BIP LOSS REPORT

AUG 2023

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Cover Photo by Brian Carlton as part of our Image Gallery Photo Contest. Find details about the current contest images on page 95!

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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 print, $32; two years print, $58; one year digital, $22; one year print and digital bundle, $40; two years print and digital bundle, $66. All other countries, (U.S. Currency only), one year print, $72; two years print, $144; one year digital, $22; one year print and digital bundle, $77; two years print and digital bundle, $154. Send remittance by money order, bank draft, express money order, or check or credit card. Bee Culture (ISSN 1071-3190), August 2023, Volume 151, Issue 8, 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 • info@BeeCulture.com

Advertising – 800.289.7668, Ext. 3216; Jen@BeeCulture.com

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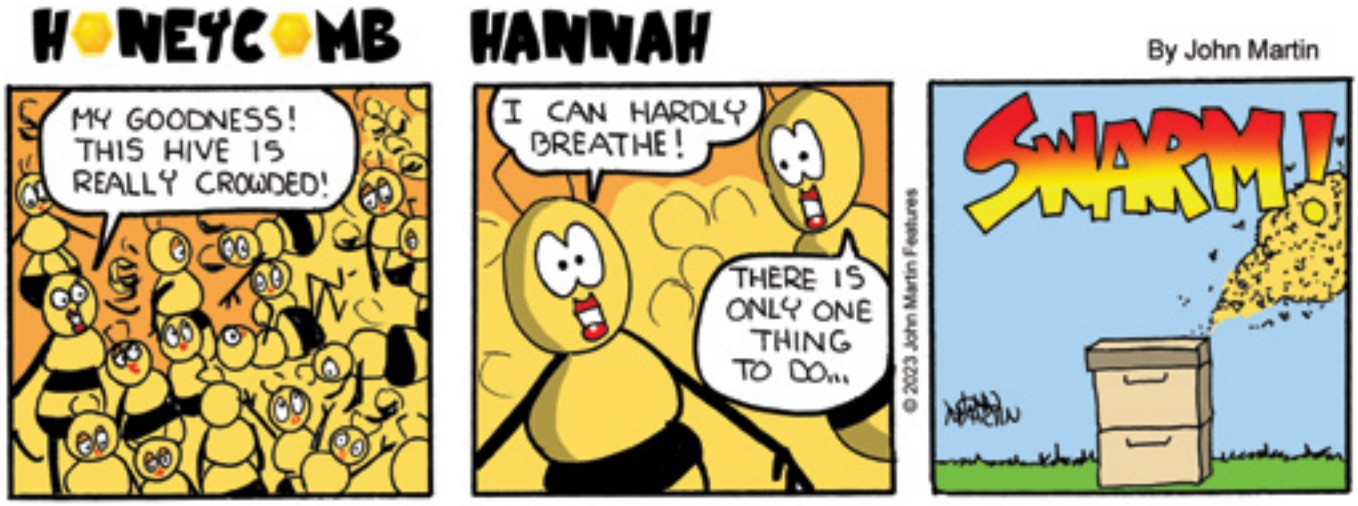

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Catch the Buzz

In response to the Catch the Buzz article *Plant Cell Based Honey…* (read it here: **https://www.beeculture.com/plant-cell-based-honey/**)

It would be a bigger disaster for the beekeeping industry if the plant cell honey sale would succeed, more than *varroa* mites. It would destroy the pollination industry as well. The plant honey will save the ecosystem damaged by the honey bee??? We will see.

Ronglin

Successes and Problems...

I really enjoy the simple information you are adding about bees and beekeeping. One suggestion from a few issues ago was to smear honey on clean plastic on new frames. The author stated that by the next morning the bees were making comb in those new frames. I tried that and will agree completely. If those frames are in the body, I have a strong showing of brood within a week (three or four frames full of brood). If I do that with supers, I have supers full within five or six days (60 pounds of honey). That can make a real difference at extracting time. I have pictures of beeyards where many of the hives have four to eight full supers at extracting time.

Thank you again for letting us hear what is working for other beekeepers. One problem I am having is there are people here that come in and take brood frames and honey out of the body and replace them with either new frames or used frames they have from somewhere else. I have had hives that have produced well over a hundred pounds of honey ready to ship that when I started checking why the bees were not really active in the hives discovered that the hives contained all new frames. In some cases, no comb whatsoever. Some of these tid bits can make a real difference.

Ernest
Region 5 Honey Reporter

Warning!

It has come to our attention here at *Bee Culture* that there are some people receiving communications about renewals that **DO NOT** come from *Bee Culture*.

For many years we worked with a couple of third-party companies for subscriptions. We ended our working relationships with them last year for a variety of reasons, including them taking your money for subscriptions and then never sending us the money or information for those subscriptions, or when they did, it was over a month later. Since then, the only one we remained working with ended their consumer subscription service earlier this year. Due to this, we wanted to put out a warning regarding subscription renewals:

Bee Culture will only contact you for renewals through a letter in the mail and/or an email, depending on the type of subscription you receive. If you receive ANY phone calls asking about a renewal, it is not *Bee Culture* staff, we never call people for renewals. If you are ever unsure about whether a renewal request is legitimate, please reach out to us! You can reach Jen or Emma at **jen@beeculture.com** and **emma@beeculture.com** or you can call us at 330-725-6677, ext. 3216. Please be aware that if you attempt to renew and pay through a third-party for your renewal, *Bee Culture* is unable to do anything about it.

For anyone with a print only or bundle subscription, you will receive a letter in the mail when you are near subscription expiration. These renewal letters will have a paid postage envelope included with the following return address:

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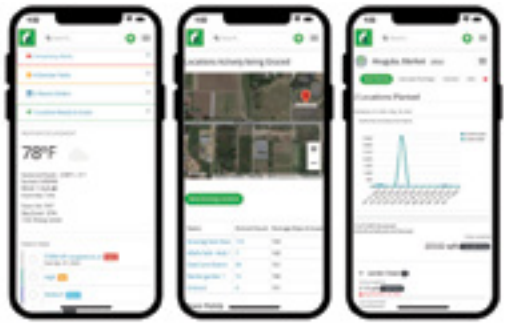
For anyone with a digital only or bundle subscription, you will receive an email from us when you have three issues remaining, with a few follow-ups after if you have not renewed the digital piece of your subscription. If you are not directed to either **www.BeeCulture.com** or **Store.BeeCulture.com** to renew, it is not an email from us.

We do have working relationships with some of the big beekeeping brands like Betterbee and Mann Lake, but we always suggest that you subscribe directly through us. Subscribing through us is the best way to guarantee you get your first issue on time and that if a problem should arise, we are in the best position to help you.

We want everyone to have a wonderful experience with *Bee Culture,* both with the content of the magazine and the rest of the experience with us. Please be careful about these renewal notices. And if you ever have any questions or concerns about your subscription or renewal, please contact us directly!

New Product

farmbrite



Keeping accurate and up-to-date records for your beekeeping operation is critical to help you measure the performance and health of your hives. Farmbrite gives you the business tools to manage, track and organize your bee operation, all in one place.

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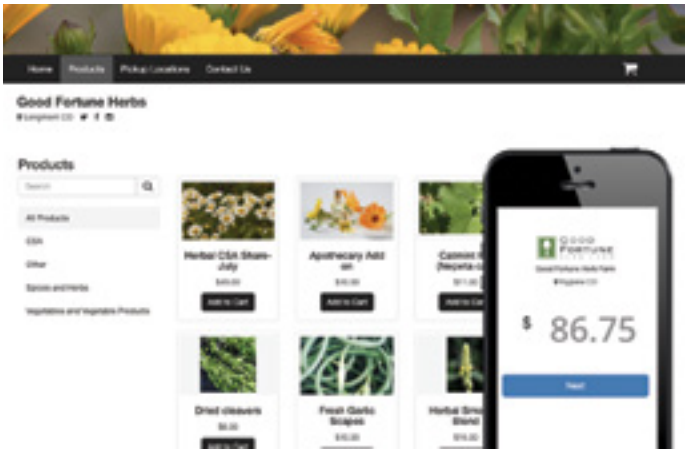

NEXT MONTH

Region 1
- Extract surplus honey
- Combine or re-queen weak colonies
- Sample for mites and treat after supers are removed
- Sample after treatment – did it work?
- Fall is coming. Check stored food supply
- Be sure colony is healthy for Winter bee production
- Put on mouse guards
- Fall flow?

Region 2
- Do you know how to control mites and SHB?
- Check queens
- Re-queen weak colonies
- Sample, treat, sample for mite control success
- Consider feeding weak hives
- Get ready for Fall flow
- Make Winter nucs
- Remove supers / condense colonies

Region 3
- Sample and treat for *Varroa*
- Feed nucs
- Feed light colonies
- Treat for *Varroa* with labeled product
- Monitor for small hive beetle
- Combine weak colonies
- Pull Fall honey

Region 4
- If mite treatment is needed, could use ApiGuard
- Sample and treat for *Varroa,* if necessary
- Assess queen status
- Extract Fall goldenrod and aster honey
- Combine weak colonies
- Balance resources in colonies
- Make last splits

Region 5
- Pull Fall honey
- Sample, treat, sample again for mite control
- Feed small colonies or combine with others
- Check queen laying pattern
- Gather hives for shipping south
- Check stores

Region 6
- Take off honey supers
- *Tools for* Varroa *Management Guide*
- Feed colonies needing it
- Add supers for Fall flow (hopefully in Texas)
- Harvest and extract honey
- Prepare for Winter

Region 7
- The goal is low mite count
- Young healthy queens
- Nosema treatment
- Feed weak colonies
- Start insulating colonies
- Sample after mite treatments
- Combine weak colonies with strong colonies

Honey Reporters Wanted

We are expanding our Honey Reporter population in EVERY region. We ask that you fill in most of the sections, most months, and our short survey at the bottom. We give you a FREE subscription for your service. So if you are interested fill out the form **https://forms.gle/EnZW531NHM7sbMUz8** OR send an email to **Emma@BeeCulture.com** and put REPORTER in the subject line. Include name, email, phone number and mailing address and we'll get you the next Honey Report form. Sign up today and be a part of the BEST Monthly Honey Price and Beekeeping Management Report in the industry.

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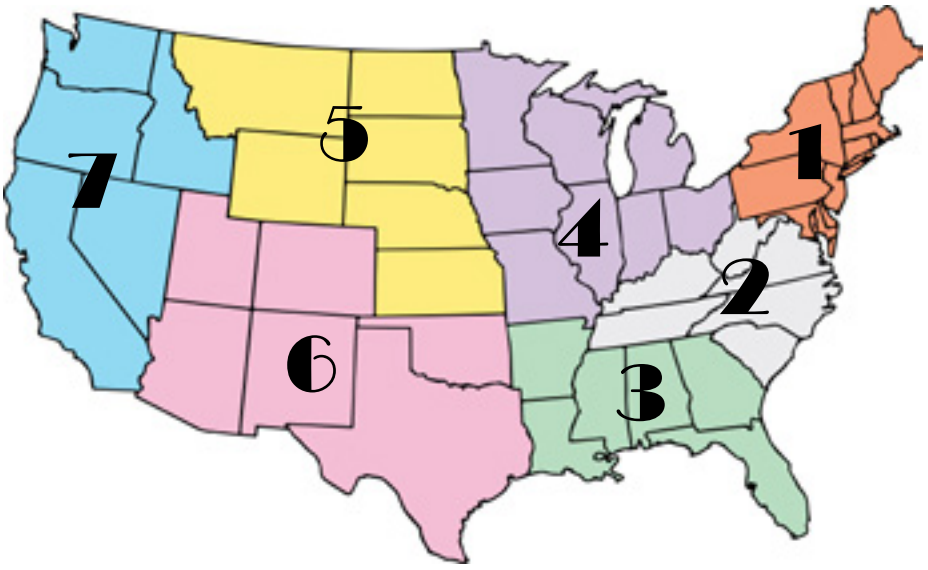

AUGUST – REGIONAL HONEY PRICE REPORT

REPORTING REGIONS											History	
	1	2	3	4	5	6	7					
EXTRACTED HONEY PRICES SOLD BULK TO PACKERS OR PROCESSORS								**Range**	**Avg.**	**$/lb**	**Last Month**	**Last Year**
55 Gal. Drum, Light	2.41	3.75	3.25	3.00	2.95	2.74	2.95	2.00-3.75	2.93	2.93	2.92	2.65
55 Gal. Drum, Ambr	2.27	2.80	3.25	2.97	2.95	3.63	2.85	2.00-5.45	2.98	2.98	2.82	2.45
60# Light (retail)	232.31	351.25	266.67	214.17	240.00	227.42	290.00	120.00-450.00	249.77	4.16	241.92	219.66
60# Amber (retail)	231.43	310.80	268.75	209.80	220.00	227.42	225.00	120.00-400.00	241.49	4.02	238.70	218.53
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS												
1/2# 24/case	99.26	114.60	94.50	94.00	129.80	90.00	-	66.00-168.00	101.57	8.46	95.44	95.46
1# 24/case	161.19	188.00	164.50	146.24	204.71	134.18	144.00	96.00-264.00	162.76	6.78	164.79	150.75
2# 12/case	146.13	192.00	146.25	128.11	173.76	170.00	156.00	84.00-264.00	147.69	6.15	154.55	151.27
12.oz. Plas. 24/cs	120.45	162.48	131.33	99.95	119.70	112.48	117.60	72.00-240.00	122.04	6.78	137.33	118.54
5# 6/case	153.18	240.00	157.21	124.50	110.46	168.61	-	45.00-330.00	149.72	4.99	179.44	153.05
Quarts 12/case	194.17	214.00	214.83	204.00	199.63	194.94	201.00	119.88-312.00	203.82	5.66	197.18	167.04
Pints 12/case	114.60	138.00	129.55	129.40	135.20	135.00	129.60	72.00-192.00	128.68	7.15	114.02	112.05
RETAIL SHELF PRICES												
1/2#	6.00	7.50	6.40	6.14	6.73	5.33	-	3.00-15.00	6.37	12.75	6.36	6.12
12 oz. Plastic	7.60	9.35	7.31	7.25	6.91	8.59	6.17	4.29-15.00	7.72	10.29	7.93	7.35
1# Glass/Plastic	9.79	12.22	10.36	9.55	12.29	8.60	10.50	5.79-20.00	10.38	10.38	10.17	9.60
2# Glass/Plastic	16.61	22.57	17.95	17.78	20.02	13.94	25.00	7.88-35.00	17.96	8.98	17.24	16.33
Pint	12.28	14.63	11.33	13.30	13.52	14.60	12.20	5.00-30.00	13.12	8.74	12.88	11.91
Quart	22.75	25.85	20.86	21.80	19.27	20.99	20.17	10.00-45.00	22.31	7.44	21.82	20.86
5# Glass/Plastic	35.94	43.75	40.88	33.67	31.18	47.50	-	23.50-60.00	37.25	7.45	36.28	46.45
1# Cream	12.08	12.80	16.00	11.36	9.90	20.00	16.00	6.69-21.00	12.46	12.46	11.60	11.38
1# Cut Comb	15.76	16.40	17.75	14.89	12.00	20.00	25.00	8.00-30.00	16.11	16.11	14.57	13.92
Ross Round	12.29	17.20	-	11.33	-	25.00	15.17	8.00-25.00	14.55	19.40	14.88	11.91
Wholesale Wax (Lt)	6.71	8.33	7.75	7.83	7.50	5.00	3.75	3.00-10.00	7.03	-	6.85	8.15
Wholesale Wax (Dk)	4.83	7.36	7.00	7.45	8.00	3.75	-	2.25-10.00	6.15	-	6.01	6.09
Pollination Fee/Col.	86.17	74.00	97.50	161.00	200.00	-	50.00	50.00-250.00	103.71	-	103.36	83.00
Price of Nucs	178.81	185.42	163.75	169.17	183.75	200.00	190.67	100.00-299.00	178.11	-	185.28	-
Price of Packages	159.26	139.17	146.25	156.25	150.00	150.00	200.00	110.00-200.00	156.03	-	153.36	-

Please note: anywhere within each region that there is a '-' it is because no information was sent to us for that specific item in that region.

How do you compare to our honey reporters? All data collected is from May/June 2023.

Average Honey Flow Time and Amount per Region

Region 1:
Timing of Flow: Early
Amount of Flow: Average

Region 2:
Timing of Flow: Normal
Amount of Flow: Average

Region 3:
Timing of Flow: Normal
Amount of Flow: Light

Region 4:
Timing of Flow: Normal
Amount of Flow: Average

Region 5:
Timing of Flow: Late
Amount of Flow: Light

Region 6:
Timing of Flow: Normal
Amount of Flow: Equally light and average

Region 7:
Timing of Flow: Equally early and late
Amount of Flow: Average

Mite Treatment per Region

Region 1: Most used no mite treatment due to honey flow.
Region 2: Most used no mite treatment due to honey flow.
Region 3: Most used no mite treatment due to honey flow.
Region 4: Most used no mite treatment due to honey flow.
Region 5: Most used either a Formic product, a non-chemical treatment method or no mite treatment due to honey flow.
Region 6: Most used either an Oxalic Acid Vapor product, a Formic product or no mite treatment due to honey flow.
Region 7: Most used no mite treatment due to honey flow.

Top Blossoming Plants per Region

Region 1: Clover, Black Locust, Dandelion, Honeysuckle, Locust
Region 2: Clover, White Clover, Poplar, Blackberry, Catalpa, Chestnut, Honeysuckle
Region 3: Clover, Sumac, Palmetto, Privet, Crepe Myrtle, Sourwood, Soybean, Wildflowers
Region 4: Black Locust, Clover, Sweet Clover, Basswood, Raspberry, White Clover
Region 5: Clover, Alfalfa, Chokecherry, Dandelion
Region 6: Fruit Trees, Russian Olive
Region 7: Blackberry, Dandelion, Meadowfoam

Overall Top Blossoming Plants

Clover, Black Locust, Dandelion, Honeysuckle, White Clover, Sumac, Blackberry, Sweet Clover

STUDY HALL

United States Honey Bee Colony Losses 2022-2023: Preliminary Results from the Bee Informed Partnership

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Note: *This is a preliminary analysis. Sample sizes and estimates are likely to change. A more detailed final report is being prepared for publication in a peer-reviewed journal at a later date. Previous years' peer-reviewed publication can be accessed on the survey information page:* **https://beeinformed.org/citizen-science/loss-and-management-survey/**.

The Bee Informed Partnership (**http://beeinformed.org**) is a non-profit organization that strives to improve honey bee colony health in the United States by performing data-driven research in collaboration with beekeepers. Its vision is to create an environment where new and established beekeepers can be successful in maintaining healthy honey bee colonies. One of the organization's longest running programs, the national Colony Loss and Management Survey, was initiated with the support of the Apiary Inspectors of America in 2007. Since then, it has monitored colony loss rates of managed honey bees in the United States (Bruckner et al., 2023), as well as identified risk factors and protective measures associated with health, particularly as they relate to beekeeping management (Steinhauer, vanEngelsdorp and Saegerman, 2021). The survey is organized in collaboration with the Bee Lab at Auburn University (**https://aub.ie/bees**) and the Bee Lab at University of Maryland (**https://www.umdbeelab.com/**).

The survey is a retrospective online questionnaire, which relies on voluntary participation of beekeepers across the country during the month of April. The 2023 survey covered the one year period between April 2022 and April 2023. Small scale beekeepers (1-50 colonies) and large-scale beekeepers (>50 colonies) took slightly different versions of the survey (survey question previews can be found at **https://beeinformed.org/citizen-science/loss-and-management-survey/**).

This year, 3,006 beekeepers from across the United States provided valid survey responses. These beekeepers collectively managed 314,360 colonies on 1 October 2022, representing 12% of the estimated 2.70 million managed honey-producing colonies in the country in 2022 (USDA NASS, 2023).

Colony loss rates were calculated as the ratio of the number of colonies lost to the number of colonies managed over a defined period. Loss rates should not be interpreted as a change in population size, but are best interpreted as a mortality rate. High levels of losses do not necessarily result in a decrease in the total number of colonies managed in the United States because beekeepers can replace lost colonies throughout the year.

During Summer 2022 (1 April 2022 – 1 October 2022), an estimated 24.9% [18.0 – 31.7, 95% bootstrapped confidence interval (CI)[1]] of managed colonies were lost in the United States (Fig. 1). This was on par with recent years. The Summer loss rate was just 1.1 percentage point (pp) higher than last year's estimated Summer colony loss (23.8% [16.7 – 31.5 CI]), and 2.2 pp higher than the average Summer loss reported by beekeepers since the Summer of 2010 (22.6%, 12-year average), when Summer losses were first monitored.

During Winter 2022-2023 (1 October 2022 – 1 April 2023), an estimated 37.4% [28.6 – 48.1 CI] of managed colonies in the United States were lost (Fig. 1). This Winter loss rate was 13.2 pp in excess of the previous Winter loss rate (24.2% [20.3 – 29.9 CI]), and 9.1 pp higher than the average Winter loss (28.2%, 15-year average) reported by beekeepers since the start of the survey in 2008, making 2022-2023 the second highest year of Winter loss after 2018-2019 (37.7% [26.5 – 50.6 CI]).

[1]Confidence intervals were obtained from the distribution of bootstrapped estimates for each group of respondents (n-out-of-n method, 1000 rep). Due to the stochastic nature of bootstrap analyses, 95% CI are expected to vary slightly at each computation.

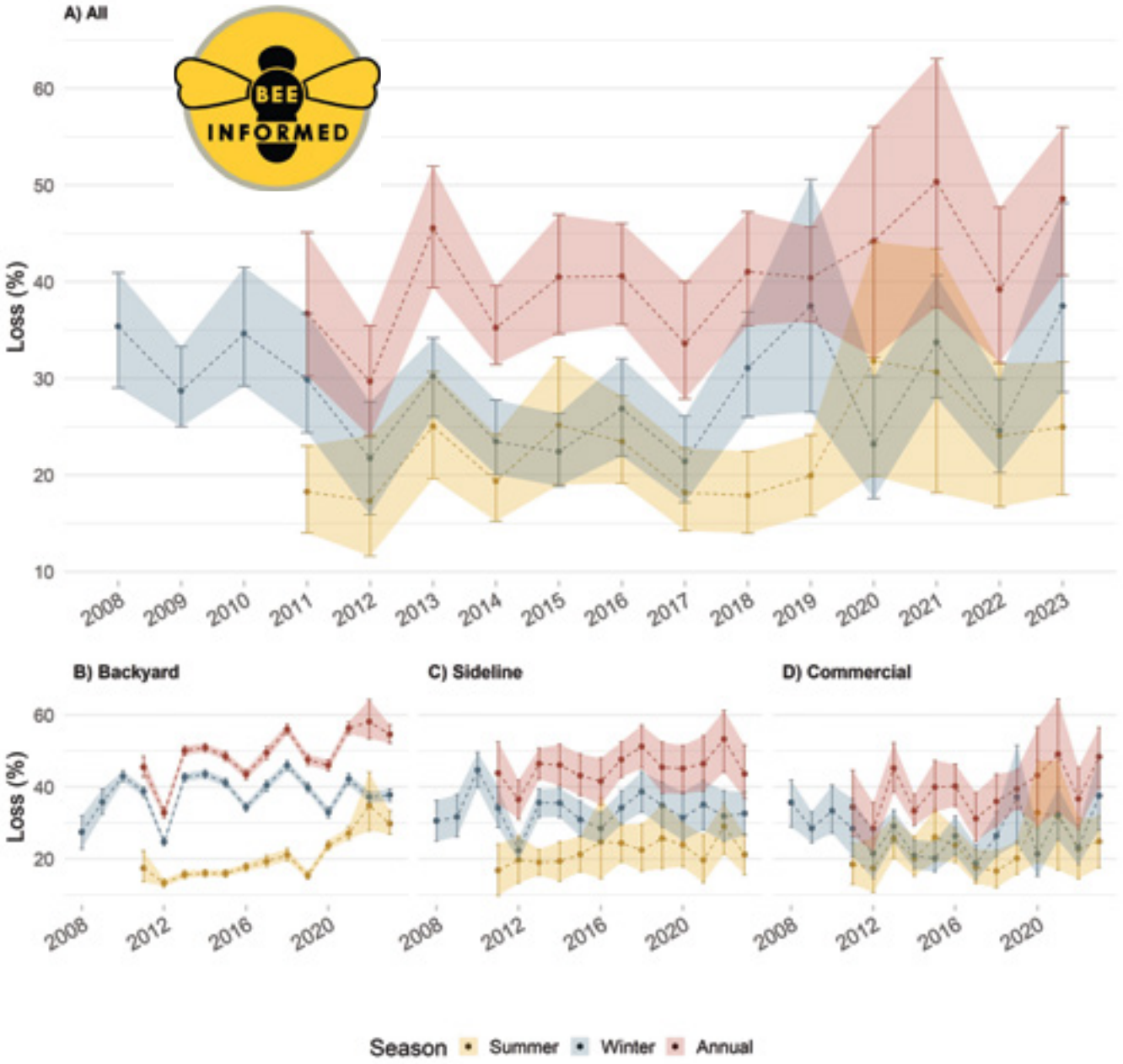

Figure 1. Seasonal managed honey bee colony loss rates in the United States across years (A), and by operation type (B-D): backyard (managing up to 50 colonies), sideline (managing 51-500), and commercial (managing >500 colonies) beekeepers. The loss rate was calculated as the total number of colonies lost divided by the number of colonies at risk during the season. Colonies at risk were composed of living colonies at the start of a period, as well as new colonies made or acquired, while excluding colonies sold or parted with. Annual loss covers the whole period from one 1 April to the next 1 April (in red); Summer (1 April – 1 October, in yellow); Winter (1 October – 1 April, in blue). Error bars represent the 95% confidence interval obtained from a bootstrap resampling of the data (n-out-of-n, 1000 rep).

The percentage of colony loss over the Winter deemed "acceptable" by beekeepers was on average 21.3% in 2022-2023, which was on par with the previous nine years during which the acceptable loss has hovered around 20%. In 2022-2023, over 60% of the surveyed beekeepers reported Winter loss above this threshold.

Over the entire year (1 April 2022 – 1 April 2023), beekeepers in the United States lost an estimated 48.2% [40.7 – 56.0 CI] of their managed honey bee colonies (Fig. 1). This was 9.2 pp higher than last year's estimated annual loss (39.0% [31.6 – 47.7 CI]), nearly as high as (2.6 pp lower than) the highest annual loss on record (2020-2021, 50.8% [37.4 – 63.1 CI]), and 8.5 pp higher than the average loss rate (39.6%, 12-year average) over the last 12 years.

The honey bee industry in the United States can be loosely divided into three groups of beekeepers – backyard (managing up to 50 colonies), sideline (managing 51-500), and commercial (managing >500 colonies), with the majority of colonies being managed by commercial operations, even though they are a small proportion of beekeepers (1.4% of the surveyed beekeepers, who collectively managed 89.7% of surveyed colonies in 2022-2023).

As in previous years, backyard beekeepers experienced a higher annual rate of loss than commercial beekeepers in 2022-2023 (54.6% [52.2 – 57.2 CI] for backyard vs 47.9% [39.9 – 56.4 CI] for commercial). This represented a higher loss year than average for both backyard beekeepers (5.8 pp more than their 12-year

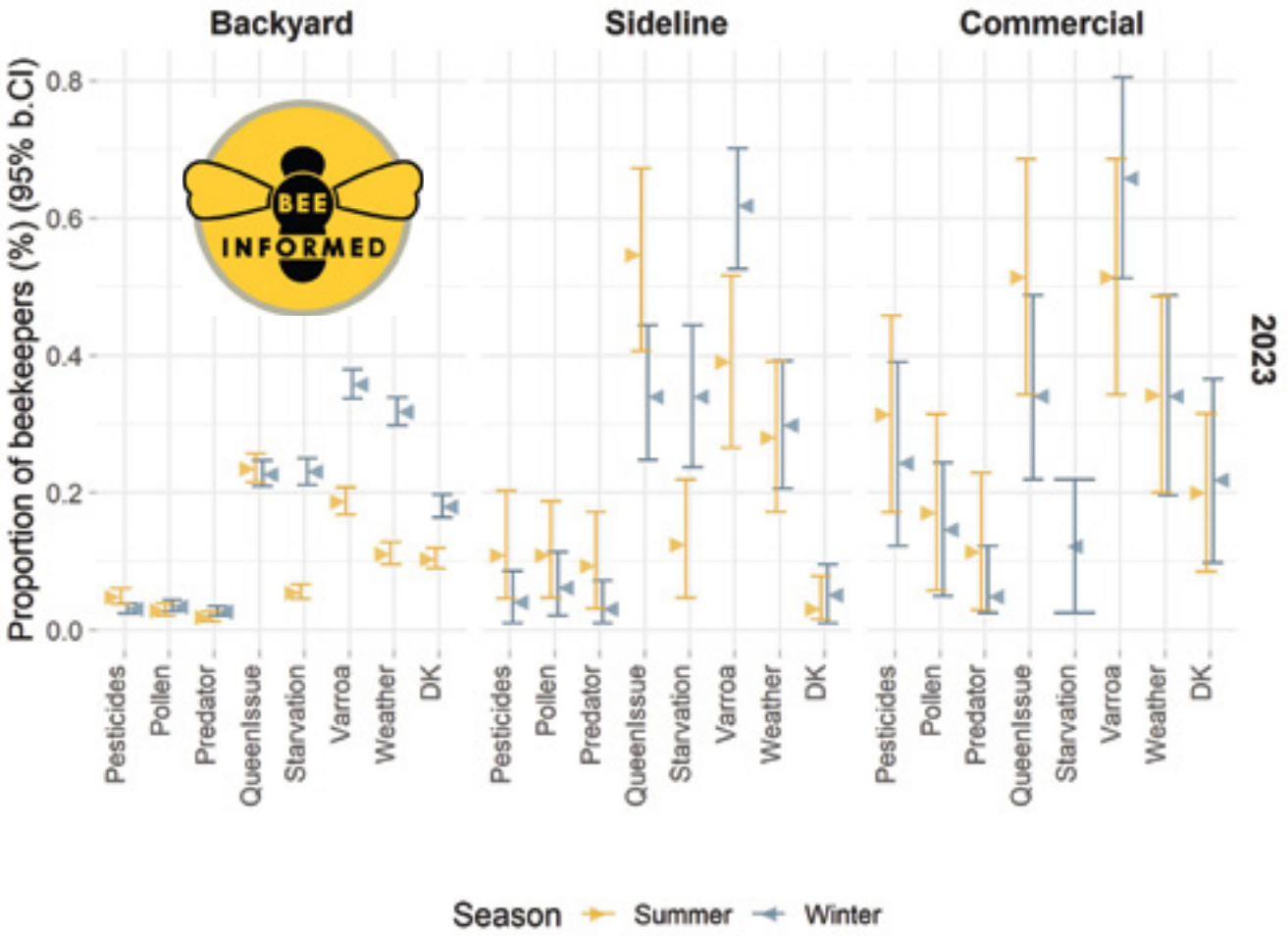

Figure 2. Self-reported causes of colony loss over Summer 2022 (1 April - 1 October, in yellow) and Winter 2022-23 (1 October - 1 April, in blue), as reported by U.S. beekeepers grouped by operation type: backyard (managing up to 50 colonies), sideline (managing 51-500), and commercial (managing >500 colonies). Number of respondents: backyard (Summer: 1,495, Winter: 2,070), sideline (Summer: 64, Winter: 97) and commercial (Summer: 35, Winter 41) beekeepers. The arrow represents the proportion of beekeepers having selected the specific cause of loss in a list of multiple choices associated with the question: "What factors do you think were the most prominent cause(s) of colony death in your operation in [season]?". Errors bars represent the 95% confidence interval obtained from a bootstrap resampling of the data (n-out-of-n, 100 rep).

