STATE APIARISTS AND VETS

MAR 2023

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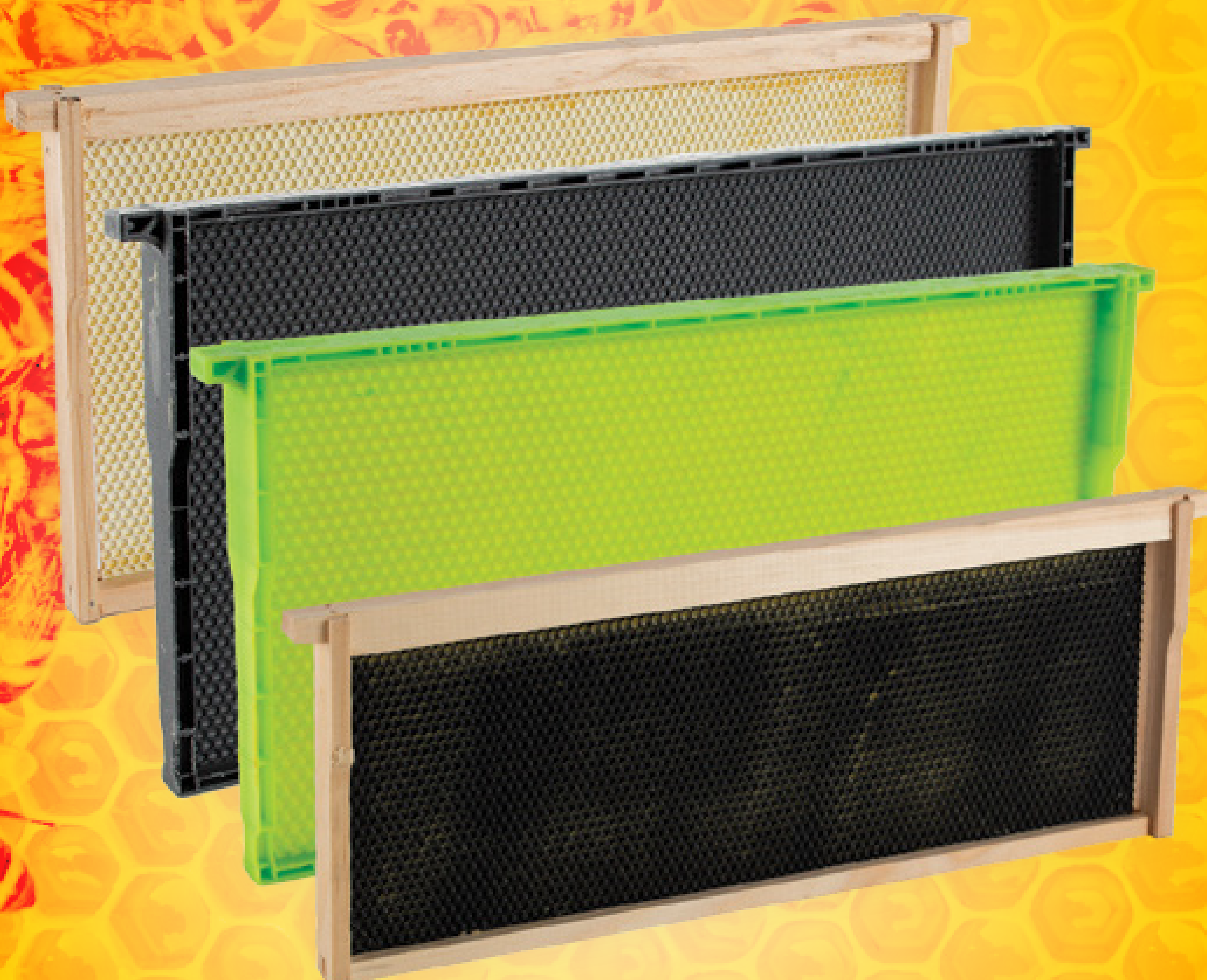

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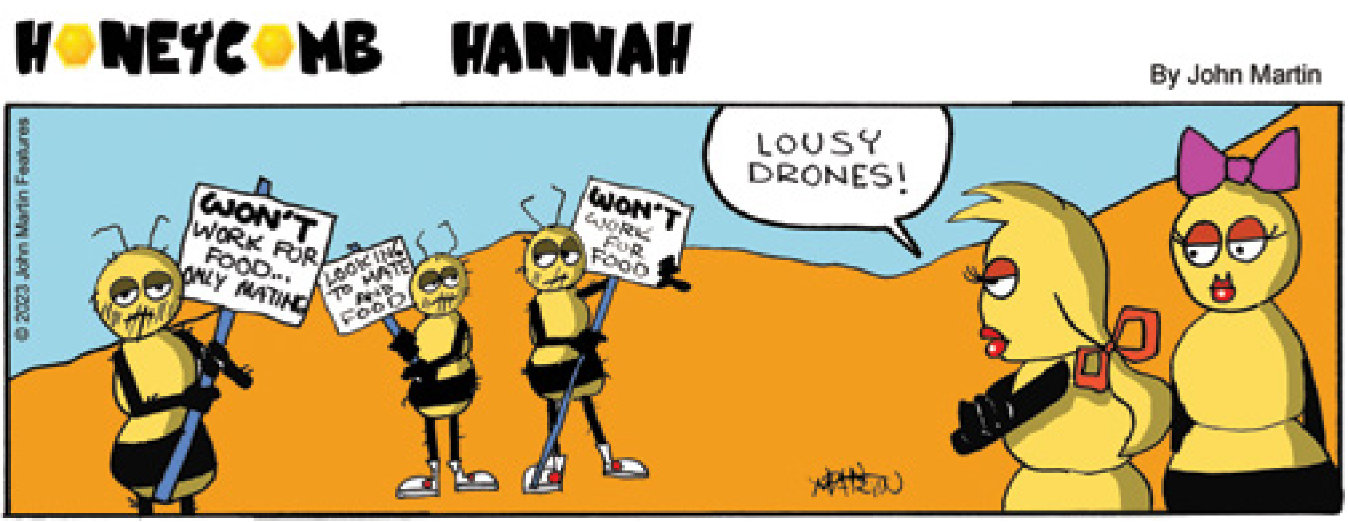
HONEYCOMB HANNAH
By John Martin
© 2023 John Martin Features
WON'T WORK FOR FOOD... ONLY MATING
LOOKING TO MATE NOT FOOD
WON'T WORK FOR FOOD
LOUSY DRONES!


"Kelly"
Size & Style
for competitions
as well as general
comb production

NEXT MONTH

Region 1
- Keep ahead of *Varroa.* Sample (alcohol), treat, sample (alcohol)
- Feed hives losing weight
- Check to see if queenright
- Get ready to add supers if early Spring
- Get ready for splits
- Get ready to equalize colonies
- Ready to requeen?
- Remove Winter wraps
- Clean out dead bees blocking entrance

Region 2
- Do hive inspection on warm day
- Supplemental feed
- Check for swarm cells
- Check queen brood pattern
- Super if dandelions are early
- Add boxes for colony to grow
- Make splits as necessary
- Swarm control
- Pull and sell nucs

Region 3
- Super for first flow
- Extract early honey
- Splitting colonies
- Too late to treat for *Varroa*
- Check for swarm cells
- Add supers
- Add brood boxes
- Swarm control
- Make nucs to sell

Region 4
- Perform a thorough hive inspection
- Reverse hive bodies if necessary
- Clean bottom boards
- Make splits for yourself
- Requeen
- Equalize brood between and among colonies
- Install new packages
- Are honey supers ready?
- Make room, make room
- Swarm control
- Feed Indiana bees

Region 5
- Sample with alcohol wash for mites. Treat if over 3/100
- Remove hive wrap
- Feed, feed, feed
- Check food stores
- In the event of a nice day, inspect hives
- It's still Winter. Cross your fingers
- Put pollen sub on
- Are empty brood boxes ready?

Region 6
- Order bees
- Check for deadouts
- Add supers
- Requeen and split
- Make sure colonies are queenright
- Do meticulous hive inspection
- Set out swarm traps
- Summer is coming!

