing to be fed while still providing a large work force. He also felt that the space between frames in the upper and lower hive bodies was a barrier to the bees, and slowed their progress. In 1924 he decided to move half of the colonies in each apiary to the new modified Dadant hive. It was a poor honey year, but 1925 was much better, and with 40 colonies in each of three outyards, it was a good test of the new hive design. The Dadant hives produced 335 lbs of surplus honey each, compared to the best British Standard with only 224 lbs. Brother Adam was a hard-working man, either assembling or making from scratch the materials he needed, often with the nails from the boxes groceries arrived in.

It is easy to see how the survival of the black bee when combined with the Ligurian bee would get him interested in the possibility of better genetics. And the ideas planted by what he was reading motivated him to try to improve the stock at Buckfast. He realized that he needed an isolated mating yard, and with the cooperation of the Devon Beekeepers Association and their agreement to give him a five mile radius, he found just such a place on the harsh and wind-swept Dartmoor which has few natural homes for bees. There was poor understanding of the mating of honey bee queens, but he knew he needed to pay as much attention to the drone producing colonies as he did to his queen mothers. In the spring of 1932, he and Father Benedict left early in the morning one day, to transport 200 mating nucs to Sherbeton on Dartmoor. On arrival, they decided to let the bees rest a minute in the van while they enjoyed their morning cup of tea in the sunshine. Somehow, the van caught fire with the nucs inside, and though they raced to it as quickly as they could, it was too late. An entire year's work was lost.

Also about this time, Brother Adam was using inverted tins to feed sugar syrup to the bees. However, early morning temperature shifts could cause the vacuum in the tins to be lost and all the liquid to drain out on the bees. Winds could also blow the tins around once they began to lighten. This prompted Brother Adam to invent and patent his own style of hive top feeder. He built them for all of the hives, which were now so numerous that he also had to build a new mixing tank for the syrup that would hold 15 tons of sugar at once. He mixed it in cold water using a 16" wide paddle in about 15 minutes, then pumped into vats in the waiting van for transport to the apiaries.

Big changes needed to be made to the extracting and bottling facilities as well. In 1921, Adam had 160 colonies which produced nine tons of clover honey, and all of the supers had to be hand carried up a winding flight of stairs to the honey processing room where a new hand-cranked extractor, a big improvement over the old two-framer, kept him busy late into the nights. Another challenge that needed to be addressed was the handling of the heather honey. This honey, like Manuka honey from New Zealand, is thixotropic, meaning that is gelatinous and as such, it could not be extracted by centrifugal force alone[2], but had to be warmed and pressed from the comb with great weight. He formulated plans, had them drawn by a draughtsman, and a prototype built. After a few modifications, a new press was made that accepted a stack of 10 combs, steam-heated and pressed them to a ½ inch thick wafer of wax. They could now process two tons of heather honey per day. Adam built 11 storage tanks that would hold 27.5 tons of honey, with pipework for warming the honey for bottling.

Of course, he wasn't working alone. Other men from the monastery helped, but Adam was right there in the thick of it. He not only worked at keeping the bees, doing the work on the facilities, processing the honey, and raising 500 queens for sale each year, he still helped out in the kitchens, and was involved in planting flowers for the bees. One year he raised 2500 begonias from seed, and then selected the best dozen plants to propagate from.

Between so much work and so little sleep, and the death of his father, it should not be surprising that Brother Adam fell ill in the winter of 1932. He was 34 years old. He spent three months at home in Germany with his mother, and returned in the spring to take up the care of his bees. Early in the year of 1939, he went home again to care for his mother who was ill. Nazi indoctrination was everywhere, and he feared for her and for Germany. That same winter, he fell ill again, and was diagnosed with a heart disorder caused by over-work. He was told never to work again. He tried to slow down for a while, and spent just a half hour each day overseeing the work on the honey house. It was completed in 1940, and he could be content.

He spent a Winter convalescing and reading, and emerged in the Spring excited about seeking new and better genetics to improve his bees at Buckfast, but the war was on, and the timing wasn't right. With so many of the inhabitants of the monastery being German, honey production was critical to good public relations. Finally, after the war, on March 20th, 1950, he set out alone in his Austin A40 equipped with smoker, veil, and sample collection supplies. He was seeking pure strains of bees, that seemed not to have crossed with outside genetic influences, but at first had a hard time finding what he considered pure strains. He also visited universities and beekeeping scientists along the way. He stayed at monasteries as he traveled, looking for bees with characteristics that he thought would contribute well. It seems as though he drove through the countryside, looking for beehives. He would pull in and look for the owners, inspect their colonies, and

convince them to give him their queens. This early trip was much different than his later ones, when he was better known, when he stayed with well-known scientists and beekeepers, and followed more organized itineraries.

As he found what he considered pure strains of bees, he would collect samples, boil the bees to kill them, then preserve them in alcohol and ship them to a laboratory for morphometric study.. He built an amazing collection of more than 1300 honey bee samples that today would no longer be available for study, due to hybridization. He also sought queens that he could ship home to his assistant where they would be installed in nucs awaiting his arrival and crossing into his line of bees. He had permission from the government to write his own health certificates that allowed the importation of stock.

He traveled throughout Europe, Asia Minor (like Turkey and Yugoslavia), and even into the oases of the Sahara desert. Mostly things went well, but sometimes disaster struck. He slid off icy roads, and once over-turned his car, suffering only a cut ear and a broken windshield. He successfully found the coal black Tellian bee, *Apis millifera intermissa* which he thought was a primary race of bees from which others had descended. Upon returning to Algiers, he took a very rough weeklong boat trip to Israel, during which he was seasick and mostly confined to his quarters by the anti-religious sentiment of his fellow travelers. He arrived in Israel on the Thursday of Holy Week, and with the hospitality of a kibbutz, was allowed to celebrate Passover with them. He loved it, and felt at home and comfortable. One time in Italy, disaster struck. He carefully packaged the precious queens for shipping, and left them on the table in his room overnight. In the morning he was horrified to find the table and queen cages covered in tiny black ants. Every single one of the queens was dead! It was too late in the year for him to retrace his steps, and with heavy heart he returned to Buckfast to commence the honey harvest.

In 1987, at the age of 89, Brother Adam undertook one last trip to the rain forest in Tanzania near Kilimanjaro, and Mount Kenya in Africa. He was seeking the reportedly more passive Africa bee, *Apis m. monticola*. He was accompanied by his friend Herr Fehrenbach, his daughter who was a doctor, Michael Van Der See from Holland, Walter Davie, bee diseases officer with the ministry of Ag, the author of his biography, and a film crew. Brother Adam fell and cut his head open when he arrived, and that set things off badly. There were fewer colonies to inspect than had been hoped, and the first one was incredibly aggressive. The heat and altitude combined to sap Adam's energy. His beekeeper friends actually carried him in a wicker chair one day, but finally convinced him that discretion was the better part of valor. The group with him was able to find a few queens that he wanted to try combining into his bee line. After all of this struggle, though, the queens didn't live to make it home to Buckfast. Although disappointing in some respects, the trip was also a good learning experience. He had only one day in Kenya, but it was enough to affirm his belief that the peaceful and productive *Apis monticola* bee was the one he wanted to work with. This work has been followed up by a group of beekeepers who crossed the Buckfast bee with *Apis monticola* from the Elgon region, and so, Brother Adam's work indirectly influenced yet another line, the Elgon bee.

Throughout most of his years of beekeeping, the Abbot at Buckfast was Dom. Leo Smith, who not only helped with the bees occasionally, but also traveled with Br. Adam as he sought out the queens to cross into his line. It had been a long and happy friendship. Father David Charlesworth became the new abbot at Buckfast, and he had a different outlook on Brother Adam's fame. He decided that it was time for Adam to retire, and after eye surgery and difficulties with hearing and balance from Meniere's disease, it may have been for the best, though Brother Adam was deeply hurt. According to a few people who knew him, Brother Adam did not suffer fools gladly, and may have been a little hard to get along with. Father Leo took over as head of the department, assisted by Brother Daniel and Peter Donovan, the man who had come to Buckfast as a boy of 13 during the war, and who had become indispensible in the beeyard. After retirement, Brother Adam lived for a time in his room near the honey facility, but it was too isolated, and his advancing age eventually sent him to live at a rest home. He had served his God as best he could through his bees, and went home to heaven in 1996 at the age of 98.

Peter Donovan was sent to Buckfast Abbey when he was 13 years old, to escape the bombing of the cities during WWII. He became Brother Adam's indispensable beekeeping assistant. Photo credit Peter Donovan via Erik Osterlund, **https://elgon.es/**

Across all of these travels, the adventurous spirit which had brought him to Buckfast Abbey in the first place served him well. His love of bees, his gift of observation, and interest in selection and improvement combined to help him bring a gift to the world of bees and beekeepers. Part of that gift is the collection of bees and scientific information he created. Part of it is the Buckfast Bee. And part of it is the knowledge that selecting for the best traits and creating a stable line of bees can be done. This is serving us still today in our search for mite resistance in our honey bees. BC

Most of the details of this article came from the biography of Brother Adam, For the Love of Bees, *by Lesley Bill. She must have known him well. There are photos of her traveling with him, and inspecting colonies at Buckfast alongside him. I have been unable to contact her. It is a well-written book, and I highly recommend it.*

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1 "Isle of Wight Disease"; The Origin of the Myth, by L. Bill, published by the Central Assoc. of Beekeepers, Glouchester, England

2 **https://www.youtube.com/watch?v=Lke7Yl04dgo** Both Manuka honey and heather honey become workable after stirring, so modern equipment includes a machine that stirs the honey in each cell before the frame is sent to the extractor.