Legend: Pesticides (Non-apicultural pesticides); Pollen (Nutritional stress (pollen deprivation)); Predators (e.g. bears); Queen issues; Starvation (honey/nectar/sugar water); Varroa (varroa mites and associated viruses); Weather (adverse weather (e.g. drought, cold snap)); DK (Don't know). Answers selected by less than 10% of respondents in all three groups are not shown. Other multiple choice options not listed in the figure: Brood diseases (e.g. AFB, EFB), Natural disaster (e.g. hurricane, flood), Apicultural treatments (e.g. formic acid, amitraz), Shipping stress (e.g. overheating, truck issues). Equipment failure (e.g. moisture, ventilation), Failure of environmental controls in sheds, Scavenger pests (e.g. small hive beetle, wax moth).

average of 48.8%) and commercial beekeepers (9.7 pp more than their 12-year average of 38.2%), but it seems issues occurred at different times of the year for the two groups.

Backyard beekeepers again experienced one of their highest Summer losses on record (the last four years classified as the top four, three, one and two, respectively, in the 13-year record), with 29.8% Summer 2022 loss [26.9 – 33.4 CI], this was 10.0 pp over the previous 12-year average of 19.8%. Commercial beekeepers reported Summer losses (24.7% [17.6 – 31.7 CI]) on par (1.8 pp over) with their average over the previous 12 years (22.8%).

Though the loss rates of both groups were comparable for the Winter season (37.8% [36.0 – 39.4 CI] for backyard beekeepers, and 37.6% [28.1 – 49.1 CI] for commercial beekeepers), this represented a high loss season for the commercial group (10.7 pp over their 27.0% 15-year average), but an average season for backyard beekeepers (0.2 pp lower than their 38.0% 15-year average). Such high Winter loss rates for commercial beekeepers have only been reported once before in this survey, in 2018-2019.

The most prominent cause of colony death reported by beekeepers over the Winter 2022-23 was "*varroa*" (*Varroa destructor*, and its associated viruses), for all three operation types (Fig. 2). Backyard beekeepers then tended to cite "adverse weather" and "starvation" (meaning lack of honey, nectar, or sugar water) as the second and third most prominent causes of Winter colony loss in their operations. Sideline beekeepers equally cited "queen issues" and "starvation" as their second most prominent cause of Winter loss. Commercial beekeepers cited equally "queen issues" and "adverse weather".

In the Summer of 2022, the most prominent cause of colony death reported by beekeepers of all operation types was "queen issues" (Fig. 2). Both backyard and sideline beekeepers then listed "*varroa*" and "adverse

weather". Commercial beekeepers cited "*varroa*" as frequently as "queen issues" as their most prominent causes of loss over the Summer, followed by "adverse weather".

Although the total number of honey bee colonies in the country has remained relatively stable over the last 20 years (~2.6 million colonies according to the USDA NASS Honey Reports), loss rates remain high, indicating that beekeepers are under substantial pressure to recover from losses by creating new colonies every year. The Bee Informed Partnership's annual Colony Loss and Management Survey offers an important record of such loss rates experienced by beekeepers across the United States each year. Until the survey was launched in 2007, there was no rigorous record of loss rates of managed honey bee colonies, making it difficult to compare losses against historic levels.

To obtain more information about Bee Informed Partnership's annual national Colony Loss and Management Survey, visit: **https://beeinformed.org/citizen-science/loss-and-management-survey/**.

State level estimates, including estimates for single-state and multi-state operations, will be published on **https://research.beeinformed.org/loss-map/**. BC

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FOUND IN TRANSLATION

Gut Microbes Help Bees Survive the Seasons

Jay Evans, USDA Beltsville Bee Lab

Listen along here!

It will surprise most *Bee Culture* readers that microbes come in flavors that can be good, bad or indifferent to the health of their honey bee hosts. As we approach Fall, it is tempting to focus on the microbes on the good side and try to find out how to feed them for bee health prior to Winter. As someone who studies honey bee disease, I can't help but focus on the good microbes that might interfere with agents of harm lurking in our beehives.

Kirk Anderson and colleagues in the USDA's Tucson Carl Hayden Bee Research Laboratory have been exploring the impacts of gut microbes on bee health for a decade now. In past work, they showed how these microbes are beneficial in the guts of bees but generally 'don't' help in the processing of pollen stored as bee bread. They have also shown how queens and workers differ greatly in the microbes they harbor and the impacts of bee contact on moving microbes around (see Anderson's 'Google Scholar' profile for lists of his papers on these topics; **https://scholar.google.com/citations?user=JiEFFkIAAAAJ&hl=en&oi=ao**).

They have also explored how bees suffer mortality when the delicate microbial balance is upset. Recently, they have investigated honey bee overwintering, testing for the right mixes of nutrition and temperature that improve the odds of colony survival (hint: cold is good, to a certain degree). In a paper this past year, they describe how the gut microbes of bees react before and during Winter, building the case that microbes are critical for overwintering success (Anderson, K.E.; Maes, P. Social microbiota and social gland gene expression of worker honey bees by age and climate. *Scientific Reports* 2022, *12*, 10690, **doi:10.1038/s41598-022-14442-0**).

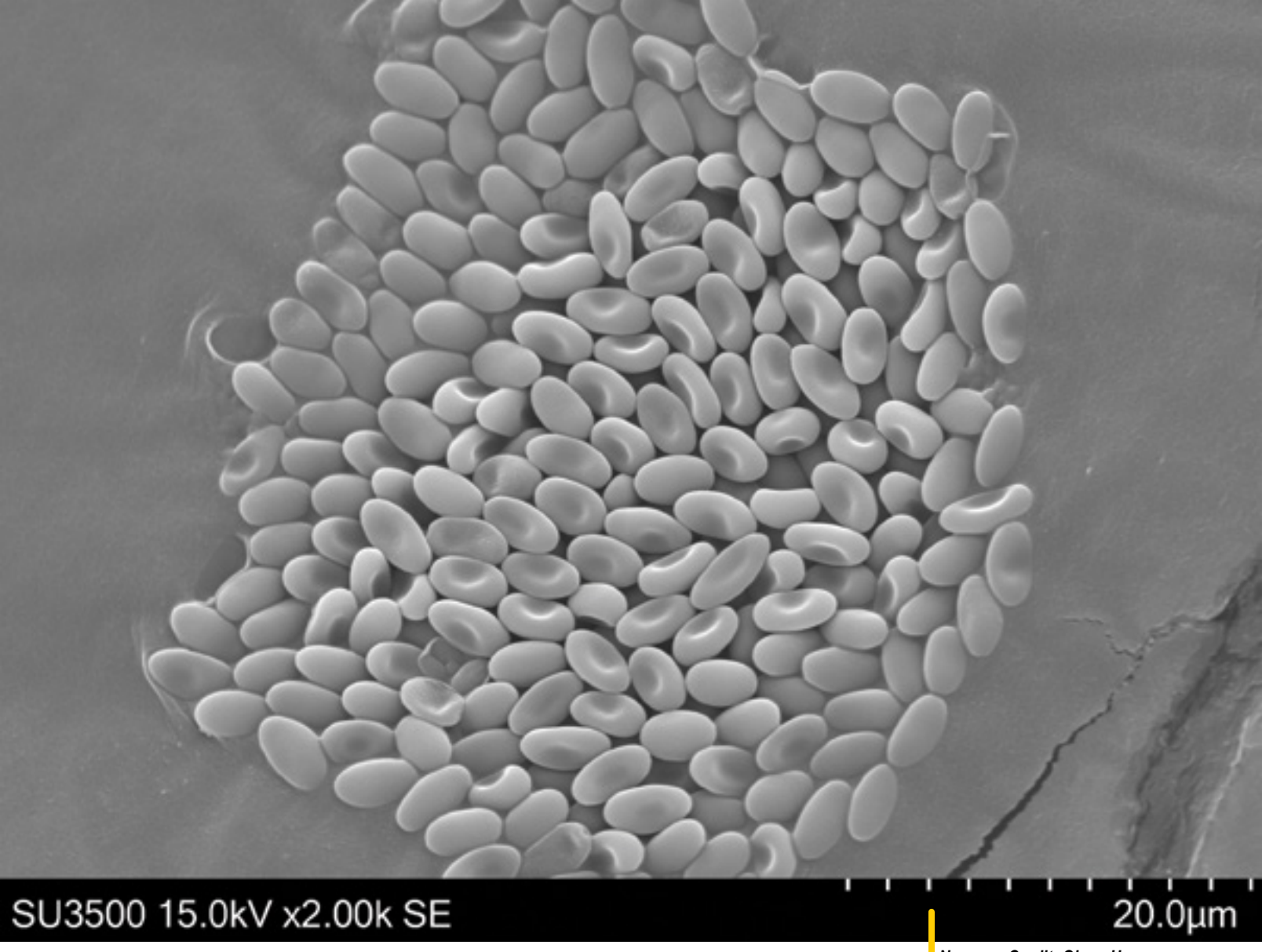
They also show that the overwintering environment can favor certain microbes that are less helpful for bee health. Specifically, bee colonies overwintered in a warm environment started with the typical population of gut bacteria but that population broke bad in the end, notably thanks to overgrowth (these were NOT found in bees) as well as several types which ARE known to decrease bee health. Just what it is about warmer Winter environments that favors an odd, and apparently harmful, bacterial group is not known, and solving this will be key in future work aimed at prepping bees for current or future Winter climates.

More generally, disease agents are opportunists; taking advantage of their victims when something else is out of whack. These opportunities can arise from stressors in the environment, poor genetics or inadequate nutrition. Opportunities might also arise when populations of good bacteria are somehow absent. There are a myriad of ways that such 'good' microbes could help bees in the face of disease, from providing a physical layer on the gut wall that frustrates pathogens, to improving nutrient transfer or stimulating bee immunity.

Finally, gut microbes might directly attack the bad actors. Studies showing increased honey bee disease following heavy antibiotic treatments provide ample evidence for the roles of natural bee bacteria. In one such study, led by Jiang Hong Li and my USDA colleague Judy Chen (Li, J.H.; Evans, J.D.; Li, W.F.; Zhao, Y.Z.; DeGrandi-Hoffman, G.; Huang, S.K.; Li, Z.G.; Hamilton, M.; Chen, Y.P. New evidence showing that the destruction of gut bacteria by antibiotic treatment could increase the honey bee's vulnerability to Nosema infection. *PloS one* 2017, *12*, e0187505, **doi:10.1371/journal.pone.0187505**). Gut microbes were shown to help bees resist nosema disease. A cleansing of gut bacteria by an intensive antibiotic regime resulted in shorter lifespans overall, and increased the impacts of nosema exposure on longevity.

Sean Leonard and colleagues, in the University of Texas laboratory of Nancy Moran, showed that a human assist can further sharpen the impacts of natural gut microbes on bee parasites. Specifically, they engineered (in the laboratory) a common 'good' bacterium of bees so that it targeted challenges as distinct as *Varroa* mites and Deformed wing virus (Leonard, S.P.; Powell, J.E.; Perutka, J.; Geng, P.; Heckmann, L.C.; Horak, R.D.; Davies, B.W.; Ellington, A.D.; Barrick, J.E.; Moran, N.A. Engineered symbionts activate honey bee immunity and limit pathogens. *Science* 2020, *367*, 573-576, **doi:10.1126/science.aax9039**).

Work this year based on the same strategy (led by Qiang Huang from Jiangxi University, working in Moran's lab) showed resident bacteria could be altered to successfully target nosema disease (Huang, Q.; Lariviere, P.J.; Powell, J.E.; Moran, N.A. Engineered gut symbiont inhibits microsporidian parasite and



Nosema. Credit: Qiang Huang

improves honey bee survival. *Proceedings of the National Academy of Sciences* 2023, *120*, e2220922120, **doi:10.1073/pnas.2220922120**). Bees with the engineered bacteria both lived significantly longer and had far fewer nosema spores to pass on to their nestmates. Interestingly, bees fed the gut bacterium alone, and the bacterium with a nonspecific (not targeting nosema), modification also showed signs of reducing disease impacts, supporting the evidence that the bacterium itself is also a friend to bees.

Short of this high-tech solution, are there ways that beekeepers can help nurture the natural gut bacteria found in their beehives? If you supplement your bees, a recent paper by Elijah Powell and others in Moran's group suggests that pollen-based supplements tend to lead to a more balanced 'core' set of bacteria in the bee gut, possibly decreasing the threats from at least one bacterial pathogen of adult bees (Powell JE, Lau P, Rangel J, Arnott R, De Jong T, Moran NA (2023) The microbiome and gene expression of honey bee workers are affected by a diet containing pollen substitutes. PLoS ONE 18(5): e0286070. **https://doi.org/10.1371/journal.pone.0286070**). I know there are many colony supplements available and I don't claim this makes a pollen-based supplement better for bees overall than supplements with a different protein source (nor, of course, does this represent any formal endorsement of one type of bee feed over another). Still, it is interesting to contemplate how particular supplements affect not just bees but the hitchhiking microbes that have adapted to life in their guts.

One thing is clear from these diverse studies. While many of us focus on the microbes whose effects are damaging to bee colonies, most hive microbes are neutral or even beneficial to their bee hosts in Summer and Winter. Bees have been harnessing this power for millennia, and we would do well to help them sustain the right mix of gut partners. BC

During and After

John Miller

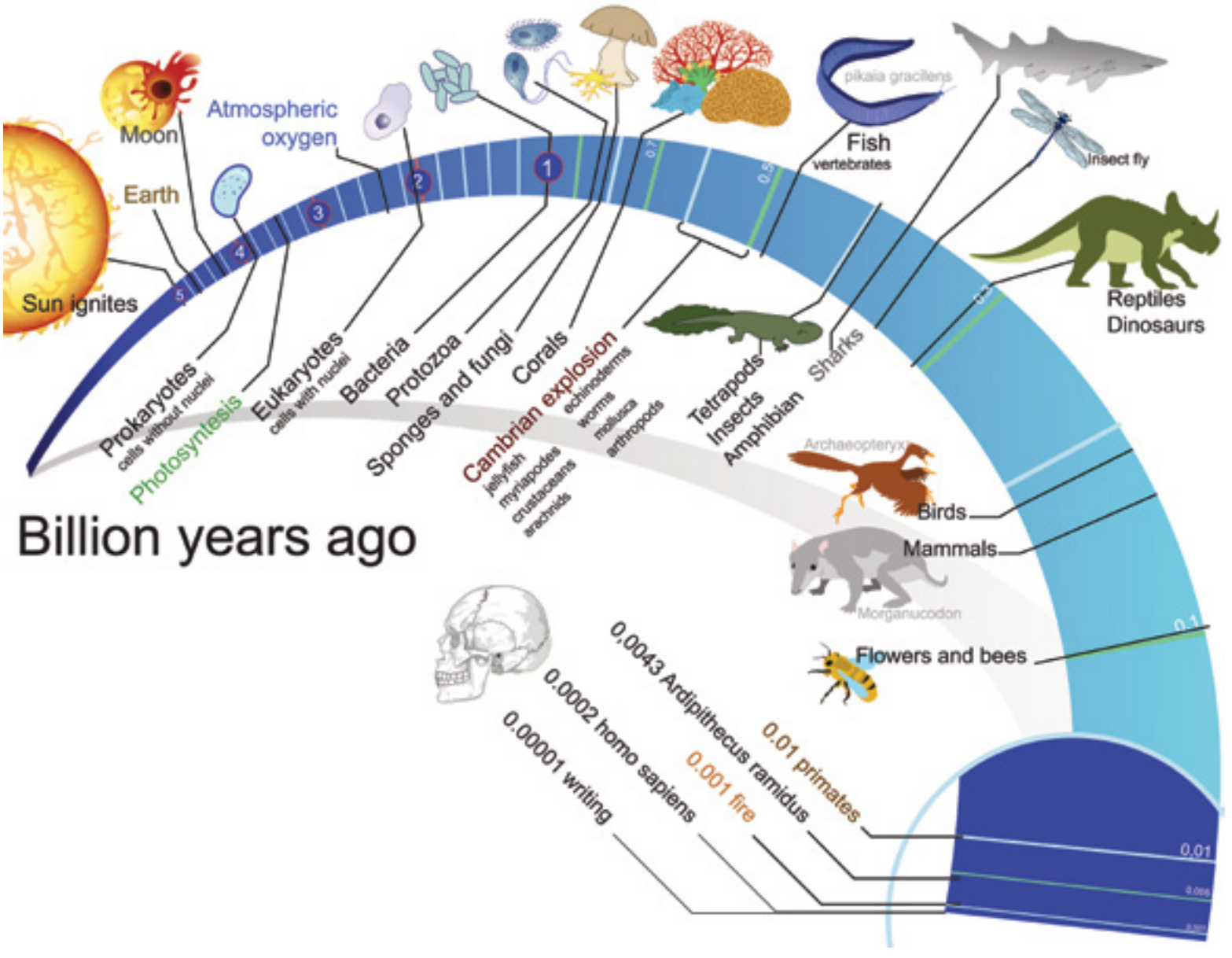
In 1980, I was paying serious attention to how to succeed in beekeeping. The important factor in beekeeping survival was economic inflation. Paul Volker and Ronald Reagan were wringing inflation out of the U.S. economy. I bought my first home – with a mortgage interest rate of 10.75%. The monthly payment was $504.00 – which was a lift for a young couple with our first child. The first month, I mailed in our $504.00 payment and received by mail, a receipt. The principal paydown on that mortgage was .04 (four cents). $503.96 went to interest. In that one moment, I learned all I ever needed to know about debt.

Different challenges confronted us at different times in beekeeping since 1980. Sometimes the challenges were existential, sometimes governmental, sometimes trivial and sometimes malignantly underthought and destructive. It is possible to go broke keeping bees, but as Frank Pendall says, "It takes longer to go broke keeping bees than any other business."

As a respected radio commentator once said: "Over my shoulder a backwards glance."

What were the top challenges to beekeeping in 1980? Varroa mites were not yet here. The use of antibiotics to treat AFB was a blessing. The price of honey was not good. (Have you noticed how the price of honey has always, *always,* ALWAYS been too low?) Pollination fees were low. Bees were abundant, and easy to keep alive. Labor costs and availability were an annoyance, but farm families were still large and farms were still small. Compliance with ever expanding regulations had not yet knocked on the door of beekeepers. If you didn't mind not making a lot of money – things were fine. Tracheal mites blew through the industry, creating a blip in sales of microscopes beekeepers never learned how to use. Beekeeping learned nothing from Tracheal mites.

What were the beekeeping challenges in 1990? Varroa was savaging American beekeeping. Quarantines only wiped out the 'de-populated' outfit – while the rest of us fled into the wilderness only a little bit *Varroa*-infected. The Conservation Reserve Program had taken firm root in the Great Plains for better or worse. Silage corn was grown for the still numerous dairy cows in the Great Plains. Scant acreage of corn for



grain or soybeans was harvested in the Dakotas. Demand for California almond pollination expanded. Stocking rate recommendations varied. In 1997, the price of honey doubled from .70/lb. to $1.40/lb. Honey packers decided to put these words on jars of honey: 'Do not feed to infants under a year old.' The sky – and the honey market – did not collapse.

In 2000, finding labor in beekeeping outfits became a real issue. Farm families were smaller. Farms were larger. Corn for grain and soybean acreage range expanded north into short season regions. Crop genetics and production agriculture resulted in: 'nothing grows inside the crop' to gently state how seed companies viewed corn and soybean acreage. *Varroa* savaged beekeeping. Foulbrood no longer savaged beekeeping. Compliance with regulations, trucking, hours of service, DOT inspections, IRS regulations, fuel storage, off-label pesticide uses, all gathered regulator-scrutiny. Asian Citrus Psyllid destroyed the Florida citrus industry.

In 2010 – news of 'self-compatible, self-pollinating' foods manifest as crop geneticists sought to eliminate insect-provided pollen transfers. A tidal wave of corn and beans paved the prairie.

35-head North Dakota dairy herds were bought out and moved to 35-times larger dairy herds in California.

Varroa savaged beekeeping. Business succession plans succeeded and failed as 'old-school' outfits passed onto younger operators. Some outfits returned to their prior owners, a ruin. Some outfits thrived as some beekeepers realized the most important hire they ever make is their successor. Tax law became a thing. Understanding and embracing change was wrenching as honey producers became pollination providers – some living in the honey production past – got rolled by the present. Enforceable contracts became a thing. The supply of bees failed to keep up with the demand for bees. Nationally, the supply of flowers failed to keep up with colony nutrition needs. H-2A became the focus of beekeeping labor supply decisions.

In 2020, successful beekeeping outfits were figuring out *Varroa*. Lessons had been repeated until learned. It is not an understatement that OA & Glycerin formulation g*iven* to the industry by Randy Oliver changed things. Funny honey upset American beekeepers – and damaged markets. Still, every product finds a buyer of last resort, somehow. Almond acreage exploded; with 24% of total acreage not yet of bearing age at the precise moment global demand for almonds collapsed. An ominous rumble from Southeast Asia predicted another parasite, this one five times more destructive than *Varroa*; *Tropilaelaps mercedesae.*

By 2030, a number of *Bee Culture* readers will pass. In 2030, a white-hot battle over control of Tropi will vex beekeepers and growers. Humans dependent on arguably the most beneficial insect on earth will experience food-price/availability shocks. It is not known if production agriculture and beekeepers will successfully respond. A generation of thoughtful beekeepers will be pressed into considering the future of beekeeping, and the future of food. Beekeepers will not be alone in the considerations – but we will most acutely feel the spear. As gate-keepers of the food supply – what does the gate look like? BC

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A Closer LOOK

Immunity Mechanisms and Immunosenescence

Clarence Collison

"Honey bees face many important parasites and pathogens against which they have evolved behavioral, morphological, physiological and immune based defenses" (Evans, 2006). At the individual level, immune mechanisms are comprised of: 1) resistance mechanisms associated with anatomical and physiological barriers of the body, 2) cell-mediated immunity involving hemocytes (blood cells, including plasmocytes, lamellocytes and granulocytes), 3a) congenital humoral resistance related to the activity of lysozyme (N-acetylmuramylhydrolase), the prophenoloxidase system and hemagglutinins (lectins), and 3b) induced humoral resistance based on the action of antimicrobial peptides: abaecin, apidaecin, hymenoptaecin and defensin. In addition to the individual resistance of each bee, there are also defense mechanisms activated at the colony level. Shared secretion resistance is connected with the presence of antipathogenic compounds in secreta and in bee products, i.e. propolis. Social immunity is associated with hygienic and nursing behaviors, as well as with age polyethism in the colony, swarming and the changing behavior of sick individuals (Strachecka et al., 2018).

The innate immune system includes the circulating hemocytes (immune cells) that clear pathogens from hemolymph (blood) by phagocytosis, nodulation or encapsulation. Honey bee hemocyte numbers have been linked to hemolymph levels of vitellogenin. Vitellogenin is a multifunctional protein with immune-supportive functions identified in a range of species, including the honey bee. Hemocyte numbers can increase via mitosis (cell division), and this recruitment process can be important for immune system function and maintenance. Hystad et al. (2017) tested to see if hemocyte mediated phagocytosis (engulfing of microorganisms) differs among the physiologically different honey bee worker castes (nurses, foragers and Winter bees), and studied possible interactions with vitellogenin and hemocyte recruitment. They found that nurses are more efficient in phagocytic uptake than both foragers and Winter bees. Vitellogenin was detected within the hemocytes and they found that Winter bees have the highest numbers of vitellogenin positive hemocytes. Connections between phagocytosis, hemocyte-vitellogenin and mitosis (cell division) were worker caste dependent. Their results demonstrate that the phagocytic performance of immune cells differs significantly between honey bee worker castes, and support increased immune competence in nurses as compared to forager bees. Their data also provides support for roles of vitellogenin in hemocyte activity.

As honey bees mature, the types of pathogens they experience also change. As such, pathogen pressure may affect bees differently throughout their lifespan. Wilson-Rich et al. (2008) investigated immune strength across four developmental stages: larvae, pupae, nurses (one day old adults) and foragers (22-30 day old adults). The immune strength of honey bees was quantified using standard immunocompetence assays: total hemocyte count, encapsulation response, fat body quantification and phenoloxidase activity. Larvae and pupae had the highest total hemocyte counts, while there was no difference in encapsulation response between developmental stages. Nurses had more fat body mass than foragers, while phenoloxidase activity increased directly with honey bee development. Immune strength was most vigorous in older, foraging bees and weakest in young bees. Importantly, they found that adult honey bees do not abandon cellular immunocompetence as was recently proposed. Induced shifts in behavioral roles may increase a colony's susceptibility to disease if nurses begin foraging activity prematurely.

Male and female bees are subject to differing selective pressures due to their differences in colony tasks and changes in the threat of pathogen infection at different life stages. Laughton et al. (2011) investigated the immune response of workers and drones at all developmental phases, from larvae through to late stage adults, assaying both a constitutive (phenoloxidase, PO activity) and induced (antimicrobial peptide, AMP) immune response. They found that larval bees have low levels of PO activity. Adult workers produced stronger immune responses than drones, and a greater plasticity in immune investment. An immune challenge resulted in lower levels of PO activity in adult workers, which may be due to the rapid utilization and a subsequent failure to replenish the constitutive phenoloxidase. Both adult workers and drones respond-

ed to an immune challenge by producing higher titers of AMPs, suggesting that the cost of this response prohibits its constant maintenance. Both castes showed signs of senescence in immune investment in the AMP response. Different sexes and life stages therefore alter their immune system management based on the combined factors of disease risk and life history.

Randolt et al. (2008) employed the proteomic approach in combination with mass spectrometry to study the immune response of honey bee workers at different developmental stages. Analysis of the hemolymph proteins of non-infected, mock-infected and immune-challenged individuals by polyacrylamide gel electrophoresis showed differences in the protein profiles. They present evidence that in vitro reared honey bee larvae respond with a prominent humoral reaction to aseptic and septic injury as documented by the transient synthesis of the three antimicrobial peptides (AMPs) hymenoptaecin, defensin 1 and abaecin. In contrast, young adult workers react with a broader spectrum of immune reactions that include the activation of prophenoloxidase and humoral immune responses. At least seven proteins appeared consistently in the hemolymph of immune-challenged bees, three of which are identical to the AMPs induced also in larvae. The other four, i.e., phenoloxidase (PO), peptidoglycan recognition protein-S2, carboxylesterase (CE) and an Apis-specific protein not assigned to any function (HP30), are induced specifically in adult bees and, with the exception of PO, are not expressed after aseptic injury. Structural features of CE and HP30, such as classical leucine zipper motifs, together with their strong simultaneous induction upon challenge with bacteria suggest an important role of the two novel bee-specific immune proteins in response to microbial infections.

Female insects that survive a pathogen attack can produce more pathogen-resistant offspring in a process called trans-generational immune priming. In the honey bee, the egg-yolk precursor protein vitellogenin transports fragments of pathogen cells into the egg, thereby setting the stage for a recruitment of immunological defenses prior to hatching. Honey bees live in complex societies where reproduction and communal tasks are divided between a queen and her sterile female workers. Worker bees metabolize vitellogenin to synthesize royal jelly, a protein-rich glandular secretion fed to the queen and young larvae. Harwood et al. (2019) investigated if workers can participate in trans-generational immune priming by transferring pathogen fragments to the queen or larvae via royal jelly. As a first step toward answering this question, they tested whether worker-ingested bacterial fragments can be transported to jelly-producing glands, and what role vitellogenin plays in this transport. To do this, they fed fluorescently labeled *Escherichia coli* to workers with experimentally manipulated levels of vitellogenin. They found that bacterial fragments were transported to the glands of control workers, while they were not detected at the glands of workers subjected to RNA interference-mediated vitellogenin gene knockdown, suggesting that vitellogenin plays a role in this transport. Their results provide initial evidence that trans-generational immune priming may operate at a colony-wide level in honey bees.

Honey bee larvae are highly susceptible to the bacterial pathogen *Paenibacillus larvae* (causative agent of American foulbrood) only during the first instar of larval

development. Transcript levels were measured for genes encoding two antimicrobial peptides, abaecin and defensin, as well as two candidates in the immune response cascade (PGRP-LD and masquerade) in control larvae and larvae exposed to the pathogen. Transcripts (a length of RNA or DNA that has been transcribed respectively from a RNA or DNA template) for all four are present throughout development. This suggests that other physiological or dietary factors may better explain the age-based change in vulnerability to this pathogen. One of these genes, abaecin, shows significant up-regulation 24 hours following oral inoculation with *P. larvae*, precisely when the bacterium surmounts the midgut epithelia of bees. Expression of both antimicrobial peptides varied by 1000-fold across different nestmate bees, indicating an allelic component to their expression (Evans, 2004).

An example of immunosenescence is seen in the worker caste. The bee's age-associated transition from hive duties to more risky foraging activities is linked to a dramatic decline in immunity. Explicitly, it has been shown that an increase in the juvenile hormone (JH) level, which accompanies onset of foraging behavior, induces extensive hemocyte death through nuclear pycnosis (degeneration of cell nucleus). Amdam et al. (2005) demonstrated that foragers that are forced to revert to hive-tasks showed reversal of immunosenescence, i.e. a recovery of immunity with age. This recovery, which is triggered by a social manipulation, is accompanied by a drop in the endogenous JH titer and an increase in the hemolymph vitellogenin level.

They also established that worker immunosenescence is mediated by apoptosis (the death of cells), corroborating that reversal of immunosenescence emerges through proliferation of new cells. The results reveal a unique flexibility in honey bee immunity.

Immunosenescence, the systemic reduction of immune efficiency with age, is increasingly recognized as having important implications for host-parasite dynamics. Changes in the immune response can impact the ability of an individual to resist or moderate parasite infection, depending on how and when it encounters a parasite challenge. Using the European honey bee *Apis mellifera* and its microsporidian parasite *Nosema ceranae*, we investigated the effects of host age on the ability to resist parasite infection and on baseline immunocompetence, assessed by quantifying constitutive (PO) and potential levels (PPO) of the phenoloxidase immune enzyme as general measures of immune function. There was a significant correlation between the level of general immune function and infection intensity, but not with survival, and changes in immune function with age correlated with the ability of individuals to resist parasite infection. Older individuals had better survival when challenged with a parasite than younger individuals, however they also had more intense infections and lower baseline immunocomptence. The ability of older individuals to have high infection intensities yet live longer, has potential consequences for parasite transmission (Roberts and Hughes, 2014).