Region 7
- Do hive inspections
- Check if hives are queenright
- Feed hives
- Split colonies if needed
- Do swarm cell check and control
- Finish building hive boxes and frames
- Raise new queen
- Put on supers
- Clean out deadouts
- Rotate brood boxes

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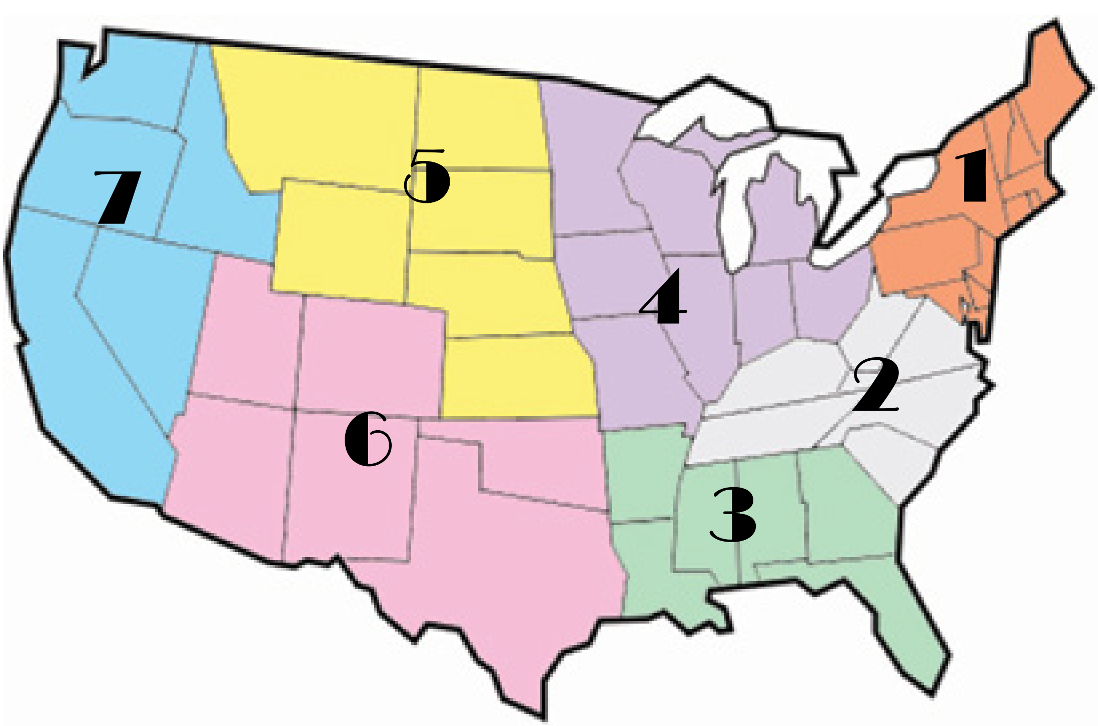
MARCH – REGIONAL HONEY PRICE REPORT

	REPORTING REGIONS							SUMMARY			History	
	1	2	3	4	5	6	7	Range	Avg.	$/lb	Last Month	Last Year
EXTRACTED HONEY PRICES SOLD BULK TO PACKERS OR PROCESSORS												
55 Gal. Drum, Light	2.73	2.16	2.92	2.95	3.00	2.72	3.20	1.95-3.50	2.84	2.84	2.81	3.39
55 Gal. Drum, Ambr	2.63	2.53	2.80	2.94	3.00	2.50	3.03	1.80-3.50	2.76	2.76	2.74	3.10
60# Light (retail)	235.80	262.50	205.80	206.29	180.00	191.14	310.00	165.00-350.00	225.80	3.76	232.83	215.58
60# Amber (retail)	229.98	250.00	194.67	196.60	-	183.74	252.50	160.00-310.00	218.30	3.64	230.86	213.34
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS												
1/2# 24/case	121.49	144.00	75.00	82.00	-	95.00	-	67.20-288.00	112.61	9.38	103.32	102.75
1# 24/case	172.12	219.00	154.40	130.60	-	149.18	144.00	96.00-325.00	161.74	6.74	163.87	145.14
2# 12/case	163.65	204.00	135.13	113.50	-	180.00	156.00	84.00-300.00	152.42	6.35	152.74	147.75
12.oz. Plas. 24/cs	134.19	162.00	101.99	99.43	99.60	124.98	117.60	72.00-240.00	122.53	6.81	124.26	116.61
5# 6/case	178.29	330.00	127.41	126.90	-	225.00	-	90.00-330.00	171.61	5.72	162.17	154.41
Quarts 12/case	210.00	213.14	153.61	169.20	156.60	196.66	205.50	119.98-330.00	191.79	5.33	200.61	175.19
Pints 12/case	112.33	119.98	108.06	95.80	81.00	139.50	109.07	72.00-180.00	110.23	6.12	119.27	100.71
RETAIL SHELF PRICES												
1/2#	6.63	7.36	5.45	5.25	-	5.00	-	3.50-10.00	6.21	12.42	6.09	5.97
12 oz. Plastic	8.28	7.94	6.85	6.73	5.50	6.20	6.63	4.29-14.00	7.45	9.93	7.41	6.88
1# Glass/Plastic	10.62	12.15	9.66	8.55	-	9.12	10.00	5.79-18.00	10.21	10.21	9.87	8.89
2# Glass/Plastic	18.45	20.40	16.90	16.22	-	14.00	18.50	7.99-30.00	17.78	8.89	17.59	15.78
Pint	12.65	13.11	10.82	11.50	7.63	15.67	11.40	5.00-22.00	11.91	7.94	11.89	10.93
Quart	24.14	24.00	18.29	20.30	15.07	22.67	21.43	10.00-42.00	21.55	7.18	20.82	19.95
5# Glass/Plastic	36.83	60.00	34.49	30.27	15.00	34.00	-	15.00-60.00	35.83	7.17	37.50	31.88
1# Cream	12.14	9.00	10.49	11.42	-	-	12.50	6.39-20.00	11.66	11.66	11.97	11.46
1# Cut Comb	16.12	15.33	13.13	14.89	6.00	17.50	-	6.00-25.00	15.18	15.18	14.70	14.11
Ross Round	13.42	8.00	-	11.00	5.00	-	15.08	5.00-20.00	12.44	16.59	12.96	12.95
Wholesale Wax (Lt)	10.25	10.33	8.92	7.89	7.00	9.75	5.38	4.00-18.00	9.03	-	8.23	8.36
Wholesale Wax (Dk)	9.31	7.83	7.50	6.75	-	4.00	-	3.00-16.00	8.04	-	7.52	6.55
Pollination Fee/Col.	85.50	80.67	78.33	161.00	-	-	122.50	40.00-250.00	103.57	-	92.97	101.41

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.



BEEHEROX

Asian Giant Hornet

Huw Evans

Invasive species are among the leading threats to native ecosystems, habitats and wildlife; they can also have a negative impact on economy and livelihoods. One such example is the Asian hornet (*Vespa velutina*) first spotted in France back in 2004. Since that time, this honey bee predator has spread all across France, down into Spain and Italy, up into Belgium and even crossed the sea to the UK. As a result, the Asian hornet is now regarded in many parts of Europe as a bigger threat to beekeeping than *Varroa destructor*. Following several years of field work, conducted in northern Italy, using sound, we managed to identify a pretty robust acoustic signature to identify the invasive hornet. Indeed the algorithm could even distinguish the Asian hornet from the native European hornet (*Vespa crabro*).

In 2019, *Vespa mandarinia* was seen for the first time in Washington state and British Columbia. Termed the murder hornet by the U.S. media, the *V. mandarinia* is larger than its cousin the *V. velutina*. Furthermore, rather than picking off foragers as they return to the hive, the *V. mandriana* scouts, invades and occupies honey bee colonies.

Working with the USDA, we were able to position an acoustic monitor within an inch of a nest entrance for several days before the nest was exterminated. This resulted in a large quantity of high quality acoustic data, which enabled us to tune the recognition algorithm to the *V. mandarinia*. Dr. Chris Looney, entomologist and field engineer at the WSDA, managed to catch a few of the hornets with a net, and contain them in a flight tent along with the acoustic monitor. From this acoustic data, we could see a clear difference in the size of the specimens, later confirmed by size information (weight and dimensions) forwarded by Chris.

The acoustic data also allowed us to observe flight behavior, offering valuable insights into total activity, precisely when the hornets started and stopped flying, flight hours and flight frequency, allowing us to plot the daily flight profile. Furthermore, we could retrospectively apply the size information giving us insights into the nest demographic.

One of the major obstacles facing field engineers studying the hornet and tracking its spread is one of inaccessibility; these areas rarely have cell coverage or even good road access. Therefore, the ability to monitor for hornets remotely is very valuable. This has been achieved using a gateways unit with satellite communications to which up to 32 acoustic monitors can communicate, raising an alarm if a hornet is seen or monitoring activity in areas the hornets are already established. Moving forward, such acoustic monitoring techniques can be employed both within the apiary and at major ports or other potential points of entry. BC


Flight tent with acoustic monitor

Hornet in flight tent


Dr. Huw Evans. Heads BeeHeroX, the innovation arm of BeeHero.