BIGGER PICTURE

Jessica **Louque**

Know Your Area, And Your Area Knows You

We have now lived in this spot for about two years. This past year, we obviously had a lot of home time. This is not necessarily a bad thing in a lot of ways because we were able to spend more time with our family, spend time outside, and work on some projects. A lot of people might look at our house or where we live and it would be their greatest nightmare. We live at least a half mile off the road with no discernable driveway and you only see our house from the highway if you know to look for it. There's a lot of mud, and animals everywhere, and the closest gas is 15 minutes away if you don't get behind a tractor or someone moving their herd of cows. For us, it's perfect. We know all our neighbors for the most part, as the same families have lived in the area for several generations. At our house, we have woods that are both deciduous and evergreen, open fields for growing things and riding ATVs, ponds and streams and creeks and the river to play and fish in – and very few visitors. It also makes a great place to keep bees if they're in the right place. I have learned over the years that if I put them down the hill near the pond, I can get some really pretty pictures, but the cold humid air settles in the hives and I will lose anything that stays there past October. It's unfortunate because the pond is surrounded by tulip poplar and black locust, but I can put them at the top and it's not like they can't just fly over the hill.

Mountain camelia – an unknown NC forest plant.

No matter where you live, you should know the area around you. Especially in the context of bees, knowing the local flora can definitely be a boon to your honey production. Since we all still seem to have time on our hands, if you're looking for a long-term project it could be useful to multiple people. It's one thing to have a general idea of what your bees like to eat, but it's another thing to know specifically what you have, how abundant it is, and when it blooms. For example, no matter where you live, Asters are most likely going to be the top food source for your bees in the Summer and Fall, with a mix of ragweed, wildflowers, sunflowers, and goldenrod. Sumac is probably going to be a good source since it's so common on roadsides. Obviously, your major sources will depend heavily on your region, the urbanization or farmland use in your immediate vicinity, and your rainfall. It's still good to know what is around your bees and their foraging habits even if you can't control where they go or what is available.

As a botanist/entomologist, it would appear that I would have an advantage over the average person. Unfortunately for me, using a key for insects and for plants is the bane of my existence, even when I was in school. My saving grace for both plants and insects is (besides being a reference book hoarder) that I am really good at seeing something once and remembering what it is. I might not can tell you for the life of me why I know what it is, but I'll always remember the name. That being said, a picture really is worth a thousand words. I'll give you the rundown of how I went about getting started and it can hopefully help you too.

I started with my iPhone. If you would rather be slightly more artistic, you can use a real camera for this. Taking walks while taking photos is a great way to start your catalog. If you can find it close to your house, it's probably found in more places in your area. Make sure you get a photo of the flower if it's there, the leaves close enough that you can see the venation, the edges, and how it connects to the stem (like alternate or opposite), and one of the whole plant if possible to get a good idea of its environment and size.

Once you are satisfied with your walk or photo collection, it's time to ID your plants. There are several ID books that are available with different types of organization. It would probably be best to look at either a sample of some of these or actually go to a bookstore to look at them before purchasing, unless you like having multiple books. If you're not familiar with how your brain catalogs ideas, this will be how you find out. Some books that don't follow the way you think will positively irritate you. For example, if you're only going by flowers, some wildflower books categorize by flower color, then by number of petals. Some go by time of year and plant habit. Some go more by photographs, and some by description. Use whatever suits your methods best, but sometimes it will take a couple books to find your plant.

The internet can also be a great resource if you trust it (obviously a questionable statement at this point in the life of the internet and the people giving information on it). If you know people in the area, and you use social media, posting the photos and asking what they are can be a quick answer and you also learn who to harass with other plants. You can always double check answers by doing an image search to make sure it's the right ID. Someone in your locality should also have an online resource for your plants. Here in NC, the cooperative extension through NC State is an excellent resource and has a lot of help for local plant ID. It's helpful because if you come up with something weird, it may just be the wrong species and there's a native one that's more accurate. If push comes to shove, type in the most basic description of your plant in a search bar and it should set you on the right path.

Now for the information itself. Let's say you've figured out what your plants are. What do you do with it now? That depends on what you want. I make a list by Order, Family, Genus, and Species, with common name and keep in an excel file. The list I'm currently working with are plants in the woods, plants in the field, plants at the pond, and plants I put here. Depending on how far you want to go, you may want to keep a folder on your computer of the photos of each plant and label it. Then, think about the information most relevant to your needs. Blooming period is the most important aspect as a beekeeper so that you can keep up with the flow that feeds your bees. Take some time in the morning if you get a chance to observe some of the more prevalent flowers. You may want to record the time of day that they are being visited, or note that no bees find it attractive. If you record the bloom period for a few years in a row, you will have a much more reliable source of information for your bees. A large percentage of my list is not bee attractive, but I like to know what is in the area. You may want to do a bit more research on the plant itself to see if it has medicinal properties, or how common it is. If your pictures are useful, you could create a folder on your computer to catalog your findings.


Trout lilies are small and easily stepped on but seem to be appreciated by bees in the morning on cold Spring days.

Once you start looking for plants, it is important to not overlook trees. Here in NC, some of our biggest honey producers are trees. We have black locust (ironically very light honey), sourwood (our most popular honey but tastes like burnt coffee), basswood (often mistaken for sourwood because it's similar in timing but doesn't taste like burnt coffee), and the overly prevalent tulip poplar, the major Spring flow. Don't forget to slam on your brakes erratically in the highway too if you see something unusual and snap a few photos. If you can drive to it, your bees can probably fly to it. Also drive around and observe what's happening in your local farmers' fields. If you're not having a current feud with them (as is wont to happen with overly zealous beekeepers and occasionally grumpy overworked farmers), ask them about their crops and nicely ask them what they spray. You may be able to move or close your bees for a day or two if you know when something is going to be sprayed on a bee attractive crop. I had a neighbor who had an incident with weed seed in his Winter wheat where it was mostly mustard. I asked him about it and he let me move a few hives to the field and even let it


Black Locust tree in bloom over the pond.

stay until the blooms stopped so the bees could forage. If you can, take advantage of situations like this and also mark it on your list as a local food source.

Overall, if you can dedicate some time to this project, you will have a lot of extremely useful information at your disposal for your bees. You may also find some rare or unusual flora in your area. Consider keeping some of the best photos and doing a presentation at your local bee meeting (or over Zoom at this point) so that other people in the same area might be able to use the same information. If you're feeling competitive, and your neighboring beekeeper goes to the same places as you and tries to promote their honey as better than yours . . . maybe don't share? Either way, it will definitely help you with your bees. BC

Spring Blooming Plants In The Northeast

Connie **Krochmal**

Cornelian cherry

This region has a marvelous diversity of bee forage. A rich profusion of flowers for bees emerge during the Spring in the Northeast.

Cornelian cherry (*Cornus mas)* is a shrubby European dogwood species that thrives in the Northeast. During the late Winter and very early Spring, it is one of the earliest shrubs to bloom. The floriferous, 20 foot tall plant is covered with small, bright yellow blossoms.

Hardy to zone five, the plant also bears delicious fruits that are generally red. They make a wonderful jam. All of the dogwoods can provide surplus honey.

No article about the Northeast would be complete without the common **dandelion** (*Taraxacum spp.)*. Flowers begin to appear in the Spring when the temperatures are still cool – usually before apple and other fruit tree flowers emerge. In warm climates, flowering can occur nearly year-round.

A second flush of flowers can appear in the Fall in cold climates, but these aren't as numerous as the Spring blossoms. Bearing nectar and pollen that is readily available to bees, the dandelion is considered an excellent bee plant. Some of the yellow to golden yellow pollen can end up in the honey.

Both the pollen and nectar serve to build up colonies. This species is listed as a major bee plant in the Northeast, North Central, the western mountainous states, Alaska, and Hawaii. The plant can be found in all regions in a wide range of habitats.

Dandelion has the potential to bring large honey crops in some locations, but a typical surplus is about 30 to 40 pounds per colony. However, IBRA reports that worldwide, there has been as much as 800 pounds per acre in some areas.

With a slightly strong flavor that mellows as time passes, the cloudy honey can be about any shade of amber to various shades of yellow. This tends to crystallize readily and develops fine to coarse, hard grains.

Forget-me-nots (*Myosotis sylvatica)* have naturalized in the Northeast, and add a beautiful carpet of blue when the plant is in bloom in early Spring. Normally, the plant is a perennial in the Northeast although in some other regions it can be an annual.

Flowering usually lasts for about a month, but there can be repeat blooms during the Summer as well. The plant self sows freely. These blossoms provide pollen and nectar.

During the Spring and Summer, **honesty or money plant** (*Lunaria annua)* bears lovely blossoms. These plants can self sow, but rarely naturalize. Regardless of where they pop up, I would never consider them a weed.

The scented blossoms are typically purple, but are sometimes white. They appear on two to three foot tall flower stalks.

Honesty is grown both as an annual and perennial. The plant is best known for the flat, papery seed pods. The flowers are rich in nectar and pollen as are most other members of the cabbage family.

Boxwoods (*Buxus spp.)* are popular evergreen shrubs in the Northeast. Several species are in cultivation with hardiness varying somewhat. Bees are sure to seek out these small, white, sweetly scented blossoms, which

Dandelion.

Forget-me-nots.

Winter aconite.

emerge during the Spring. They yield nectar and pollen and a good quality honey.

Lots of Spring flowering bee bulbs thrive in the Northeast. But few can match the beauty of the **Winter aconite** (*Eranthis spp.).* In some years, the vivid yellow, cup-like flowers can begin appearing in February. Only 2½ to eight inches in height, the plants feature leaves that resemble those of buttercups. Winter aconite blossoms are excellent sources of nectar and pollen.

Peonies (*Paeonia spp.)* thrive in the Northeast. These long lived, reliable bulbs can live for around 50 years or so. Some types are suited to zone three, although most are hardy to zone five.

Generally, most peonies are three to four feet tall with a matching spread. The free flowering plants are very floriferous with the large, showy blossoms in a wide range of colors. Many kinds of peonies are available.