Young honey bee workers (zero to two to three weeks old) perform tasks inside the colony, including brood care (nursing), whereas older workers undergo foraging tasks during the next three to four weeks, when an intrinsic senescence program culminates in worker death. It was hypothesized that **foragers** are less able to react to immune system stimulation than nurse bees and that this difference is due to an inefficient immune response in **foragers**. To test this hypothesis, an experimental design was used that allowed them to uncouple chronological age and behavior status (nursing/foraging). Worker bees from a normal age demography colony (where workers naturally transit from nursing to foraging tasks as they age) and of a single-cohort colony setup (composed of same-aged workers performing nursing or foraging tasks) were tested for survival and capability of activation of the immune system after bacterial injection. Expression of an **antimicrobial peptide** gene, *defensin*-1 (*def*-1), was used to assess immune system activation. They then checked whether the immune response includes changes in the expression of aging- and behavior-related genes, specifically **vitellogenin** *(vg*), **juvenile hormone esterase** *(jhe*), and *insulin-like peptide*-1 (*ilp*-1). A significant difference was found in survival rate between bees of different ages but carrying out the same tasks. The results thus indicate that the bees' immune response is negatively affected by intrinsic senescence. Additionally, independent of age, foragers had a shorter lifespan than nurses after bacterial infection, although both were able to induce *def*-1 transcription. In the normal age demography colony, the immune system activation resulted in a reduction in the expression of *vg*, *jhe and ilp*-1 genes in foragers, but not in the nurse bees, demonstrating that age and behavior are both important influences on the bees' immune response. By disentangling the effects of age and behavior in the single-cohort colony, it was found that *vg*, *jhe and ilp*-1 response to immune system stimulation was independent of behavior. Younger bees were able to mount a stronger immune response than older bees, thus highlighting age as an important factor for immunity. Taken together, the results provide new insights into how age and behavior affect the honey bee's immune response (Lourenco et al., 2019).

Foragers facilitate horizontal pathogen transmission in honey bee colonies, yet their systemic immune function wanes during transition to this life stage. In general, the insect immune system can be categorized into mechanisms operating at both the barrier epithelial surfaces and at the systemic level. As proposed by the intergenerational transfer theory of aging, such immunosenescence may result from changes in group resource allocation. Yet, the relative influence of pathogen transmission and resource allocation on immune function in bees from different stages has not been examined in the context of barrier immunity. They found that expression levels of antimicrobial peptides (AMPs) in honey bee barrier epithelia of the digestive tract do not follow a life-stage-dependent decrease. In addition, correlation of AMP transcript abundance with microbe levels reveals a number of microbe-associated changes in AMPs levels that are equivalent between nurses and foragers. These results favor a model in which barrier effectors are maintained in foragers as a first line of defense, while systemic immune effectors are dismantled to optimize hive-level resources (Jefferson et al., 2013). BC

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Fall Feeding for Bees: Preparing Colonies for Winter Survival

Dara Scott, Founder HiveAlive

As the autumn season approaches, it becomes imperative for beekeepers to ensure that their colonies have an ample food supply to sustain them throughout the winter months. Nutritional preparation of bees during fall is vital for promoting colony health, increasing their chances of survival, and ensuring a thriving population when spring arrives. Similar to humans, bees require a source of carbohydrates, protein, and fat for adequate nutrition.

Feeding Carbohydrates to Bees:

The ideal carbohydrate source for bees is their own honey, so it is preferable to leave a certain amount of honey in the hive after the honey harvest. In addition, you can supplement their food by feeding them syrup or fondant. During the fall, it is recommended to provide a heavier syrup (2 parts sugar to 1 part water) using white sugar instead of brown sugar, which may contain additives like molasses. A heavier syrup requires less energy for bees to remove moisture, preventing excess moisture in the hive, which can be problematic at this time of year.

However, there are some disadvantages to feeding sugar syrup. Firstly, its nutritional profile is not as good as honey. Secondly, it lacks the antibacterial and antifungal properties naturally found in honey. Thirdly, it can ferment in the feeders. To address these concerns, you can choose a feed supplement like HiveAlive, which has been shown to tackle these issues.

Additionally, if the syrup temperature drops below 50 degrees F, bees may not consume it. In such cases, it is recommended to use fondant as an alternative food source.

Fondant is a solid, sugar-based food that provides bees with essential carbohydrates. Compared to syrup, fondant contains less moisture, eliminating the risk of drying out the feed and preventing excess moisture in the hive.

Another advantage of fondant is that it serves as an emergency food source, even if you believe you have sufficient stores going into winter. As the colony naturally contracts during winter, the bees that die out won't be replaced until closer to spring, causing the cluster to move further away from their food supply. If they are too far or haven't stored enough food, they may starve without breaking the cluster. Placing fondant directly over the center of the colony, either over a hole on the cover board or beneath it, ensures immediate access to food. Opt for high-quality fondants that don't dry out, allowing them to remain in the hive throughout winter, ready for when the bees need them. Similar to sugar,

fondant lacks nutrients and antimicrobial properties but there are fondants on the market that contain additives to help address this. Feeding fondant is a small investment that could potentially save your colony. Unused fondant can be melted with water in spring to create syrup. To prevent drying, make sure to wrap up any unused fondant or purchase pre-sealed options.

Feeding Protein to Bees:

Pollen collected by bees is the best source of protein. However, it may not always be readily available. To prepare for winter, it is crucial to raise strong and well-nourished bees that have a higher chance of surviving the cold season. Bees lacking protein will have shorter lifespans, diminishing the colony's chances of winter survival. Therefore, it is essential to ensure an adequate supply of protein for the brood being reared in the fall.

A recent study conducted by Dr. Vanessa Corby-Harris on behalf of Project Apis M demonstrated that bees fed protein in the fall performed better in the following spring. Colonies with access to pollen fared the best, with increased pollen intake correlating to higher survival rates. This highlights the importance of feeding bees as much pollen as possible before winter, as bees have evolved alongside pollen for millions of years. Among the groups that were fed protein, only those receiving pollen had zero winter mortality. This study emphasizes that feeding bees with abundant pollen prior to winter can significantly enhance survival rates and promote thriving colonies in the spring. In some regions, protein can also be fed to colonies in early fall to strengthen them for potential splits. There are a number of protein patties on the market but make sure to check the pollen content and that the pollen has been irradiated to prevent disease spread.

By following these guidelines and adopting best practices for fall feeding, beekeepers can optimize the nutrition of their colonies, increase their chances of survival, and ensure the overall health and productivity of the bee population.

Go to usa.hivealivebees.com for more information.

Is Beekeeping a Ponzi Scheme?

Stephen Bishop

As an expert in cryptozoological species, like Bigfoot, I would like to take some time to discuss cryptocurrency, which is what cryptozoological species use to pay for everyday expenses of living, like when the Loch Ness Monster needs to pay for dry cleaning. Just kidding, I suspect Nessie wouldn't conduct commerce with cryptocurrency; even a pea-brained dinosaur would have more sense than to use a currency that only gives you ten guesses at your password before it locks away your fortune permanently (really, millions of dollars' worth of Bitcoin have been lost forever because people can't remember their password.)

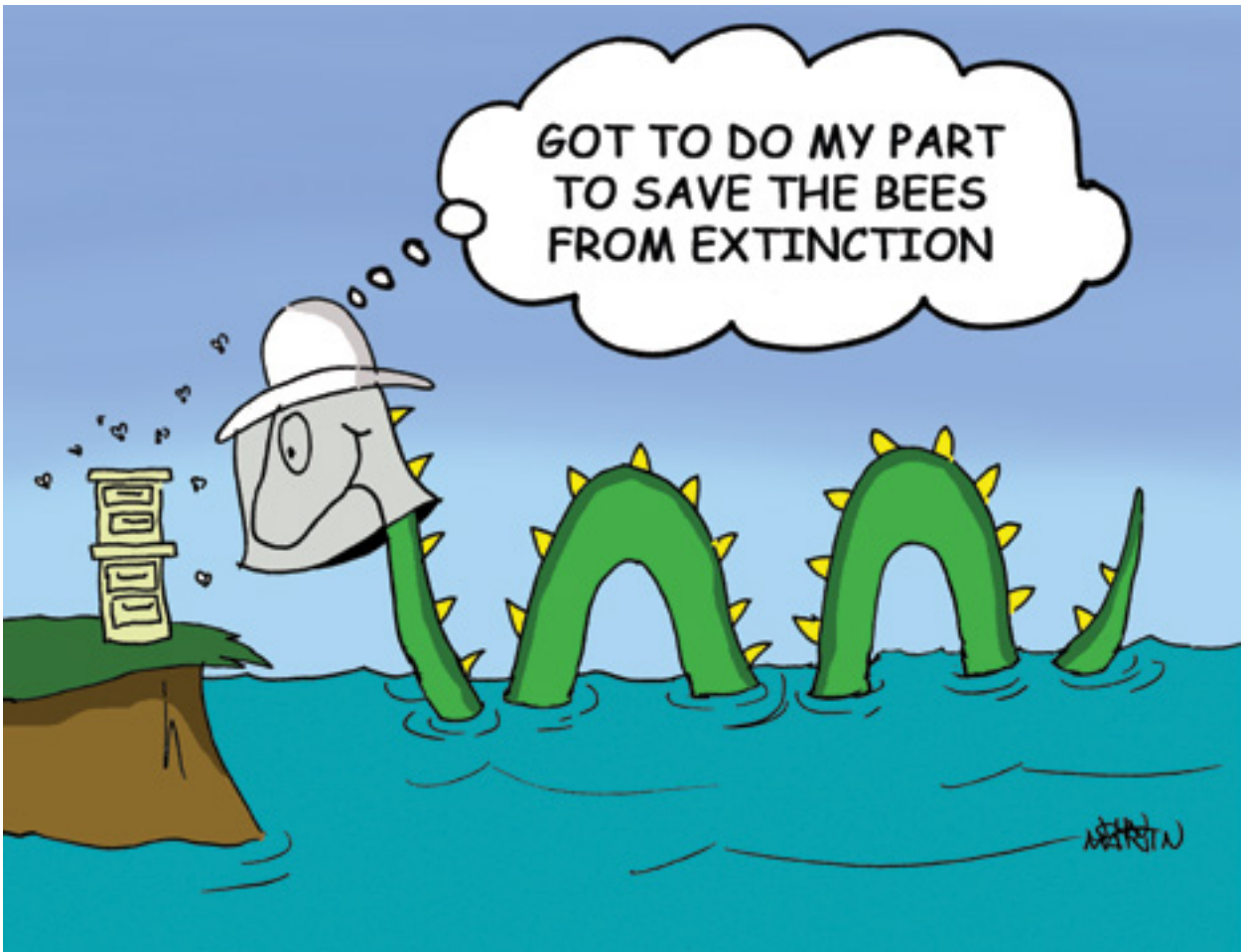
But people are gullible, especially smart people. Think about all the really smart people who thought Sam Bankman Fried was the second-coming of Warren Buffet, when really he was just the second-coming of Bernie Madoff.

And think about all the normally sensible folks who bought emus several decades ago. Emus, yes, emus were supposed to compete with cows as the other red meat. At one point during the emu craze, breeding emus cost $25,000 apiece. I'm not an expert in math, but if a bird costs $25,000, then the drumstick is going to be price-prohibitive at the grocery store. I guess that explains why a feral emu once roamed the woods in the upper end of my county; some say it escaped but most likely it was set loose when the emu market went bust. Apparently, Americans didn't like paying $1,000 per pound for poultry, even if it was red meat.

Recently, over in India, some major breakthroughs in the art of swindling occurred when enterprising con men combined a Ponzi scheme with old-fashioned emu hype. Two men were sentenced to twenty years in jail for scamming aspiring emu farmers out of six million dollars. For a mere $500,000 they would give farmers twenty emu chicks for breeding purposes, in exchange for the promise of buying back future chicks at astronomical prices. Of course, the only way that scam works is by finding more gullible people to invest in chicks, meaning it's a tried-and-true Ponzi scheme dressed up in emu feathers.

But this is my point: sometimes I wonder if beekeeping is a Ponzi scheme dressed up in a bee suit. If you think about the revolving door of new beekeepers who invest in bees and beekeeping each year, who fork over hundreds if not thousands of dollars, often because they want to do their part to "save the bees," only to have their bees promptly and predictably die—it sure seems like a Ponzi scheme. Certainly, the *varroa* mite has helped sustain the scheme. When *varroa* kills a colony, the dead bees perpetuate the myth that bees "need saving" luring in a new round of philanthropic investors (a.k.a aspiring beekeepers) and causing some of the previous investors (a.k.a new beekeepers) who lost bees in their first year to double-down and reinvest.

I guess the one difference between a Ponzi scheme and beekeeping is that nobody is promising a rate or return, or really any return. In fact, these days I feel like most bee schools are more like scared-straight sessions, where experienced, *varroa*-hardened beekeepers are pleading with new beekeepers to either treat for mites or turn back now. It's a tricky balance because you don't want to dishearten an aspiring beekeeper before they even start, but not emphasizing the importance of *varroa* control would certainly be a dereliction of duty, if not a fraudulent representation of the state of modern beekeeping—and any beekeeping guru who doesn't teach *varroa* control probably has a lot in common with an emu huckster. BC



August 2023

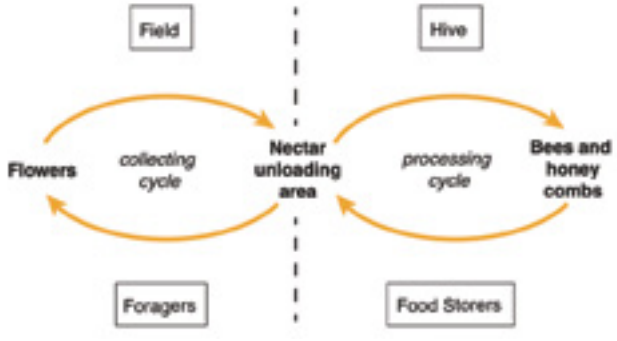
Fig 1. A nectar storer (left) has inserted her tongue between the mouthparts of a nectar collector (right). The storer bee is imbibing the nectar that the collector bee is regurgitating from the full "honey stomach" in her swollen abdomen. Photo by Kenneth Lorenzen

The *Tremble* Dance

For many years, I kept on the hillside above my little house outside Ithaca, New York, a special hive of bees. This hive was mounted on a platform scale of the sort that is normally used for weighing heavy packages. I visited this hive close to dark every evening from April to October, to weigh it and see how much food (nectar and pollen) the bees living inside this hive had collected that day. On many days, flowers yielding nectar and pollen were scarce, so this scale-hive colony gathered little food and I recorded in my notebook a weight gain of just a few ounces, or maybe even a weight loss. But on some days—such as during the explosion of dandelion flowers in May, the flowering of basswood trees in July and the profusion of goldenrod flowers in September—I recorded weight gains of several pounds. Most of these big weight gains marked strong collection of nectar. On one remarkable day in September 1992, for example, my scale-hive colony had amazing success... it took in more than 27 pounds of goldenrod nectar! I estimate that when ripened into honey, the bees' gain from this one day's labor was about 11 pounds of honey, which is enough to fill 15 plastic squeeze bears. Days like this tell us that a colony of honey bees must cope with booms and busts in its intake of nectar. This article describes a nifty communication behavior that helps a colony do so... the tremble dance.

The acquisition of nectar involves two distinct groups of bees: (1) the bees that work outside the hive collecting nectar and (2) the bees that work inside processing nectar (Fig. 1). The members of the first group, the nectar-forager bees, are among the oldest bees in a colony while the members of the second group, the nectar-storer bees, come from the ranks of a colony's middle-aged bees. These two groups interact in the unloading area just inside the hive entrance. This is where the nectar foragers pass off their fresh nectar to the nectar storers (Fig. 2).

Fig 2. The division of labor between nectar foragers and nectar stores in honey bee colonies.



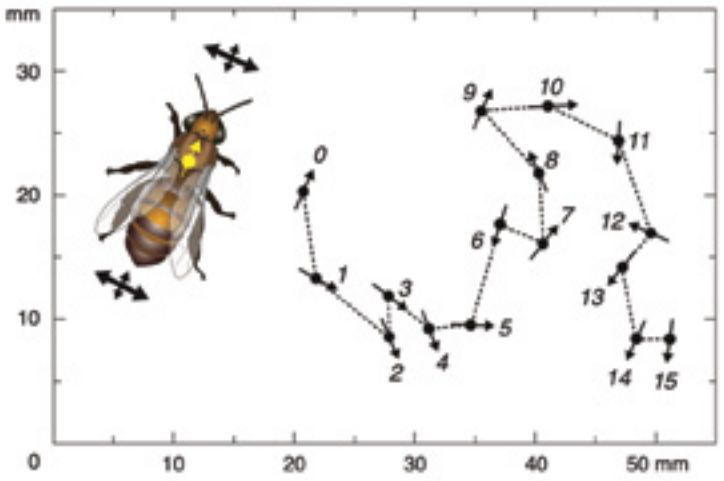


Fig 3. A 15-second record of a worker bee's behavior while she performed the tremble dance. Drawing on left illustrates the striking, side-to-side trembles of her body. Track on right shows how this bee walked slowly across a comb and rotated her body by about 30 degrees every second or so. Scale: 50mm = 2 inches

These bees either distribute the nectar to hungry nestmates or they store it in the honey combs for future consumption.

The specialization by worker bees on different parts of the overall task of nectar acquisition—nectar collecting and nectar processing—boosts the efficiency of a colony's honey making. It means, for example, that when a forager has located a patch of flowers laden with nectar, she can concentrate on exploiting these flowers before they fade, competitors arrive,or darkness falls, rather than spreading her efforts between collecting work and processing work.

At the same time, however, this division of labor creates a problem of work coordination within a colony. The rates of nectar collecting and nectar processing must be kept in balance for the overall operation of nectar acquisition to proceed smoothly. If the collecting rate exceeds the processing rate, then nectar foragers will experience delays in unloading upon return to the hive. Reciprocally, if the processing rate—or more precisely, the processing capacity—exceeds the collecting rate, then the nectar storers will experience delays in finding nectar foragers who need to be unloaded. Such problems of coordination associated with division of labor are not limited to honey bee colonies. They arise in human factories as well, since the efficiency of any multistage production process depends critically upon the absence of bottlenecks in the flow of items from one stage of the process to the next.

Some years ago, as part of my studies of the organization of nectar collection by honey bee colonies, I discovered that honey bees have a special communication signal that is produced by nectar *foragers* and is sent to potential nectar *storers*, and that helps a colony to keep its rates of nectar collecting and nectar processing well matched. This discovery was an especially sweet one because it also solved a long-standing mystery that had been raised in the 1920s by the Austrian zoologist and Nobel laureate, Karl von Frisch.

In 1923, von Frisch published his first major report on the communication dances of honey bees. In this report, he described not only the famous waggle dance, by which foragers inform one another of the locations of rich food sources, but also a dance that he called the tremble dance (in German, *der Zittertanz*) (Fig. 3). My translation of his description of the tremble dance reads as follows:

At times one sees a strange behavior by bees who have returned home from a sugar water feeder or other goal. It is as if they had suddenly acquired the disease St. Vitus's dance [chorea]. While they run about the combs in an irregular manner and with a slow tempo, their bodies, as a result of quivering movements of the legs, constantly make trembling movements forward and backward, and right and left. During this process they move about on four legs, with the forelegs, themselves trembling and shaking, held aloft approximately in the position in which a begging dog holds its forepaws. If they have brought home sugar water... often [they] will retain it until they have quieted down. The duration of this "tremble dance" is quite variable. I have seen instances where the phenomenon has died away after three to four minutes, then the bee appeared normal again and flew out of the hive. Usually, however, this dance lasts much longer and three times I have observed a bee tremble on the combs without interruption for three quarters of an hour.

The message of the tremble dance was a mystery to von Frisch, for although it seemed to be a communication signal, he was unable to identify its cause or detect any effect on other bees in the hive, despite having observed more than 60 bees perform this behavior. This led him to the tentative conclusion that the tremble dance gives the other bees no information. Some 40 years later, in his masterwork on the bees' dances (von Frisch, 1967), he repeated this conclusion: "I think it [the tremble dance] tells the other bees nothing." He noted that several other investigators had reported that tremble dances seemed to be the result of foragers experiencing adverse circumstances outside the hive—such as a marked deterioration of their food source—and he suggested that the tremble dance might be an incidental effect of a "nervous conflict" in these bees.

In 1987, I began to see that von Frisch's conclusions about the tremble dance might be mistaken. I realized that this dance might play an important role in the organization of a colony's foraging for nectar. My suspicions about this arose from some surprising results of an experiment that I performed with a colony living in an observation hive. When I removed most of the nectar storers from this colony and then observed the effects of this "surgery" on the colony', I saw—as expected—that the nectar foragers had to search noticeably longer than usual to find nectar storers to get unloaded upon return to the hive. Their search times jumped from about 10 seconds to nearly 50 seconds. But, I also saw—to my surprise—that soon after the nectar foragers entered my observation hive and had difficulty finding nectar storers, they performed tremble dances. Wow! Furthermore, I saw that after about two hours, by which time

A Call for Help!

Thomas D. Seeley

the colony's nectar foragers no longer needed to conduct lengthy searches to find nectar storers, the nectar foragers stopped performing tremble dances. It was clear that, somehow, the colony had replaced the nectar-storer bees that I had removed.

These serendipitous findings led me to form a two-part hypothesis regarding the tremble dance: first, its *cause* is nectar foragers experiencing long searches to find nectar storers; and second, its *effect* is to stimulate additional members of the colony to function as nectar storers. In other words, I proposed that the tremble dance serves to remove a bottleneck in the nectar acquisition process at the start of a honey flow by signaling a need for more workers to function as nectar-storer bees.

Four years later, in the Summer of 1991, I undertook an experiment designed to test my hypothesis. I moved a colony living in an observation hive to the Cranberry Lake Biological Station (CLBS), which is located in the Adirondack State Park, in northern New York. I took my study colony to this site because it is surrounded by nearly unbroken forests and lakes, so it is a place with very few flowers. Indeed, no honey bee colonies live around the CLBS, except those that I bring to it for my experiments. Here I can easily control the rate at which a colony's nectar foragers bring nectar (sugar water) into their hive, because their only significant sources of food are the sugar-water feeders that I provide. And with the help of assistants tending the feeders, I can control the number of bees foraging at my feeders.

To test my hypothesis about the *cause* of the tremble dance, I provided a colony living in an observation hive with two sugar-water feeders and I regulated the rate at which "nectar"-laden foragers returned to this hive by controlling the total number of bees visiting my two feeders. When this number was low (only 30 bees total), the forager bees quickly found nectar-storer bees (in just 10 seconds, on average) when they got home. And virtually all of the forager bees performed waggle dances. But when the number of bees visiting my two feeders was high (120 foragers total), these bees had difficulty finding nectar-storer bees (on average, each forager searched 45 seconds). And these forager bees no longer performed waggle dances; instead, they performed tremble dances! Overall, I saw that if a nectar forager located a nectar storer within 20 seconds of entering the hive, then she performed a waggle dance, but if she had to search for 40 seconds or more to find a nectar storer, then she performed a tremble dance (Fig. 4).

To test my hypothesis about the *effect* of the tremble dance, I again regulated the rate at which nectar foragers returned to the hive, but this time I counted the number of bees functioning as nectar storers on days with low and high levels of nectar-forager traffic, i.e., on days without and with tremble dancing. To count the nectar storers in my study colony, I replaced the glass on one side of my observation hive with a stiff nylon mesh (i.e., tulle, the material used to make tutus for ballet dancers) and then I daubed paint on the back of each bee that I saw unloading nectar from a forager. The effect of tremble dancing soon became clear. For example, on July 19, 1994 when the traffic level of nectar foragers was low (just three bees per minute entering the hive) and no tremble dances were performed, I labeled only 550 bees functioning as nectar storers. But on the next day, when the traffic level of nectar foragers was high (more than 25 bees per minute entering the hive) and more than 15 tremble dances were performed simultaneously within the hive, I labeled more than 1500 bees functioning as nectar storers.

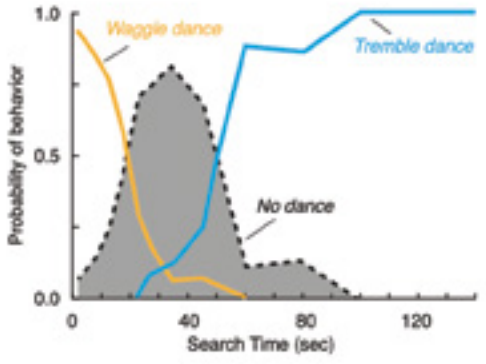


Fig 4. Dance behavior as a function of the in-hive search time for foragers that have visited a rich nectar source. Search times shorter than 20 seconds were followed by waggle dances, and search times longer than 50 seconds were followed by tremble dances.

These studies of the tremble dance deepened our appreciation of the complexity of the inner workings of a honey bee colony, especially of the bees' social organization for making honey. We have long admired how foragers can share information about rich food sources by means of the waggle dance. We now understand that the effectiveness of the waggle dance in boosting a colony's rate of nectar intake can create a problem for the bees, that of having too few nectar storers to handle the unloading needs of an enlarged group of nectar foragers. And we now understand that this problem is solved by means of a second dance produced by nectar foragers when they experience excessive delays in unloading—the tremble dance. Maybe there is even a lesson here for us. Perhaps our banks, grocery stores, and other places where customers must wait to be served should adopt a communication system like the bees' tremble dance so that when long waiting lines develop the customers can call for additional tellers, cashiers, and the like, rather than just wait and quietly hope that more will soon appear. BC

Tom Seeley is a retired professor in the Department of Neurobiology and Behavior at Cornell University. This article is adapted from a chapter in his forthcoming book *Piping Hot Bees and Boisterous Buzz Runners. 20 Mysteries of Honey Bee Behavior Solved.* Princeton University Press.

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Apistan, field study: 84% efficacy (Apiguard: 86%; Apivar: 79%; HopGuard: 64%), @ Mississippi State University (Insects 2018)

Apistan: **94.90%** efficacy (2019, Veterinary Bee Inspector, Spain)

Apistan: **96.92%** Efficacy (2018, Veterinary Bee Inspector, Spain)

Apistan + 50 g Apiguard: **97.97%** Efficacy (2018, Veterinary Bee Inspector, Spain)

Apistan: **97%** Efficacy (2014, FNOSAD, France)

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Minding Your Bees And Cues

If Bears were Bees

Becky Masterman & Bridget Mendel

"If Bears were bees, they'd build their nests at the *bottom* of trees." Thus spoke Winnie the Pooh, the iconic bear whose paw is forever in the honey pot.

In a way, we've conceded to Pooh's wishes by keeping our bees in Langstroth hives, near the ground. Easy enough for bears to knock apart and eat up those delicious grubs.

Here in the Midwest, bears are bad this year. They are bursting through electric fences, barging into apiaries, busting into brood boxes, battering frames and leaving a total mess in their wake. Our reaction is a mix of impressed, mad and endeared. For something their size, bears are kind of cute.

Here in Minnesota, we have black bears (*Ursus americanus*), whose historical range used to cover most of the United States (Figure 1). Black bears typically live in the forests and swamps of the northern part of Minnesota where they eat acorns, berries and insects, and avoid humans. But in recent years, they have been increasingly ranging down to forage in corn fields, garbage cans, bird feeders and apiaries. Like all wild animals these days, their native habitat is threatened as forests turn into fields. And their forage can be impacted by erratic weather, especially extreme drought, impelling them to visit non-traditional areas like open fields or suburban yards.

A little black bear fact checking might help you understand why this beloved-by-many mammal is a formidable apiary pest. Black bears are big (and strong) with the average adult male weight at 300lbs and female at 160 lbs. While they tend to stay away from humans, their home ranges are vast with males covering 100 square miles and females at 25-50 square miles. They can live for 30-40 years in the wild and are highly intelligent. Add a keen sense of smell (their nasal mucosa area is 100 times larger than humans) that some say can extend

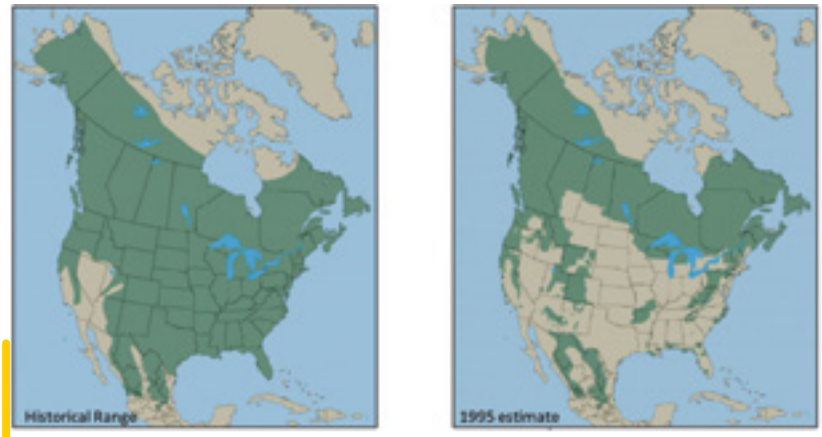

Figure 1. Maps of the historical and 1995 estimate of the black bear range in North America adopted from the North American Bear Center (bear.org) website with permission.

to a mile or more and their preference for eating honey bee pupae and larvae as a source of fat and protein, your apiary might be vulnerable if in smell's range of a black bear (**www.bear.org, Bear Series, Part One: A Bear's Sense of Smell - Yosemite National Park (U.S. National Park Service) - Yosemite Ranger Notes (nps.gov) and Berchielli, L., & Stegemann, E. (2004). Black Bears. New York State Conservationist, 59(2), 15–18.**)

If you've ever had a bear get into your apiary, you know the best word to describe them is destructive. Electric fences are a fix but not foolproof. Mark Sundberg, owner of Sundberg Apiaries, Inc. and current Minnesota Honey Producers Association President shared that fence costs to a commercial beekeeper with over 100 yards in bear territory can be significant. Sundberg said, "The real cost of fencing yards just begins with putting up the fence. It's the ongoing

Photo 1. After the bear fence was breached multiple times and destroyed numerous colonies, Mark Sundberg had to drop this beeyard. Photo Credit: Mark Sundberg, Sundberg Apiaries, Inc.

Photo 2. Bears are not just a rural problem for beekeepers. Black bear issues are not uncommon in Minnesota suburban apiaries. Photo credit: Tom Minser, Nature's Nectar, Inc.