Acknowledgments: Dr. Chris Looney (WSDA), Dr. Todd Gilligan (APHIS) and Anne M Lebrun (APHIS).

FOUND IN TRANSLATION

Bees Good

Jay Evans, USDA Beltsville Bee Lab

Listen along here!

Waiting for Spring makes one hopeful and, simultaneously, a bit reflective on why we all keep at this, despite heavy Winter losses and expenses. This year, massive floods in California will wreak havoc with bees and beekeepers in holding yards and during the first commercial stop of the year in almond plantations. Most years the opposite is true; crippling droughts decrease yields from almonds and other crops, diminishing the agricultural benefits of bee pollination. Still, most of the time, bees and beekeepers get a break and honey bees and other pollinators provide a solid boost to the production of healthy foods. This essay is devoted to the bees and beekeepers whose actions improve food production and human welfare.

Our sister branch of USDA, the National Agricultural Statistics Service (NASS), provides quarterly and annual views showing how honey bees impact humanity in the USA (**https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Bee_and_Honey/index.php**). These reports document how the hard work to keep bees alive pays off in the farming economy and the food supply. Jennifer Bond and colleagues at the USDA's Economic Research Service pulled data from NASS and other sources to generate a full view of the bee industry and its drivers in *Honey Bees on the Move: From Pollination to Honey Production and Back* (2021, **https://www.ers.usda.gov/webdocs/publications/101476/err-290.pdf**). This short book shows the challenges faced by beekeepers and the targets that keep them on their toes, highlighting that 80% of annual pollination income to beekeepers is derived from one early-season source (almond plantations, flooded or otherwise). Bees and their migratory keepers then disperse widely for additional pollination events and, weather and habitat permitting, the production of honey and wax. Overall, beekeepers receive $320 million in pollination fees for their efforts, and these efforts have a twenty-fold greater impact on U.S. crop production.

Pollination of crops not only provides an economic engine for growers and (some) beekeepers, but pollination by bees is literally saving lives. A recent global analysis generated values for pollination impacts on world crops by estimating decreased productivity when bees were limiting (Matthew Smith and colleagues, *Pollinator deficits, food consumption, and consequences for human health: A modeling study*, 2022, Environmental Health Perspectives, 130(12) 127003-1 **https://doi.org/10.1289/EHP10947**). By looking at peaks versus observed productivity across farmed regions, the authors estimate that inade-

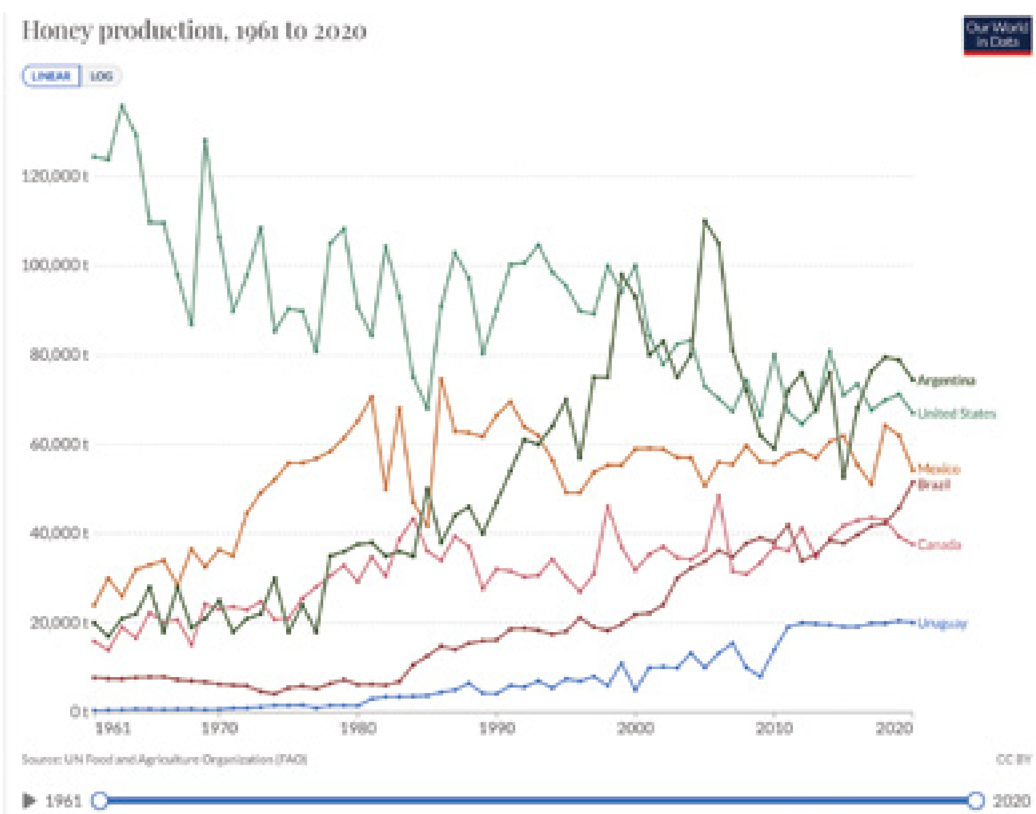
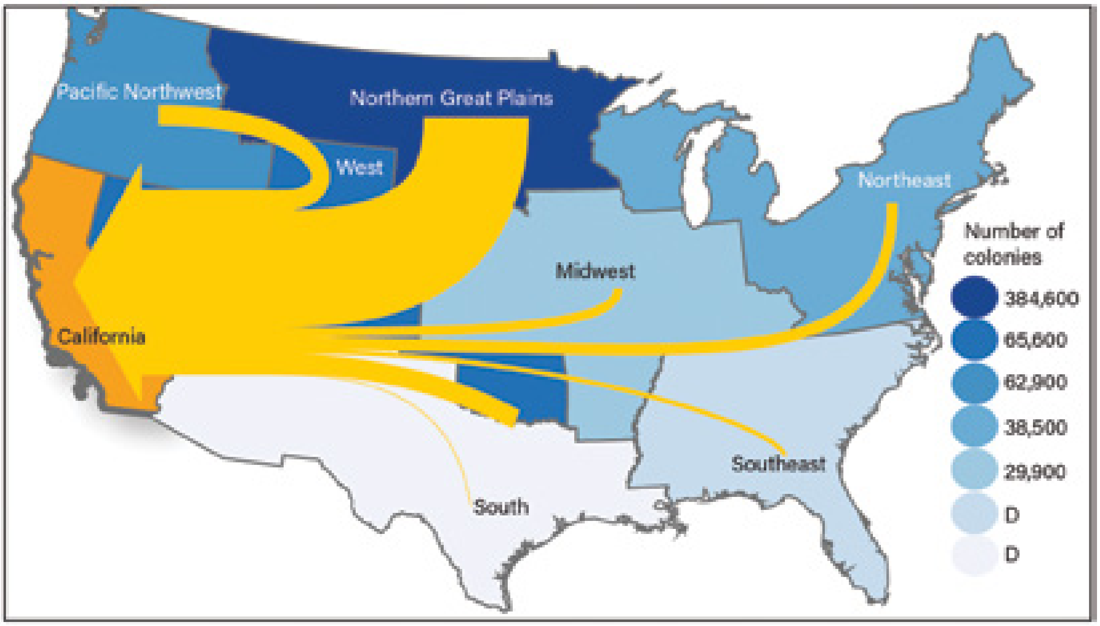


Figure 1
Honey bee colony movements into California, July 1, 2017-January 1, 2018



quate pollination decreases yields for fruit and nut crops by 5%, on average. Similarly, vegetable yields are reduced by 3%. These estimates cover 60+ crops that supplement the diets of billions of people on all continents except Antarctica. Using conservative measures, the authors estimate that 500,000 people die annually due to decreased food yield or quality caused by missed pollination events by bees. This human toll differs across countries, with some populations suffering from all-out hunger and malnutrition while others (including the United States) are impacted more by shifts in diet tendencies away from more nutritious pollinated crops such as fruits and nuts. In a second recent paper (*Pollination deficits and contributions of pollinators in apple production: A global meta-analysis*, 2022, Journal of Applied Ecology, **DOI: 10.1111/1365-2664.14279**), Aruhan Olhnuud and colleagues present data for one critical worldwide fruit (the apple) and argue for even greater impacts of missed pollination on yields and seed set, in the range of 40% and 20%, respectively, much higher in some countries. Seed set for apples does not limit the industry overall, but fertilized seeds lead to a more attractive fruit shape. Honey bees, of course, are not the only insect pollinators of crops and both of these papers take great pains to account for the impacts of diverse pollinators. Nevertheless, in many counties, including ours, honey bees are the primary pollinators of crops, especially for larger farms.