The best types for bees are single and semi-double flowered ones. The common peony generally blooms in mid to late Spring – May and June – with the flowers being four inches wide. These are great sources of pollen and also yield some nectar.

One other Spring blooming bulb, the **anemone**, is well worth mentioning. The windflower or Greek anemone (*Anemone blanda)* is hardy to zone five and very easy to grow. It thrives in light shade under tall trees. Around a foot tall, the plants bear buttercup-like foliage and daisy-like flowers in March and April. These blossoms are rich sources of pollen. Various varieties of this anemone is readily available in the Fall wherever bulbs are sold.

Although willows have been profiled in previous articles in this series, they are such important bee plants that they deserve to be included here as well. Of all the willows that thrive in the Northeast, the common **weeping willow** (*Salix babylonica)* is one of the most picturesque and can serve as a focal point in the landscape. This is among the very early blooming trees in the area. The wide spreading, short trunked, long lived species often grow along streams and waterways.

The cascading branches sweep the ground. This is among the easiest of the woody plants to propagate. Just cut off one of the sturdy stems, and place it in moist soil.

Willows tend to bloom very early – typically from later February into March. While both male and female flowers yield nectar, only the males produce pollen. These plants are known to also yield surplus honey as well.

Typically, the thin bodied honey has a delicate, distinctive flavor. Variable in color, it has a light aroma.

High honey yields are possible – up to 90 pounds per colony. Willows are also good sources of honeydew.

Bergenias (*Bergenia spp.)* are early blooming, evergreen perennials. Usually purple, white, or rose-colored, the flowers form broad, flattened clusters in the Spring. These are good nectar and pollen plants. Requiring little care, the plants prefer a moist soil in partial shade.

Maples (*Acer spp.)* are among the major bee plants in the Northeast. In addition to the native species, some other types are widely cultivated, such as the Norway maple (*Acer platanoides).* The native sugar maple (*Acer saccharum)* is one of the most common maple species in the region and one of the best known.

Blooming fairly early in the Spring, maple flowers are good sources of pollen and nectar. They can yield up to 50 pounds or so of honey per colony. Maple honey has a mild aroma and typically features a distinctive flavor that improves with age.

The color can range from white or light amber to amber, sometimes with a pinkish or greenish tinge. This typically is slow to crystallize, and can develop coarse to fine granules.

Serviceberries (*Amelanchier spp.)* are a vision of beauty in early Spring. These native trees or shrubs are

Skunk cabbage.

clothed with the small white blossoms. The plants are sources of pollen and nectar and help to build up colonies in the Spring. There can be a small crop of honey.

Skunk Cabbage (*Symplocarpus foetidus*)

While the plants featured above have appeared in articles over the years, the skunk cabbage hasn't. This long lived, coarse, native perennial is also known as swamp cabbage and polecat weed. It occurs in the East southward to Tennessee and North Carolina westward to Minnesota and Iowa. The plant inhabits wet sites, thickets, wet meadows, swamps, bogs, and moist spots in woodlands. Skunk cabbage is hardy to zone three or so.

Description of Skunk Cabbage

Skunk cabbage has to be one of the easiest native wildflowers to identify for few other species bloom as early. There is also the unmistakable odor, which accounts for the plant's common name. These are very low growing, but mature ones can be quite wide spreading, up to four feet across.

Skunk cabbage foliage appears as the blossoms begin to fade. Two feet in length, the leaves are borne on foot long petioles. The large, attractive foliage, all of which is basal, is almost round to heart shaped.

The leaf blades are eight to 12 inches in diameter. When crushed, the leaves release a fetid odor.

With blossoms that emerge before the leaves unfurl, this typically begins flowering in early March, depending on location. But it can sometimes occur in late February.

This plant is a member of the Araceae or arum family, making this a relative of the jack-in-the-pulpit. All of the arum family members bear the same basic type of flower structures consisting of an inner and outer component.

The outer one, called the spathe, is hooded and serves to protect the inner stalk, known as the spadix. Growing very close to the soil, the mottled, fleshy, ovoid to rounded spathe is generally purplish with green stripes and greenish-white flecks.

Four inches long, the club-like to rounded spadix is covered with tiny crowded blooms all along the length of the stalk. The male blossoms appear on the upper part of the stalk with the females being below.

The fruit contains greenish-brown, berry-like seeds, similar to those borne by jack-in-the-pulpit. One-third of an inch long, these are enclosed within the spathe. The seeds ripen in the Fall.

Bee Value of Skunk Cabbage

Because they are so early blooming, skunk cabbage is a valuable pollen plant. The pastel yellow pollen is a tremendous aid to brood rearing. Some beekeepers regard the plant as one of the best early pollen sources.

Bees eagerly seek out these flowers, which are very rich in pollen. They can work the blooms when the temperature is as low as 42°F. even when the snow is still on the ground.

This is one of the few plants that can actually generate heat, which can melt snow around the plant. The sturdy flower structure safely protects the blossoms from freezing temperatures and inclement weather.

Growing Skunk Cabbage

Yes, some wildflower enthusiasts do grow this eastern native. Given favorable conditions, the plant can thrive. This species is a perfect choice for a wet, shady spot where other plants can't survive. It is also recommended for artificial bogs, swampy or boggy areas, and along ponds, streams, and brooks.

When planting skunk cabbage, always give this ➪

species plenty of room. As the plant continues to grow, it can become quite large. For the most part, little routine care is needed other than to be sure that the soil remains moist.

Light shade is best in the South. In the North, skunk cabbage can tolerate sunny, open areas. A rich heavy soil that stays moist throughout the growing season is recommended.

Mature skunk cabbage plants can be divided, but this is a tremendous undertaking for the rhizome can be several feet deep in the soil. This process requires a lot of strength and effort.

If dividing a skunk cabbage, cut the rhizome into pieces so that each one contains at least one to two nodes. Place each piece several inches below the soil surface horizontally.

The easiest method of propagating skunk cabbage is by seed. Collect the seeds as soon as they ripen in the Fall. Be sure that you harvest the spadix before it becomes completely decayed and disappears.

Remove the fresh seeds from the spathe and sow them in a shady area. They will sprout in the Spring. Allow the seedlings to grow in the seed bed until they are large enough to transplant to their permanent position.

Keep the seedlings watered at all times. Skunk cabbage plants are available from Quackin' Grass Nursery.

Related Species

In some parts of the West, a distant relative of the eastern skunk cabbage can be found. Known as American skunk cabbage (*Lysichiton americanus*), this species begins flowering in April or so. It is a member of the same family as the eastern one.

Like the eastern one, the western species is a valuable source of pollen. American skunk cabbage is native from WA to CA, ID, MT, and WY. BC

Connie Krochmal is a beekeeper and plant expert in living in Kentucky.


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Sticking To It With Beeswax Collage

Alice **Eckles**

This is the beeswax collage I finished from this process, Christmas Cactus, 8"x8", based on a still life drawing and flattened to be somewhat abstract."

Beekeeping is work but for people who love it it's also sometimes play. And for people who love beekeepers there are many hobbies companionable to beekeeping such as foraging, photography, nature study, plein air painting, and art with beeswax and honey. This is useful because the way I see it, everyday is a working vacation in the life of a beekeeper's keeper. On beautiful sunny days when my honey-winner works with the bees I sometimes tag along to pick flowers and herbs for my beeswax salves, take photos as references for paintings, and study nature. When I study nature on these bee outings I sometimes come up with wise (in my opinion) ideas about things such as this: it might be a good idea to wash the mower between mowing different beeyards to prevent spread of invasive plants such as poison ivy. Beekeeping, though there are many parts of the job I don't consider pleasant, has limitless points of interest that have helped both my beekeeper and I stick with beekeeping together through thick (crystallized honey, my favorite!) and thin (unripened nectar).

It's helpful when tracing your drawing to use a different color pencil so that you can see where you have gone over your lines, and so that the whole image will appear transferred onto your substrate.

One of the great qualities of beeswax is its stickiness. At the right temperature it's tacky and useful for adhering and embedding papers, objects, and making textures. A simple and direct way of using this quality artistically is beeswax collage, an art process that is good enough for fine artists, weekend crafters, young artists, vision board makers, and students alike.

I consider myself to be a pretty fine artist so in my recipe and instructions below you will find the simple how-to as well as a more in depth art lesson. Like any recipe you can alter it to suit your needs using your own common or not so common sense. In fact this recipe comes from me not following someone else's recipe, at least not wholly.

How to make a beautiful abstract still life beeswax collage ready to hang on the wall:

First bring some nature inside your home, setting it up in some pleasing way on a tabletop. Make some simple line drawings of it. These are your ideas for painting. Or if you already have a simple line drawing you'd like to use, find it.

Gather these supplies and have ready on your workspace:

Your drawing

An 8"x8" or smaller painting panel

I like to use one with cradled edge on backside (similar to the inner cover of a Langstroth beehive, except quite a bit smaller). This allows for easy hanging on the wall later. I toned my panel with a layer of pink gesso so that the color would show through any unfinished spaces on my picture. You could also use an initial layer of tissue paper on your collage for the same purpose.

Collage papers

I've used wallpaper samples, rice paper samples, and painted collage papers I had pre-made. But you could use any sort of paper you have collected. Because Beeswax lends transparency to thinner type papers do you want to paint the back sides of any newspaper or

Here I'm applying a flower photo cutout from my printer with the hot wax stylus. A crockpot for melting wax is optional you can do the whole painting with a hot wax stylus, though it might take longer.

You can also use the hot wax art stylus to make polka dots with beeswax crayons or move the color around into whatever shape you desire."

magazine cuttings you use with matte medium before applying to your collage with beeswax so that the writing on the backside doesn't bleed through the image on the front side.