Becky Masterman led the UMN Bee Squad from 2013-2019. Bridget Mendel joined the Bee Squad in 2013 and has led the program since 2020. Photos of Becky (left) and Bridget (right) looking for their respective hives. If you would like to contact the authors with your own bear stories or other thoughts, please send an email to mindingyourbeesandcues@gmail.com.

maintenance and battery expense that makes it so burdensome."

For smaller operations, ratchet straps can also keep bears from being able to break apart boxes (in some cases) but again, once the bear knows about the bees, she will knock over the colony over and over again, even if she can't break it apart.

Bears are not just a rural problem. Tom Minser, owner of the Twin Cities bee supply store Nature's Nectar, has his pulse on area bear sightings and apiary ambushes. Servicing many new small-scale beekeepers, Minser includes bear deterrence in his advice to those establishing apiaries. Fences need to be installed preventively, before the bear ever discovers the bees. Once she finds your bees, a bear won't be deterred by a quick zap.

What to do if a bear gets into your bees? It's important to report it to the Department of Natural Resources (DNR) or your state's equivalent agency. Their job is to balance the desire for a healthy bear population, but not one that bothers people. The number of problematic bears reported could affect things like the length and permits of bear hunting season, as well as their efforts to restore bear habitat. The DNR wants you to report bears, not just so they can study populations but so that they can manage them.

Bears should be on a beekeeper's radar, but more importantly beekeepers should be proactive in communicating with agencies and organizations invested in the stabilization and/or restoration of bear populations. In the long term, reacting to bear threats in your apiary may not be as effective as having an organized plan. The Wisconsin Honey Producers have formed a Bear Committee and are working with Wisconsin's Department of Natural Resources Black Bear Advisory Committee as stakeholders (Busy Bees – Mid-West Farm Report (**midwestfarmreport.com**)). Beekeepers in each state can communicate with the organizations who are making black bear decisions, document bear apiary damage and most importantly, encourage other beekeepers to take measures to protect our bees. This work also protects bears from getting in trouble. For all of us, this destructive but storybook worthy creature can inspire us once again to take action to mitigate climate change and ensure that important bear habitat is protected.

Resource

For excellent information on bear fence installation and maintenance, please visit:

How to Build an Electric Bear Fence – Carolina Honey bees **https://carolinahoneybees.com/electric-fence-for-bears/** BC

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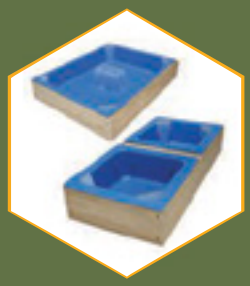

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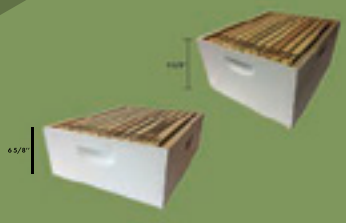

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From the University of Florida Honey

January: Overview of the HBREL at UF
February: Honey Bee/Beekeeping Teaching Programs
March: Research on Honey Bees
April: Apiculture Extension (Part 1)
May: Apiculture Extension (Part 2)
June: Roles in a Typical Honey Bee Lab
July: How Labs are Funded
August: The Lab's Physical Infrastructure
September: What it Take to Run a Laboratory Effectively
October: Professional Development in the Lab
November: Members of the HBREL Team and What They Do
December: The HBREL's Most Notable Successes/Contributions to the Beekeeping Industry

UF IFAS UNIVERSITY of FLORIDA

HONEY BEE RESEARCH & EXTENSION LABORATORY

Hello, my name is Chris Oster. I am the Lab Manager at the University of Florida, Institute of Food and Agricultural Sciences (UF/IFAS), Honey Bee Research and Extension Laboratory (HBREL). The mission of the HBREL is to advance our understanding of managed honey bees in Florida, the U.S. and globally, with a goal of improving the health and productivity of honey bees everywhere. We address this goal by conducting basic and applied research projects on honey bees, communicating our findings to assorted clientele groups through diverse extension programming, and training future generations of bee educators, researchers, conservationists and more. This is our mission statement, which can be found on our website: **www.ufhoneybee.com**. There you may take a full virtual tour of our facility as well, providing you with a "bee's-eye view". Alternately, you can reach the virtual tour by scanning this QR code with your smartphone (Fig. 1) or going to **https://mpembed.com/show/?m=8aixQmS5aWn&mpu=493&mpv=1**. In this article, I will provide a brief description of the HBREL's infrastructure which allows us to strive towards our goal.

Figure 1. QR Code to access our virtual tour.

The new HBREL facility was officially opened on August 24, 2018. It was built through the tireless efforts of the Florida State Beekeepers Association, the Florida State Legislators, the University of Florida, corporate sponsors and supportive beekeepers. Since its opening, members of the HBREL (faculty, staff and students) have been conducting cutting-edge research, hosting award-winning extension programs and teaching hundreds of students about beekeeping and honey bees. To carry out these tasks, a state-of-the-art facility is needed, and that is exactly what we have. I will start with our classroom (Fig. 2).

In many ways, our classroom is exactly what you would expect of a modern classroom: thirty seats, all with electrical outlets for students to charge their laptops, a projector for presentations and a whiteboard. What stands out to

HBREL Front Entrance. Photo Credit: Chris Oster

Bee Research and Extension Laboratory

The University of Florida Honey Bee Laboratory Facilities

Chris Oster

Figure 2. HBREL classroom during an extension event. Photo credit: Chris Oster

Figure 3. Inside the HBREL classroom overlooking the apiary. Photo credit: Chris Oster

many people about our classroom (and the entire facility) is the color scheme. Many of the walls and the floors are accented in "Bee Hive Yellow". Details like this bring home the point that this facility was built specifically for honey bee research/teaching/extension, down to the most minute detail. My favorite feature of our classroom is what I like to call our reverse bay window (Fig. 3). This floor to ceiling window not only looks over our on-campus apiary containing nearly 50 colonies, but it also is an extremely valuable teaching tool. A beekeeper can give a hive demonstration to a group of people while they are in the classroom gathered around this window. The beekeeper wears a microphone that projects their voice into the classroom, while in the classroom, a microphone can be passed around the visitors so they can ask questions of the beekeeper. This window allows us to take people to beehives who would not get the chance otherwise. Now do

not get me wrong, we will take almost anyone into the apiary with us for a hive demonstration, from toddlers to the elderly. But for some, suiting up and standing out in the sun is just not an option. That is why this window is such an amazing resource for teaching and extension.

The next notable room in our facility is our Dutch Gold Honey graduate student and visiting scholar office (Fig. 4). At the time of writing, this room provides personal desk space for three graduate students, one visiting scholar, with two more on the way. Having a permanent personal space is vital for students and researchers alike for conducting data analysis, attending online classes, planning research projects or simply doing homework. Having a space that you can call your own can help to facilitate a more enjoyable and productive working environment. Also, note the hexagonal windows, which when viewed from the outside, make our lab's logo. These windows serve as another reminder that you are in the HBREL.

Figure 4. Dutch Gold Honey graduate student and visiting scholar offices. Photo credit: Chris Oster

Figure 5. David J. Mendes Research Laboratory Space. Photo credit: Chris Oster

Just down the hall from the graduate student and visiting scholar offices is the physical laboratory space (Fig. 5 – David J. Mendes Research Laboratory). As the Lab Manager, this room is my favorite and least favorite place simultaneously. On one hand, it is where much of our research is conducted. I take pride in that. On the other hand, it is my responsibility to make sure everyone in the lab is properly trained in the event of a chemical spill, all the chemicals are being used and stored in a safe manner, all the machinery is calibrated, accurate, and is being used properly and safely, all the freezers and refrigerators are the proper temperature and are defrosted regularly, etc. I could go on, but that article is for next month's edition, so stay tuned.

All in all, the David J. Mendes Research Laboratory is the heart of the HBREL. For state-of-the-art research, we need a state-of-the-art lab. The main lab area consists of four islands with bench space for four researchers at each island. One island is sectioned off for pesticide research to limit the potential spread to other experiments. One corner of the lab is dedicated to DNA work with another corner dedicated to microscopy. Around the exterior of the lab are four auxiliary rooms. The first contains our emergency eyewash/shower station and our fume hood, which is used if experiments may generate harmful fumes. The second room, the Gamber Container, INC. room, is dedicated to molecular work to keep it separated from traffic and thus free from contaminants. The third room is a USDA APHIS-compliant and permitted room for using imported royal jelly to rear honey bees *in vitro*. The final auxiliary room of the laboratory is the Florida Farm Bureau Federation freezer, refrigerator and incubator room. In this space, we have three -80°C freezers for preserving DNA, three ordinary refrigerator/freezer combo units for sample storage, a chest freezer, five incubators, and an ethanol grade refrigerator that stores our honey bee collection. This collection has over 80,000 samples of different *Apis* species and their pests from all over the world. This collection is always expanding as lab members travel the world for teaching, research, and extension and as samples are donated for preservation.

Figure 6. Jester Bee Company Observation hive room. Photo credit: Chris Oster

The final room of our main building is the Jester Bee Company observation hive room (Fig. 6). From my research, this room is truly unique. Here, we can set up twelve observation hives, all with access to the outside for research involving honey bee behavior. The hardest part about studying any behavior is minimizing the effects of your observations on the outcome of the experiment (otherwise known as "observer or detection bias"). To mimic conditions in an actual honey bee hive, we have the capabilities to use only red light in this room. Since honey bees cannot see red wavelengths of light, this appears to them like a normal interior of a hive. We can also heat this room independent of the rest of the building to near the optimal hive temperature, mitigating the burden on the bees to thermoregulate in what would be a typical outdoor hive.

While outlining notable features of our main office, I did not even include our three faculty offices (including the Lois La Seur and the Laurence Cutts offices), the four staff offices (including the Peter E. A. Teal memorial office and the Senator Kevin & Rabbi Amy Rader office) capable of seating eight, the Robert L. Steele Family computer lab, or the D&J Apiary break room. These labs, offices, and spaces come together to make the main, but not the only, building of the HBREL. There are two more buildings that make up our overall facility. One is the Gordon Clauss outdoor classroom/teaching pavilion (Fig. 7). This space is used for teaching classes that cannot be taught in a traditional classroom, such as smoker lighting or hive construction. It also

Figure 7. Gordon Clauss outdoor classroom/ teaching pavilion during Bee College. Photo credit: UF/IFAS Communications

Figure 8. Workshop. Photo credit: Chris Oster

comes in handy when you are scheduled to teach a hive demonstration class while it is pouring rain.

The final building that makes up the HBREL is very important to the success of our laboratory. The Amy E. Lohman Apiculture Center includes our workshop (Fig. 8) where we store all our beekeeping equipment when it is not in use. We also have a 355-square-foot, walk-in freezer for storing drawn comb that cannot be invaded by ants, roaches and wax moths. Our workshop also has all the necessary woodworking tools one might need to construct beehives or modify them for research purposes.

Adjacent to our workshop is the Dadant honey processing facility (Fig. 9). This room is one of the most impressive spaces we have to offer. It is a fully functional honey extraction and bottling facility which highlights these processes at every scale of beekeeping. We have five extractors: a two-frame hand-powered, a four-frame motorized, a twelve-frame radial, a twenty-frame radial, and an 84-frame radial extractor. Current and prospective beekeepers can come to this facility to learn the journey that honey takes to get from the hive to the bottle. To complete the commercial line, we have an uncapping machine that feeds into our 84-frame extractor. From there, the honey flows through a set of baffles into 1,000-pound storage tanks. The honey can then be pumped through a honey dryer or directly to a bottling machine. This room is mostly used for hands-on extracting classes using a hot knife and our trusty twelve-frame extractor, but hopefully someday soon we can put the commercial line to the test. As a bonus, the honey house meets the requirements to be a commercial kitchen in Florida. Once we receive this designation, any honey bottled in our facility could be sold wholesale.

The last room I get to tell you about is the one that most excites me. We are in the process of curating a beekeeping museum to show all the amazing beekeeping antiques that have been donated to the lab. This will be the Helen and David K. McGinnis Beekeeping Museum. We want our facility to be somewhere people can go to learn all aspects of beekeeping, including its history. Some highlights of our current collection include nearly 50 smokers (some of which date back to the 1800s), over 640 editions of *Bee Culture Magazine* (including Volume 1 Numbers 1-12 published in 1873), over 550 editions of the *American Bee Journal* dating back to 1948, honey jars, pots and tins that have somehow survived the ages, and many more amazing pieces. Our collection is growing all the time as new pieces are donated. While I cannot

Figure 10. Sample of the Helen and David K. McGinnis Beekeeping Museum display cabinet. Photo credit: Chris Oster

Figure 9. Honey extraction being taught during Bee College in the Dadant Honey Processing Facility. Photo credit: Cat Wofford, UF/IFAS Communications

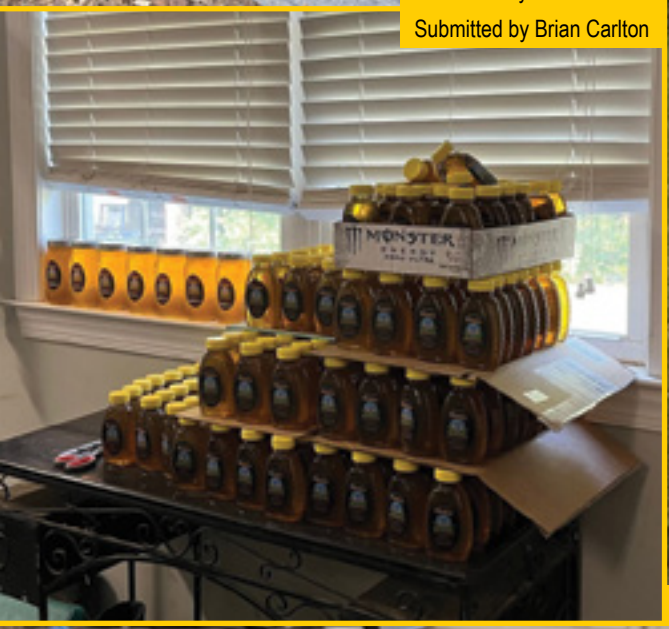
show off the museum just yet, Figure 10 is a sneak peek! When it's completed, we hope to have one of the finest beekeeping museums around.

Hopefully after reading this, you have come to the conclusion that the University of Florida's Institute of Food and Agricultural Science HBREL is a special place. The HBREL is not only the physical space we occupy, but also includes the staff, students and faculty who work here. We have all the beekeepers who have supported us throughout the years to thank for this incredible space to devote to research, outreach and education. If you are ever in Gainesville, we offer public tours of our lab on the first Wednesday of every month. The sign-up page for this tour can be found on our website, **www.ufhoneybee.com**. BC

Submitted by Julia Mahood

Submitted by Deborah Sasser

Submitted by Brian Carlton



Submitted by Deborah Sasser

Submitted by Joshua Krug

Submitted by Christine Contelmo

Submitted by Deborah Sasser

Submitted by Brian Carlton

Image Gallery

Apiaries, Splitting and Nucs & Honey Hauls

Submitted by Deborah Sasser

All The Buzzz in...

Hello Friends,

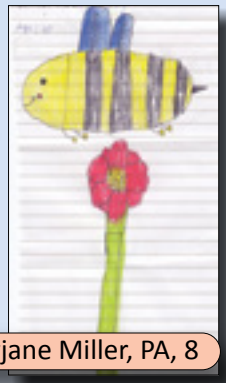
Enjoy the last days of summer. I hope you have many barefoot days.

Bee B.Queen

Bee B. Queen Challenge

Make a list of all the tools you use.

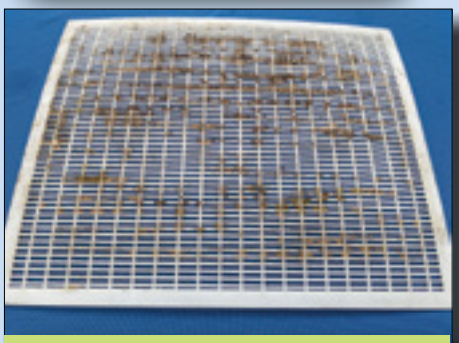
Loyla, 10, PA



Maryjane Miller, PA, 8

Terrific Tools

Having the right tools can make any job easier. It is the same with beekeeping. Here are some valuable tools used by beekeepers.



Queen Excluder - The usual purpose of a queen excluder is to keep the queen from laying eggs in the honey supers. Smaller worker bees can pass through the slits while the larger queen cannot.

Extractor – How do you get the honey out of the comb? An extractor is a machine that spins bee frames in a circle. Because of centrifugal force, the honey is pulled out of the frame. There are small, two frame extractors up to large commercial ones that can hold 100 frames at one time!

Smoker – A fire is built in the metal canister. A bellows supplies oxygen to the fire and is used to pump smoke at the entrance of the hive and on the frames. It is used to help calm the bees down while working a hive.

Feeder – There are times when bees may be short on food. Sugar water can be fed to the bees using this tool.

Hive Tool – This tool is used to open the hive top, pry frames out of the hive, scrape beeswax off frames, scrape propolis from the hive and frames, and remove burr comb.

Frame Grip – Pulling out bee frames is made easier by using a frame grip. Securely clamp the grip onto the top of a frame and lift.

Bee kid's corner

Produced by Kim Lehman
www.kimlehman.com
www.beeculture.com
August 2023

Beekeeping Tools

Across

3. used in moving bees from a frame
4. helpful for lifting the frames from the supers
6. used to loosen the cover and frames stuck together with propolis
7. helps to calm the bees

Down

1. useful for controlling where the queen lays her eggs in the hive
2. used to give the bees sugar water for food
5. a tool for getting the honey out of the comb

We All Use Tools

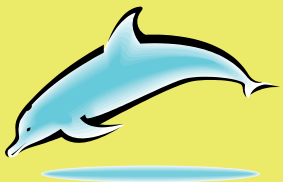
Can you name at least one tool used by the following people?

Teacher - _____
Carpenter - _____
Nurse - _____
Student - _____
Gardener - _____
Plumber - _____
Astronaut - _____
Scientist - _____
Police Officer - _____
Firefighter - _____
Chef - _____

S	O	Q	S	O	C	A	W	C	U	G	S	Y	V	C
E	K	T	Y	O	S	P	C	C	P	O	V	E	O	T
S	S	D	A	Y	Q	S	A	V	V	T	Q	E	I	S
U	E	E	N	S	W	C	U	N	B	L	L	G	T	D
P	E	T	L	O	R	A	N	G	U	T	A	N	S	O
O	Z	Q	R	E	Q	S	O	L	B	O	E	H	J	L
T	N	C	Z	G	P	V	A	V	O	D	V	Z	Y	P
C	A	U	E	Z	X	H	Q	L	O	D	F	S	I	H
O	P	B	L	V	Q	G	A	R	L	C	C	A	T	I
N	M	Y	Z	E	J	T	V	N	Z	I	Q	Q	K	N
V	I	G	N	L	S	G	Y	I	T	X	R	Z	U	S
T	H	S	R	E	T	T	O	X	V	S	A	O	S	E
G	C	M	A	C	A	Q	U	E	S	C	Y	E	G	P
H	V	G	P	K	O	K	N	I	W	A	A	B	H	G
G	Q	X	Y	G	X	Z	B	G	Z	C	W	O	D	I

Animals That Use Tools

Chimpanzees
Crows
Orangutans
Elephants
Dolphins
Sea Otters
Gorillas
Octopuses
Rodents
Macaques



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AHH! TO HAVE THE RIGHT EQUIPMENT

James Masucci

The problem with being a sideliner is that you are "in between". Too small for all the cool things that the commercial guys have, but too big to do things the way hobbyists do. I made a couple big purchases this year that have brought step changes in the efficiency of my operation. Though expensive, my buyer's remorse transformed immediately into a smile after using them for the first time. It got me thinking about other beekeepers with expanding operations that wonder about what to buy. So, I thought I would talk about the larger purchases I've made that have truly increased my efficiency. This is not a product review or endorsement of any kind. Just a discussion of what I've found to be helpful.

I am going to talk about two areas of beekeeping where the right equipment has made a world of difference. Extracting and bottling. Each of these can be done with minimal equipment. But adding the right tool can dramatically improve the process by making it easier, neater and/or faster.

Let's talk about extracting. I have a 20-frame extractor and a decapping tank that holds 20 frames. These are must-have pieces of equipment if you're going to process thousands of pounds of honey. With just this equipment, I would hire a kid in the neighborhood to spend a week or two uncapping frames. The process worked. By the time we got 20 frames ready to spin, the previous spin was about complete. Unload the extractor, reload the extractor, uncap frames, repeat. However, our wrists ached and there was honey all over the place by the end of the day. In addition, the decapping tank needed to be cleaned out each day, meaning gravity didn't have enough time to remove all the honey from them. At this year's ABF meeting, I walked into the trade show and there she was… an automatic decapping machine. I looked at it and said, "this is what I need." But it was $4,000. The more I walked by

Picture 1: An automatic decapping machine greatly sped up my extracting operation. My decapping tank fit nicely underneath to catch all the cappings and gravity allowed me to capture all the drippings. Uncapping frames is no longer a rate limiting step.

Picture 2: Straining honey is not my new bottleneck. Running multiple strainers helps the process, allowing me to clean one strainer while the other is working. However, I am considering a honey clarifier to eliminate this problem.

Picture 3: A 30-gallon tank on a hydraulic scissor lift was the first step to streamlining bottling. A quality stainless steel honey gate was neater than others I have tried and the high volume is enough for a day's worth of filling. With the scissor lift, I can add honey while lowered and pour when raised.

it, the more I wanted it. I pulled the trigger and brought it home. I got to use it this Spring for my black locust honey. Holy cow, it was a step change in extracting. The twenty frames were done in no time (see picture 1). Even working by myself, I would stand around and wait for the extractor to spin. In fact, I texted my wife that I need another extractor. I could easily run two 20-frame extractors now (IF I want to invest in another one). The machine isn't perfect. I still needed to scrape low portions of the comb and every so often a frame would misfeed, but uncapping frames is no longer a bottleneck. My arms no longer ache and the honey house is a lot cleaner.

Plus, my decapping tank fits underneath the decapper and two-days' worth of cappings fit into it, I can now fill it to the brim. That allowed me to recover more of the honey from the cappings by gravity.

Removing the decapping bottleneck has led to the next one… straining (see picture 2). I run my honey through a strainer to remove wax and other debris. The strainer is constantly getting clogged. I have a few strainers so I can clean one while the other is straining. But this takes time and slows the process. I don't have an answer, yet, but I am looking at honey clarifiers. I don't want to pump honey into storage tanks, etc. Too much money and takes up too much room. I am in the process of building one with three five-gallon buckets which will then empty into another bucket for storage. If I can get that to work, then a two-extractor set-up is really feasible and I can nearly double my extracting rate. If I can't get it to work, a commercially made clarifier may be my next large purchase (next year).

Bottling is another one of those time consuming and messy processes that all beekeepers must do. Like most everyone else, I started with a 5-gallon bucket and a honey gate. The honey gates always leaked, and I was constantly refilling the bucket. When honey crystallized in the bucket, it took days with one of those heated wraps to liquefy it. As I grew, I was constantly pouring bucket into bucket to fill orders. My first solution was to buy a 30-gallon bottling tank with a quality, stainless steel honey gate. I could fill it once, allow impurities to float to the top, and then fill a lot of bottles without stopping. One tank-full was a good day's worth of pouring. The trick to its success, however, was to purchase a manual, hydraulic lift cart (picture 3). I fill the tank on the cart in its lowest position, then raise the tank so the honey gate is above the tabletop allowing me to pour. Now, I could do cases of bottles and jars without stopping.

That was a big improvement over the 5-gallon buckets and well worth the investment. It was still time consuming and slightly messy due to drips and overfills. Hence, my latest investment; an automatic bottler. Just the bottler, not the table that automatically feeds bottles/jars (picture 4, next page). Boy, was that a game changer. I just had an order of 60 jelly jars for a customer. I had them filled in 10 minutes and NO drips with every jar receiving the same amount of honey. It hooks up directly to my bottling tank giving me access to 30 gallons of honey to be automatically bottled. It cut my bottling time in half. It's so simple, now I can have friends and family help me bottle without the risk of getting honey all over the floor.

The last component of bottling is liquification. How do I liquefy multiple buckets of honey to fill large orders? My solution was to buy the heating element and conversion kit that turns my decapping tank into a hot water

Picture 4: My latest purchase, an automatic bottler. The intake connects directly to my bottling tank. It quickly and accurately fills my jars without any drips.

Picture 5: The heating element conversion kit of my decapping tank allows it to double as a water bath. I use it to liquefy three buckets of honey at a time. It takes about 24 hours.

bath (picture 5). With this set-up, I can liquefy three 5-gallon buckets at a time and it takes about 24 hours. I find it works best when I cover it with an old comforter to help insulate it. My only complaint is that I wish it was bigger. I would like to be able to liquify six to 10 buckets at a time. I converted an old chest freezer using a reptile heating element and thermostat. It's mediocre, it's slow and there is a heat gradient from top to bottom. I am considering getting a water trough and using a water heater element to build another water bath… or bite the bullet and buy another decapping tank.

One of the dilemmas a business owner constantly faces is the cost of "automation" vs the cost of labor. Writing a check for a couple thousand dollars is hard to justify when you know you can do the same thing by hand. But then you must ask yourself, "How much is your time worth? What if you can increase productivity by 50% or more? What if you can prevent injury (i.e. carpel tunnel)?" Sometimes, making the investments makes sense. Sometimes, it helps to hear how effective a piece of machinery is before you buy it. What I can tell you is this… I don't regret purchasing any of the equipment I just talked about. Each of them made the process easier, and easier is a good thing. As you are thinking about your operation, think about it in terms of efficiency gains. What are your bottlenecks and what would happen if you removed that bottleneck? There is equipment out there that works for us sideliners, if you look. BC

Off the Wahl Beekeeping

MECHANICS OF A HIVE INSPECTION

Richard Wahl

One of the more daunting tasks in beekeeping is deciding what to look for and when to do hive inspections. I have to admit that in my first year of beekeeping I did not do any deep hive inspections. I only opened the hive once to add a second ten-frame deep midway through the Summer after seeing more extensive bearding on the front of the single deep hive. I did not realize at the time that this was more likely due to overheating inside the hive rather than a lack of space. There is a good likelihood that the additional space was needed at that time, but as with many of my actions in that first year, I was correcting some perceived need of the bees for the wrong reason. Fortunately, that first captured swarm was resilient enough to survive through my faulty logic and I was on my way to becoming a more knowledgeable beekeeper.

After reading more on beekeeping through that Summer, my next action was to treat for mites on only one occasion in the following Fall. No further adjustments were made to the two deep hive until the following February when I added a candy board to the hive having seen the recommendation for supplemental Winter feeding in a video. This too must have been an opportune decision as the hive devoured the entire candy board and came into the next Spring as an active hive. Perhaps some of the strong genetics of this first colony of bees linger in my apiary after fourteen years as I have gotten at least one hive through every Winter since that first lucky endeavor.

I now realize that that first year hive should have been split going into its second season. But as a greenhorn beekeeper, I was not yet aware of splitting techniques or even the now obvious strength of the hive that would have warranted splitting.

Since that first year of beekeeping, I have become much more proactive in my hive inspections and have learned much more about what to look for and which actions to take for rationale reasons rather than relying on simple luck, based on erroneous logic. I still try new techniques or test new approaches with a single hive now and then to see if some differing approach has significantly different results. That has resulted in some tried and true techniques which sometimes seem to work in my apiary and at other times result in the loss of a hive, particularly through the following Winter.

The first point to consider when contemplating a hive inspection is to have a reason for the inspection. Any deep inspection where frames are removed, and even when replaced in the original order disturbs the environment of the bees. It may slow nectar and/or pollen collection for up to a few days before the bees reestablish their ideal internal humidity and temperature conditions. Damage may need to be repaired in interconnected frame patterns or pathways and comb that may have been inadvertently stressed. And then, there is the chance that the queen was in a bad spot and got injured or damaged during the removal or replacement of a frame. It is estimated that after a deep hive inspection it may take the bees up to two days to return themselves to their desired ideal state.

If the need is determined for a hive inspection, the first step is to have any needed equipment at the ready in the hive area. Prepositioning additional honey supers and/or nucs can save valuable time after the hive is opened. Having all of one's hive equipment close by can also aid in making timely inspections.

And let's not forget about getting the smoker going with an adequate amount of fuel nearby. A little cool white occasional smoke can go a long way to settling down a testy hive. The smoker should be loaded about halfway with the user's choice of fuel and then lit with some vigorous compressions of the baffle to get a good flame going with its underlying embers. I have found that using a plumber's butane blow torch with a click switch igniter at the top makes starting a smoker quite easy. I have been using my butane torch for the past thirteen years and it is still going strong even after a few minor plumber repair jobs. Once the flame is steady, the remaining half of the smoker can be filled with fuel which should result in the embers below producing a steady white smoke when the cover is closed. If the resultant exhaust smoke is nearly clear or flames are exiting the spout then the fuel is burning too hot, this will only annoy the bees more. Strive for a steady white smoke stream with just a few puffs at the hive entrance. This disguises the pheromones of the entrance guard bees which are then less likely to alert the remainder of the hive. Remove the outer cover and lift the rear of the inner cover and aim a few puffs of smoke into the hive just between the inner cover and the top deep. A few puffs can be directed at the inner cover center ventilation hole as well.

Cool white smoke from a lit smoker.

Reset the inner cover for a minute or two and as the smoke is sensed by the bees, they will begin to engorge on nearby honey which should reduce any tendency to be aggressive toward the beekeeper. As I learn the temperament of my various hives in the first, late Spring inspection I often choose to not even use smoke on some hives that seem very gentle. The key to any good inspection is to move slowly and carefully so as not to injure any more bees than is absolutely necessary.

Once the inner cover is removed I like to set aside any upper honey supers and the upper second brood

deep (if used) and start any inspection in the bottom deep and move up. Set any removed supers over the inverted outer cover to minimize bees falling into the grass or surrounding ground. Any bees landing on the outer cover can be shook back into the hive before it is reclosed. Carefully, pull a frame straight up at the outer side of the super and hang it on a frame support or set it in a spare nuc. The queen is not normally on one of the outer most frames which more often than not contains mostly nectar, honey or pollen.

The brood chamber frames should always be shoved together tightly as this provides the correct bee space between frames and results in less cross frame comb being built particularly if new undrawn comb frames are being used. There will still be a little play in the space at the outer edges of the frames in supers where the bees may have extended the comb a bit. It is not unusual to see bees being rolled on these extended frames as the outer most frame is removed. This is another reason to start at an outer frame so as not to be rolling the queen on an inner frame if she were to be there. On occasion, I have started by pulling the second from the edge frame out first if the outer most frame seems to be too stubborn as a result of the propolis holding it in.