While these studies focused on pollination impacts, honey bees provide a bounty for beekeepers small and large that was not accounted for in these two studies. The nutritious value of honey, and to a lesser extent pollen and brood, improves nutrition in many countries. Further, the receipts from honey and wax sales have a huge impact on human health worldwide and are arguably one of the most important sources of small-farm income in developing and industrialized incomes. Bernard Phiri and colleagues analyze yields from hive products worldwide in *Uptrend in global managed honey bee colonies and production based on a six-decade viewpoint, 1961–2017*, 2022, Scientific Reports 12:21298, **https://doi.org/10.1038/s41598-022-25290-3**). This fascinating synopsis highlights the losses and (mostly) gains of beekeeping across continents alongside the economic and population drivers behind those changes. As has been well documented, North America has seen a 30% decrease in honey bee colonies since 1961, while Europe (including Russia) has lost 12% of its colonies. South America, Africa, Australia and Asia have more than compensated for those losses, doubling or even quadrupling (Asia) managed hives in that time frame. Overall, the number of managed honey bee hives has doubled since 1961, matching a doubling in human population. All regions have perfected honey and wax harvesting, with honey yields even in North America surpassing those of prior years, despite lower colony numbers. This North American increase reflects heavier harvests in Mexico and Canada that outweigh decreased honey yields in the U.S. (**https://www.visualcapitalist.com/cp/mapped-food-production-around-the-world/**). Asian countries increased honey harvests by eight-fold over this time frame. It would be fascinating to estimate how greatly honey production impacts populations worldwide, not simply in local consumption but as an attainable and sustainable cash crop in developing and more industrialized countries. My guess is that the impacts of honey harvesting on lives improved and saved from premature death would rival that achieved by increased pollination from managed hives.

Whether you are keeping bees for family munchies, selling honey on a table or fully engaged in commercial pollination and the production of hive goods, you are playing a role in an essential partnership with one of the planet's truly extraordinary animals. Thanks for doing that. BC

It's Worse Than You Think

John Miller

Other groups met concurrently during the January 2023 American Beekeeping Federation convention in Jacksonville, FL. One of those groups is the Apiary Inspectors of America. These inspectors do a lot of bee sampling in a lot of different states. During the Thursday, January 5 AIA meeting, AIA attendees and invited guests discussed and brainstormed the known and the unknown about *Tropilaelaps mercedesae* (Tropi).

We know a lot less than we think we do. For one thing, we don't know what the Animal & Plant Health Inspection Service (APHIS) action plan for Tropi is. We should. Soon. It's important – but the plan is focused on reactive action **after a detection.** This will be too late for North American beekeeping.

My focus is **prevention.** Prevent Tropi from further range expansion. Keep it in Asia.

A four-year study will soon commence in South Korea. Tropi is in Korea. Tropi requires brood rearing to continue reproduction. But wait: Korea has Winter like North America has. Brood rearing ceases – yet, Tropi persists in Korea. How?

Parasites come in a lot of flavors and colors. Most are obligate parasites. A parasite depending entirely on its' host is called an obligate parasite. A parasite that does not depend entirely on a host is referred to as a facultative parasite. According to Jeff Pettis, PhD and President of Apimondia, who attended the meeting – it is possible Tropi may be a facultative parasite. The secondary host may be rats (and their nests). The facultative host site may be in the soft tissues of the rat mouth, eyes or in the nest, surviving on nest debris, or lice living in the nest. Maybe.

Rats are global. They like riding on ships. They come ashore in/on shipping containers. They like fresh produce, dry goods, clothing, just about anything that floats can be a home for rats. Rats don't mind beekeeping operations either. But overall, Tropi prefers bee brood. Not just *Dorsata* or *Meliffera* brood; although Tropi does not prefer *Cerana*, a small comfort.

May 19, 2019 – Aussie Beekeepers in Gackle, ND

Australia is now in a fevered rush to eradicate *Varroa*. *Varroa* almost certainly arrived from Indonesia, a host country to Tropi. Australia is a big supplier of packages bees to Canadian beekeepers. Thoughtful leaders suggest now might be a time to re-open the Canadian border to American queens and packages – and close the border(s) to Australian packages. This out of an abundance of preventative caution. I don't know a single beekeeper wishing harm to our Aussie beekeeping friends.

American beekeepers are the most mobile beekeeping industry on earth. September 25, 1987, *Varroa destructor* was discovered in Florida. Six years later it had infested virtually the entire nation. The need, the **urgent** need is to prevent history from repeating. The voice of beekeepers must be mobilized.

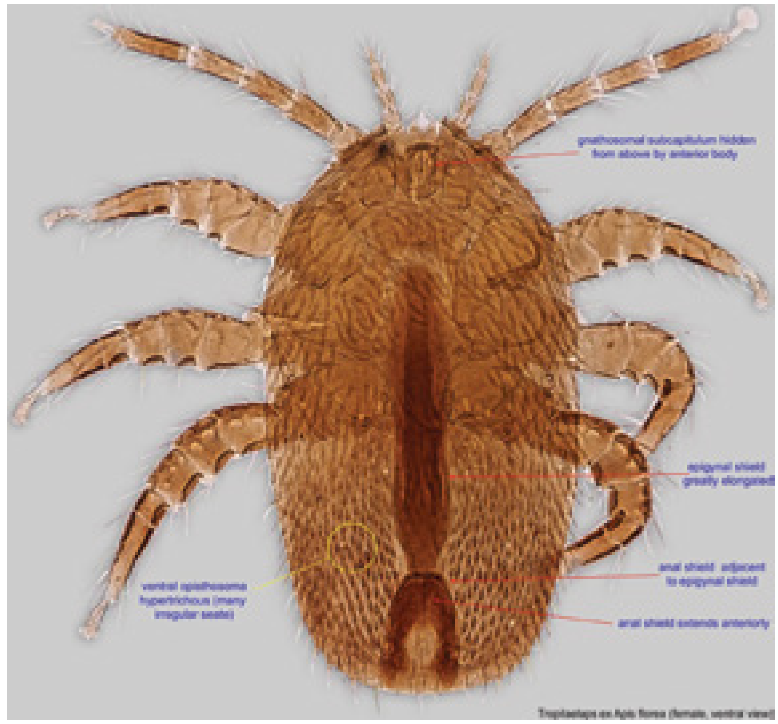
How could we better converse with each other? Facebook must have a zillion beekeeper pages; LinkedIn is not far behind. We all have our favored group of beekeepers with whom we share photos, snark, information, gossip and announcements. What we don't have is a contact list for ALL INTERESTED BEEKEEPERS, or even all the clubs, or even all the state associations.

Beekeepers join local, county, state, regional and national organizations. In every organization, a faithful worker bee person keeps track of membership and contact information. Hundreds of thousands of other human worker bees attend, learn and keep bees. These beekeepers have a real live stake in contacting APHIS. Beekeepers are entitled to know what the action plan is. Beekeepers should arouse APHIS and 535 Congresspersons of this real live existential threat to our food supply. *No bees = no food.*

According to unconfirmed reports, when Tropi entered Pakistan, it killed every single *Meliffera* colony in the country. For reference, please watch Dr. Sammy Ramsey's YouTube video: **The *Tropilaelaps* Mite: A Fate Far Worse Than *Varroa* – YouTube.**
The idea becomes real clear.

I'm not the guy to congregate the anti-Tropi congregation. I don't know how.

What I can do, and am doing is nudging key stakeholders towards an activist campaign to **prevent** Tropi



from North American shores. I have reached out to:

- California State Beekeepers Association and the 13 affiliated CA bee clubs
- California Bee Breeders Association
- The Almond Board of California
- Blue Diamond Growers
- Apiary Inspectors of America
- North Dakota Beekeepers Association

I know these groups.

I don't know the 48 other state beekeeping organizations. I don't know the hundreds of clubs.

I don't know if the Federation or if American Honey Producers Association are ramping up the anti-Tropi alarms. But the readership of *Bee Culture Magazine* do know the hundreds of clubs, the states and are members and probably participants in whichever of the above clubs is their homey club. A lot of us are members of several clubs.