Three chunks of cappings wax, about 2 oz each
Hot Wax Art Stylus craft iron, or mini quilters iron
Crock pot for beeswax
A cheap paintbrush from the hardware store for painting wax
Oil pastels
Beeswax crayons
Box cutter
Scissors

1. Plug in the crockpot and put in two small chunks of cappings wax to melt.

2. Transfer your drawing to your painting panel. You can do this freehand or if your drawing is the same size as your panel you can transfer it using transfer paper- we used to call it ditto, or carbon paper. If you don't have transfer paper you can make it by covering the whole backside of your drawing with graphite, either using a pencil or a stick of graphite. Then you put your drawing face up on top of your panel and draw over the lines of your drawing to see them transferred onto the panel. This step is not necessary but it's usually the way I work.

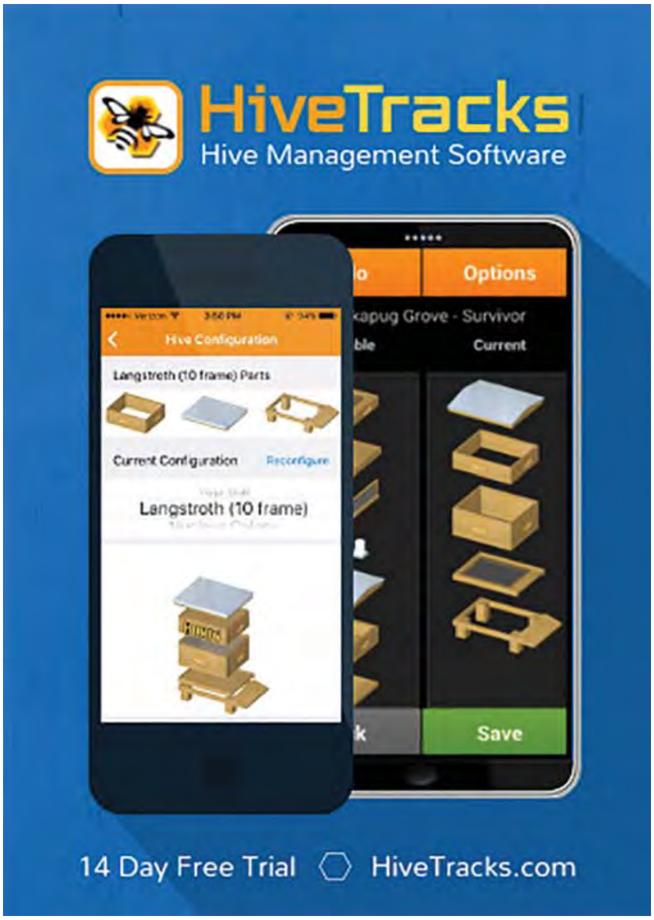
3. You might want to have a large collage shape cut out or even a piece of tissue paper the exact size of your panel as the first piece you collage on, and have it ready to apply. Use the hardware store brush to paint a thin layer of the melted wax over the whole painting panel. The wax hardens quickly but if you have a shape ready to stick on, stick it on while it is still tacky. I put a piece of thin white tissue paper over the whole thing to start. The first cut collage piece I put down in my Christmas cactus collage was the wallpaper background in the upper half of the painting.

4. Plug in your hot craft iron. Now the creative process is really begun. Using my craft iron I made drips of beeswax fall onto the wallpaper I had just stuck on. Then I ironed those drips smooth until the wax permeated and submerged the paper. I use the iron this way until I have the effect I want: transparency, smoothness, adhesion, and clarity. Sometimes clarity of the color and design is somewhat lost under the thickness and color of the beeswax. You can alter this by ironing some of the beeswax off and by adding color selectively with oil pastels and melted crayons.

Cutting the shapes you want can be tricky. You can do a lot of it free hand. Sometimes I put the paper to be cut on top of the shape drawn on the panel and peak under to make little dots on the paper at the peaks and valleys of the shape and draw the lines from dot to dot to complement the shape and then cut it out. If that doesn't work well enough for me I use the transfer paper method. This is like creating a puzzle of your drawing and putting it together.

Just keep using this process of cutting out shapes, and ironing them to the picture with beeswax until your collage/painting is roughed in.

5. This is the last step where you make your collage a bit of a painting by adding refinement with oil pastel, beeswax crayon, and some cutting away with the razor.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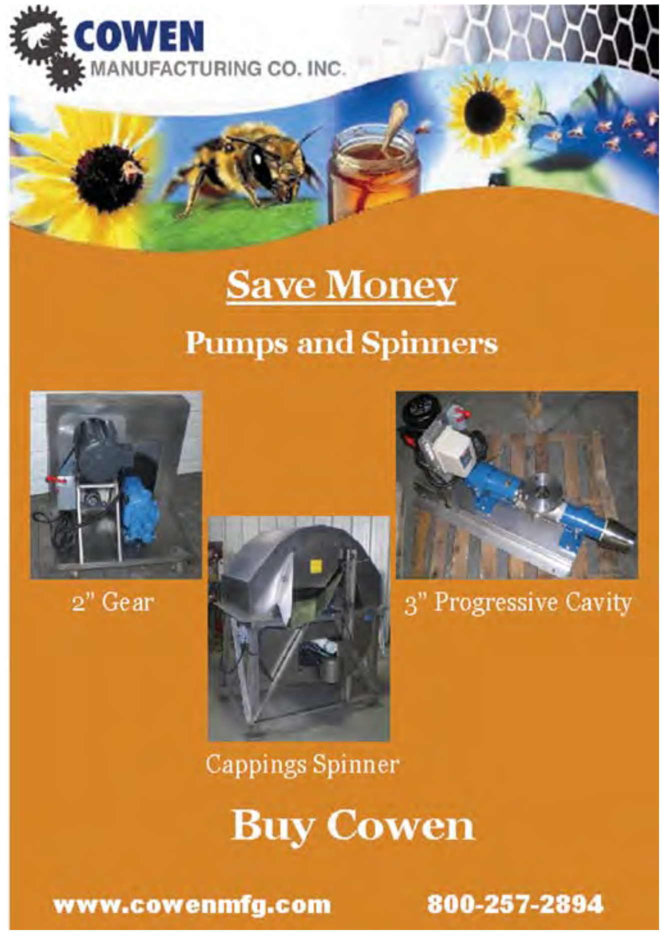
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I wipe off the stylus with a rag to clean it before I move onto another color, or uncolored beeswax."

You can use a hot wax art stylus for different effects with the beeswax such as adhering images, making drips, spreading color and melting away color and texture.

I forgot to mention that sometimes along the way I use a flat razor to gently shave off a layer of wax if it's too thick when I'm smoothing. A razor blade or box cutter can also be used to add texture or trim edges of shapes. Texture is your friend in abstract art so don't worry about getting everything smooth. Those edges in relief where you have adhered thicker papers can be used to pick up oil pastel color, so try outlining certain shapes in oil pastel and rubbing in the color until it softens and pleases your eyes. I saved the melted crayon until last because it's very strong. You can add and move this strong color the same way you dripped drops of beeswax on your painting to adhere collage elements. Use your hot craft iron to move and smooth the melted crayon color. If there is anything you'd like to "erase" in your painting you can melt it off with the iron and or cut it off with the razor.

When is it done? It's extremely close to done when you sign your name to it, and it's definitely done when it sells. That's my answer. What's yours?

You can have a lot of fun making art part of your life. Now that our lives are limited to fewer things by the pandemic I think it is clear that art is more essential than Americans have understood until now. Speaking of pandemic activities, art and bee related, I look forward to writing next about making sour dough bread with honey. Artfully yours, Alice. BC

Alice Eckles is the author of The Literature Preferred by Wild Boar, *a novel. While she assists in beekeeping, she mostly handles the value added parts of the beekeeping business she shares with Ross Conrad and has fun exploring the intersection of beekeeping and art via her artist business* ***AliceEcklesStudio.com.***

Only the person who has faith in himself is able to be faithful to others.

Native Stingless Beekeeping In Australia

Greg **Coonan**

Along the east coast of Australia the keeping of native stingless bees has really taken off and there is no wonder why.

Native stingless bees are harmless gentle creatures. They are disease-free and because they can self regulate food stores they require little or no maintenance. They are versatile pollinators and produce delicious honey.

The lock downs associated with COVID19 have been the catalyst for a massive increase in gardening interest in this country and as this interest has continued to grow so has the interest in owning native stingless bees.

They are becoming increasingly popular, being suitable for any sized yard including small unit balconies with no registration or licencing requirements. It is now common place for schools, kindergartens and day care centres to keep native stingless bee hives. Most family-owned plant nurseries and garden centres have stingless bee hives on display.

The three main species being kept are *Tetragonula carbonaria (TC), Tetragonula hockingsi (TH) and Austroplebeia australis (AA).* All three are black with grey heads and are stingless. TCs and AAS are about 4mm long and THs are slightly larger at about 4.5mm long. The queens in each species have a much larger cream and brown abdomen and are about 1cm long. *Please note: Australian native stingless bees are not available outside their natural range.*

A mature hive has 8,000 to 10,000 bees and are usually kept in small timber hive boxes standing 300mm tall and having a base of 200mm x 280mm. They have a foraging range of around 500 metres from the hive.

Unlike European honey bee queens, the native bee queen is unable to fly again after she mates and enters a hive to begin laying.