Once a frame has been removed I then use my hive tool to pry any subsequent frame horizontally into the opened space resultant from the removed frame before lifting the next one out. If additional frames need to be checked, they in turn, are slid to the open space removed, inspected and replaced or lifted out. Unless one is doing a split or removing a brood frame to increase the needs of another hive, the frames should be replaced in the same order in which they were removed. This minimizes the disturbance of the hive as noted before.

Single deep hive inspection revealed need for another super. Note the homemade frame holder with two outer frames removed and frames three and four slid horizontally.

The reasons for inspections can vary greatly throughout the season. In the initial late Spring inspections it is good to know the state of individual hives. This can include the relative hive strength or apparent number of bees, whether a queen is present with a nice brood pattern with larva and eggs on some frames, the amount of nectar/honey and pollen that is present and the age of repeat use frames that are in the brood supers. I mark my frames with the last number of the year and try to annually remove some of the oldest frames in the brood chamber to be replaced with newly waxed foundation frames. This also gives newly emerged bees a place to draw out new comb as they want to do after a few weeks serving as cleanup and nurse bees.

Another reason for a thorough hive inspection is to spot any diseases early and to look for any pests such as wax moths, hive beetles or *varroa* mites. As a minimum, any hive inspection should allow for a quick mite count test with the resultant assessment as to whether a mite treatment is required. More hives are lost due to lack of monitoring and treating for mites than for any other reason. Once hive qualities are noted in that first deep hive inspection, decisions can be made as to whether a queen is needed, if a hive is a candidate for a split, or if mite treatments should be considered. This is also the time to determine the most likely reason for any dead-outs that may have occurred and notes made to change or alter past year or Winter procedures.

A hive inspection does not require that every frame be looked at. If there is uncertainty about the presence of a queen it is not always necessary to find the queen. As frames are sequentially removed and checked, it is not unusual to see increasing brood patterns as one gets closer to the center of super frames. Once a good brood pattern is seen and larva and eggs are spotted there is no reason to go deeper into that hive. When a queen lays an egg in the bottom of a cell it stands upright and vertical for most of the first day. During the second day, it begins to lie on its side and by the third day it is lying horizontal at the bottom of the cell. It is during this egg development that the nurse bees are filling in the bottom of the cell with a jelly like substance. Once cells are seen with eggs you know that the queen has been present in the last day or two, doing her job of laying eggs and no further frame inspections are necessary unless other indicators require looking further for disease or other problems. Close up the hive and move on. Once I am happy with the hive or split or nuc that I am inspecting, I may not do another deep inspection until late Fall other than for mite checks. Nucs and splits will require more frequent inspections as nucs with brood frames can expand quickly and splits require a check to see if a new queen has developed.

A beautiful capped brood frame found in an early Summer hive inspection.

Even a mite check requires one to go no further than that first good brood frame that one comes across in order to gather brood frame bees for the mite check. Since mites like to gather to enter brood frames just before capping, a brood frame containing open larva is a good frame to take bees for a mite check. If a mite treatment has recently been completed and no other reason exists to do a deep inspection, I may only add honey supers as needed by looking at the bee population and the tops of frames in the previous honey super. If there is evidence of honey/nectar in all but one or two frames, it is time to add another super.

Another quick way to check a super is to slide the brood or honey super back a few inches from the one below it and tip the super forward so as to look at the bottom of frames in the super. With a bit of experience, one can tell by looking at the bottom of frames if additional supers need to be added. If my most recent check indicated all is well and I see bees bringing pollen into the hive entrance, I may not check that hive further other than to insert mite treatments. If bees are bringing pollen into a hive it is a good indication there is a laying queen since the pollen is made into bee bread to feed new larva that is yet to be capped. On the other hand, if a hive that has been relatively calm seems in later weeks to be a bit testy and there is no pollen being brought in it can mean the queen is no longer there, a supersedure is going on or some other problem exists warranting a deeper inspection.

Adding Supers

The general philosophy is that another super should be added when there are only one or two frames left with room for the queen to lay eggs or the workers to store honey and nectar. One of the most common reasons for swarming is the lack of space in an overwintered hive. A queen eager to lay more eggs that has frames filled with emerging brood, pollen and nectar and no more room is a ready invitation for the swarming instinct as the worker population expands in late Spring and early Summer. I have had several times in my early beekeeping experience where I kept adding supers as space requirements dictated resulting in a hive getting to over six feet tall. I have since increased my number of hives and taken full honey supers off more frequently rather than only once in the Fall to keep hives to a shorter height. Some beekeepers prefer to keep only one brood deep and the remaining supers above reserved only for honey supers. This works best if there is an equal mix of open space, pollen, nectar stores and brood frame space in the single brood super. It may require the removal of several honey or pollen frames from an overwintered hive that still has plenty of resources in it to provide the needed egg laying space. As the queen gets into a cycle of laying eggs where recently emerged brood has left, a continual cycle of egg laying and brood rearing can occur provided there is also a frame or two of pollen and the same for nectar or capped honey as a food source. I tend to err on the cautious side and prefer to provide a second deep for brood space before adding honey supers knowing that my brood, pollen, nectar and empty cell frames are not always equalized in a single brood super. If one is using the eight frame deeps it will almost become a necessity to have at least two brood supers as there are two less frames for this equalization of use.

Honey Supers

The inspection of honey supers is much less of a challenge. They are either uncapped nectar or capped honey in varying numbers of frames. When all but one or two frames have room left it is time to add another honey super. If in an inspection the inner most frames are filled with nectar or capped honey, they can be moved to the outer edges of the super and the empties at the outer edges moved to the center. The bees prefer to work vertically through a hive rather than horizontally to the outer frames. The bees will move up into the next honey super before outer edge frames are filled below, particularly if the frames need new comb cells built on the foundation. If new foundation is being used honey supers need to have ten frames (or eight in eight frame supers) until all frames are drawn out with comb. This maintains the correct bee space between frames. Since there is a little slop in the spacing in most supers, the honey frames should be equally spaced throughout the super. After the honey super has been uncapped and the honey extracted the honey super can be stored and reused for many subsequent Summers to come. The bees will clean up and rebuild any frayed comb edges and recap honey each following year. In subsequent years, nine frames can be equally spaced in a ten frame honey super (or seven in an eight frame) and the bees will draw the comb on each frame out just a bit farther making it easier to use any uncapping tool.

Nine frame spacer tool used to equally space frames on a previously used ten frame honey super.

Understanding the need for good pre-inspection preparation, what to look for during inspections, timing of inspections and the actions to take as a result of the inspection can measurably assist in becoming a more proficient beekeeper. The one major asset to my beekeeping career is that from day one of my first swarm catch, I took notes as to what was happening every time I worked with my bees.

Your inspection schedule may vary based on your time constraints, job or family commitments and other obligations. But developing a solid approach to efficient hive inspections can go a long way toward improving your beekeeping skills. BC

Listen along here!

Beekeeping

A Path to Some Economic Freedom

The economic upheaval of the recent COVID years has revealed weaknesses in our economic system and many of the unsung benefits we beekeepers can enjoy from practicing our craft. We saw what's been called the "Great Resignation" where workers left their jobs in droves. One of the primary reasons employees quit was due to the way employers treated them. For others, it was the company culture and values that did not align with their own. For those stuck in dead-end jobs, the COVID Economic Impact Payments provided the financial buffer they needed to transition into a new working situation. The dramatic decrease in unemployment made it challenging for employers to hire help, but made it much easier for workers to leave lousy jobs. The ruling and economic elite hate low unemployment because then workers have options and it makes it too easy for them to leave their jobs for a better one. This also puts upward pressure on wages which decreases profits. Far too many employers rely on the Federal Reserve's efforts to manipulate interest rates and keep living expenses high enough so people's savings will get used up and there will be plenty of desperate workers willing to accept jobs that they normally would not take. The Fed also works to keep unemployment high enough so most workers would not dare to leave their jobs, no matter how bad they are, because there are lots of financially hurting people waiting in the wings to take their place and there is so much competition for work that getting a better job is difficult.

Higher interest rates put the brakes on the housing market but apparently too many consumers still flush with cash saved up during the pandemic continue to spend. When discussing the Fed's increases in interest rates on the November 2, 2022 airing of National Public Radio's Morning Edition, the President of the Federal Reserve Bank of Kansas City, Esther George, stated, "We see that there is a bit of a savings buffer still sitting for households, that may allow them to continue to spend in a way that keeps demand strong," she said. "That suggests we may have to keep at this for a while."

NPR's Morning Edition also interviewed Federal Reserve Chair Jerome Powell who stated: "No one knows whether there's going to be a recession or not, and if so, how bad that recession would be… Our job is to restore price stability so that we can have a strong labor market that benefits all, over time." Of course, Powell's idea of a strong labor market is one where there are lots of people out of work so that employers have no problem finding workers for jobs that offer poor pay and few-to-no benefits. The "all" that benefit from the price stability of more people out of work due to higher interest rates is the business class, not the majority of the people who work for a living.

In honey bee economics, each individual bee's efforts are primarily aimed at supporting the common good of the whole. No worker tries to monopolize hive resources and control or restrict access to the rest of the colony for their own personal gain. With a few notable exceptions, most of human culture that's dedicated to the capitalist economic system works in the opposite way of a honey bee colony. Greed is promoted and rewarded. Monopolization, consolidation of power and control of the market is the goal, and employees are seen as an expense that should be minimized as much as possible, and are too often considered disposable. Unskilled laborers in particular are treated with little respect and dignity.

Of course no employee ever gets paid what they're actually worth. The system is designed so that a company must purchase your labor wholesale so they can sell it retail. We have all been well indoctrinated into accepting this situation as the natural order of things but it took a long time to get us to this point. The first factories to open up and hired unskilled laborers at the dawn of the industrial age were greeted with strong opposition and protests from the populace. Rather than a person using a skilled craft to produce something useful that they could then sell or barter, individuals traded their time for money doing jobs that most anyone could do with a little training. Folks back then saw this for what it was, treating people with disrespect and compromising their independence and dignity.

People believed there was little difference between being a factory worker and a slave. Of course the factory worker's situation is supposed to be voluntary and temporary since they can choose to quit at any time. Unlike a slave that the slave owner has to house, feed and clothe, the factory worker is expected to use their meager earnings to purchase their own accommodations and necessities and hope there is enough left over for a little discretionary spending.

To prevent employees from scrimping and saving so they can afford to eventually leave their jobs, companies took a page from indentured servitude farmers and establish company stores to provide their employees with goods, and built lodging to rent to workers, all at rates designed to ensure they could never afford to leave.

There are those who argue that working for others provides great benefits such as a reliable working situation, a greater sense of one's basic needs being provided for which can instill a sense of personal security and stability, and not having to take the financial risks of running

While most beekeepers are backyard part-timers with a few hives, a small percentage of beekeepers make a part-time, or full-time, business of beekeeping, and it is these beekeepers that account for the majority of managed honey bee colonies.

your own business. While this is all true, much of the same can also be said of slavery.

As far back as 44 BC, Cicero is quoted as saying "vulgar are the means of livelihood of all hired workmen whom we pay for mere manual labor, not for artistic skill; for in their case the very wage they receive is a pledge of their slavery."

When Fredrick Douglass took a paying job, he is reported to have declared "Now I am my own master." After life as a slave, receiving a wage that you can decide how to spend can feel like you have some level of freedom. Only later did he realize to the contrary, "experience demonstrates that there may be a slavery of wages only a little less galling and crushing in its effects than chattel slavery, and that this slavery of wages must go down with the other."

Through a craft like beekeeping, one has the opportunity to escape wage slavery, choose their own hours and make their own decisions. Sure they take on all financial risks, but they also get to enjoy all the financial benefits. Beekeepers may not become millionaires from their efforts, but there is immense satisfaction that comes from being your own boss and living the agrarian lifestyle.

We have become well indoctrinated into maintaining capitalism and identifying with it as our means of survival for so long, that the idea of people working together, rather than competitively, to meet their collective needs like in the example of the bee hive, seems improbable if not impossible. What would we get in return for our selfless efforts to help maintain each other's existence?

One well established economic model inspired by bees and the rest of the natural world comes in the form of the cooperative business. Work that is not based upon individual craft work can be organized by worker self-management. An example is Sioux Bee Honey, a beekeeper owned co-operative that notes on its website: "One bee can't do it all, neither can one farmer. It's why five humble beekeepers from Sioux City, Iowa, formed a co-op to share equipment and resources to bring more honey to market. It's a way of doing business where family farms stay in the family and decisions are made democratically."

Like all farming, beekeeping provides the foundation for a strong and resilient economy by creating new human centric wealth from the communal wealth of the natural world. Almost all other businesses and economic activities simply re-

organize human centric wealth that already exists in order to extract more wealth, but farming in general and beekeeping specifically, combine sun, air, water and earth with the efforts of a bee colony to create new wealth (e.g. honey, beeswax, etc.) that did not previously exist. This is why agricultural revolutions must come before industrial or economic revolutions.

Beekeeping provides self-employment and all the social and economic benefits that go with it. The greatest advantage is throwing off the yoke of wage slave employment in our increasingly volatile economy and not being subject to the whims of "at will" employers. You also get to write-off legitimate beekeeping expenses on your tax return, reducing your tax bill so you get to keep more of your hard-earned money.

Beekeeping also appears to be somewhat technologically future-proof. The nature of beekeeping work suggests that despite current efforts to replace humans with robots and artificial intelligence in many areas of the economy, beekeeping is unlikely to ever become fully automated. There is a long list of technological promises like the paperless office that computers were supposed to create, less toxic pesticide use thanks to genetically engineered organisms, and electricity from nuclear power plants that is too cheap to meter, all of which never came to fruition. Sure there are sensors and gadgets we can use to monitor hives and provide real-time data on colonies, but a human being knowledgeable in honey bee management, biology, pests and pathogens, along with a working knowledge of meteorology and apiary goal considerations will still be needed to analyze the data and determine the best course of action to take, as well as carry out the necessary physical hive manipulations in the field.

When planned accordingly, beekeepers have a better chance of avoiding on-the-job burnout by freeing up some of their time, since unlike other farm and domesticated animals; bees do not need daily attention. Of course a beekeeper can keep so many colonies that they end up working seven-days-a-week, but a beekeeper can enhance their time flexibility by choosing to keep the number of colonies down to a manageable amount that can be worked within whatever number of days a week the beekeeper wants to work on a regular basis.

A little bit of economic freedom, allows you to make choices. We, who live in the highly developed countries of today, have choices unparalleled in the history of mankind. We can chase after money and be incredibly wealthy, get an amazing education, choose to be lazy, or try to make the world a better place. We have many choices but to exercise those choices it helps a lot to have some economic freedom. Beekeeping is one way to provide some of that freedom. BC

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Management Tactics to Keep Mites Low

Tina Sebestyen

As mentioned in my previous article, miticides, and even organic miticides, have detrimental effects on honey bees at all levels; workers, drones and their sperm count and viability, and queens and their reproductive capacity. This is why repeated treatments and prophylactic treatments (when you don't even know if you need them) are such bad ideas. Don't get me wrong, treat when necessary or be prepared to kill a colony if you are unwilling to treat. But, there are all kinds of things we beekeepers can do to help our girls keep mites under control. That is the topic for this month.

Life Cycle of *Varroa destructor*

Varroa mites live in our honey bee colonies and reproduce inside brood cells along with our baby bees. The foundress mite (the mother) enters a brood cell in response to pheromone signals of the larva as it prepares to be capped and pupate. She then hides under the larval bee in the royal jelly until the larva spins its cocoon. Then she sets to work. She lays her first egg 60 hours after capping occurs, this will be her son. Every 30 hours thereafter[1], she lays another egg, girls from here on, that will hatch and mate with their brother. The baby mites are all white at first, and as they age, the girls turn light red. The male stays white and will never develop the exoskeleton that would harden and allow him to live outside the brood cell. The food for the mother and all of her babies comes from the pupating bee. The foundress marks the side of the cell in the ten o'clock position with frass, or mite poop, so that her babies can find the place on the bee where she has drilled a hole and injected digestive fluid into the bee's fat body (kind of like a liver) so that they can eat and grow big and strong and ready to reproduce. Mites also inject viruses into bees, which means that the bee is not only compromised by having its fat body eaten, but it also needs to fight a disease, often this is Deformed Wing Virus.

Mites in drone brood. Varroa destructor loves to reproduce with drone brood. This makes it easy to cull them.

What the Fat Body of Honey Bees Does[2,3]

The fat bodies of honey bees store energy, just like our livers do for us humans. This energy will be used to fuel the bee's metabolism, help regulate brood nest temperatures, and in Winter, get through times when it is too cold for the cluster to move to honey. Fat bodies help bees get through times of decreased nutrition so that they can continue to feed larval bees properly. They also store other nutrients, such as 24-methylene cholesterol which must be fed to larval bees in order for them to shed their skins and grow from one in-star to the next. A larval bee that does not receive this nutrient, either from in-coming pollen or fat body storage in the nurse bee, dies since it is imprisoned in a too-small skin.

Fat bodies help bees mount an immune response to viruses and bacteria (and remember, mites carry these diseases to the bees). They help adult bees synthesize lipids, otherwise known as beeswax and oil. One of the things bees do with wax and oil is to coat their exoskeletons with cuticular hydrocarbons to help regulate hydration and keep diseases from entering through the skin. Bees with a too-thick cuticle cannot dehydrate poop that they must hold during the Winter, they get too full of fluid, stop eating and die of starvation with food right there, but no room to hold it. Bees with a too-thin cuticle get dehydrated and die, or get a disease.

Bee must also detoxify pesticides, and that doesn't just mean Round-up and 2-4 D. Plants themselves produce toxins to keep bugs from eating them. Bees bring these chemicals home in the pollen, and their fat bodies help them utilize this food without harm to themselves. Fat bodies fuel pupating bees while their cells re-organize in metamorphosis, and are crucial to

Medium frame with drone brood. When a medium frame is placed in a deep hive body, the bees will often draw drone comb below the bottom bar. This can easily be cut off, though cutting on this one should be done judiciously, since there are active queen cells in the middle of it. As a bonus, this frame could be used in the first super to draw bees up into a new hive body.

storage and production of vitellogenin, a hormone critical to many things in the honey bee. All that is to say that it is very important for us to keep mite numbers low, rather than just knocking them down with poison periodically.

Integrated Pest Management Techniques

It has been said that the first step in IPM is monitoring for mites, and that surely is very important. As a seasonal timeline, however, the first step in IPM is drone brood removal.[4] In the Spring, mites are as anxious to reproduce as honey bees are, and even more than the usual 75% of the mites in the colony will be under brood cappings. Mites prefer drone brood to reproduce with since the longer pupation time allows for more mature mites to emerge with the drone than could occur with female bees. So, removing the first batch of drone brood in early Spring will eliminate many of the mites within the colony. This can be done quite easily by purchasing the green plastic frame with bigger cells embossed on it. Other methods are adding a frame without foundation to the edge of the brood chamber or a medium frame into a deep hive body. Without foundation as a guide, the bees will often draw comb for drones or honey (which will work for drone brood). These frames of drone brood can be frozen for 24 hours and returned to the hive for cleaning, or simply cut out and fed to the compost pile (my chickens don't like drone brood at all). The trick is doing this on time, without fail. If the drone brood is allowed to emerge, the mite population may increase dramatically. It takes 24 days for drones to emerge from their cells, not a month. Drone brood can be culled any time after it has been capped. I remove drone brood throughout the Summer. I don't pull all of it, but the big clusters or full sheets that I find go in a nuc across the yard, which will usually make its own queen. I put a milder miticide in this nuc to knock the mites off of the emerging drones, so that I can still help with filling DCA's, but am not producing my very own mite bomb.

Cultural Control

These are things that affect the entire colony. One example is apiary location. Hives that are in full sun have mites and small hive beetles that are less able to reproduce because it is warmer and may even have temperature spikes as bees work harder to maintain a proper interior climate.[5] Another cultural control that is not relative to mite monitoring since it should always be done is having mite-resistant queens. There are several mechanisms by which bees themselves work to control mite numbers; grooming one another and themselves, biting the legs off of mites (ankle-biters), removal of sick pupae (hygienic bees), removal of mite-infested bees (VSH), Pol-line queens, Russian queens and others. Mite resistant queens can be bought and should be monitored to ensure that later generations remain resistant (unlikely).

Physical or Mechanical Controls

The previously mentioned drone brood culling is a physical control. The second most important physical control is the brood break. That means that there needs to be a time in each colony when there is no capped brood. Life is dangerous for mites when they can't hide under cell cappings. They can be damaged, bitten or fall off of bees. They are vulnerable when in their dispersal phase (what used to be called the phoretic phase). Timing of the brood break is important. Mites can out-reproduce bees if a queen is allowed to produce enough consecutive brood cycles. This leads us to the July re-queening mentioned in my July article. Caging of the queen, either in a standard cage or on a sheet of drone comb can work, as well. Adding a sheet of young drone larvae from another colony to an otherwise broodless colony is what is known as Dutch Drone Brood Trapping.[7] All of the mites in dispersal will gravitate to the drone brood just before it is capped, and this can be culled.

Screened bottom boards were previously thought to reduce mite numbers since mites dislodged from bees would fall to the ground and be unable to climb back up into the hive. It has since been discovered that a screened bottom board with the slider (the mite drawer) removed, actually increases mite reproductive success.[6] With the slider out, the hive will be a bit less humid, and mites reproduce better in lower humidity. Yes, the bees are working to maintain the humidity in a range suitable for honey bees. It just so happens that at the lower end of that range, mites do better than in the higher end of the range.

Also, the higher humidity that is present in a hive with a solid bottom (or screened bottom and slider) means that the bees work harder to maintain perfect brood temperatures. More humidity equals higher temps, and even temperature spikes, which also can kill mites or reduce reproductive success. Honey bees do quite well at the top end of both humidity and temperature ranges maintained within the hive, mites do well at the lower end. A screened bottom with a greased slider works great for capturing fallen mites.

A mechanical control that is important but not well-known as a mite control measure is removal of old brood comb. We all know that old comb harbors disease pathogens and pesticides, but as it turns out, old comb is invaded by reproducing mites four times more often than newer comb.[8,9] As brood comb is successively used for brood-rearing, layers of cocoons and feces reduce the distance from the cell rim to the surface of the comb. Mites are then able to more easily detect the pheromones that the larval bees are using to signal readiness for capping.

It was thought for a time that since smaller bees emerge a bit sooner, mites would be less successful in reproducing in small-cell comb. This has since been disproven. In fact, mites can increase over-all numbers more quickly in small cell combs, since each comb contains more larval bees, and thus more places for mites

to reproduce. One study found an average of 5.1% mite load in small cell colonies versus a 3.3% mite load in current standard-sized foundation colonies.[10]

Biological Control

An example of biological control is keeping a cat for catching mice. In honey bee colonies, this means finding a bug that eats or kills mites. One such bug has been found, the pseudoscorpion, but when introduced to colonies it mostly moved to the floor of the hive where it lived in the duff and ate already-dead mites. More work is being done on this, but it isn't there yet. Work in developing microbes or fungi that attack mites is also failing to deliver so far.

Monitoring for *Varroa*

While the previously mentioned mite control strategies should be practiced all of the time regardless of mite loads, monitoring for mites is the only way to know when a chemical control should be used. Monitoring not only alerts us to dangerous levels of mites, it also helps us find genetic lines of bees that naturally keep mite numbers lower. The alcohol or detergent wash is considered the most accurate method by busy scientists. Many backyard beekeepers would prefer to use the powdered sugar method since it doesn't kill bees and isn't quite as big a risk to the queen if she should happen to be accidentally included in the half-cup of bees necessary. When powdered sugar is used properly, it can be equally effective, the term *"properly"* being of prime importance here. The way to learn to do an effective powdered sugar roll is to follow it with the alcohol or detergent wash. If more mites fall during the alcohol wash after a powdered sugar roll has been done, then the beekeeper needs to shake the bees in the sugar more vigorously, for longer, or both, until no more mites are washed off in the following alcohol wash.

The timing of monitoring and real control of mites is important. The fat Winter bees will start to emerge in late August to mid-September, depending on your microclimate. Mite levels should be very low when these eggs are laid, so that the bees that need to survive Winter, help heat the colony and feed Spring brood have intact fat bodies and are disease-free. We can't have mites damaging our fat Winter bees while they are pupating.

The astute beekeeper may be asking why we can't use powdered sugar as a mite control agent, since it obviously knocks mites off of honey bees. Good question! This can be done, but it is very labor intensive. Since powdered sugar desiccates larval bees, all of the adult bees need to be removed from the colony and shaken with powdered sugar in a hive body that has a solid bottom and screened top. Just dropping powdered sugar between the frames does not work.[11]

The **HoneyBeeHealthCoaliton.org** website is great place to find up-to-date information about acceptable mite percentages and both organic and non-organic treatments. Even

Powdered sugared bees. When done properly, a powdered sugar roll knocks off bees for counting. Four of five bees will die, but the rest will be fine. If half of them die, or take a long time to recover, you are shaking too hard. Check yourself by following with alcohol until you learn to get it right.

repeated chemical treatments are not very effective if no IPM is practiced, and those treatments are harmful to honey bees, since we are trying to use poison to kill a tiny bug on a slightly larger one. Be pro-active with IPM and be a better beekeeper with healthy, long-lived bees. BC

Tina keeps bees in three kinds of hives, and loves to speak to bee clubs about honey bees. For a list of topics, visit her web page at **https://beequest.buzz**, or contact her with bee stories or questions at **bee.seeking@gmail.com**.

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I had the privilege of growing up in the vibrant era of the 60s and 70s. During those years, I experienced the simple joys of drinking water straight from the water hose, riding my bicycle without a helmet and fearlessly playing with sharp and dangerous toys. The overwhelming scent of cigarette smoke wafted through the air, as it was everywhere in those times. In our household, we had a remarkable treasure sitting on our bookshelf, the precursor to the internet known as "The World Book" encyclopedias.

My older brother and I shared a deep fascination with space, fueled by our dreams of becoming astronauts. The 60s witnessed a fierce space race, and becoming an astronaut held an unparalleled allure for kids.

Fast forward to today, and 52% of kids six to 17 want to become a YouTube star. Rocket science is no longer in *Vogue*. It's funny, I'm sure my encyclopedia had a section on beekeeping, but I never read about what I would one day enjoy with a greater passion than being a rocket scientist. I traded rocket science for beekeeping citizen science.

Sometimes beekeeping feels like rocket science. Beekeeping appears simple enough, right. Throw bees in a box, harvest the honey. But it never is that easy. If you think about it, beekeepers often boldly go where most people have never gone before, and attempt to somehow communicate with a species who only view us as a threat while we try to use our technology and wisdom to make their world better against their natural instinct.

While beekeeping is not rocket science it does demand that we become citizen scientists. Let me explain: we are adventurous, creative and resourceful. It demands we possess critical thinking skills, explorers in our own right, a citizen scientist.

Astronauts must pass psychological tests which applies to beekeepers too: Strong motivation for achievement, resiliency, adaptability and high emotional stability. Well for beekeepers, given the last one, three out of four isn't bad.

However, many beekeepers fall short of reaching their full potential as citizen scientists. Newcomers often fall into the trap of chasing quick fixes, the latest gadgets, concoctions and specialty queens instead of investing in the solid solutions that demand hard work and education. In a formulaic era where success is believed to lie in following prescribed formulas, we miss out on the opportunity to become true citizen scientists.

What is a citizen scientist in beekeeping? It's our ability to learn about bees through education and our own personal experience rather than simply having others tell us what to do. But how can we become true citizen scientists?

Build Your Own Bee Lab

1.*A Five Frame Nuc*

Wait, this is not a university bee lab, but rather your own bee lab that is merely a five frame nuc. Five frames of bees in a five frame nuc box. This will be your lab. It's smaller and easier to manage. It's challenging trying to learn beekeeping in a full size hive with two deep boxes and maybe four honey supers. By having a five frame nuc box in addition to your large hive(s), now you do not have to worry so much about killing your queen or opening it too often or battling a contingent of guard bees.

Your five frame bee lab is now your galaxy to travel, and see the difference between capped honey and capped pupae. You can pull a frame out every day if you want and watch your bees. You can even try to find your unmarked queen every day until you are a master at finding the queen.

2.*A $30 Digital Microscope*

Next, add an inexpensive digital microscope to your bee lab. Begin to observe the anatomy of your bees. Look at the veins and hairs on their wings or the hairs that make up their pollen baskets.

David Burns

Beekeepers

3. *Create Your Own Lab Experiments & Goals*

Perhaps your first goal might be to become familiar with various items on each frame or to locate the queen or finally be able to identify eggs. Learn to identify drones and even pick them up—they don't have stingers. This will help you have the courage to pick up your queen eventually.

Since this is your bee lab it's okay to mess up and fail. NASA lost plenty of test rockets. Scientists will experience failure. None of us want to mess up a large hive. But the little five frame nuc is dedicated to allow our mess ups to happen. If we never mess up and fail, we limit our ability to try things that give us greater experience. Often our ego gets in the way of beekeeping. If we lose a hive, then we feel we have failed, and that people will judge us at the next club meeting. But did anyone really learn to ride a bike without crashing and falling? Skilled beekeepers are only successful now because they got all of their messes and failures out of the way and applied what they learned. It's okay to mess up if you learn in the process.

In this evolving world, where childhood aspirations shift and the vogue of disciplines change, the essence of exploration and scientific curiosity remains timeless. Embracing the role of citizen scientist in beekeeping allows us to delve into a realm where nature and technology intersect, where we unlock the secrets of the hive and make meaningful contributions to the well-being of bees. So, let us embark on this captivating journey, where beekeeping and citizen science intertwine, opening doors to endless possibilities and fostering a deep connection within the remarkable world of honey bees.

If you'd like to watch my video on becoming a citizen scientist, visit: **https://www.honeybeesonline.com/davids-youtube-channel** BC

as Citizen Scientists

Soils are Important to Honey Plants and Bee Locations

It is important for all beekeepers to understand the effect that soils will have on honey production. The small hobbyist beekeeper will probably keep their bees at their home regardless of whether or not it is an ideal location. The small beekeeper can benefit by knowing what plants can thrive in their area and what yields can be realistically expected. The commercial or sideline beekeeper can use a knowledge of soils to decide where to begin looking for new locations.

In his book *Honey Plants of North America,* John Lovell quotes W.Z. Hutchinson as saying "The foundation of success in beekeeping is the location. Unless a man has a proper location, he had better relinquish beekeeping as a specialty, or else seek the right location." Lovell himself states "There is a small number of states in which commercial beekeeping is profitable throughout their entire extent; but in most cases there are only a few sections well adapted to this industry, while the remainder of this territory will support a small number of colonies."

In the Preface to *Honey Plants of North America* written in 1926, Lovell states "A beekeeper should be familiar with the soils of his state and should obtain and study the maps prepared by the Bureau of Soils in Washington." A lot has happened since 1926. In the late 1920's, we had the beginning of the dust bowl that lasted almost to the end of the 1930's. That event led to the creation of the Soil Conservation Service (originally the Soil Erosion Service and now the Natural Resource Conservation Service) under Hugh Hammond Bennet. Individual counties created Soil Conservation Districts and federal staff were assigned to these counties. An effort was begun to map the soils on a county by county basis that still continues. By sending out soil scientists to walk across the landscape, our country has assembled the maps of what soil lies where for most of our country.