Where does lightning need to strike? Congress: via the 2023 Farm Bill. APHIS. Organizations representing insect-pollinated food for humans and livestock; Apimondia; ABF; AHPA.

Where will North American beekeeping be in five years?

For more information about *Tropilaelaps*, please see the PDF that's provided with this article posted at **https://www.beeculture.com/its-worse-than-you-think/**. BC

A Closer LOOK

Pollen Micronutrients

Clarence Collison

Carbohydrates, proteins, lipids, vitamins and minerals available to honey bees are factors responsible for the amount of progeny produced, longevity and health of adults and for the survival and productivity of a colony. Colonies facing a limitation of an essential nutrient, such as pollen in general, or an essential amino acid or vitamin in particular, will cease brood production and may not survive if not supplied with the missing nutrient (Brodschneider and Crailsheim, 2010). There are approximately 25 vitamins and minerals (elements) that should be accounted for in a honey bee diet. Their classification is made not on the basis of chemical structure, but on their chemical activity and biological properties (Lipiński, 2018).

Sterols and Lipids

Honey bees obtain lipids exclusively from pollen, and the lipid content of pollen from various species ranges between 0.8% and 18.9% (Roulston and Cane, 2000). Lipids are mainly metabolized during the brood stage of honey bees and are regarded as an important energy source, and as precursors for further biosynthesis (Cantrill et al., 1981).

For honey bees, lipids from pollen are important sources of substances that contribute to their development and reproduction (Manning, 2001). Simple lipids, popularly called fats, are the main source of glycerol, essential fatty acids, sterols and fat-soluble vitamins (A.D.E.K.) (Lipiński, 2018).

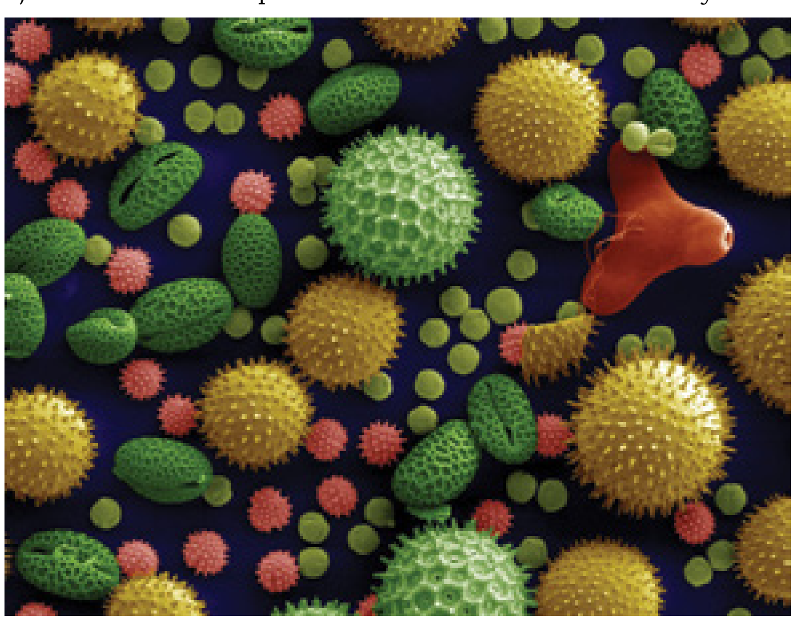
A sterol, 24-methylenecholesterol, is common in pollen and is the major sterol source for honey bees. Nearly all insects need to obtain sterols from their diet because of their inability to synthesize them directly. Sterol is the precursor for important hormones such as the molting hormone, which regulates growth because it is required at the time of each molt. It is not clear what other lipids are required by honey bees, but most likely normal consumption of pollen provides all the lipid requirements. Pollen with low fat content is less likely to be consumed by honey bees, but can be made more attractive to bees with the addition of lipids. The total lipid concentration within a pollen supplement is recommended to be 5-8% (Huang, 2010).

The sterols of prepupal honey bees, from brood reared by workers fed chemically-defined synthetic diets containing cholesterol, campesterol, sitosterol, stigmasterol, 24-methylenecholesterol or no sterol over a 12-week period were isolated, identified and quantified. The major sterol present in each prepupal sample was 24-methylenecholesterol, but significant levels of sitosterol and isofucosterol were also present in every case, as was a very small percentage of desmosterol (usually <1%). This is the first report of isofucosterol being identified in the sterols of the honey bee. A considerably larger percentage of each dietary sterol was found in prepupae reared by workers fed that particular sterol in the diet. This was most dramatic in the case of the cholesterol diet in which case cholesterol content increased to as much as 17.2% of the prepupal sterols, whereas cholesterol had not exceeded 2.2% in samples from other diet regimens. However, stigmasterol comprised no more than 6.3% of the total sterols in any sample from prepupae fed the stigmasterol diet. The preponderance of 24-methylenecholesterol in all prepupae, regardless of the dietary sterol provided to the workers, as well as the lesser quantities of sitosterol and isofucosterol present in all samples, suggest a unique system of utilization and metabolism of these dietary sterols by the worker bees. Apparently, they make available to the brood varying amounts of unchanged dietary sterol plus considerable and fairly constant portions of 24-methylenecholesterol, sitosterol and isofucosterol drawn from their own sterol pools (Svoboda et al., 1980).

The honey bee is one of only a few species of phytophagous insects known to be unable to convert C-24 alkyl phytosterols to cholesterol. Regardless of the dietary sterols available to worker bees, the major tissue sterol of brood reared by the workers is always 24-methylenecholesterol, followed by sitosterol and isofucosterol. Normally, little or no cholesterol is present in honey bee sterols. The maintenance of high levels of certain sterols is accomplished through a selective transfer of sterols from the endogenous sterol pools of the workers to the developing larvae through the brood food material secreted from the hypopharyngeal and mandibular glands and/or the honey stomach of the workers. The selective uptake and transfer of radiolabeled C_{27}, C_{28} and C_{29} sterols have been studied to correlate these aspects of sterol utilization with the discovery of an unusual molting hormone (ecdysteroid) in honey bee pupae as the major ecdysteroid of this stage of development. The phylogenetic implications of this selective transfer phenomenon in the honey bee and comparison with sterol metabolism in certain other hymenopteran species emphasize the diversity of steroid biochemistry in insects (Svoboda et al., 1986).

Plant pollens have distinctive fatty acid profiles; some are characteristically dominant in one or more fatty acids. Pollens with high lipid concentrations and dominated by linolenic, myristic and dodecanoic acids probably play a significant role in inhibiting the growth of the spore-forming bacteria *Paenibacillus larvae larvae* (American foulbrood), *Melissococcus pluton* (European foulbrood) and other microbes that inhabit the brood combs of beehives. Those pollens high in oleic and palmitic acids probably have a greater role in honey bee nutrition (Manning, 2001).

Honey bee colonies require adequate pollen for maintenance and growth. Pollens vary in nutritional value, and a balanced diet is achieved by mixing pollens with complementary essential nutrients. Subjective evaluation of pollens by foragers in colonies deprived of one or two essential fatty acids (eFAs), alpha-linolenic acid (omega-3) or linoleic acid (omega-6) were tested. Four pollens, two rich in omega-3 and two rich in omega-6 were used. A colony in an observation hive was allowed to forage for two to five days on a single pollen source. The following day, we repeatedly presented one of three pollens: the same pollen that the bees had been collecting the previous days, a novel pollen that was similarly deficient in omega-3 or omega-6 and a novel pollen that complemented their eFA deficiency. The rate of waggle dances, which reflects on the strength of recruitment effort, of foragers returning to the observation hive from each of the pollens were measured. Dance rates did not differ between the four pollens, but they were the highest to the "complementary" pollen and the lowest to the "same" pollen. Furthermore, this effect was greater for pollen combinations with greater eFA disparity between the same and the complementary pollens. Their findings support the ability of bees to balance colony eFA intake. Conditioning of the proboscis extension response (PER) tests showed that pollen foragers discriminated well between the four pollen odors, but the mechanisms by which bees assess pollen eFA composition remain to be elucidated. Differential dancing would recruit foragers to pollens that balance colony nutritional needs (Zarchin et al., 2017).



Vitamins

In general, the vitamin needs of a honey bee colony are satisfied as long as the beebread stores are abundant in the hive, or fresh pollen is available to bees. Also, microbiota present in the elementary canals of bees provide vitamins and other central substances which complete the diet (Standifer, 1980). Nurse bees are thought to need the following vitamin B complex for brood rearing: thiamine, riboflavin, nicotinamide, pyridoxine, pantothenic acid, folic acid and biotin. Ascorbic acid (vitamin C) also seems essential for brood rearing (Huang, 2010).