In native bushland, stingless bees construct nests in a cavity/ chamber, usually the hollow in a tree left by termites. The bees use varying mixtures of wax that they secrete; and resins collected from

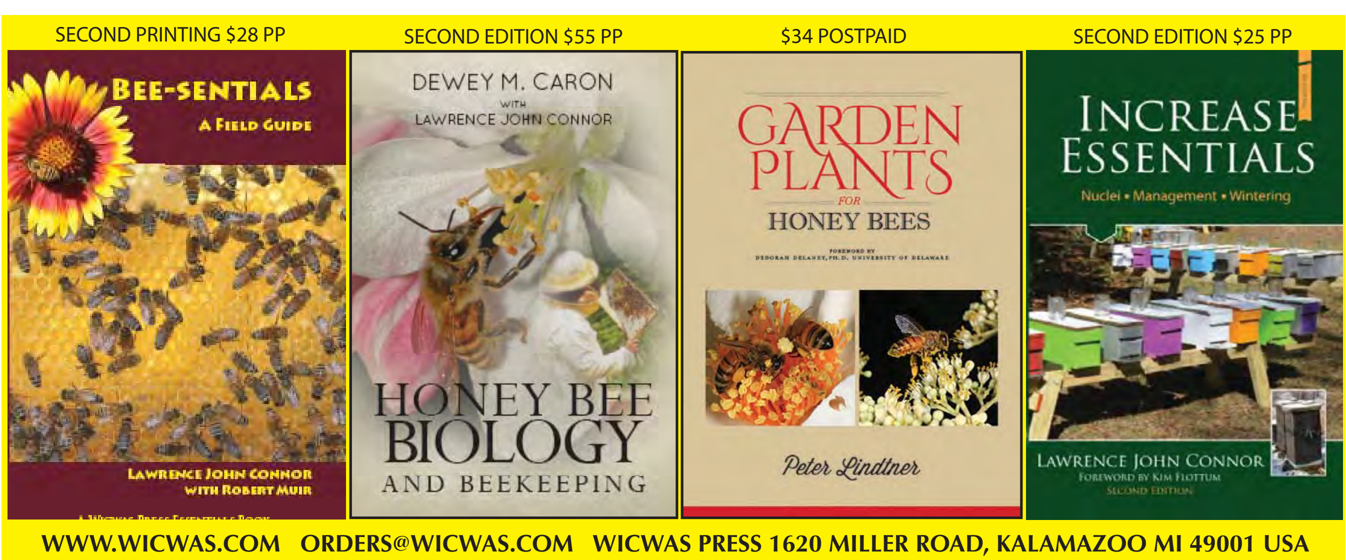
Photo of TC broad and a TC bee close up. (Daniel Ellis photos)

Native stingless bees are much smaller than European Honey Bees (Honey bee on left side of flower, native stingless bee near the center). Close up photo of TC queen.

plants, to create what is called propolis to build the structures in the hive.

We live in Brisbane Queensland and are very lucky because we are able to keep three different species of native stingless bees TCs, THs and AAs which naturally occur and thrive in this area. Our passion is native beekeeping, and we enjoy making it easy for others to gain the knowledge and confidence to

INNER PEACE begins the moment you choose not to allow another person or event to control your emotions.



look after and be enriched by these fabulous little creatures.

We specialise in rescuing native beehives and propagating hives. We have also written a book "Keeping Australian Native Stingless Bees" to provide a simple guide for new starters that was published by Northern Bee Books and is available through Amazon.

Owning a native bee hive is a pleasure and for many people an end in itself. From the people we deal with we would estimate that two thirds of hive owners are more than happy just owning a self-sufficient native beehive and have no desire to harvest honey or to propagate further hives.

However, for some people, the desire to develop their interest into a hobby sees them progress to native beekeeping, involving honey harvesting and/or hive propagation and/or pollination services.

We are finding that the people who are investing in native bee hives can be categorised as follows.

Animal lovers – As anyone who owns a native beehive will tell you, they are a joy to watch. Native bees are terrific, self-sufficient pets with none of the usual holiday pet hassles, and to cap it off, unlike keeping honey bees there are no registration requirements, no hassles with neighbours, no stings to worry about and no ongoing costs.

Honey lovers – they produce delicious honey, between half and one kilogram per year. The honey has a similar taste to honey bee honey but with a citrus twang a bit like someone has placed lemon rind in your honey. Native stingless bee honey also possesses strong antimicrobial properties equivalent to high potency Manuka Honey. Recent University of Queensland research is also indicating sugar found in native stingless bee honey has a lower GI which means it takes longer for the sugar to be absorbed into the blood stream, so there is not a spike in glucose that you get from other sugars.

https://www.uq.edu.au/news/article/2020/07/science-sweetens-native-honey-health-claims

Keen gardeners – Native bees are fun to watch, great pollinators of fruit trees, vegetables and flowers. As native bee hives live so long, they can become a point of intergenerational connection, that can be passed on from generation to generation.

Retirees – For a retiree or a person planning to retire, native beekeeping is a great hobby opportunity. As a hobby you can invest as little or as much time as you want, without being a drain on your finances as it is not too difficult for this hobby to pay for itself. Stingless bees are easy to manage, lightweight and do not take up much space.

Environmentally conscious – For the person who simply wants to stay true to nature and have a positive impact on the environment, they can help pollinate the native plants and trees in their neighbourhood simply by owning a native beehive.

People with children – Many families with young children want to introduce their children to owning a pet but may not have the confidence, or time, or be able to afford the costs normally associated with owning most pets, or do not want to be tied down with a pet at holiday time. A native beehive is an ideal solution. Apart from the cost of initial purchase there are no ongoing costs, no registration fees and the hive is self-sufficient. Importantly, the children will find the frenetic activities of bees working from the hive educational and fun to watch, while being safe. BC

Boxed hive.

Rescued log hive.

Native stingless beehives complimenting a garden. (Layla Coonan photo)

Even babies and toddlers can be drawn to watching bees and are competely safe.

I Read A Book . . .

with all the instructions

Greg **Carey**

Let me tell you a story about a beek who had read a book about keeping bees. His first year he noticed that there were open cells in the capped brood, and the book said spotty brood was a sign of queen failure. He was also concerned because the queen which came with his package had a white mark, and it was 2008. The mark should have been red according to the book. The population seemed strong, and he had harvested 20 pounds of honey this first year. It was late July, which was a perfect time to let them requeen themselves, so he picked that spotty queen up and dropped her to the ground and stepped on her. Let them make a new one! A couple of days later he looked and found emergency queen cells surrounding the brood nest on almost every brood frame. Good! The first one out will go around and kill all the rest and take over the hive. Everything was going according to the book.

On August 14th he stood and watched a great dust storm of bees exit the hive and settle in the top of an extremely high oak tree. He called experienced beekeepers; "we do this sort of thing all the time." The father/son act exuded confidence, sporting tee shirts, Bermuda shorts, and sockless loafers. So, a couple of tarps were spread on the ground, a hive body with frames placed directly under the swarm, and the pickup truck with a picnic table in the bed was parked with a 24-foot ladder on top to allow the experienced beeks to get just out of broom's length from the swarm. The plan was to swat the swarm and knock it onto the hive body and tarps below for easy collection, so a cobb web duster with an extendable pole was quickly placed into the hands of the younger "experienced" beek. After he swiped the swarm, the air once again filled with bees, some raining down onto the tarp but mostly congregated around the swiper who tossed the duster to the opposite side of the yard and came down that ladder with hands and feet outside the rails like a veteran firefighter at the Olympics. He hit the top of the picnic table with enough force to cause concern for the truck's suspension. Within seconds he had leaped across the yard to the water hose and was furiously spraying himself and the air around him. His father ran over pulling out a credit card en route (the mark of true experience). He then proceeded to scrape the swiper, reminiscent of the book reader's childhood days of scraping a scalded hog in the Fall. The "experienced" beeks had to go to the ER for evaluation and to get some shots, you know, just in case. About an hour later the elder beek called to report that the ER had administered Benadryl and stared at his son until they felt he would be okay and had released him. All being well, we laughed a little about the day and called it a day.

That swarm was history. Not to worry, the hive was still very strongly populated and still had queen cells. About five days later the book reader was standing in the yard watching yet another swarm in flight, headed for his neighbor's cedar trees. That swarm was within reach with a stepladder and with the neighbor's permission was hived the next day by the now slightly experienced book reader. The original hive was now much less populated, but still had a virgin queen ready to mate and go into the Winter. He now had two hives. Success!?

Turns out the "spotty brood" was only normal open heater bee cells that the read books had not mentioned. The white mark was not according to international marking because the supplier just used white for all queens. It was simpler and made them easier for new beeks to see. And, that first queen out does not necessarily kill all her sister queens. Sometimes she just gathers a crowd and goes to find a better home, leaving her sisters to squabble over Ma's estate. The second and third queens out may well do the same thing depending on population and nectar flow (note: Bees do not know the difference between a syrup bucket and a nectar flow). The book reader thought the population "seemed" strong, but it was, in reality, extremely strong given the first year, 20-pound harvest and the two (maybe more) virgin swarms issued.

The thing is if the books were to run down every rabbit trail that bees can lead you down, they would be way too tedious to read and would not move off the shelves as well as the authors would like. So, the books keep it simple and concise, and the new beeks hear 15 answers from 10 beekeepers for every question, because there's more answers, but that is all the 10 beekeepers can remember. The book reader continues to devour every written word he can get and has emerged as that guy who sits in the back of the meeting, quipping that he has never seen a bookcase or a calendar in any of the colonies he's inspected. If someone asks him, "When?", he never answers with a date but with a set of conditions. Next to him is usually a friend who has defaulted to answering questions with, "It depends." Experience is, after all, the best teacher. Now, relight that smoker and get to it! BC

Based on Greg Carey's experience with that first package in 2008. Greg is a Southern Maryland beekeeper.

Once Upon A Time . . .

Stephen **Bishop**

[While restoring the home of the Brothers Grimm, builders found an old manuscript crinkled and stuffed behind a plaster wall. Researchers from the University of Schnikeygobblestrasse suspect the Brothers Grimm discarded this long lost fairy-tale, believing it best used for insulation. The lost fairy tale has been translated from German, so you can judge for yourself whether it's worthy of the Brothers Grimm cannon.]

Once upon a time, a Big Bad Wolf napped in the forest while waiting for Little Red Riding Hood to walk by on a trail. This being modern fairy-tale times, Little Red Riding Hood never played outdoors, much less in the woods (which was probably good because a Big Bad Wolf was waiting there). So the wolf napped restlessly, lamenting the lack of passers-by, when a person tapped the wolf on the shoulder.