In a system similar to the way in which plants are classified, USDA Soil Taxonomy has also been developed. We can demonstrate the similarity of the two systems as follows by comparing the classification of the plant white clover and the soil Honeoye:

Kingdom – Plants	Soils
Phylum – Pterophyta	Order – Alfisol
Class – Angiosperms	Suborder – Udalf
Subclass – Dicots	Great Group – Hapludalf
Order – Rosales	Subgroup – Glossoboric Hapludalf
Family – Legumes	Family – Fine, loamy, mixed, mesic
Genus – Trifolium	Series – Honeoye (NY's State Soil)
Species – repens (white clover)	Phase – HnB, Honeoye 3 to 8% slopes

So the largest group in the soil classification system is the order. Soils are grouped into orders based on the manner in which they were formed. The factors that influence the formation of soils are:

1. Climate (temperature and precipitation)
2. Living organisms (especially native vegetation)
3. Parent Material (bedrock or materials transported to the site)
4. Topography
5. Time (Some soils are relatively young; others are worn and old)

For the beekeeper, knowing the orders and suborders of the soils in your region and actually, all across the United States can be very useful.

There are twelve orders of soils. Seven of these orders cover relatively large areas in the United States. These are the Mollisols, Alfisols, Inceptisols, Ultisols, Entisols, Aridisols and Spodisols. The remaining five soil orders cover smaller geographic areas and are the Andisols, Gellisols, Histosols, Oxisols and Vertisols. All twelve soil orders are important to the beekeepers that happen to live near where these soils occur. Here is a brief description of each soil.

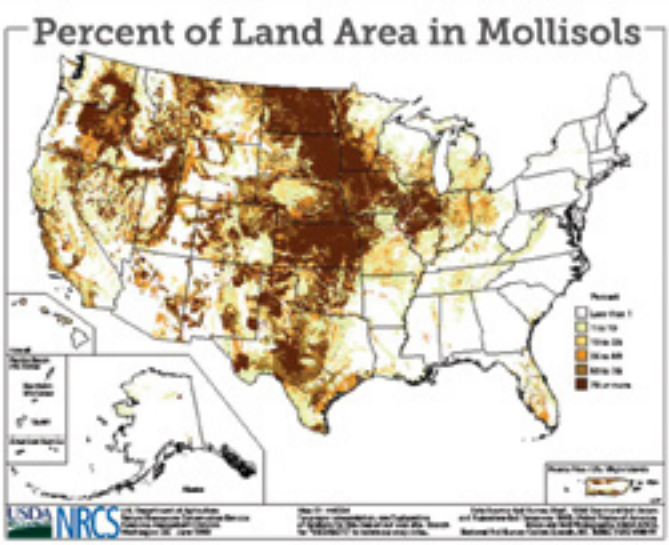
Mollisols

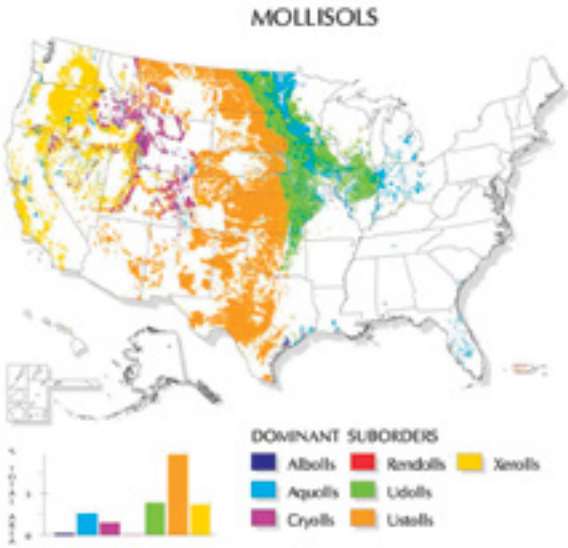
Mollisols occupy 22% of the ice-free land area of the United States, more than any other order. The Mollisols are the most important agriculturally productive soils in North America as well as on a world wide basis. They are located in the temperate regions of the world. The mollisols are a relatively young soil and formed under grasslands in a semi-arid to semi-humid climate. They have a very deep surface layer and are very high in organic matter. The soil is very fertile. The parent material is either limestone bedrock, glacial till or wind blown silt or sand. The topography can be either relatively flat to moderately sloping to steeply sloping. North Dakota is dominated by mollisols and is the top honey producing state in the U.S. according to USDA National Agricultural Statistics Service in 2020. 38.61 million pounds of honey was produced there, 26% of the total reported U.S. production. In 2021, another 28.325 million pounds were produced, 22% of the U.S. production. According to USDA NASS, South Dakota has a higher average per colony honey production. Both states have registration of bee locations. Most of this honey comes from the calciphile plants sweet clover, alfalfa, white clover and crimson clover. Oilseed crops such as rape and sunflower can also be important sources of honey.

The Mollisols are further divided into Sub-orders based on climate and topography. The best Sub-order of the Mollisols would be the Udolls, described as being formed in a humid climate. These are located in eastern sections of North Dakota, South Dakota, Kansas, and large parts of Iowa and Illinois. The Sub-order Ustoll is said to be formed in semi-arid to sub-humid climates. Most of the Ustolls are located west of the Udolls. When driving from east to west across

Part 2: A Knowledge of Soils Can Help the Beekeeper to Choose Good Bee Locations

Michael Johnston





states such as North Dakota, South Dakota, Nebraska and Kansas, it is striking to notice the increase in irrigation equipment as you proceed west. Xerols are freely draining soils that formed in Mediterranean climates of the western states and are often used as irrigated cropland.

Alfiols

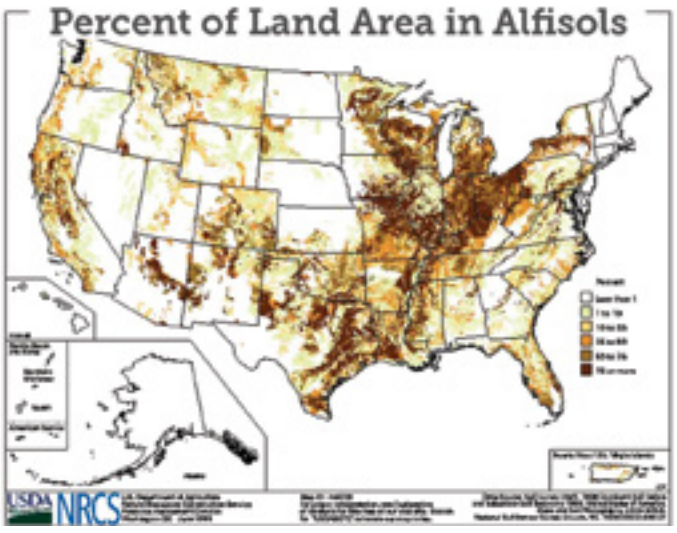
Alfisols occupy 14% of the ice-free land area of the United States and is another important soil order for beekeeping. I live close to the boundary between these high lime soils and the more acidic Inceptisols of the Appalachian highlands.

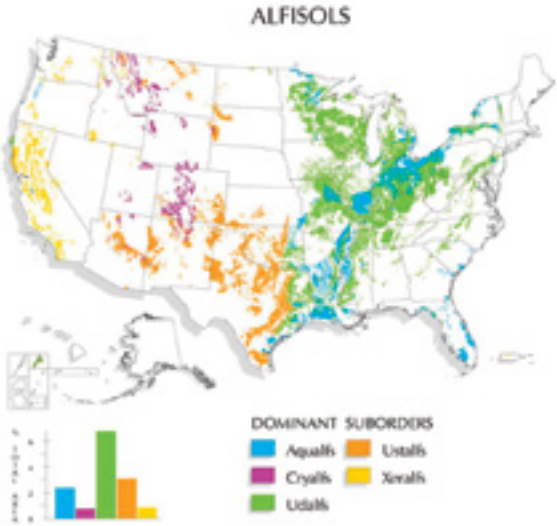
Alfisols get their name from the presence of aluminum (Al) and iron (Fe) in much of the clay particles of these soils. In North America, these soils most often formed under deciduous forest areas under temperate humid or subhumid conditions. Parent material is either glacial till or limestone bedrock with a high pH. Alfisols have relatively high fertility and are very productive. Calcium, Magnesium and Potassium are naturally, relatively abundant. These soils are not as fertile as the Mollisols but are more fertile than Ultisols. In *Honey Plants of North America,* John Lovell describes a white clover belt that includes Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota and Iowa. This clover belt would correspond with areas with the presence of Alfisols.

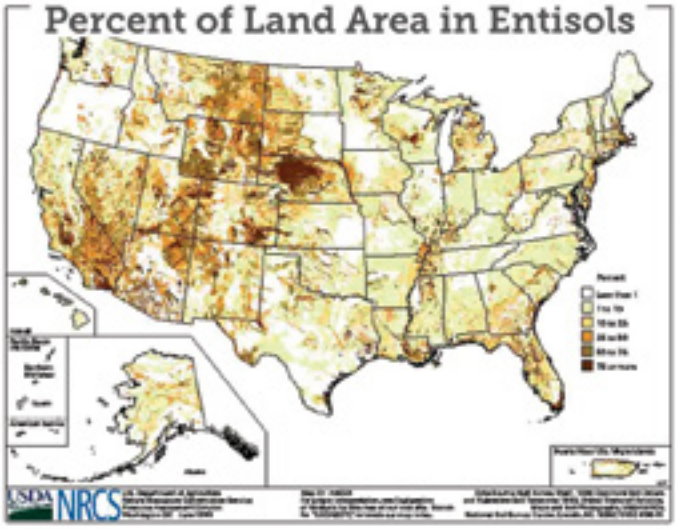
Udalfs are the most extensive suborder of the Alfisols and formed under forest conditions. Ustalfs have a more pronounced dry season and are found further west. Xeralfs are found in the far western states.

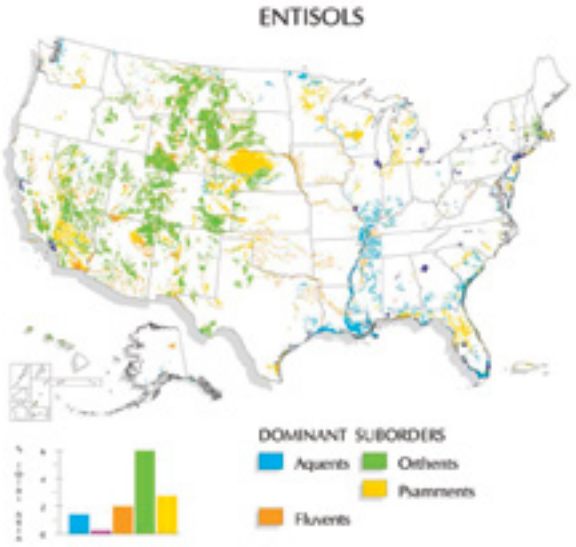
Entisols

Entisols occupy 12% of the ice-free land area of the United States. Entisols are a very widely distributed soil order on the planet. Their main distinguishing feature is a lack of a strong development of horizons in profile but they can be very diverse in other properties. Entisols are soils that have been eroded by wind or water from other areas and deposited in their present location. They can also be old soils where the parent materials were not exposed to soil forming factors. The great deserts of the world such as the Sahara are Entisols. Our river valley bottomlands are also









Entisols and can be very important to the beekeeper. Great bee locations can be found on the boundary between valley bottoms and uplands where bees can reach honey plants located on two different soil orders.

Inceptisols

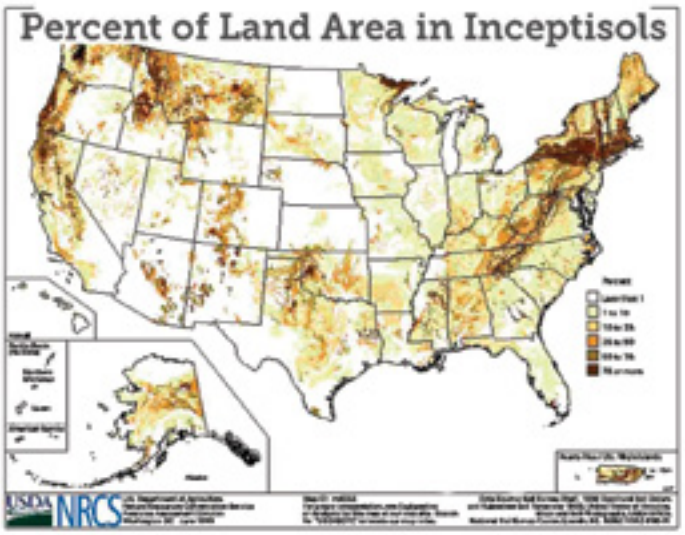
Inceptisols occupy 10% of the ice-free land area of the United States. Inceptisols get their name from the latin word inceptum meaning beginning. They are relatively young soils that do not show significant horizon development from leaching. They are common on resistant bedrock parent materials. This soil order seems to be a bit of a catch-all. They are not formed on volcanic ash but do on lava. They do not form in dry conditions or on permafrost and their clay particles do not shrink or swell depending upon moisture. A typical soil series of the Udept suborder would be Mardin. The pH can be strongly acid to slightly acid in the upper soil layers where plant roots are present. These soils typically have a fragipan (compaction layer) at a depth of 14 to 25 inches that will limit plant root growth and lead to temporary wetness in the Spring. A good honey flow can be expected from early Spring until early July starting with sugar maple, followed by black locust and ending with basswood. A dearth in mid-Summer is then experienced lasting from mid-July until mid-August. Good Fall crops are usually obtained from goldenrod and aster. The Xerepts suborder occurs in the far western United States and is found in areas with very dry Summers and wet Winters. Yellow star thistle is the best source of honey in the foothill surrounding the northern Sacramento Valley but rain is needed in May and June for this plant to produce.

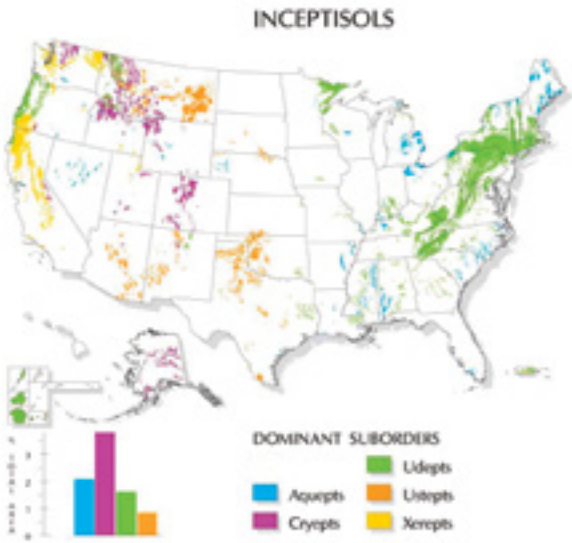
Ultisols

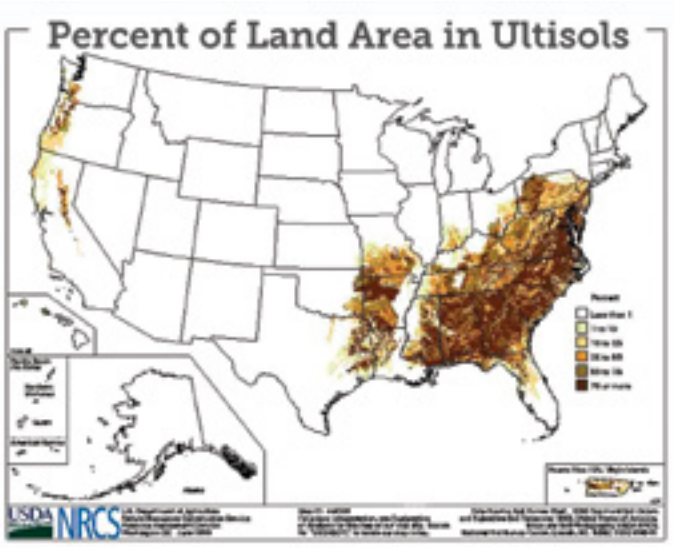
Ultisols occupy 9% of the ice-free land area of the United States. The Ultisols are acidic soils formed from weathered bedrock parent materials. They are located mainly in the southeastern United States. Because of leaching of nutrients, these soils are low in natural fertility. Aluminum and iron oxides remain and the iron is the cause of the color of the red clay in Georgia. They have a good capacity to retain nutrients because of their high clay content. Ultisols can be agriculturally productive with the addition of lime and fertilizers. Common honey plants would be tulip poplar and black locust in the uplands and gallberry and tupelo in the lowlands. Cotton, peanuts and soybeans would be agricultural crops yielding surplus honey.

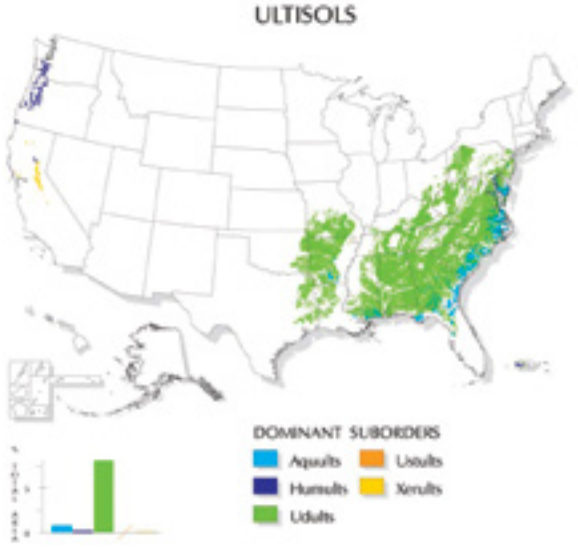
Aridisols

Aridisols occupy 8% of the ice-free land area of the United States. Aridisols are soils that have formed in dry climates. They differ from desert entisols in that they were formed in place from parent materials on site. The soils are typically low in organic matter and can accumulate salts due to a lack of leaching. USDA NASS lists 26.00 honey producing colonies in Arizona in 2021 with a









and rabbit brush (composite family).

36 pound yield of honey per colony. Beekeeping is concentrated in the lower elevations in the southern part of the state. In both Arizona and Texas, surplus honey can be obtained from irrigated crops such as alfalfa and cotton. Native plants such as mesquite (Legume family) and catsclaw (legume) can yield good honey crops. The range of mesquite extends beyond the aridisols and covers almost all of Texas, parts of New Mexico and half of Oklahoma. Some minor honey plants on aridisols can include prickly pear (Cactus family), yucca (aperagacea)

Spodosols

Spodosols occupy 4% of the ice-free land area of the United States. Spodosols are generally soils that formed under coniferous forests. They are acid soils and are considered to be naturally infertile. The Adirondack Mountains of New York are dominated by Spodosols. Bees there can get a decent honey flow from raspberry and possibly wild blueberry but little else. Spodosols are present in the higher elevations of Vermont and New Hampshire. Most of the beekeeping in those states occurs in areas with other soil orders.

Andisols

Andisols are the least widely distributed order; they comprise 1% of soils worldwide and 1.7% of soils in the United States. The presence of volcanic glass is a defining characteristic of these soils, found in the Cascade Mountains of California, Oregon, Washington and Idaho as well as the Aleutians in Alaska. It is the most common order in Hawaii. These young soils are typically fertile and have good water holding capacity

but also good drainage. In most places in North America, they support productive coniferous forests. Good honey crops can be obtained from fireweed in the Northwest and manzanita in northeast California.

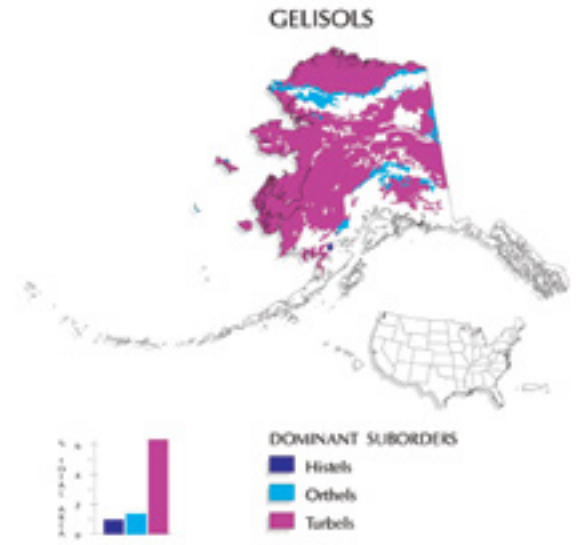
Vertisols

Vertisols occupy 2% of the ice-free land area of the United States. These are soils with clay particles that shrink and swell with changes in moisture. These soils form cracks that lead to mixing of the upper soil layers with the lower soil layers. They are common in Texas, the Upper Midwest and some other areas. Vertisols are slippery when wet and very hard and dense when dry. These soils can require a higher level of management but are actually very fertile. The pH can vary between neutral and alkaline as high as 7.9. Plants listed for East Texas that would do well in this relatively high pH are bluebonnets (Fabaceae), Texas betany (Lamiaceae), various clovers, mesquite (Fabaceae), Russian sage (Lamiaceae) and others.

Gellisols

Gellisols occupy 9% of the ice-free land area of the United States. To be considered a Gellisol, permafrost is present within two meters of the surface. Typically, the upper surface (O Horizon) will be organic matter and can vary in depth between one inch and 20 inches. Plant life is lichens, mosses, sedges, shrubs and spruce trees. The frozen mineral portion consists of sand, silt and gravel. The pH can vary between 3.5 and 7.5 depending upon the composition of the mineral portion. Gellisols are usually infertile since many nutrients are locked in the frozen mineral portion and dissolved nutrients are easily leached. Plants on these soils do have the benefit of long daylength. In his North of 60 Beekeeping project, Etienne Tardif has worked to identify the source of honey produced in the Yukon Territory. Nectar producing plants such as lingonberry (low bush cranberry), labrador tea and various willows do occur on permafrost soils but also grow on other soil types; it is difficult to gauge how much of a honey flow is coming from plants growing on Gellisols.

According to Alaska Fish and Game, 85% of the soils in Alaska are underlain by permafrost. With Alaska's area being 665,400 square miles, that leaves approximately 100,000 square miles to be occupied by the other six soil orders present in Alaska. Most of the beekeeping in Alaska is located in river valleys such as the Matanuska (Anchorage area), Tanana (Fairbanks) and Kuskokwim (Bethel) where Entisols and other soil orders predominate.



Histosols

Histosols occupy 2% of the ice-free land area of the United States. Located in much of the Great Lake states, along the mid-Atlantic coast and in the gulf coast states from Florida to Louisiana. Histosols have more than 50% organic matter in the surface horizons and are formed from decayed woody and herbaceous plant materials. They are often called muck soils. These soils are nearly level and form in low depressions on the landscape. These soils are often drained for agriculture using a combination of open ditches and drain tile. In an undrained condition, the water table will be near the surface during much of the year. The pH can vary anywhere between acidic and alkaline depending upon underlying mineral material. In Madison County, NY the depth of organic material on muck soils can vary between eight inches and 60 inches.

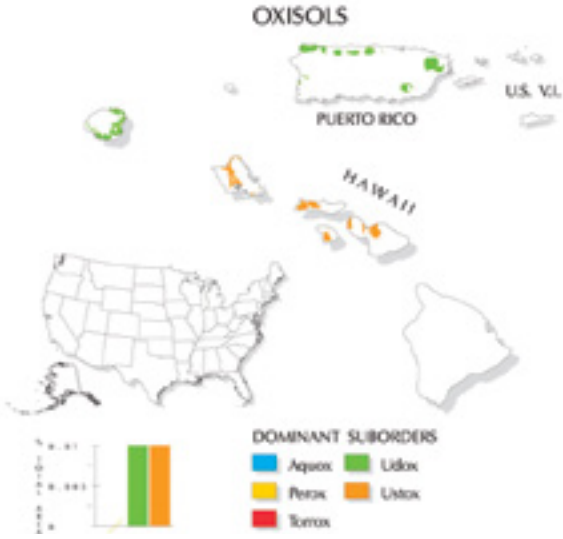
Oxisols

Oxisols occupy 0.02% of the ice-free land area of the United States. These are soils of tropical and subtropical regions. On a worldwide basis, Oxisils occupy 8% of the land area. They can be found in Hawaii, Puerto Rico and the U.S. Virgin Islands. There are very extensive areas of Oxisols in South America and Africa. Oxisols are older soils subject to weathering that has removed much of the clay particles. They are low in fertility, most nutri-

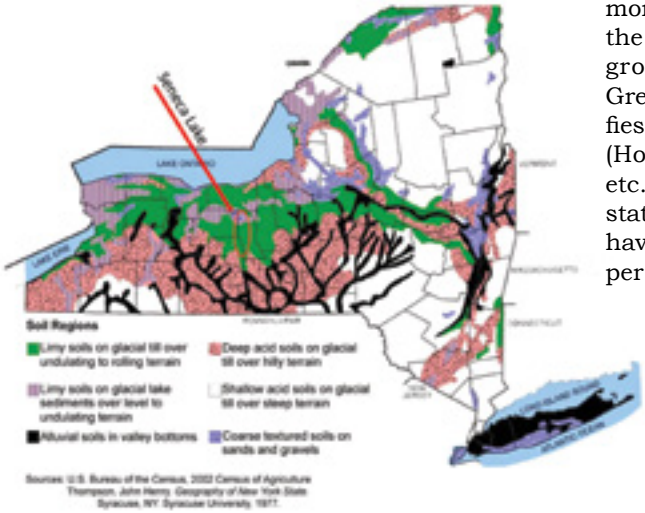
ents are tied up in standing vegetation. In Hawaii, Oxisols are not found on the more recently formed big island of Hawaii. Progressively larger amounts of Oxisols are found as the age of the islands increase.

These soils can be productive with the addition of lime and fertilizer because they do have some good physical characteristics. There are 10 soil orders in Hawaii; it can be expected that most honey production comes from the other soil orders.

By searching the internet, the beekeeper can obtain general soils maps of many, but not all, of the states in the U.S. Below are two generalized soils maps of New York State. The first map by the Bureau of the Census is much less detailed than the second map compiled by the USDA Soil Conservation Service (now Natural Resource Conservation Service). The Bureau of Census map is still very helpful in showing locations of the sweet soils of the Alfisols, the acid soils of the Inceptisols and the valleys of the Entisols. The soils of the Adirondacks, Catskills, Tug Hill Plateau and the Allegany area are put in one group described as shallow acid soils on glacial till.

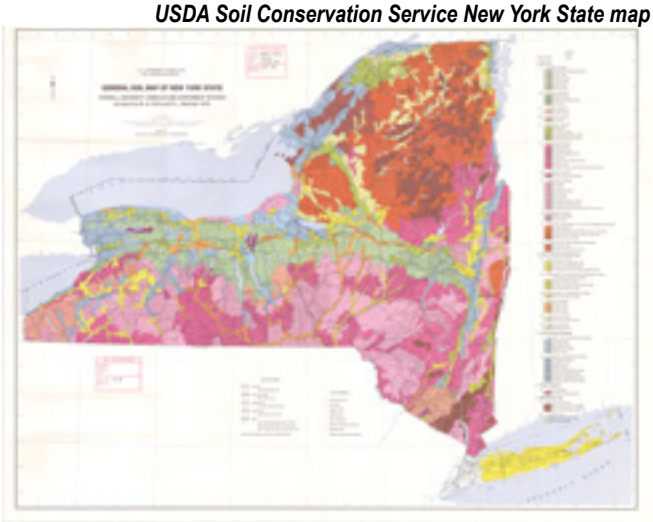


The General Soil Map of New York State by SCS is much more detailed and goes beyond the Suborder classification and groups soils together at the Great Group level. It also identifies the most common soil series (Honeoye, Mardin, Chenango, etc.) in locations throughout the state. Many County Soil Surveys have tables that identify yields per acre of crops and pasture by soil type. While the soil survey will not project honey production, fertile soils that produce good crops could also be good to the beekeeper.



Bureau of the Census New York State map

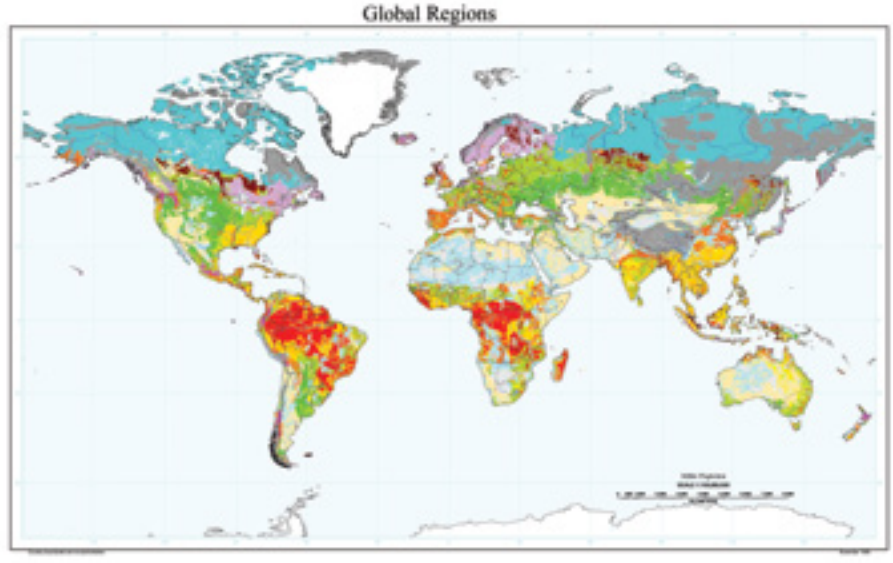
USDA Soil Conservation Service New York State map



By using a generalized world soils map combined with our now cursory knowledge of soil orders, it is possible to identify the location of good honey production areas in the temperate regions of the world. Areas with large amounts of Mollisols and Alfisols should be good honey producers. Countries such as Canada and Ukraine are located at higher latitudes and should benefit from longer daylengths. Other good honey producers would be Germany, parts of Russia, some former Soviet republics, China, Argentina, and some areas of Australia and India. Honey production from tropical and sub-tropical areas with Oxisol soils is deserving of a separate article.

I hope this article does not offend the many soil scientists who have done great work mapping the soils of our country and who know far more about soils than the author. Sections on soil orders are incomplete and could contain far more information. Separate articles could be written on each order or each individual U.S. state, Canadian province or foreign country. The bottom line is that soils are very important to honey production and a knowledge of soils can be very helpful to the beekeeper. Almost always when introducing this subject to fellow beekeepers, it comes as a revelation. When researching this article quite often contacts are not aware of the soils in their area. It behooves all of us to become more aware of the soils in our area and how these soils can affect honey production.