The requirements of nurse honey bees for fat soluble vitamins to support brood rearing was studied by feeding a chemically defined diet supplemented with either vitamin A, D, E or K (0.4 µg/gram diet) or with a complex of all four vitamins. Control bees were fed the basic diet without fat soluble vitamin supplementation. Bees fed diets containing vitamin A reared more bees to the sealed stage; bees fed vitamin K and ADEK diets reared the next most brood. These three diets all resulted in twice as much brood as the control diet. Bees fed diets containing vitamin D or E consumed little diet and reared minimum levels of brood to the sealed stage (Herbert and Shimanuki, 1978).

Diet in the Winter has a vital effect on the survival and condition of a honey bee colony in the Spring. The effect of supplementation of the diet with vitamin C (ascorbic acid) on the total antioxidant status (TAS), glutathione content and activity of four antioxidative enzymes: superoxide dismutase (SOD), peroxidase (POX), catalase (CAT) and glutathione transferase (GST) of honey bee brood developing in the Spring was studied. Twelve stages, from newly hatched larvae to emerging adult worker bees were studied, allowing changes in the antioxidant profile during brood development to be determined for the first time. It was shown that bees are more exposed to oxidative stress after emergence. In workers emerging in colonies after supplementation with vitamin C, higher contents of protein and glutathione, and higher activities of peroxidase, catalase and glutathione transferase were observed. Vitamin C did not alter brood weight increase, and the level of protein in emerged workers was higher than in the control group. The mean of bee losses over Winter were about 33% lower in colonies receiving vitamin C (Farjan et al., 2012).

The effect of dietary vitamin C on brood rearing of honey bees was studied using both free-flying and confined colonies. Pollen traps were placed on free-flying colonies for a three hour period and the weight of pollen and levels of vitamin C (L-ascorbic acid and dehydroascorbic acid) were determined. The amount of sealed brood in each of these colonies was also measured. Additionally, the consumption and brood rearing by caged bees fed a pollen substitute fortified with zero, 500, 1,000

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or 2,000 µg L-ascorbic acid/g diet were measured. Pollen proved to be a rich but variable source of Vitamin C depending on the date of collection and floral source. There was, however, no relationship between the vitamin C level in the pollen collected and the rate of brood rearing. There were highly significant differences in the vitamin C levels in pollen depending on the date of collection. In the study using caged bees, significantly more brood was reared by bees fed either the diet supplemented with 500 µg/g or the control than by bees offered diets containing either 1,000 or 2,000 µg/g L-ascorbic acid. This study also demonstrated for the first time that bees are able to produce this vitamin since prepupae from colonies fed the diets without vitamin C had equivalent levels of ascorbic acid to those fed the enriched diets (Herbert et al., 1985).

In this investigation, the effects of different levels of vitamin C in sugar syrup on the rate of queen laying, colony population and body weight and protein in honey bees were studied. Experimental colonies had the same age queens and the same population and fed with sugar syrup (50% sugar) in three levels 2000, 4000, 6000 mg/L syrup—soluble vitamin C while the control group fed only with sugar syrup (treatment one control, treatment two, three, four respectively 2000, 4000 and 6000 mg/L vitamin C) were compared. In this experiment, feeding colonies for 60 days in May and June (the first 45 days of feeding every second day and the other without feeding-period of 15 days) were done. The highest average brood area was in treatment two with 2000 mg/L vitamin C (9049 cm^2) while the lowest one was in treatment one (control) (4848 cm^2), respectively. Mean colony population in treatment four was higher than control (10.41 vs 8.38 comb), respectively. The highest mean percent of protein was in treatment two (17.5%) while the lowest was in treatment three (14.18%). Worker bees in treatment four had the greater mean body weight than other groups. The results indicated that supplementing the level of vitamin C to Spring nutrition (1:1 sugar syrup) to the colonies, increases the brood area, colony population and the worker's body weight and protein (Andi and Ahmadi, 2014).

Minerals

The mineral requirements of honey bees are poorly understood. High amounts of potassium, phosphate and magnesium are required by all other insects, and so presumably are by honey bees as well. Excessive levels of sodium, sodium chloride and calcium have been shown to be toxic to honey bees. Again, all the required minerals can be obtained from pollen, although nectar also contains minerals. Dark honey contains higher levels of minerals. The optimal ash concentration for maximum brood rearing seems to be at 0.5%–1%. Pollen with more than 2% ash inhibits brood production (Huang, 2010).

In general, pollen contains the common nutritional minerals: potassium, phosphorus, sulphur, calcium, magnesium, sodium, iron, zinc, manganese and copper (Galetto and Kevan, 2015).

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A Boy and the Beekeeping Bug

Stephen Bishop

Men, if your wife is trying to tell you she's pregnant, whatever you do, don't turn to her and say, "But I don't need one, I've already got three."

Not that I had three children already, I had three bee jackets. The fact is I didn't have any children—my wife and I had been trying for years. Once you've been married for eight years, you start to resign yourself to the possibility that the only offspring you'll hear in your house will be when you rediscover your long-lost burnt CD collection in a storage box[1] (sorry, if you didn't get that joke, it was really very clever—you just weren't a teenager in the 1990s. Please refer to footnote #1 for historical joke context).

So I certainly wasn't expecting to be greeted with life changing news when I walked through the door one Friday after a long day's work. But on the kitchen counter was an envelope, my name written on it in my wife's handwriting. That was unusual; normally, if my wife wanted to communicate with me, all she has to do was tell me the same thing at least two or three times—no writing was usually necessary. A card should have been a red flag because it wasn't my birthday and, after a quick mental panic, I realized it wasn't our anniversary either. But I didn't have time to process the other alternatives because my wife then handed me the envelope and told me to open it.

"What's this for?" I asked.

"Just open it, and you'll see," she said.

Well, I didn't see. The greeting card had two little cartoony bees on the inside, and it said, "I'm so happy to bee with you." Underneath that, my wife had written, "It looks like you're going to need a new bee suit." And underneath that, she had drawn a tiny little bee, about the size of a popcorn kernel. Likely, because I'm a man and was too busy wondering where the gift card was to pay for said bee suit, I overlooked that baby bee and blurted out, "But I don't need one, I've already got three."

And my life has never been the same since. Thomas, my little baby bee, is now two years old, and I'm actually starting to shop for his first beekeeping apparel. He got his first sting a few weeks ago, on the ear lobe, and understandably he is now a little standoffish toward *Apis mellifera*. I hoping that having his very own toddler beekeeping suit will empower his interest in bees again. At the very least, I can put him in the suit and take him to the farmers' market to help with marketing—who could resist buying honey from an adorable toddler in a beekeeping suit?

Secretly, I do hope that Thomas will one day enjoy beekeeping. Growing up, my dad always took me fishing and metal detecting, his two favorite hobbies, and some of my best memories are from spending time with him doing those two things. That said, beekeeping is a lot more like work than fishing or metal detecting, so I'm not terribly optimistic. Right now, Thomas mostly just like trains, firetrucks and tractors.

Even if the beekeeping bug doesn't eventually bite Thomas, as his parent, I've still got a contingency plan—namely a teenager has got to develop a good work ethic, and there is no harder work than lugging honey supers around on a hot July day with your dad.

[1]*In the 1990s, there was a popular band called The Offspring and this thing called Napster where teenagers downloaded music for free to record, a.k.a. to burn, onto CDs. This was more or less illegal, but everybody did it.*

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Stephanie Meyers

IOWA HONEY PRODUCERS

Student (left) Nicholas Wise, brother (center) and mentor Mike Swett (right) examining a hive. Photo credit to Elizabeth Wise.

Mentor (left) Angie Croll and student (right) Zane Wihlm doing a hive check. Photo credit to Tammy Wihlm.

A problem. A plan. A legacy. These three things describe the Iowa Honey Producers Association (IHPA) Youth Scholarship Program. This program, over the course of the last 16 years, has fundamentally changed the organization for the better.

Teresa Brandenburg had a wild idea after being active in the Iowa Honey Producers Association (IHPA) for a couple of years. While serving as the American Honey Princess in 2006 and after completing her one year reign as the Iowa Honey Queen in 2005, she attended all IHPA board meetings. During these years, the IHPA Board was concerned about the future of beekeeping in Iowa as current members were aging and membership overall was decreasing. The board desired involvement from young people but was unsure how to achieve that idea.