"Excuse me, you from around here?" asked a man dressed in all white, head to toe.

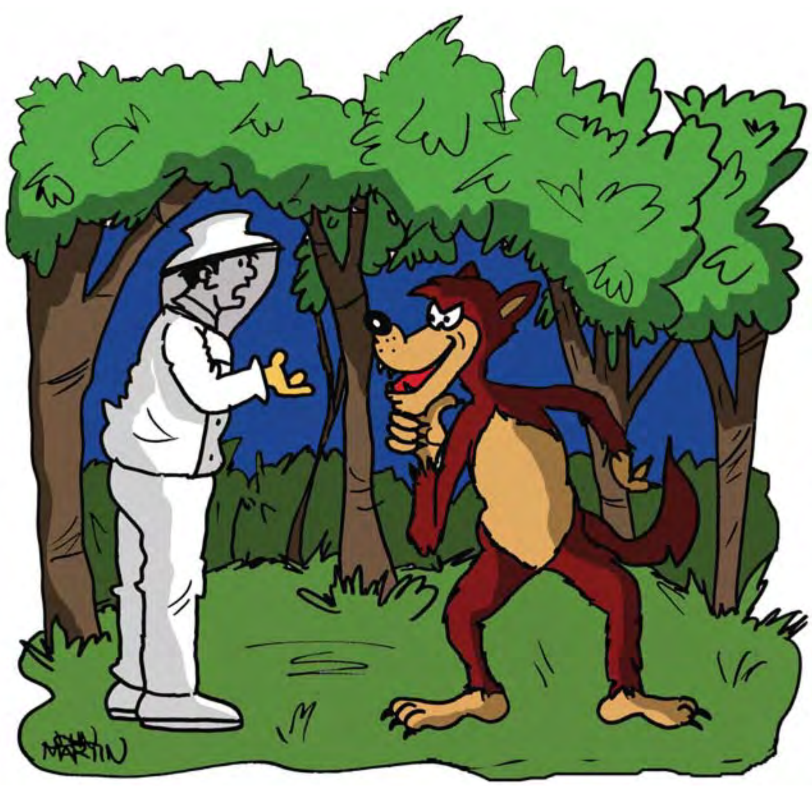
"Crikey," said the wolf, "how'd you sneak up on me?" The wolf sized up the biped. His first thought was "abominable snowman." His second thought was, "No, abominable snowmen are the stuff of legend. This must be some other creature."

"I move quietly and in slow deliberate movements," said the man, "I'm a beekeeper."

"Beekeeper!" said the Wolf, "never thought I'd see anyone in the woods today, much less a beekeeper. Thought y'all had gone extinct. You 'bout scared me to death. I rarely get visitors anymore."

"I know," said the Beekeeper, "This place is deserted. Didn't think I'd ever find anyone. I got a call from this lady, Granny Riding Hood – says she's got bees in her house. And darned if my phone's GPS didn't lose signal 'cause this is such a dark forest. Could you point me in the direction of the Granny Riding Hood residence? The directions were over the hills and through the woods to 5312 Pear Tree Lane."

The Big Bad Wolf couldn't believe his good luck. A lost beekeeper, large in circumference (if not bordering on overweight), with more meat on the bone than Little Red Riding Hood, had given him the address to Granny Riding Hood's residence. This was too good to be true. The wolf had long planned to devour Granny, if he only knew her address. Now, better yet, he could devour Granny and eat the beekeeper for dessert. So the wolf sent the beekeeper on a round-about way to Granny's house, meanwhile he ran straight there and knocked on the cottage door. And he knocked and knocked. No answer.



Granny, having waited for the beekeeper all morning, had left just minutes earlier to get her hair done at Connie's Curl 'N' Color. The wolf thought, "Well, easy come, easy go – more room in my stomach for the beekeeper. I bet he'll have a nice smoky flavor from his bee smoker." So the wolf broke in, dressed up as Granny Riding Hood, and waited for the beekeeper to knock.

But the beekeeper never knocked. He came straggling up to the house, his bee suit soaked in sweat, and quickly noticed activity around a knot hole in a clapboard – yellow jackets. The beekeeper, having spent all morning searching the boonies for this house, left in disgust and disappointment. He cursed his bad luck, never realizing a wolf dressed as an old lady would have eaten him had he knocked on the door. BC

Stephen Bishop is a humor writer specializing in agricultural antics and yellow-jacket swarm calls. You can see more of his work at misfitfarmer.com or follow him on ***Twitter @themisfitfarmer****.*

For Those Gloomy March Days –

Shana **Archibald**

HONEY CHOCOLATE COOKIES

2½ C of flour
½ C quick oats
1 tsp baking powder
½ tsp baking soda
1-1/3 C of brown sugar
1/3 C of sugar
½ C Crisco
8 tbsp butter
3 tbsp of honey
2 tsp vanilla
2 eggs
1½ C of chocolate chips. (Or put as many as you want! I won't judge)

Mix flour, oats, baking powder & baking soda in a bowl. In a separate bowl, combine brown sugar, sugar, butter, honey, vanilla & criso. Add eggs one at a time while mixing. Add dry ingredients, while mixing slowly. Next, using a spatula, fold in chocolate chips. Ball the dough into your desired size and bake for 8-11 mins on 350°F. Let cool, and enjoy!

WINTER ENERGY BITES

For those Dark Gloomy Days of Winter you might need a little energy push and the Flavor and Savor of these easy 'Winter Energy bites'

2/3 cup creamy peanut butter
½ cup semi-sweet chocolate chips
1 cup old fashioned oats
½ cup ground flax seeds
2 tablespoons honey

These are so easy to make & make a great healthy snack. Combine all ingredients in a bowl & stir. Place them in the fridge for 15-20 minutes. That will make them easier to roll into balls. Roll them & there ya go! You can keep them in a bowl in the fridge for up to a week

Robbing Is A Normal Way Of Bee Life

Oh, wow!!

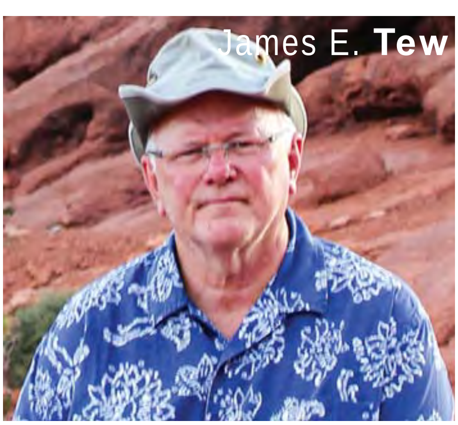
Man, last month, I was really on a roll. Just a few weeks before, my colonies had turned on their neighbors and shamelessly robbed each other – some more than others. I had not disturbed the colonies – not in any way. They started this mess all by themselves. I get bee things like this on my mind, and I frequently write about them. It is not uncommon for me to dwell too long on such topics. Yes, I know that I am near the edge with this topic.

I know that there is a risk of topic overplay here, but I want to go just a bit more with this robbing behavior subject. I promise that after this month, I will let the topic go – *for a while.*

A summary of last month's column

What I write here this month is promulgated on what I wrote last month. So, a summary of last month is in order. With copious amounts of wild speculation, last month I postulated:

1. Robbing behavior is actually a procedure for resource (honey) consolidation.
2. Robbing bees are much more than bored foragers that have gone on a rampage.
3. Food reserves – at any time of the year – are absolutely vital to the colony.
4. Bees first forage on blossoms, then bees forage on neighboring colonies' resources.
5. Within the ecosystem, colony robbing is a mechanism for maximizing food stores.



What is robbing behavior? Then and now.

I have never tried what I am about to try here. Having been a writer for many years, I normally have previous articles or publications on many common bee topics. *Robbing* behavior is one of those topics about which I have previously written. Through the years, I got my earlier thoughts and comments from the writings of other authorities and from my own experience. What I would like to try here is to add, in red font, the updates and changes in my current ideas. No doubt, a few years from now I will do this again in yet some other color.

So, what is robbing behavior – then and now?

When colonies are near each other in the beeyard, occasionally a behavior manifests itself in a behavior that beekeepers call "robbing". In times of a nectar dearth, forager bees will seek neighboring hives' honey resources. That is all that is taken – no pollen, no wax, no propolis, and no brood – only honey. The behavior can become intense with bees trying to get into any crack or opening in the victimized colony.

The event usually occurs during Summer months, when colony populations are high and there is no nectar flow. *(Importantly, in addition to Summer months, significant robbing behavior occurs after all Fall flows have ended. Colony forager populations are strong and no other food resources are available except for the stores of their neighboring colonies.)* It can start reasonably slow but build to a level approaching being completely out of control in only a few minutes. Normally, weak colonies are attacked, but many times powerful colonies can be under siege also. *(I suspect that all colonies are attacked, but it's the weak units that are unable to consistently resist the attacks.)* Though the exact reasons are unclear, robbing may not be a completely natural behavior. *(No, not true. Robbing is a natural behavior. But the behavior is unintentionally amplified in managed apiary situations.)* In nature, there would rarely be 10, 15, or even more colonies so close together in one location. With so many unemployed foragers available, great numbers of foragers can be directed to the colony being attacked. *(This is apparently true, but I don't know what communication mechanism is used to recruit foragers and direct them to the beleaguered colony(s).)* In most cases, the beekeeper is responsible for either she or he has opened a colony and has performing some assigned beekeeping procedure thereby leaving the open colony vulnerable. Opening all colonies at once may put all the colonies on alert, thereby reducing robbing tendencies. *(I have read this management statement many times and, in fact, I have told others to follow this procedure. However, when I have been in an apiary that is undergoing full-blown robbing, I have not found that opening all colonies does anything other than greatly add to the general confusion.)*

A colony under attack showing both robbers and hive bees orienting.