**Soil order maps are provided by USDA Natural Resource Conservation Service.* BC



Antibiotics, Disease Diagnosis

Kirk E. Anderson

Researchers in Tucson, Arizona, are developing an AI-powered application to simplify and automate honey bee brood disease diagnosis and promote effective disease management. Leading the charge is Dr. Duan Copeland, a postdoctoral researcher in Dr. Kirk E. Anderson's Lab, dedicated to diagnosing brood disease using only a smartphone photograph. "What can be challenging for even master beekeepers are the subtle visual cues produced by various disease-causing agents that target honey bee larvae, including bacteria, viruses and fungi" said Copeland. "We can train an AI program to recognize these differences in the same way an expert beekeeper or apiary inspector could."

Figure 1. Duan Copeland, Ph.D., inspecting hives in Tucson, AZ.

Connecting the dots

This brood disease research was sparked by Illinois State Apiary Inspector Jim Wellwood. In 2015, Jim came to visit the Tucson lab in conjunction with the annual apiary inspectors meeting. I was intrigued by our conversation, so I began a study of brood disease sampling throughout Illinois. Using these findings as preliminary data, the Anderson lab was awarded a large NIFA grant that included disease experts and co-PIs, Dr. Jay Evans and Dr. Meghan Milbrath, titled: *Using big data to improve diagnosis of larval disease in honey bees*. We began this project by high-throughput sequencing the bacterial microbiomes of third, fourth and fifth instar larvae to document disease progression across six diseased and one disease-free apiary. Simultaneously, we photographed the same larvae at high resolution (**https://www.nature.com/articles/s41598-023-28085-2**).

Of the apiaries we selected for deep sequencing, five of seven were experiencing EFB symptoms, one was asymptomatic and one had "melty" symptoms. Our approach sampling throughout larval development showed that EFB disease can manifest in a variety of ways. Similarly, recent results sequencing the genomes of EFB causative agent, *M. plutonius,* indicate that different bacterial strains have radically different personalities, and differ substantially in their ability to cause disease. The behavior of *M. plutonius* as a larval commensal, opportunist or pathogen is defined by a collection of virulence genes that allow it to exploit larvae. Additionally, there are genes in the *M. plutonius* genome that confer survival in the worker gut and hive environments, including royal jelly and honey.

Surprisingly, asymptomatic larval microbiomes frequently contained *M. plutonius,* including those sampled from asymptomatic apiaries and colonies. Some of this result came from the Tucson Lab Apiary where we rarely, if ever, experience EFB symptoms, yet a significant proportion (41%, 31 of 75) of the healthy larval microbiomes contained *M. plutonius*. Similarly, at one of the Illinois apiaries with no EFB symptoms, 75% (18 of 24) of

and Artificial Intelligence

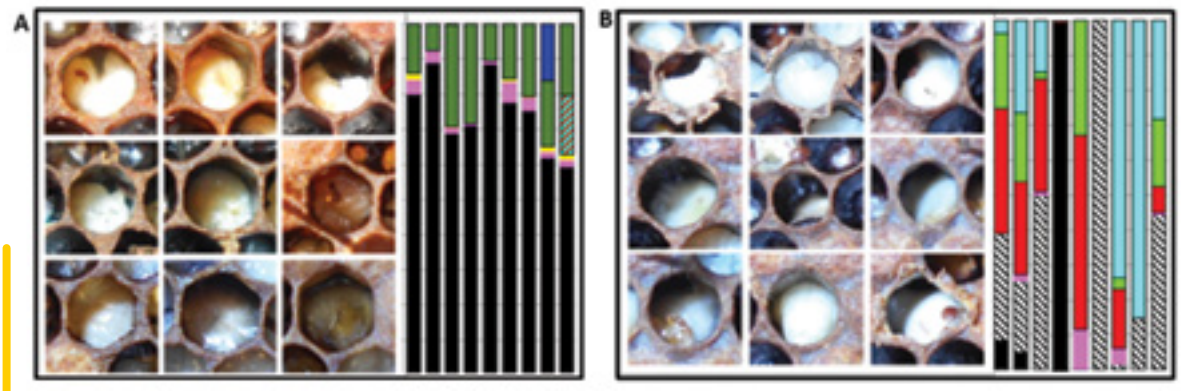


Figure 2. Images of larvae and their associated bacterial microbiomes (vertical bars) from two different apiaries with brood disease: A) Larvae infected with EFB (black) and secondary invader Fructobacillus fructosus (dark green). B) Larvae infected with Acute Bee Paralysis Virus (ABPV) and associated opportunistic bacteria that carry antibiotic resistance genes including Serratia marcescens (red) and Frischella perrara (diagonal striped). The beekeeper treated apiary "B" with antibiotics, but the treatment was ineffective.

asymptomatic larvae were positive for *M. plutonius*. The high-throughput method used to acquire this data is more sensitive than most tests and detects small amounts of bacteria providing a more complete picture of "who" is in there versus traditional culturing methods.

We discovered a variety of bacteria that occur as relatively harmless commensals in first through third instar larvae. As demonstrated for other species, these molecular patterns serve to "train" the immune system of developing larvae. We found that the progression of European Foulbrood (EFB) differed significantly by apiary due to secondary invaders and differences in beneficial bacteria. The discovered secondary invaders were very different from those identified with earlier culture-based methods with the single exception of *Enterococcus faecalis*, common to all EFB diseased apiaries. In fact, the presence and abundance of *E. faecalis* was positively associated with that of *M. plutonius* across multiple apiaries especially in asymptomatic larvae. This pattern of association is consistent with culture-based results and often indicates synergy among bacterial species. This pattern wasn't limited to *E. faecalis*. A number of bacteria that commonly occur throughout the honey bee social network revealed their opportunistic nature, increasing with EFB disease progression. These species were *Frischella perrara*, the bacterium that commonly forms a scab in the worker gut where the host waste products are excreted, *Apilactobacillus kunkeei* an extremophilic bacterium that specializes on honey, and *Fructobacillus fructosus*, a lesser honey specialist that also occurs in healthy larvae but is scarce in the adult gut.

At one of the apiaries, one colony showed symptoms of Varroosis (Parasitic mite syndrome: PMS, also known as Idiopathic Brood Disease Syndrome: IBDS). Digging a little deeper, we found that Acute Bee Paralysis Virus (ABPV) levels were extraordinarily high in the symptomatic larvae, and correlated absolutely with the "melty, deflated and sunken" symptomology recorded by the apiary inspector. Critically, all of these comprehensively defined disease states and larval stages were recorded with high-resolution digital imaging. After many weeks examining these photos and disease states, we hypothesized that larval symptoms alone could be leveraged to accurately diagnose disease.

While it is known that paralytic viruses can infect larvae, honey bee science lacks an understanding of the microbes that either cause or result from "EFB-like" brood disease, molten brood, melty larvae, Parasitic mite syndrome and Varroosis. As part of our recent NIFA grant, we have been funded to unravel this can of worms; the crud, snot brood, melty brood, and mysteries that surround EFB-like brood disease. Our approach first relied on verbal descriptors, which we quickly determined are overly subjective, and woefully inadequate for diagnosis. We instead opted for the "picture does not lie" approach. In other words, a picture is comprised of pixels of quantifiable brightness, color and hue, arranged to form emergent properties that the computer program (or your mind) has been trained to interpret as shapes, in this case larvae, healthy or diseased.

Traditional methods used to diagnose brood disease in the field require years of expertise. Like the rest of us novice beekeepers, perhaps it required a few seasons of dedicated beekeeping to form a reliable picture of the major honey bee brood diseases; conditions like chalkbrood, sacbrood, AFB, EFB, and EFB-like. Misdiagnosis is common, and prompts the unnecessary use of antibiotics, which disrupts the balance of the honey bee's native microbiome. In turn, this disruption promotes the emergence of antibiotic-resistant strains of bacteria, further complicating disease management. In the case of the ABPV apiary (Fig. 2), the beekeeper assumed EFB disease and applied antibiotics. As illuminated by our metagenomic analysis, the antibiotics depleted the larval microbiome of beneficial bacteria and likely contributed to ABPV disease progression by removing the native barrier to opportunistic disease.

The future with AI

By leveraging the power of AI, the team aims to minimize the risk of misdiagnosis, reduce the reliance on antibiotics and ultimately contribute to more effective

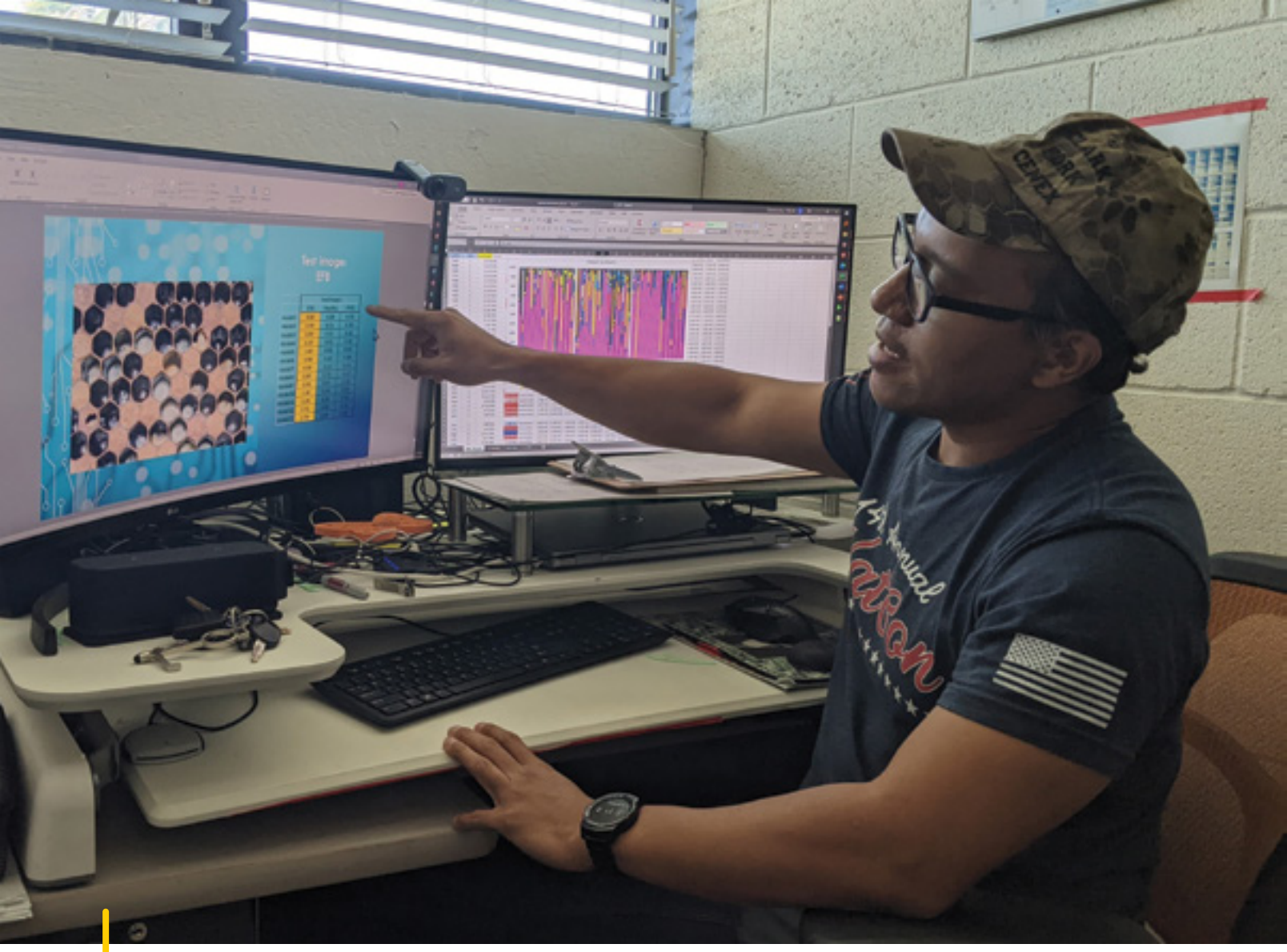


Figure 3. Duan Copeland evaluating the efficiency of prototype AI models.

disease management practices for honey bees. Artificial Intelligence has already demonstrated success in honey bee research. Examples of image-based AI include identifying subspecies by wing patterns, detecting parasitic mites, tracking pollen foraging behavior and identification of comb resources.

"Even a novice could look at diseased larvae and tell you some physical characteristics about it… this one looks yellow, this one is brown, this one's melty," he says. "An AI program can pick up on these same patterns, but it's crucial we have the correct diagnosis and labeling to facilitate the AI training process." Anderson's team is collaborating with the Bee Disease Diagnostic Service in Beltsville, Maryland and apiary inspectors around the U.S. to expand their AI image training dataset by including a wider variety of AFB, EFB, viral and fungal disease. This partnership has broadened our collection of digital images and diverse brood disease phenotypes. In addition, diseased brood samples undergo molecular diagnostic screening and microbiome analysis in Anderson's lab to ensure the correct diagnosis. By incorporating a more comprehensive range of disease symptoms, the researchers aim to continually update and improve the AI application's diagnostic capabilities as a honey bee health management tool. "The honey bee pathosphere is constantly evolving, so we want to keep our AI database up to date with what is being seen out there," Copeland says.

AI in the palm of your hands

The culmination of this research will be the development of a digital product, the Big Data Brood Disease (BDBD) app. This technology will assist the broader beekeeping community by substantially increasing the probability of an accurate diagnosis when the symptoms are unclear, or when a beekeeper has little experience and has not yet formed a reliable picture of various larval disease states. Following the recent big boom in hobbyist and beginner beekeepers across the nation, our tool will significantly reduce the development of antibiotic resistance in both pathogenic, opportunistic and beneficial bacteria. The early and rapid identification of disease outbreaks will facilitate the decision to apply antibiotics or alternative approved treatments. As a result, the BDBD app will contribute significantly to healthier bee populations and more sustainable beekeeping practices. If you are dealing with larval disease outbreaks, and would like to contribute to this project, please contact the Anderson lab NIFA project manager Brendon Mott: **Brendon.Mott@usda.gov.**

Honey Bees vs. Native Bees

Alyssum Flowers

Instead of writing about a pollinator plant, I want to address the weary accusation that somehow honey bees outcompete native bees and "don't belong here" or "we can do just fine without honey bees." Lately this controversy has gained steam despite countless research articles showing that honey bees and native bees have been getting along just fine for centuries, thank you. Truthfully, these pollinators supplement each other on our behalf. A study by Greenleaf and Kremen observed that interactions between wild bees and honey bees doubled pollination rates and enhanced the prevalence of hybrid sunflowers by five-fold.

Honey bees have been in the United States since at least 1622, but most likely since the 1500's when Spaniards established St. Augustine, Florida – USA's oldest city – to obtain beeswax for their candles. Recent research discovered a fossil of the honey bees' relative *Apis neararctica spp.*, in Stewart Valley, Nevada that dated back to the Miocene Era. So, the honey bees have been getting along with native bees for centuries!

So, what has changed? Mankind, or not-so-kind. As areas are bulldozed and stripped of woods, fields, wetlands and streams, the insects, birds and other wildlife lose places to nest, find food and shelter and exist. Pristine lawns and tidy shrubs do not provide habitat for most pollinators, let alone other wildlife. 50 million acres of perfect suburban lawns in the U.S. doesn't help. An environmental 'black hole'.

Honey bees are generalists with short tongues, meaning that they prefer flowers with shallow centers so that they can access the pollen and nectar easily. They like the flowers of many trees, shrubs, perennials, bulbs and annuals, including some non-native "weeds" like Japanese honeysuckle, Autumn olive and spotted knapweed. Generally, they are active on sunny days when the temperature is over 60°F, and back in the colony by evening to cool or warm the colony.

Native bees have specific preferences for plant species, for instance leafcutter bees pollinate alfalfa, canola, cranberries, onions, peas, blueberries and various other vegetables and melons. Bumble bees visit larkspur, iris, columbine, as well as tomatoes, peppers, blueberries, cranberries, broad beans and other "long throated" flowers. Several species of bumble bees are used in greenhouses, but they are expensive to order and maintain the many colonies that are needed inside these closed CEA's (Controlled Environment Agriculture). Many native bees have long tongues and visit specific wildflowers.

The squash bee is specifically designed to pollinate squash flowers but requires soft soil at the edge of the field in which to dig five to eight inch deep tunnels in which to deposit pollen and lay eggs. Although efficient at pollinating many cucurbit flowers, they only fly a quarter of a mile from their soil tunnels. If the edges of the field are treated with herbicide, plowed or mowed, the squash bees will not survive.

Mason bees are Spring time pollinators. They emerge from tubes or stems in early Spring and are mostly finished by early June. They only fly 100-300 yards from their nests. Leafcutter bees cut those curious perfectly round circles in redbud and rose leaves which they use to fold into cups to place eggs and pollen bundles into stems, holes in wood or the ground. They are active in mid-Summer (70°F) and pollinate flowers within 100 yards of their nest. Obviously, none of these bees can cover the tens of thousands of acres of orchards, fruit, vegetable and soybean fields in the United States alone.

Other pollinators such as syrphid flies, moths and beetles are far less efficient because their bodies are not hairy nor do the bodies have much contact with the pollen or stigmas. In fact, the USDA showed that the pollination services of non-*Apis* pollinators were valued at USD $3.44 billion, while honey bees contributed approximately $15 billion in the USA. Honey bees are responsible for pollinating over 80% of all flowering plants and 130 types of fruits and vegetables in the U.S. alone.

Perhaps the most obvious point to the argument is that honey bees are by far the most efficient pollinator that can withstand regular management and long-distance trucking. What other insect can you pick up its nest, put it on a semi truck, drive it bouncing along for hundreds and hundreds of miles, unload it and have it still be alive, readjust to the new environment and go out and search for pollinator dependent flowers?

Honey bees pollinate $20 billion worth of crops in the United States each year, including more than 130 types of fruits, nuts and vegetables. This of course, is in addition to the $3.2 million's worth of honey produced in 2017 (USDA-National Agricultural Statistics Service (NASS)), beeswax, royal jelly, pollen and propolis that is harvested. Honey bees possess "flower fidelity" in that they will visit 50-100 apple blossoms, onion or carrot flowers or clover flowers in one trip instead of going to an apple flower then a clover then a mustard bloom, therefore the flowers visited by honey bees benefit by receiving only pollen from its cultivar or species, receiving maximum pollination. They can be placed in orchards or fields as needed to supply pollination for the entire

https://www.almonds.com/why-almonds/almond-living-magazine/without-honey-bees-there-would-be-no-almonds

field, then moved to meet the demands of another crop. Beehives are often important elements of urban gardens due to the pollination services they provide for backyard and community gardens, wildflowers and parks. Thanks to honey bees, birds, insects and many animals thrive on the fruits produced from the work of the honey bees.

Currently, 330 million people live in the United States with an estimated count of 400 million by 2050. Since 2000, the total area of farmland in U.S. has decreased annually. In that period, the total farmland area has decreased by almost 50 million acres, reaching a total of 893.4 million acres as of 2022. For the first time, the United States has imported more food than it has exported, meaning that we are depending upon other countries for food. In the monoculture system common in the U.S. and other advanced countries, honey bees are crucial to provide the pollination needed to feed animals and people. A study by Ritchie showed that crops are not pollinated sufficiently and that populations in many countries (including the U.S.), are undernourished due to insufficient pollination. Instead of arguing about honey bees or native bees, we should be concentrating on finding ways to keep farmland in production and provide more habitat for *all* pollinators. BC

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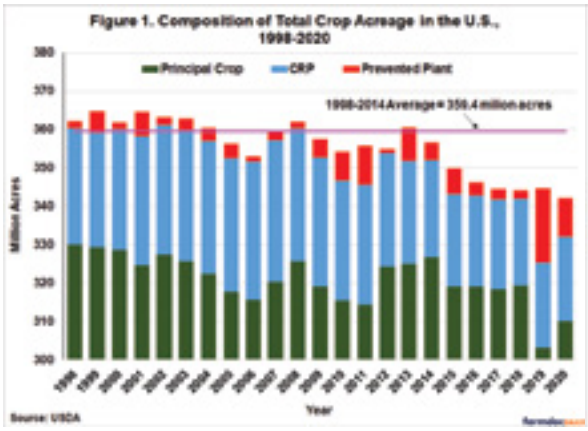

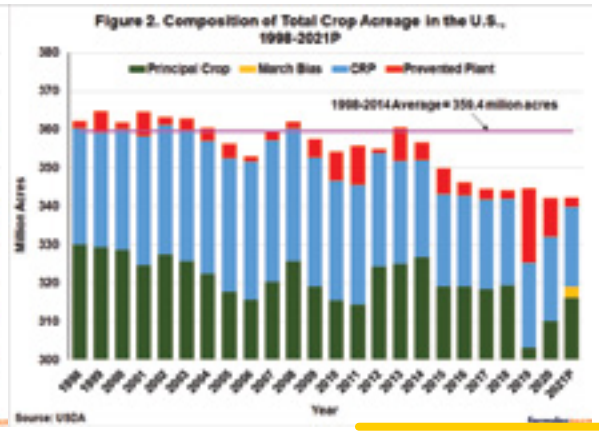

Prevented planting is a failure to plant an insured crop with the proper equipment by the final planting date designated in the insurance policy's Special Provisions or during the late planting period, if applicable. https://farmdocdaily.illinois.edu/2021/06/estimating-total-crop-acres-in-the-us.html

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Clarence H. Collison

KEEPING BEEYARDS ON TRAILERS

"Mobile Beeyards"

Figure 1. Jeff Ott, Beekeeper, Podcaster and conversationalist.

Trailering Bees

I recently chatted with Jeff Ott, an experienced beekeeper about trailering bees[1]. I recorded the conversation and transcribed it for you.

Jim: I must have five trailers right now, and before anybody says, "*Oh, my stars!*" you should know that they're all small. I've got anywhere from really small trailers that go behind my small tractors all the way up to two bigger trailers that I can tow behind my truck.

At one time or another I have had bee colonies on every one of those trailers. It's been my experience, as an older beekeeper, that I want wheels or rollers on everything in my bee life.

When moving hives for pollination, even as a younger man, I was eager to use trailers. Is there any way that I can use a trailer and not have to take these colonies off this truck, set them down, go back eight to 10 days later, and do the whole thing over again? It's a vast amount of work to load and unload hives.

Figure 3. A hybrid-looking system using a front-end loader to set hives from the truck onto a farm wagon for distribution around the planting.

An immediate question for the grower is, *"Can I just put these hives on a trailer and then unhook it and be gone?"* Many times, the growers would stand their ground and require me to set colonies throughout the orchard. That was a lot more work and it is easier to lose a colony in tall grass.

Jeff: The big guys, have their front-end loaders and pallets and they're all set to do this kind of in-and-out type of beekeeping and pollination or whatever you're doing. All the while, moving from one location to another while following the bloom, so to speak. Smaller beekeeping operations can't afford the front-end loaders or skid loaders, and the trailer becomes a viable option. There's a lot to consider when you're looking at a trailer for hauling bees.

Jim: Right off the bat. You almost said it, I was waiting for it – right off the bat, *"Why would I use a trailer of any size?"* My immediate response is because they are generally much lower to the ground than my pickup or a larger truck. I don't have to pick the colony up or lift the colony as high off the ground.

Yes, I can use ramps on the tailgate of the truck, but do you want someone to make pictures of you when you're trying to pull that beehive up those ramps – backwards – into the truck? That foot and a half or so height difference really matters. If you got the right trailer, it may actually have loading ramps that are built on the back of it.

Jeff: Yes.

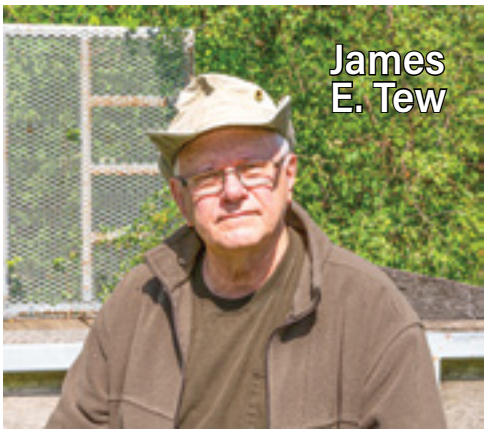
Jim: I find it much easier to load a trailer with bees than I do to get them up in my truck or, in the old days, on a flatbed truck, and then get them back off.

Jeff: No, it only takes once or twice of trying to load a heavy beehive into a back of a pickup truck before you realize this won't work as a regular event. It's good for once or twice when moving a beeyard. If you're doing on a regular basis, the trailer really comes in handy and the lower to the ground – within limits – the better.

Listen along here!

[1]Edited comments taken from "Bee Trailers – The Portable Bee Hive" podcast, Honey Bee Obscura, May 18, 2023. Podcast #126. https://www.honeybeeobscura.com/bee-trailers-the-portable-bee-hive-126/

Figure 2. A commercial beekeepers' trailered hives for pollinating cucumbers.



You have to take into consideration where your beeyards are located. If you're doing pollination contracts or following the bloom, then you have to consider ground clearances. That becomes a whole different factor in trying to decide what trailer you want.

Jim: If you're going to unhitch the trailer and then back it up again, yes, the beekeeper wants to know if the yard is level. Is the yard solid? In a perfect bee world, the sky is always blue, birds are always singing, and bees are always happy, but the common reality is that it's 2:30 in the morning, the dew has fallen, the truck's slipping on the grass, and you can't see the hitch. You've got no one to help you because you've got no friends, Jeff. You've already been through all of them years ago. The devil is in the details.

Jeff: The only friends you have at that time is mosquitoes. They're all over you.

Jim: [laughs] They're not friends. They're just there at the same time. I do want to put this in our discussion right now. If you haven't done it, you are probably going to do it.

Here's the situation. If you've got a smallish, single axle trailer, you listened to a podcast or you read an article somewhere, and you bought a trailer. Now it's time to return and hitch it back to the truck. When that trailer is not hitched to the truck and the hives are not situated right over the axle, or even better, nearer the front of the trailer, the tongue will fly up in the air because you suddenly put your body weight on the back of the trailer. The axle, serving as a fulcrum, with the hives in the center, will tilt up. Suddenly, you've abruptly got your bees unloaded. They'll come sliding down that trailer towards you. So, hitch the trailer to the truck first. Then work with the colonies. All those years ago, that brings me to the very next point, if possible, that the towing vehicle should be a four-wheel drive vehicle.

Jeff: Your towing vehicle?

Jim: Yes, your towing vehicle should be four-wheel drive. Like I said, the world's not always perfect. Sometimes it's rainy and muddy. You've mentioned pollination work. In fact, I've moved hives most of the time ***not*** for pollination work, but for management reasons.

For instance, I had a couple of hives that wouldn't stop stinging the whole neighborhood. The move was not a huge one. This was just a move of two colonies. I'm really going to have trouble finding someone to help me move them. I still used the trailer because I've got bees that are stinging everyone in sight requiring me to work alone.

So, I still used the trailer – massive overkill – just removing those two genetically angry colonies to a location 40 miles away. The funny part of this story is that a bear found those two colonies. Eastern Ohio beekeepers had not had a bear-sighting in about 100 years. I almost got my name in the local newspaper. The bear destroyed those two colonies. I wrote about this in an earlier article.

Now, you've got a four-wheel drive truck and just a single axle trailer, maybe 12 to 14 feet long, and you're going to take it to a beeyard. That yard must be able to take that kind of rig turning around, backing up, getting out. A lot of beeyards will not work well for trailering your bees just because you're going to have to do some sophisticated driving and backing if the yard is too small.

Figure 4. A heavy duty trailer with brakes and a pentel hitch on two axles.

Jeff: It needs to be able to handle it with a loaded trailer. A lot of times an unloaded trailer sits differently than a loaded trailer. You can get in there but you can't get out or you get it loaded up, but you can't get backed up. You need to put these characteristics in consideration.

When I had horses, I always used a gooseneck trailer. I love gooseneck trailers. Regarding trailers for bees, do you prefer a gooseneck trailer or a bumper hitch? Secondly, how many axles should the trailer have? One or two? Two axles is a lot more stable and you don't have that fly-up of the hitch that you have a concern with a single axle. What's your experience on that?

Jim: I have some guesses, some opinions, and some experience.

Jeff: Sure.

Jim: The two-axle trailer is probably going to have brakes on it, so that really helps. Even a loaded single axle trailer, medium size, 16 feet long with 15, 20, 30 colonies of bees on it, it's going to really push the truck. You, the driver, must realize that the stopping distance is going to be greatly increased to stop the truck. Double-axle trailers usually have brakes – surge brakes on the tongue – or something like that.

Secondly, those larger trailers are also heavier making it a different concept. More pressure on you the driver and more gas consumption. They are more stable, but there's a limit on what weight you can put on the bumper hitch.

I pulled a trailer, loaded with good junk, all the way from South Alabama to Northeast Ohio. I didn't notice until I was backing down my home driveway that my bumper had twisted downward on the truck making my bumper position at about a 35-degree angle. The bolts that held the bumper to the truck frame had slipped.

I was home, but I still had a fearful moment there. What if the bumper had come off? It's a bumper hitch, so the trailer could have come loose from the truck.

Now, having gotten to this point, I have not routinely used a gooseneck. I'm going to have to depend on you. We've used horse trailers and made them work for moving the equipment primarily, but I never used a goose-

neck trailer of any kind for moving hives. It was always a bumper hitch or a heavy-duty pentel hitch. You tell me what was involved when hooking up that gooseneck to the truck. You said it was more stable, easier to back. How difficult was it to attach a gooseneck trailer to the truck?

Jeff: It's a much more stable ride in the wind. That trailer attached as a gooseneck is a much more secure trailer. Backing was a lot easier. It's more natural, more intuitive, when backing. Even lining up the hitch and hooking it up was easier because, in most cases, you could see it up to the final second to the hitch the trailer in the middle of the truck bed. I understand some of the new trucks now even have a camera looking at the center of the bed of the truck. Even lining it up with a camera is just like many cars now with a backup assist. The downside is that these trailers are more expensive.

Jim: Jeff, I've got a question that I guess I'll check out after we finish this conversation, but right now, can you tell me, what's the different between a trailer and a wagon?

Jeff: When you say wagon, the only thing I can think of is it says *Radio Flyer* stamped on the side, or it's being towed behind a tractor loaded full of hay.

Jim: That's exactly where I was going. Years ago, I thought I had a bright idea. I took some of the university hay wagons – they're just very utilitarian devices – and put pollination hives on them. I nailed the pallets and the bottom boards to the deck of the trailer and then put the colony components on the nailed bottom boards. It really made a secure ride. These hives ***are staying*** on that trailer. All I had to do was keep the outer covers on.

What's fundamentally wrong with this? Answer? By the time I got where I was going, I had a load of the angriest, most upset bees you've ever seen, and I realized on the trip that you can only go about 20 miles per hour. A hay wagon has no suspension system on it. It's a slow wagon with a rough ride.