While Teresa was traveling around the United States as American Honey Princess, she attended several conventions, always having the aging beekeeper population in the back of her mind. At the American Beekeeping Federation annual conference in Texas, she learned about the Texas youth program, spending a large amount of time gleaning information from those involved. She was inspired to take what she learned while traveling and design a program to assist with the problem the IHPA was facing. She took all the information from what was working and had worked for Texas, along with her background in education, 4H and FFA, and designed a proposal for the IHPA board. The ultimate goal of the program was to allow young people the opportunity to learn about beekeeping and get into the industry regardless of financial means. She understood the need for a mentor, as beekeeping is something that is challenging to do alone.

Teresa's time and passion paid off as a plan was developed. In 2006, with the assistance of Mike and Donna Brahms, Lee Heine and the IHPA board, the Youth Scholarship Program launched. The IHPA board agreed to providing a free membership to the IHPA to all students who were selected. Lee Heine agreed to help with the rest of the funding for the program. Teresa built the scholarship package, wrote the applications for both students and mentors and worked to carry out the program, with the assistance of Mike and Donna Brahms.

Approximately eight students applied that first year, according to Teresa. She, along with Lee Heine, sat down and interviewed each student at the annual conference. At the end of the interviews, Mr. Heine looked at Teresa and stated that he didn't want to decide so they were going to give all the applicants a scholarship. Prior to interviews, they had planned to give out only four or five scholarships. Teresa's plan was launched in a big way. She managed the program for that year and helped to interview the second year, in 2007. Then, she got married and moved to Kansas. Mike and Donna Brahms continued the program for a few years before handing it off to other individuals to coordinate.

A legacy was created with the launching of this program. When the current program was described to Teresa, she said that it basically still looks the same. Currently, students are required to fill out and submit an application to the current coordinator postmarked by September 15th including a summary of involvement in activities (school, community, church and other youth or civic organizations) as well as two letters of recommendation. In order to apply, students must be between the ages of 13 and 16 by November 1st of the current year. The scholarship coordinator reads through the applications and extends an interview to students who meet the requirements. Interviews are held in October either over the phone or in person. A recommendation is put together and submitted to the IHPA board for approval. Students are then notified of acceptance. Those accepted into the program are invited to that year's annual meeting and required to attend Saturday's activities to begin learning about bees and talking with other beekeepers. Besides attendance at the annual conference, students receive one complete hive consisting of two standard hive deeps and two medium honey supers, all frames and foundation, a bottom board, inner cover, top cover, feeder and one 3-lb package of bees with a queen. Protective equipment is also included – a smoker, hive tool, beekeeping jacket/suit and gloves. The benefits do not stop with equipment! Students receive a one year membership to the IHPA including *The Buzz* publication and registration fees and educational supplies for beginning beekeeping classes.

The best part of the program is the mentoring component, according to past students. Each current student is assigned a mentor who will assist them one on one throughout the year. Mentors have at least three years of experience and are dedicated to teaching and working with students with a commitment of one year. Mentors assist students with assembling equipment, installing bees, examining hives, harvesting honey and anything and everything that comes up in-between. Mentors and students, many times, develop a relationship that spans years. Many past students still contact their mentors for questions and concerns. The mentoring component helps to alleviate failure and frustration as students are getting involved in beekeeping.

Scholarship students are expected to complete some tasks throughout the year. Students must attend and successfully complete a beginning beekeeping class. They must also maintain a bee colony throughout the year and contact with the scholarship coordinator and their mentor. Students are required to attend the IHPA annual meeting after their year of beekeeping and give a final report to the coordinator. This report includes their successes and mishaps through the year, some of what they learned and goals for the future. We encourage students to keep a journal or written record of their year along with photos.

The IHPA continues to look for ways to improve the program. Bee Camp, in its second year in 2023, is a two day intensive camp all about bees. Students work with beekeepers getting hands-on experiences in an overnight camp experience. The topics presented last year included basic hive inspections, queen rearing and marketing techniques. Scholarship students have the opportunity to attend free of charge. The camp will also be open to the public this year to involve other youth interested in or getting started in beekeeping. Other opportunities for scholarship students include attending Iowa Honey Bee Day at the Capitol, Summer Field Day and giving back to the organization through volunteering at the Iowa State Fair Parade and booth.

Teresa saw a problem, created a plan and left a legacy. After hearing about 16 years of a successful Youth Scholarship Program, Teresa is beyond grateful that her idea and dream was still being carried out today. When asked about her words of advice to others, she said, "You can never go wrong with getting young people engaged in something. If you have something you are passionate about and can help young people get passionate about it as well, that is how you create change!"

Personally, the IHPA Youth Scholarship Program changed our family. Our oldest daughter was a 2020 scholarship recipient. Due to the strange year, we worked with many beekeepers in our area as mentors and became involved in the IHPA. Interest was sparked in each of our children with each one being involved in different ways, from marketing to education to assisting hands-on. This program was not just about bees, it assisted our children in public speaking, relationship development, communication skills, general confidence, time management and even business skills. Other past scholarship students and families also share these positive outcomes.

Young people are the future and voice of beekeeping for generations to come. If you would like more information on the Iowa program, please do not hesitate to reach out via e-mail at **sonshinefarmsia@gmail.com**.

A problem was noticed. A plan was created. A legacy was left. Here is to the future of beekeeping! BC

Stephanie Meyers
Current IHPA Youth Scholarship Coordinator

Student (left) Nicholas Wise, mentor (center) Mike Swett and student (right) Noah DeSotel sporting beekeeping shirts at annual conference. Photo credit to Lynn DeSotel.

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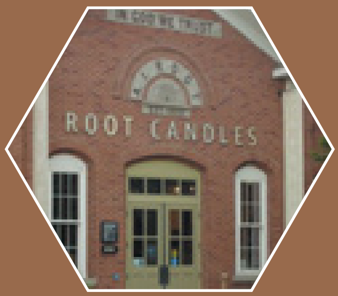

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Time to Expect the Unexpected

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Last season I killed off a perfectly good colony of bees. Not purposely, mind you. Believe me, I thought I was doing what was best for the bees – until I thought again.

It was mid-September when I noticed that a colony in one of my Vermont beeyards had no brood. This is a situation I have gotten somewhat used to. After harvesting the honey supers between the end of August and early September, all the bees get crowded down into the equivalent of two to 2½ deep supers and they sometimes send off a late season swarm. I figure that the part of the colony left behind following these late season swarms have a more difficult time successfully replacing their queen due to the cooler weather, lower drone population and reduced forage that typically occur here in the northeast at that time of year. All too often in September and October, I have seen colonies become queenless, or turn into drone layers, and I have typically attributed this situation to the poor mating conditions that exist at this time of the season. It's beekeeping and stuff happens.

Rather than simply let these queenless colonies slowly fizzle out, and possibly get invaded by wax moths, I have always preferred to place any full honey supers from the queenless hive on colonies that could use more honey for Winter. The hive bodies full of bees get temporarily placed on top of the inner covers of colonies that could use a boost in their bee population. As I was breaking this queenless hive up to share its resources between some of the other colonies in the apiary, I noticed that the hive was unusually full of bees. The population was much more than I would expect for a hive that didn't have a laying queen. Then I saw the queen. She looked perfectly normal. In fact more than normal; she looked good. But I judged her on her performance and there was no brood, and without the ability to raise new workers a colony is doomed.

Now, I don't normally subscribe to the management style of killing off queens and replacing them, but when combining a colony with a queen that is no good with a queenright hive, I will kill the failed queen just to be sure she doesn't somehow replace or injure the good queen. This queen was not laying eggs so she had to go.

Then about two and a half weeks later, well into November, the weather finally turned cold enough to kill off the wax moths. I went around removing the empty supers I had stored above the inner covers of my hives to place them in an unheated shed for Winter. I like to go out early in the morning to do this while it is still cold and the bees have not warmed up and broken out of the cluster around the brood nest. This makes taking off the empty supers much easier and faster since I don't have to light a smoker because the bees are all down below the inner cover and slow to take flight.

My Ah-Ha! Moment

I didn't think much more about this queenless hive until the holiday season when I ran into another beekeeper and we did what beekeepers tend to do when they get together: we talked about the bees. This beekeeper told me that he had noticed some of his colonies shutting down their brood rearing much earlier in the season than normal. He attributed this to the very dry weather we had experienced late in the Summer and that's when I got this sinking feeling in the pit of my stomach and realized that it was highly likely that I had destroyed a perfectly good colony of bees.

The Drought Response of Plants

The impacts of drought can be much more subtle than the increased incidences of wildfires we have seen around the globe in recent years. Plants in temperate climates typically need much larger quantities of water than bees do, and the negative consequences of dry weather conditions on flowering plants is well documented.