No doubt, robbing occurs in the wild, but probably much more rarely. A colony's tree has blown down or a colony dies of mite predation and honey resources are left unprotected, so neighboring robber bees move in and clean out the residue. However, these are occasional events. *(The tree-blowing-down example is reasonable, but I suggest that robbing behavior in the wild only occurs more rarely because there are fewer colonies in the wild foraging area. Late season colony robbing behavior in the wild would most likely be a "normal" bee behavior. Why waste this abandoned store of food?)*

How to Control Robbing.

Like swarming and stinging, (I speculate that robbing cannot truly be controlled (eliminated), but it can be reduced.) The colony or colonies being robbed should have all extraneous openings closed. The entrance should nearly be completely closed allowing only one or two bees to enter or exit at once. *(What do with this thought? I have read that reducing the entrance with anything other than screen only serves to direct the searching robbers to the reduced entrance. A screen-reduced entrance confuses the robbers but does not have the same effect on bees living within the colony.)*

Normally, under desperate conditions, beekeepers use wads of grass stuffed into every entrance. Pick up all burr combs and cover exposed frames and supers or better yet, get them out of the yard. Check web or your bee book for simple robber screens that can be built at home.

Close up the colony under attack and let things settle down.

Does all this infer beehives cannot be worked during the Summer? No, but a beekeeper may not necessarily be able to manipulate a colony in late October the same way that it would have been manipulated during the Spring flow. If the danger of robbing is present[1], open the colony in question, perform the necessary tasks and get out as quickly as possible. Keep applying smoke to all the colonies and shut down the entrances to the colony that was just manipulated. Keep the yard free of other attractive sources such as empty supers or comb scrapings.

Robbers can be diverted to honey sources that have been left exposed to be intentionally robbed. *(Yes, to this point, what I wrote above more*

[1]It's clear that the danger of robbing is always present if a nectar flow is not ongoing. If there are not a lot of flowers, then watch for a lot of robbing.

This may not be the best entrance closing device. This technique may actually direct robber to the reduced entrance.

A commercially available robbing screen.

than 20 years ago is still accurate, except I have a heightened sense of hopelessness. I now speculate that seasonal robbing behavior is a way of life for bees. Robbing, to a greater or lesser extent, will happen no matter what the beekeeper does. Yes, if bee colonies must be opened, work quickly, but I feel that beekeepers have always been playing with a much larger fire than I previously realized.) For instance, if extensive beehive manipulations are planned for late summer, an attractive pile of comb cappings or some other food source can be placed in the yard. Give the bees a day or so to find the food source thereby keeping them occupied. Robbing episodes are excellent opportunities for diseases to be spread. Do not use contaminated combs or honey of unknown origins. *(I have become uncertain about this recommendation. At this very moment, I have a stack of extracted honey supers in my yard. Think about it. I have an attractive robbing source 20 yards from my ten or so colonies. (1). I assume that all the robbers in the area are from my colonies. That assumption is not necessarily true. (2). I assume that the attractive source will lure* ***all*** *robbers to that location. That assumption is not necessarily true either. Due to the nearness of the reward site, the successful robber bees' recruitment dance would be very general and without directional information. To implement the dance information, newly recruited robber bees would just explore the entire neighborhood. Some would find the reward site while others would possibly find a weak colony. Essentially, I now speculate that a robber reward site only means that I now have robbers at* ***two*** *locations – the reward site* ***and*** *my colonies. Does that make things better or worse?)*

Be aware that the practice of allowing bees to rob extracted supers from which honey has been extracted as a "treat" may encourage bees to rob other colonies – or it may not. A better procedure would be to place the empty, wet supers on colonies and let bees clean the honey residue from the inside the equipment. Many times, such wet supers are also sticky on the outside and will attract robbers to the hive having the supers stacked on.

Stack of supers with empty wet combs. Does this manipulate robber behavior?

Bee blowers or leaf blowers can be instrumental in initiating robbing activities. The aroma of fresh honey and comb is blown across the yard making it even easier for robber foragers to find open colonies. However, this process is usually self-limiting in that all colonies are ultimately opened, and supers removed. Once a colony is challenged, it will divert robbing behavior to colony defense and mitigate robbing activities. *(Hmmm, maybe that would be the effect on the bees within the colonies that had honey removed. But bees not from those colonies would continue to rob with impunity.)*

In many instances, small colonies such as queen mating nuclei or colony splits are in danger of robbing. In such cases, robbing screens can be installed. These devices require bees to learn to use their restricted entrances when entering and leaving the colony. Impatient robbers will fly directly to the entrance where they will be stopped from entering while trained bees are able to use the learned entrances. *(Yes, entrance robbing screens seem to be helpful. I have found that robbing screens should probably be removed every few days to be sure dead bees have not accumulated behind the screen.)*

What's a robber cage?

A robber cage is simply a portable screen cage, usually measuring about four feet square and about five feet tall having neither top nor bottom. The robbing cage, with the beekeeper and the hive inside, is set over the colony to be manipulated. Bees leaving the colony find the open top and leave. The cage confuses all returning bees, including robbers, that are attempting to fly directly into the colony entrance. Once the management tasks are finished within the cage, the colony entrance is reduced to one so small that only a bee or two can enter at once. Using this cage, the open colony is never directly exposed to the ravages of robber bees. *(A robbing cage is a highly unusual piece of equipment for a typical beekeeper. Their primary use is in the academic bee yard or possibly within a queen production operation. True, they work well and give both the beekeeper and the bees a somewhat safe place, but there are quirks to be considered. For instance, the use of robbing cage requires that the hive being worked sits directly on the ground. Such cages are not commercially available, but not impossible to construct. I suspect that modern-day screened dining canopies could be made to work.)*

Individual Robber Bee Behavior

Robber bees have an irregular, flighty behavior. They will hover around the colony entrance or try to fly directly into the hive. In a strong colony, guard bees attack robbers and both bees will roll around in combat. If not killed, robbers will lose much of their body hair during such skirmishes and will take on a glossy black look. In the true sense of the work, these robbers are not villains, but are aggressive foragers out to get food for their colony anywhere they can. *(All through the decades, as have all other presenters, I have described the furtive behavior of robbers. Why would robbers take on that obvious behavior? It really makes them stand out both to me and – most likely – to other bees. I know. I know. They are trying to escape. Hair rubs off, wings are torn – like you, I know the whole story. It seems to me that a "kinder, gentler" approach would nearly work just as well and would not be nearly as dramatic and flamboyant. I mean in my world; human robbers are quiet and unobtrusive. Human robbers do all they can NOT to stand out. I mean these aggressive bees are not robbers so much as they are raiders. They go in with guns blazing. Everyone sees them coming.)*

Progressive Robbing

If robbers are successful at getting into a colony and proffering a load of honey, they begin to acquire the odor of the victimized colony. Finally, they carry the odor of both colonies and can freely enter either colony. Such robbing behavior is called "progressive robbing" and is much more difficult to determine or control. No doubt progressive robbing goes on to some degree all Summer and Fall, but all things being equal, the honey that a colony's progressive robbers steal from another colony is ultimately stolen by progressive robbers from other colonies. *(I boldly wrote the description just presented all those years ago. It was a great story of intrigue and clandestine bee behavior. Maybe it still is, but now, there are those who point out that there is no data supporting this belief – cherished that it may be. If it is true that progressive robbing does not exist, then we beekeepers are only left with rambunctious robbers terrorizing the beeyard. Somehow, progressive robber bees seemed so much more civilized. The story may yet be true.)*

A collapsible robbing cage with an access door.

I'm punched out

I'm done. When our day in the apiary ends, nothing changes when it comes to managing robbing bees. We will still reduce entrances. We will still keep from scattering combs. We will do what we have always done. But, without scientific evidence to support my rambling thoughts, I will suspect that honey bee robbing (raiding??) is more logical and practical than I ever thought.

If you're inclined

Kim Flottum, the former editor of this magazine, and I talk about bee subjects such as robbing behavior on our new podcast series. You would be welcomed to listen in at: **https://www.honeybeeobscura.com** BC

Dr. James E. Tew, Emeritus Faculty, Entomology, The Ohio State University and One Tew Bee, LLC

Honey Bee Obscura Podcast at: https://www.honeybeeobscura.com

tewbee2@gmail.com; http://www.onetew.com

For a short video on "**Robbing is a normal way of bee life**" and more comments on this month's article, hover your smart device QR app over this code....

https://youtu.be/oC_qcL9RcyY

GLEANINGS

MARCH 2021 • ALL THE NEWS THAT FITS

OBITUARIES

Gary Joe Reynolds, 79, went to be with his Lord and Savior, Jesus Christ on January 12, 2021. He was born in Fredonia, KS May 4, 1941, the son of Orval and Gladys (Wright) Reynolds. He married Nancy Brown in Neodesha, KS, on June 11, 1960.

Gary graduated from Kansas State University with a BS in Agricultural Education, pursued his Master's Degree at Oklahoma State University in Forage and Cereal Grain Crops and completed his higher education at Louisiana State University studying for his PhD in Honey Bee Genetics. He was employed by the USDA for 12 years ending at the Honey Bee Laboratory in Baton Rouge, LA. Wishing to be his own employer, he moved his family to Concordia, KS to start Rainbow Honey Farm, named for the many colors of his hives. Gary always said that the honey bee was both his vocation and avocation. His love of the tiny insect was his passion for 57 years.

Gary was a 45 year member of Concordia Wesleyan Church having served as vice chairman of the board and youth sponsor. He was active in national, state and area beekeeping organizations. Gary served as President of Mid U.S. Honey Producers, a seven-state organization, President of the Kansas Honey Producers Association, Founder and President of the North Central Kansas Beekeeping Organization, a 50+ year membership of the American Beekeeping Association, President of the Salina Farmers' Market and Founder of the Concordia Farmers' Market.