I'm hypothesizing that the difference between a trailer and a wagon is the suspension system, or the lack of it. If anybody has any interest in using a hay wagon, you're going to have to go at 15-20 miles per hour. If you go much faster, you're going to be bouncing bees all over the community because there's not enough weight to settle the trailer out – even if you run the tire's half slack. That hay wagon idea blew up on me. I was not able to use those simple farm wagons as a bee-moving device on the highway. They work fine within the orchard.

Jeff: Interesting.

Jim: When you mentioned the horse wagon a bit ago, the horse trailer, you wandered into a different arena. Those are enclosed trailers. Cargo doors close them up. I had a shock years ago using a cargo truck (not a trailer) with fold-down doors. I want to tell you it's really easy, even when the temperature outside was in the 20's, to overheat that load of bees in an enclosed container.

You're bouncing them, you're jostling them, they're upset, they're confined. They'll begin to get worked up and generate heat. It was shocking to have those colonies overheat when the outside temperature was so cold. Now, as I said, that was not a trailer, but an enclosed box truck. Though it'd be the same situation with an enclosed trailer.

Figure 5. Pollination hives on a hay wagon. This was not a suitable trailer for the open road.

My situation was laughable. I had to stop at one of those all-night food stores and buy all the ice they had. While it was frigid outside, I had to put ice on those colonies to calm them down. If you use an enclosed trailer, even on a cold day, you can still overheat the colonies and suffocate them because of the jostling effect that they're going through with all of that.

Jeff: Not to go off on this tangent but that story reminds me of the time I was in Georgia, and I did a couple of articles on Wilbanks Apiaries. I was doing an article for *Bee Culture*, and I was talking to the owner. He showed me around his queen-rearing facility. Of course, he does a lot of packages and he had specially designed trailers for moving packages of bees. They were temperature controlled. He can control the temperature inside that enclosed trailer for his bees, which was an interesting concept, but addresses the concern or issues that you faced.

Jim: The reason I'm on this tangent is because of the same thing. A fellow beekeeper here, who contract-hauls packages every Spring, has an environmentally controlled trailer with doors, fans, vents and thermocouples, because he basically says the load is critical. You can insure the trailer, and you can insure the truck, and carry medical insurance – but you can't insure the live bees. If you overheat those bee packages, that's a disaster. In his enclosed trailer he's towing, he knows exactly what's happening, temperature-wise, from the cab of his truck.

Jeff: That's smart. Speaking of enclosed trailers, one of the things that I think you've seen, and all beekeepers have seen these days, some people and especially in Europe, they are using trailers and AZ-type hives to move bees around.

Jim: Isn't that interesting. I've only seen pictures of that.

Jeff: I look at that and what I know of AZ hives, I think, boy, that would be really a great way of doing things. I still to this day like the idea of putting beehives on a trailer to make my life easier as a beekeeper,

a better beekeeper, and the AZ hives could be a good way to go. Putting all of that into a trailer would be fantastic.

Jim: I want to go a little bit deeper down this rabbit hole that you've started. [laughter] About sixty years ago, a USDA researcher designed a trailer that allowed the platform bed to be jacked up and taken off the mobile trailer frame. You put four legs down on each corner of the platform, jack the platform up, and raised the platform, with the hives, off the mobile frame of the trailer. Then pull that frame out from under the platform and off you go. You took this strange looking, partial trailer-frame behind you leaving the platform and the hives at the cucumber field.

Jeff: That's like the container trailers that we see in the Pacific Northwest all the time. I'm sure they're everywhere. You see those without the container on them. It's just a frame with wheels.

Jim: Yes.

Jeff: I like that idea.

Jim: Let me tell you where it went. Let me tell you [laughter] why the researcher said you don't see such bee trailers. When you're going back to get your platform and its night and the truck's slipping, everything must be lined up exactly straight. If the mobile frame strikes either one of those back legs, the platform dumps the colonies off the bed.

Jeff: Oh my gosh!

Jim: This very event happened and about 40 colonies either shifted or fell from the trailer deck. He had some pictures of that 40-colony load of bees on that platform, tilted to one side where he accidentally struck one of the back legs. He decided the risk was too great. The idea died.

Now there's a *Chapter Two* to this saga. Years ago, I gave this same description to a beekeeping audience. To me, the audience is all beekeepers, but in reality, they're candlestick makers, soldiers, and sometimes even airline pilots. My point is that they are a blend of people with a myriad of talents. I didn't know I was talking to two professional welders. From my lecture description, they made that very trailer design, but on a much smaller scale. They took the rear wheel hubs from an ancient Oldsmobile Toronado. That was one of the first front-wheel drive cars.

You would lower pipe legs on the corners of the trailer bed and raise the deck off the frame. There's ways to do that, but I won't go into it. Then, with the deck picked up, the wheels are off the ground. You pull out a pin, pull the wheel hubs off, put those in the back of the truck. The tongue was also detachable. You put that in the truck, too. Then in theory, you took the two wheels and the tongue back to the home apiary where you had what? Other platforms. Then you hauled eight different colonies somewhere else. This design was for a small bee operation. That's why I told you a bit ago that I thought the difference between a trailer and a wagon was suspension.

The idea didn't go anywhere. Not because you knocked out the back legs, but because the ride was so rough that we're now back to 15 miles an hour again without a suspension system on the trailer. You just about can't use it to move bees because it's so rough on the colonies. This idea, this beautiful, professionally made piece of equipment – one of a kind – never developed. It was just another idea for people exploring what beekeepers could do with trailers to keep from having to unload and reload bee hives.

Jeff: Considering the amount of brain power that's been put into that over the years by various beekeepers, I'm surprised there's no easy, readily made solution these days.

Jim: I want to finish on this note. If you have a big truck towing a large trailer and you're on a narrow country road getting to a beeyard, you better be crystal clear that that truck will make the turn through the gate that you've got to go through to get to where you're going to drop those hives. Because one night, long ago, there was no way – the geometry was all wrong – that I could get my big truck to turn with that long trailer behind it to get through a narrow farmgate.

We had to unhitch the trailer in the road, unload the truck in the out-yard, bring the empty truck back, take the hives off the trailer, load them on the truck, then take the truck to the drop-off site and unload it again. A lot of good it did to have a trailer behind the truck that night. [laughter]

I love trailers. If you don't have a trailer behind you when you're moving bees, you're just not doing your job correctly. Of course, I am kidding. There are quirks to trailering. All trailers have them.

Figure 6. A custom trailer, with a detachable deck, designed to haul eight hives.

Figure 7. Platform unloaded from the trailer frame.

Jeff: I think it comes down to understanding your use of that trailer and your beeyards. Not only can you use that trailer in your beeyard or your multiple beeyards in nice sunny weather, but can you use that trailer in that beeyard on the worst possible days in the dark?

Jim: And do it all by yourself?

Jeff: Yes, by yourself. It's just that not every yard is on a flat surface. It's not always going to be on a flat asphalt surface. It's going to be on an angle, it's going to be wet, it's going to be in the mud and the bees are not going to be happy. We haven't even talked about how do you secure the beehives to the trailer?

Jim: That is a totally different subject. Ratchet straps, hammers, staples. Do not think that the propolis seal will hold that equipment together. Don't think that the colony will stay together because it's stuck together with propolis. I have tried that. You've got to strap them, but now we're off the subject. I like trailers, I want to use them for everything. If you use them, they're going to come with some quirks and caveats, but overall, they give you a broader aspect of beekeeping.

Jeff, I enjoyed chatting with you. Thanks for educating me. BC

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Book Review
Honey Bee Biology

Mark Winston

Books about honey bees gravitate towards two poles: practical guides to beekeeping, and works on biology. While beekeeping books are of interest primarily to beekeepers or beekeeping wannabees, books focused on biology are of wider interest, for the simple reason that honey bees are fascinating.

Writing about bees goes back thousands of years, showing a gradual transition from observations, some accurate and some not, to synthetic works that draw from the immense and still-expanding scientific scrutiny that has focused on every aspect of honey bee biology. The earliest commonly cited work, Aristotle's *Generation of Animals*, from about 2300 years ago, proposed that bees are divine, and mistakes the queen for a king. He correctly noted that bees collect honey from the "juice of flowers," and recognized a second food, "bee bread," carried home from the field on their legs, that has a "sweet, figlike taste." He also recorded the first observations of chemical communication, writing that "if a young swarm goes astray, it will turn back upon its route and by the aid of scent seek out its leader."

Charles Butler's *The Feminine Monarchie* (1609) is widely cited as the first scientific treatise on honey bees. Butler understood that the monarch was a queen, and provided some practical advice about beekeeping. Still, the full title indicates that it was still a fair bit away from the hard-science tone of more recent books: *The Historie of Bees Shewing Their Admirable Nature, and Properties, Their Generation, and Colonies, Their Gouernment, Loyaltie, Art, Industrie, Enemies, Warres, Magnamimitie, &c. Together with the Right Ordering of Them from Time to Time: and the Sweet Profit Arising Thereof.*

Maeterlinck's *The Life of the Bee* (1901) provided a further transition from natural history and observation to more rigorous science, albeit tinged with a heavy dose of philosophy. He introduced experimentation into the bee biology canon, letting a forager find a dish of sugar syrup and preventing her from leaving after she re-entered her nest. Yet, other bees quickly went to the feeder, suggesting the returning forager was passing on information to nest mates. He also wrote eloquently and more spiritually about the "spirit of the hive... the incomprehensible organization of the most insignificant act of life."

In 1953, British scientist Ronald Ribbands published the first modern synthesis that relied primarily on scientific studies, *The Behavior and Social Life of Honeybees*. His book not only summarized what was known at the time, relying heavily on scientific papers, but was written in clear prose easily understood by beekeepers and a broad public audience. Tragically, he was struck by a car while helping

another driver change a flat tire in the early 1960's, and never had a chance to revise his book with the many studies of the 1950's and beyond that dramatically expanded our understanding of honey bee biology.

I took up the mantle in the 1980's, inspired by Ribbands, with my first book *The Biology of the Honey Bee* (1987). I wrote with beekeepers in mind, wanting a book that was comprehensive and based in scientific studies, but also readable. I'll leave it to readers whether I was successful, but as the years went on, one thing was increasingly clear: the book was rapidly going out of date, and required a substantial overhaul in a new edition.

I never did revise my book, because I got involved in other projects, and the work to update was daunting due to the proliferation of honey bee research since 1987. But most significantly I felt that a younger, more contemporary voice was required. My time was the era of behavioral ecology, studying bee behavior in the context of interactions within the hive and with the external world. Today's bee research has taken a much deeper dive into genetics, molecular biology, neurobiology and biochemistry, not only as separate disciplines but also integrating the approaches of these disparate fields.

A new book summarizing what we know about honey bees has been sorely needed for at least a decade or two, and fortunately one has just been published, by author Brian Johnson, a professor at the University of California, Davis. It's a pleasure to report that *Honey Bee Biology* (2023, Princeton University Press) is a most worthy addition to the procession of books about honey bees stretching back well over 2,000 years.

Writing a book about honey bee biology today is difficult terrain to navigate, due to the increasingly technical nature of research, and the sheer volume of studies. Johnson does an admirable job of steering between the detail and precision expected from complex science, and writing for a public audience, producing a book that is both comprehensive and readable. "Comprehensive" is an understatement; there are 123 pages of references at the end, with about 2,100 cited publications. For comparison, my book *The Biology of the Honey Bee* had around 800 references, which covered most of what was known then. The considerably higher number Johnson referenced is indicative of just how much honey bee research has expanded, as well as his commitment to broadly present the array of knowledge that honey bee science has to offer.

He covers the basic and expected topics of anatomy, development, reproduction, division of labor, foraging, nesting, pheromones and more, bringing readers up to date on the latest findings. Perhaps the greatest strength of Johnson's approach is that *Honey Bee Biology* goes well beyond what we know to describe how we know it, with clear and engaging explanations of key observations and rigorous experiments that let readers into the rooms where science is designed and conducted. He also prolifically articulates areas where further research might be particularly productive, so that the book is an excellent primer for students and young professors seeking research topics.

Johnson also presents synthesizing chapters focused on genetics, genomics, neurobiology, cognitive science, social immunity and evolution, although these segments are more technical and require a bit of effort for non-scientific civilians to fully comprehend. Still, even a superficial read of these more difficult sections yields the essence of contemporary honey bee research, a flavor that connects diverse topics to create a fuller understanding of the remarkable behaviors and organization of honey bee society.

Johnson also does readers a great service by presenting controversies in honey bee science in a balanced, respectful fashion. He has a particularly deft touch in covering issues around which there is still disagreement, and either comes down on one side of an issue where he thinks the data supports it, or leaves the reader with the understanding that we still just don't know.

For example, honey bee colonies are made up of many subfamilies with different drone fathers, and while many sociobiologists have speculated that each subfamily would favor their own kin, Johnson notes that on balance, the data doesn't support that theory, but that there's just not enough research for a conclusive conclusion. Another example is the question of whether honey bee colonies are cooperative, working communally towards common purpose, or competitive, with individuals subtly attempting to "win" through queen rearing or various aggressive behaviors. Here, Johnson has a firmer opinion, coming down on the side of more cooperation than conflict, while recognizing even harmonious cooperating societies may nevertheless express some internal conflict.

He concludes with a few chapters that will be of special interest to beekeepers, focused on parasites, pests and pathogens, detoxification and pesticides, and honey bees as managed pollinators. These chapters are less how-to, and more about how research has informed beekeeping practices, and in that way extends basic biology into practical applications.

Writing a book about honey bee biology presents a special writing challenge because of the breadth of the audience interested in bees. Scientists want a book they can use as a reference, beekeepers read out of interest but also to understand the biology underlying management decisions, and the general public has a great appetite for fascinating biology and clearly explained science.

To thread that needle for all three audiences is a daunting task, but Johnson pulls it off. I'm pleased to recommend *Honey Bee Biology* for all readers, from scientists to beekeepers to the public. I wish Brian Johnson all success as he joins the pantheon of writers through the ages who have graced us by illuminating the science underlying the spirit of the hive. BC

Mark L. Winston is a Professor Emeritus and Senior Fellow at Simon Fraser University's Centre for Dialogue. His most recent books have won numerous awards, including a Governor General's Literary Award for *Bee Time: Lessons from the Hive*, and an Independent Publisher's Gold Medal for *Listening to the Bees*, co-authored with poet Renee Sarojini Saklikar.

Book Review
Honey Bee Medicine

Callie Rich

The first edition of *Honey Bee Medicine For The Veterinary Practitioner* is edited by T. R. Kane and C. M. Faux; with an additional 31 contributing authors from across the United States and Canada. This 386 page textbook is divided into three primary sections, including 30 chapters, comprehensive full color figures, and specific chapter appendices.

The preface is written by T. R. Kane and provides a summary of the recent changes and challenges facing beekeepers and the beekeeping industry as a whole. There is a call to action for veterinarians to get involved with beekeeping, emphasizing the importance of honey bees to our ecosystem and their management as food producing animals.

Section one is comprised of 10 chapters. Chapter one highlights some key differences between managed hives and feral hives, discussing how adapting husbandry could aid managed hives in becoming hardier like their feral counterparts. Some of the language in this first chapter assumes an understanding of hive anatomy and components that a practitioner new to bee medicine may not yet have. It may help to reference later chapters or to have a basic honey bee resource on hand to follow this chapter more easily. Chapter two moves into a description of honey bees as a superorganism, highlighting the practice of eusocial behavior as we currently understand it. There is emphasis on bee biology and the importance of treating the whole colony, not necessarily the individual. The next few chapters provide a review of honey bee anatomy and physiology with comparisons to vertebrate species, including helpful diagrams and full color images. This will be particularly useful to the veterinary practitioner that may not have had invertebrate medicine included in their veterinary school curriculum. Chapter five is dedicated to the queen bee with bolded 'practical application' summaries for the lessons the authors wish to emphasize about her management. Chapters six and seven broaden the topic to other honey bee subspecies and non-*Apis* bees encountered in the wild. These chapters include helpful charts highlighting the different characteristics of the various honey bee subspecies and a summary of both abiotic and biotic stressors that may serve as a source of disease for a honey bee colony. The nutrition and microbiota chapters are thorough and detailed with charts and graphs showing colony changes over the course of the year that greatly aid the visual learner. The final chapter in this section covers honey bee pharmacology with a review of pharmacology principles, detailed information on how honey bees absorb and metabolize medications, and potential toxicities. These details are helpful to the practitioner that may not have practical experience treating invertebrates.

Section two is comprised of seven chapters and focuses more on hive management, the apiary industry and how a practitioner may interact with honey bees and their keepers. This section breaks down the components of a hive, tools and safety, and even has a section dedicated to addressing bee stings. There are many color images provided to highlight the written descriptions. The chapters on the apiary introduce the practitioner to the different levels of beekeeping and what products and services are emphasized at each level, as well as aspects of apiary design. The last few chapters in this section focus on the veterinarian-honey bee interaction, which is still relatively new given the honey bee's recent inclusion under the food animal label. These chapters walk the practitioner through the basics of hive examination with many color images for visual examples, veterinary regulations with descriptions regarding VFD's and the shared responsibility with state inspectors and apiculturists, medical record keeping and epidemiology.

Section three is comprised of the remaining 13 chapters and expands on specific diseases of the honey bee. Chapter 18 is specifically dedicated to parasite transmission and understanding the different exposure and transmission pathways within and between colonies. Chapters 19 and 20 are focused on the more currently relevant diseases of *varroa* mites and colony collapse disorder respectively, as these diseases are the most clinically relevant for managed honey bees and beekeepers across the United States today. The next few chapters are broken down into viral (organized by the family of virus), bacterial (emphasizing American Foulbrood and European Foulbrood), fungal (primarily Nosema, Chalkbrood, and Stonebrood), and parasitic diseases (including mites and parasites other than *varroa*) that are known to affect honey bees. The remaining chapters are dedicated to pesticides and potential toxicities, diagnostic sampling, hive necropsy and husbandry. They include relevant information for any practitioner wishing to branch into apiary medicine. Further discussion with state inspectors or apiculturists would likely benefit the new honey bee practitioner for real life understanding of reporting and testing of hives.

Following the main text is a compendium of resources for the practitioner, including useful websites, university bee labs, state government sites and legal information, further supplementary books (including *Beekeeping For Dummies*, for those truly just starting in learning about beekeeping and bee medicine), and even bee suppliers for those interested in starting their own colonies.

Overall, this textbook is a comprehensive summary of information pertaining to honey bee medicine, with the target audience being the veterinary practitioner. While this book may slightly advanced for the first-time bee doctor just dipping their toes into the area of invertebrate medicine, the book provides supplemental resources for practitioners to build their knowledge-base. This is a thorough and reliable resource for veterinarians branching out into the honey bee industry. BC

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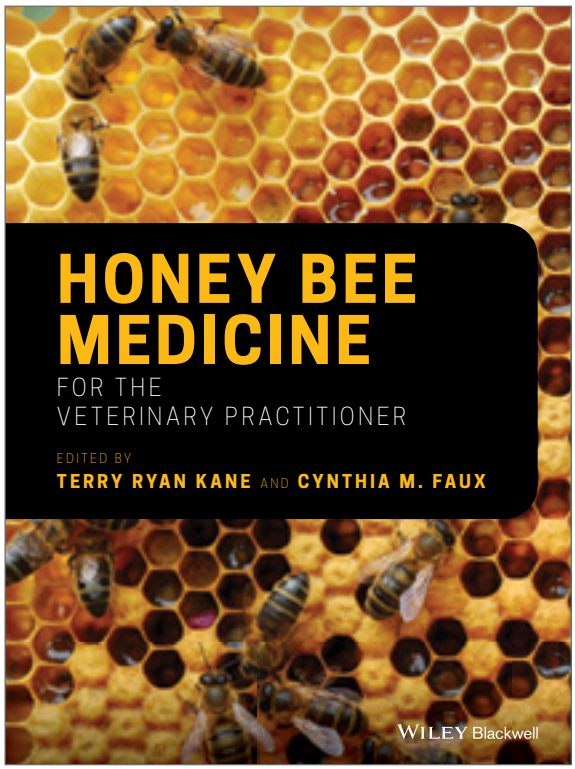
ISBN: 978-1-119-58342-4
Price E-Book $140 Print $174.99



An authoritative guide to honey bee health and hive management.

Honey Bee Medicine for the Veterinary Practitioner is designed for veterinarians and other professionals, presenting useful information for answering commonly asked questions and for facilitating hive examinations.

The book covers a wide range of topics including basic husbandry, equipment and safety, anatomy, genetics, and the diagnosis and management of disease.

It also includes up to date information on *Varroa* and other bee pests, introduces honey bee pharmacology and toxicology, and addresses native bee ecology.

THINGS YOU WILL LOVE ABOUT THIS BOOK

- Offers a guide to veterinary care of honey bees
- Provides information on basic husbandry, examination techniques, nutrition, and more
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- Written for veterinary practitioners, veterinary students, veterinary technicians, scientists, and apiarists

CALENDAR

♦GEORGIA♦

Georgia Beekeepers Association's 2023 Fall Conference will be held on September 21-23, 2023 in Gainesville, GA.

Keynote speakers include Lewis Bartlett, Dewey M. Caron, Brock Harpur, Theresa Martin and Isaac Weinberg.

The conference will also include UGA Master Beekeeper Program Testing for all levels and Welsh Honey Judge training and testing.

For more information and to register: **https://gabeekeeping.com/**

♦OHIO♦

OSBA Fall Conference will be held on October 27-28, 2023 in Wooster, OH.

There will be something for everyone from beginner to experienced beekeepers. The conference will include speakers, how-tos, latest research, honey judging, drawings and vendors.

Check for updates at **https://ohiostatebeekeepers.org/**

♦PENNSYLVANIA♦

Western PA Beekeeping Seminar will be held on February 9-10, 2024 at Gateway High School (3000 Gateway Campus Blvd. Monroeville, PA 15146).

Early bird tickets go on sale in September 2023.

For more information, please visit **https://www.beavervalleybees.net/yearly-happening-wpa-sem**

♦WASHINGTON♦

The **Washington State Beekeepers Association (WASBA)'s** upcoming beekeeping conference is October 7-8, 2023 in Olympia, WA!

The event will include a Saturday evening banquet with the famous "Dessert Auction", a live auction, raffles and much more!

The conference will conclude with the WASBA Annual Board Meeting on Sunday, October 8.

Profits from the conference benefits Washington Honey Bee Research.

You can learn more at **https://wasba.org/**.

♦ABF♦

The 2024 ABF Conference and Tradeshow will be in New Orleans. It begins with a dinner on Tuesday, January 9th, 2024 and ends on Saturday, January 13th, 2024.

A block of rooms have been reserved at the New Orleans Marriott for a discounted rate of $169/night (plus applicable taxes and fees). The hotel is located on 555 Canal Street, New Orleans, LA 70130.

Keynote speakers Dr. Samuel Ramsey and Dr. Frank Rinkevich will give the latest information about the *Tropilaelaps* mite and *Varroa* mite.

Some changes for the 2024 conference include a three track schedule with each section targeting a difference sector, meals in the evening, and ending with hive inspections at the zoo on Saturday (weather permitting). Special tours have been arranged for those that want to come early on Monday. The tours are available at a special rate.

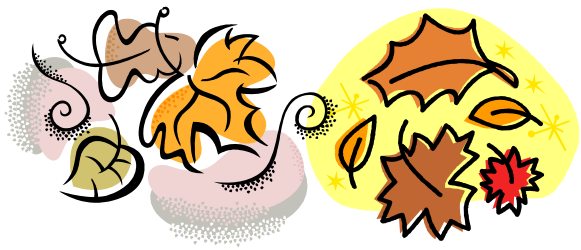
Registration will begin on July 25th, 2023 with early bird registration rates through October 31st, 2023. Pre-registration will close on December 26th, 2023. Rates are in the table below.

Watch **https://www.abfnet.org/mpage/2024-ABF-Conference-Frame** for more information as well as a link to the registration page.

Looking to exhibit or sponsor? Send an email to Regina Robuck at **partnershiprelations@abfnet.org**.

ABF Registration Pricing	Early		Regular		On-Site	
Registration	Member	Non-Member	Member	Non-Member	Member	Non-Member
Individual Registrants Full Conference	$245.00	$305.00	$295.00	$355.00	$345.00	$405.00
Individual Registrants Day Rate	$150.00	$190.00	$175.00	$85.00	$200.00	$240.00
Student, Educator, ABRC, AIA	$60.00					

* 10% discount for active military and first responders.



CLASSIFIEDS

TRAVEL

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Contact Jen Manis to place an ad: Jen@BeeCulture.com

If you are having a beekeeping event, we are happy to send back issues to give to your attendees and students. Please email Emma at Emma@BeeCulture.com with the number of magazines needed, a complete mailing address and a contact person.

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Image Contest – Honey Haul

We've started an image gallery! This month, we want to see any and all pictures you have of your **Honey Hauls**. Please make sure that your image is nice and big! We may pick your image for the gallery, or you have the chance to get on the cover! So get creative.

How To Submit:

Email your images to **Emma@BeeCulture.com**
Use the subject "**Image Gallery**"
Please include in your email:
- The image as an attachment (we will not consider it if it is embedded)
- Your First and Last name
- Your mailing address
- Your renewal code (if you know it)

If your image is chosen:

For the Gallery:
You will get three months added to your current subscription.
For the Cover:
You will get twelve months added to your current subscription.

I've never been able to grow a beard, even a bee beard. And 10,000 honey bees dangling off your chin and chest always struck me as creepy, even for a beekeeper. I only agreed to do this because Tina asked me to.

You have to understand that Tina and I go back some. When I served as president of the Colorado State Beekeepers Association (CSBA), Tina was my vice-president and the staff I leaned on. Unless you've served in a similar capacity, you likely cannot imagine the political and diplomatic challenges inherent in such a job. There were rivalries, and there were conundrums. Not everyone got along. I even received some hate mail. A lot of seemingly intractable problems centered around matters that I personally cared not a whit about. But I was the leader and oftentimes the decider in such matters.

This venerable organization dates back to 1880. Think of it! For 144 years Colorado beekeepers have rallied under the CSBA banner. My predecessor was a tireless organizer and bee advocate whose shoes I was certain I could never fill. Still, somebody needed to step up. Nobody else wanted the job.

My once lofty presidential goals dimmed with burnout and the passage of time, although in our finest hour, Tina and I did rattle some cages at the state Ag department. I found myself the skipper of a ship at sea. My principal responsibility, as I saw it, was to keep the vessel upright and off the rocks until such time as I might hand over the charts to some worthy successor.

The presidency required significant time and effort, but I got to meet and work with some dedicated – not to mention brilliant – bee people.

I don't handle stress well, and the job came with some. Tina was my salvation, the calm and clear voice on the phone that assured me that we could get through this, whatever it was. She was my confidant, my strategist, my best CSBA friend. She never let me down.

So when she asked if I'd consider donning a bee beard at the state meeting in June, I said no problem.

Then I called Dr. Katie Lee. I first met Katie in 2009 when she gave a sugar-shake mite-test demonstration at a queen rearing class at the University of Minnesota.

Later, I clipped a bee magazine photo of her wearing a massive bee beard and stuck it on the refrigerator, where it stayed for years. My gal Marilyn referred to it as "your bee pinup."

When I invited Katie to give a talk on hygienic bees at a CSBA Summer meeting, she stayed with us here on the farm. We three clicked, and Marilyn and I still talk about that halcyon weekend.

When I asked her about bee beards, she said not to worry. "I've done about 15 of them, and I've supervised hundreds." She said to use a Vaseline barrier to keep them out of my nose and eyes and ears but otherwise to just relax and enjoy the attention.

Marilyn and I hosted the night-before potluck at the CSBA Summer meeting, and Tina came up from Durango a couple of days early to help put things in order. Our place was a wreck, inside and out. Marilyn and I both have a lot going on. Tina gets that. Her priorities are the same as ours: Live your life. Take care of your bees. The lawn and the dishes can wait.

She and I made a wager at the meeting a year ago. The loser was to give the winner a day's labor, at her place or ours. But this year, when I reminded Tina that she lost the bet and needed to pay up, she turned the tables on me. "Ed, I'd come up early and help you anyway, even if I'd won that bet!"

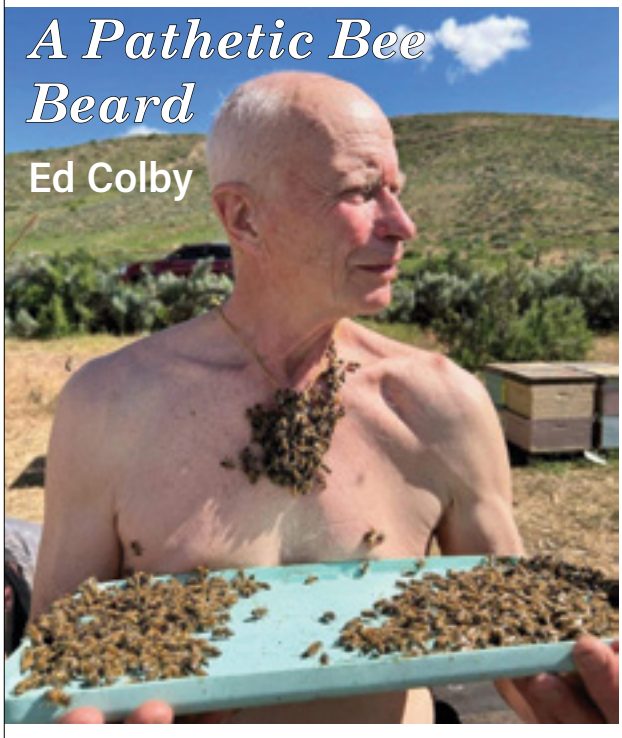
I decided to leave the details of my bee beard to her. On the appointed day, she caged the queen from a gentle hive and fastened it to a string that she placed around my neck. She instructed me to hold the lid to a large plastic tub in front of my bare chest. Then she began pulling frames out of the hive and dumping bees onto the lid. The idea was that those bees would gather around the queen, creating the beard. A little group of bees gathered 'round, but most of them ignored Her Royal Majesty. Even when Tina brushed them against the queen, they wouldn't cluster around her.

These little darlings came out of a Spring split, and someone suggested trying again with a stronger colony. I said forget it. The bees' legs pull at your bare skin in a way that's not too comfortable, and a sting now and then comes with the territory. I'd had enough.

From another point of view, maybe my cup was half-full, anyway. When I sent a photo to Katie Lee, she called my pathetic beard "a ravishing necklace." I told her she was a poet.

Look, I'm older than dirt. I don't have to prove anything. And it comes as no surprise that my beard flopped. I've never been able to grow one. BC

Gentle reader, did you find this poor epistle amusing, heartwarming, instructive? Contact Ed Colby at ***Coloradobees1@gmail.com****. Ask him to promptly mail you an autographed copy of* A Beekeeper's Life, Tales from the Bottom Board *– a collection of the best of his Bee Culture columns. Price: $25. Satisfaction guaranteed or your money back!*



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