Along with a Kansas elementary student, Gary was instrumental in securing the honey bee as the official Kansas State Insect. He appeared before the International Trade Commission in both Washington, DC and Topeka, KS in support of the honey bee.

For many years Gary substitute taught in the Concordia, Minneapolis, Clifton-Clyde and Pike Valley School districts. Known as The Honey Man, he enjoyed the students and interacting with them and provided lots of honeystix. Many classes visited Rainbow Honey Farm and Gary spoke to classes about the value of the honey bee.

Gary is survived by his wife, Nancy, sons GJ Reynolds (Alita) Lincoln NE, James Reynolds (Mechelle), Concordia and daughter Julianne Yankoviz (Kenny), Manhattan, brother Dan Reynolds (Barbara), Grand Junction, CO, 13 Grandchildren and eight Great-Grandchildren. He was preceded in death by his parents and half-brother, Wayne Bargar.

Memorial contributions may be given to Franklin Graham Samaritan's Purse Beekeeping Project, which provides starter hives, training to care for the bees and harvesting honey to families in need in third world countries, in care of Chaput-Buoy Funeral Home, PO Box 606, Concordia, KS 66901.

Regents Professor Vaughn Bryant, October 5, 1940 — January 30, 2021

It is with the heaviest of hearts that we share this sad news. Our friend, our mentor, our dearest colleague, Dr. Vaughn Bryant, passed away peacefully on the morning of January 30, 2021 after battling one of the most aggressive forms of cancer for the past several years. He will be remembered with the greatest fondness for his kindness of spirit and his generosity of heart. He created our department, made so many careers and futures here possible, and touched the lives of every person he came in contact with during his 50 years in the Department of Anthropology. We will miss him dearly. A memorial scholarship will soon be established in his name. Because of the pandemic, a service has not yet been planned, but we will share more details as soon as we can. Gifts in memory of Dr. Vaughn M. Bryant should be sent to Texas A&M Foundation, 401 George Bush Drive, College Station, Texas 77840. For online gifts please copy and paste the following link: **https://www.txamfoundation.com/How-to-Give/Honorary-And-Memorial.aspx** Please add Vaughn M. Bryant to the note area.

CALENDAR

♦KANSAS♦

Spring 2021 Virtual KS Honey Producers Meeting March 6.

Speakers include Samuel Ramsey and Clarence Collison. You must register to have the zoom link emailed to you.

To register and for more information please visit **www.kansashoneyproducers.org**.

♦MICHIGAN♦

MI Beekeepers Association Spring Conference will be held March 3-6.

Speakers include Samuel Ramsey, Tammy Horn Potter, Juliana Rangel Posada, Meghan Milbrath, Roger Hoopinarner, Julia Mahood, Peggy Garnes and Dorothy Morgan. Workshops for the whole family.

For information please visit **http://michiganbees.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**.

♦MISSOURI♦

MO State Beekeepers Virtual Spring conference will be held March 13 8:00a.m. - 3:30p.m.. Registration deadline is March 8. The conference is to all members. $10 to non-members to become a member.

Speakers for the day are Kim Flottum, Tina Sebestyen and Elizabeth Walsh.

For information contact **MSBAConf@gmail.com**. To register visit **https://mostatebeekeepers.org/2021-virtual-spring-conference/.**

♦NEW HAMPSHIRE♦

NH Beekeepers Association Virtual Spring Meeting will be held March 20, 9:00a.m. to 12:00p.m.

Keynote speaker is Landi Simone.

Registration form the meeting will be open to the public on the NHBA website beginning March 1, **www.nhbeekeepers.org**.

♦OHIO♦

Greater Grand Lake Beekeepers Association will hold their Beginning Beekeeping Class March 13, 8:00 a.m. to 5:00 p.m. at the Richardson-Bretz Building, 119 W. Fulton Street, Celina.

The cost is $50/person ($25 for second person) in advance. At the door $60/person ($30 for second person). Class size is limited to 35.

To register and for information visit **www.gglba.ohiostatebeekeepers.org** or contact Mark Beougher, 419.305.8662.

Lorain County Beekeepers Association will hold their annual Beginner Beekeeping Class on Fridays in March beginning March 5, at Life Church, 1033 Elm Street, Grafton.

The fee is $50 which includes 1 year membership to the club.

Hands-On Field Day will be held June 5 at Queen Right Colonies, 43655 State Route 162, Spencer, OH. **Bonus Class - Fall Wrap** September 10, 7:00 p.m. at Life Church.

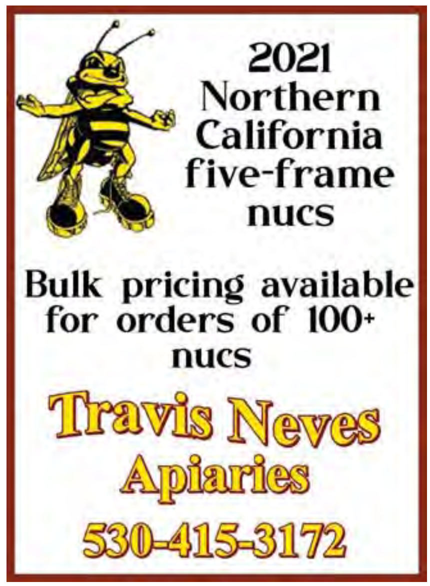
For information **www.loraincountybeekeepers.org**.

♦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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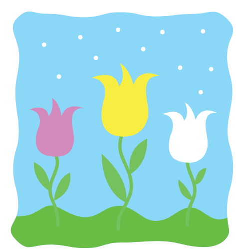

Applications now open for Mann Lake Eastern Apicultural Society (EAS) Youth Scholarship

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.

BOTTOM BOARD

True Believers

Ed **Colby**

It's a bitter, pitch-black January Sunday. Dawn will surely be here in another hour. Sundays are sacrosanct. Paul and I go fishing, no matter the weather. We just go. But this morning I awakened with an epiphany and made a call. "Paul," I said, "Let's just wait until after we get our Covid vaccinations." He sounded almost relieved. We're both on the Garfield County short list.

He comes every Sunday early. Because we're both hard of hearing, we yell at each other on our hour-long drive to the river. We're not exactly socially distanced in his Subaru. We're a dream team pair for the virus – a couple of old guys who apparently assumed that friends can't give friends the corona.

With 2020 finally behind us, for me the new year began with an opportunity – a call from England, offering help with a project long in the offing.

Then a black curtain fell, and the light was gone, with the sacking of the Capitol by true believers. It took me days to emerge from a profound despair, but remember, after the darkness, always the light.

Last night I dreamed my honey bee colonies were starving, that I was popping lids in bitter cold to feed the little darlings. In my dream I fed them the Winter patties that really are sitting in our living room.

Every other weekend Marilyn travels over two hours to peddle honey at the farmers' market in Montrose. My gal's no buttercup. She doesn't mind selling honey outdoors in Colorado in January. She lost some of her local sales outlets to the virus. She stays with my sister in Montrose. Now in a couple of weeks my one and only precious dear sweet niece and her two children will be visiting in Montrose from LA, and we're invited. We all want to stay safe but still live your lives, right? Good judgment's a slippery slope.

I have a yard on a gentle hillside, nestled against some Gambel oaks. A productive Summer location, it gets practically no Winter sun. Yet bees did just fine there last Winter and the Winter before that. I can't explain this, and I do confess I'm a bit uncomfortable that I have bees in the shade again this Winter.

The important thing is that in early December all my (broodless or mainly broodless) colonies received an oxalic acid dribble treatment for *Varroa* mites. The dribble is hard on mites. Bees seem to tolerate it. You can fret about your bees all you want, but it comes to nothing if you can't control your mite population.

And you can believe whatever you want. You can blame your Winter losses on pesticides. You might even be right. You can believe that crop rotation and re-establishing healthy soils eliminates the need for pesticides, so that bees are stronger and better able to ward off *Varroa*. You can believe that bees need to sink or swim without our help. So let the weak perish, and the strong survive! You can believe that mites are someone else's problem.

You can always find "information" on the Internet that confirms whatever you believe or want to believe. And you can make your beliefs dovetail with your approach to beekeeping. You can keep losing your bees, when the reason is right under your nose.

I'm going to tell you the truth, and you might not like it. Memorize this. Mites kill honey bee colonies, and these dying colonies spread their parasites when their honey stores get robbed out by neighboring colonies. This is not my opinion. This is no conspiracy theory. This comes from scientific consensus, and from getting decimated by mites not once, but twice. This is a fact.

It's like Covid 19. You can call it a hoax. You can insist it's not a problem. You can argue that all we need is "herd immunity" – until reality strikes, and you give it to somebody else, and they pass it along to yet other people, until somebody's on a ventilator.

Yes, we want and need queens that are naturally resistant to mites. Fine. Let's select for them, but not by allowing colonies headed by non-resistant queens to die out and spread this plague.

And yes, let's avoid – whenever possible – treating our bees with chemicals that might compromise the viability of our queens. Under no circumstances should we contaminate honey destined for human consumption. But let's give our bees what they need to stay alive. If you were starving, and someone offered you a hamburger, would you ask, "Is it organic?"

I understand and respect that some very good beekeepers in isolated locations successfully keep bees without chemical intervention for *Varroa* control. By giving bees brood breaks, removing drone larvae, keeping colonies from getting too strong, selecting for resistant queens, and accepting the loss of a lot of colonies along the way, you might eventually be able to keep your mites at bay. But the key words here are "very good beekeepers" and "isolated locations." This is not Beekeeping 101. You need to know what you're doing, and if your bees are in a neighborhood with other hives within flight range, your own bees will likely bring home mites from your neighbors' collapsing hives. These "*Varroa* bombs" are the kiss of death for chemical-free beekeeping.

Whatever way you choose to protect your bees from parasitic mites will require dedication on your part. Don't drop the ball. You're a beekeeper. This is your responsibility. This is your job. Believe me.