One effect of drought on vegetation is a reduced rate of photosynthesis (Pinheiro and Chaves, 2011), which leads to a reduction of energy available for plants to invest in the production of flowers. This means fewer and smaller blossoms are produced by effected plants (Kuppler & Kotowska, 2021).

When plants are able to produce flowers during drought conditions the blossoms produce less pollen (Waser & Price, 2016) and the pollen produced is more likely to be of low quality with reduced protein content and less reproductively viable (Al-Ghzawi et al., 2009; Rankin et al., 2020; Descamps et al., 2021). Even the scents that flowers use to attract and influence pollinators are impacted by extremely dry conditions (Burkle & Runyon, 2016; Rering et al., 2020).

Nectar production in flowers is likewise negatively impacted by drought. Generally speaking there needs to be water in the soil in order

"Beekeepers commonly claim that during times of nutritional stress or dearth, the queen will stop laying eggs... Unfortunately, this common belief does not appear to be totally accurate."

Science has already determined that in a high carbon dioxide atmosphere, plants on earth produce more carbohydrates and less protein which has resulted in a dramatic decrease in the protein content of pollen over the past century. When this greenhouse-gas induced protein reduction is combined with drought induced protein declines in pollen, the resulting dietary deficiency of protein on honey bee colonies can be severe.

for plants to produce nectar. Reduced water availability is linked to lower nectar volume in flowers (Carroll et al., 2001; Phillips et al., 2018; Gallagher & Campbell, 2017; Halpern et al., 2010; Villarreal & Freeman, 1990). Sometimes, even the sugar concentration of the nectar produced under drought conditions is negatively impacted (Wyatt et al., 1992; Waser & Price, 2016; Rankin et al., 2020).

Droughts Effect on Bees

Since drought conditions cause plants to produce less pollen and nectar and any pollen and nectar that is produced tends to be of lower quality, it is generally accepted that drought conditions result in nutritional stress to honey bee colonies. Beekeepers commonly claim that during times of nutritional stress or dearth, the queen will stop laying eggs. This is commonly observed in northern climates during the Winter months when brood production slows dramatically and often stops altogether during Winter. Unfortunately, this common belief does not appear to be totally accurate.

Back in 2004, Austrian researchers found that in times of nutritional stress the queen does not necessarily stop laying eggs or even reduce her egg laying, but she does reduce her walking activity within the hive (Schmickl & Crailsheim, 2004). The colony response that does appear to be consistent with lack of adequate food availability is that worker bees will cannibalize eggs and larvae to conserve nutrients (Webster et al.,


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1987). Eggs and middle-aged larvae are the most likely to be cannibalized. This causes the colony's larvae demographics to change dramatically within days resulting in a rapid decrease in the older larvae population. During nutritional stress events such as those that occur during a prolonged drought, cells containing the oldest larvae are capped earlier for pupation, while the eggs and younger larvae are cannibalized (Schmickl & Crailsheim, 2001). Researchers found that the less pollen stored by the hive during larvae's development, the earlier the larvae are capped. This is a logical decision by the bees since the oldest uncapped brood represents the greatest investment in brood care resources. Prior to capping, older larvae also have the greatest need for pollen, so by capping their cells early, the colony is able to compensate for a food supply shortage by reducing the young with the greatest demand. This leads to a quick reduction of older unsealed brood in response to a shortage of available protein. If a period of dearth extends long enough, all the capped brood will hatch and there will be no brood left in the hive due to the egg cannibalization efforts of the nurse bees. This explains why my broodless colony had a queen that looked perfectly normal and she was not shrunken and small from a lack of egg production like a virgin queen who has yet to lay eggs.

A Taste of Things to Come

Under climate change, extreme climatic events such as droughts are projected to increase in frequency, duration and severity (IPCC, 2022). In temperate regions, the consequences of water deficit during the peak growing months can be expected to be more severe because drought has not previously been an important environmental factor on plant evolution like it has been in arid regions (Chen et al., 2013).

Current predictions suggest that in **temperate zones** such as those throughout the northeastern U.S., climate change will increase the frequency of extreme events such as Summer droughts, leading to deficits in water availability for ecosystems. This is expected to result in plants more often experiencing water stress during the Spring and Summer. As beekeepers we need to be conscious of the fact that the current pace of climate destabilization will continue to accelerate due to our slow transition away from fossil fuels, rampant consumerism and materialism. This will cause our honey bee colonies to behave differently than what we have grown used to during previously more climate stable times.

I definitely learn more from my mistakes than from my successes. In sharing this experience, I am reminded that we all have something we can teach others, even if we only act as a stellar example of what not to do. BC

Ross Conrad is the author of *Natural Beekeeping: Organic Approaches to Modern Apiculture* and coauthor of *The Land of Milk and Honey: A history of beekeeping in Vermont.*

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1890 LAND-GRANT FUNDED BEE RESEARCHER

Austin Carey

Dr. Hongmei Li-Byarlay

Dr. Hongmei Li-Byarlay is an Associate Professor of Entomology at Central State University in Wilberforce, Ohio. Hongmei Li-Byarlay was born in Tianjin, China in 1976 and came to the United States in 2002 in order to obtain her doctoral degree in Entomology from Purdue University (Indiana). She then joined Gene Robinson's honey bee research lab at the University of Illinois at Urbana-Champaign as a postdoctoral fellow, then went to North Carolina State University for three years before joining Central State in 2017.

To follow, I talk about some of her current research in honey bee health, focused on mite biting behavior and the underlying mechanisms of mite resistance, the genetic basis of aggression behavior and the mechanisms by which different stressors impact the physiology and lifespan of honey bees. I also speak a little on the background of Central State University and the opportunities that being an 1890 Land-Grant university affords us as researchers.

Our Lab's Current Research

American beekeepers know that the European honey bee was not well adapted to dealing with a threat like the *Varroa* mite and have suffered heavy losses since the 1980s. These losses came due to increased stress on the brood, as well as diseases brought into the hive via *Varroa* invaders.

Many solutions to this pervasive pest problem have been proposed over the years but most people fall back on the tried-and-true method of acaricide use to quell their ever expanding mite populations. At Central State University, our honey bee breeding program is attempting to produce honey bees that are resistant to *Varroa* mites via an increased level of grooming behavior. Our current breeding line is called Ohio High Biting #1 (OB1) stocks. We breed feral colonies from Southern and Central Ohio with high grooming and high mite biting behavior, as well as collaborating with Purdue University bee lab led by Dr. Brock Harpur and Extension specialist Krispn Given as multi-state efforts on breeding better bee stocks.

Grooming behavior is most often assessed by carefully examining mite samples underneath a microscope determining what percentage of the mites collected in that sample have been chewed by bees in that particular colony. These samples are collected by placing a sheet of metal or plastic underneath the colony you want to sample. The colony should have a screen bottom board, so that any mites that may fall from above fall through the screen and on to our collection sheet. After a few days the sheet should be pulled out and mites carefully removed and placed into a container to be examined later.

The process of collecting biting data is essential to our work as it allows us to determine which colonies we should use in our breeding program. Once those colonies are found and selected, we either use them for grafting new queens or use its drones to inseminate other queens in the hopes of producing offspring with even better grooming potential. Our goal is to breed a mite biting honey bee stock capable of coping with the *Varroa* mite threat and to potentially apply these breeding techniques to other useful traits exhibited by honey bees. Our published paper in 2021 revealed that changes to the bee mandible may explain why these worker bees perform high grooming behavior and mite biting behavior (Smith J, Cleare X, Given K, Li-Byarlay H, 2021. *Morphological changes in the mandibles accompany the defensive behavior of Indiana mite biting honey bees against* Varroa destructor, Frontiers in Ecology and Evolution **doi: 10.3389/fevo.2021.638308**). In this publication, we compared the three dimensional morphological structures of breeding stocks and discovered the shape of the high biting workers from breeding colonies is different from commercial colonies.

1890 Land-Grant Institutions

Before we talk about how Central State being an 1890 Land-Grant institution has influenced us and our research, it is important to understand what that means. The 1890 Land-Grant

CSU Students collecting drones by our university hives. Photo by Hongmei Li-Byarlay

Institutions are national programs supported by the U.S. Department of Agriculture to deliver agricultural research, extension services and education to the public.

As of writing, there are nineteen historically black universities across the United States established under the Second Morrill Act of 1890 and are called the 1890 Land-Grant Universities (Allen and Rajotte, 1990). A lot of these institutions have active research, extension and educational programs in the topic of Entomology, which is an essential component of agricultural science, research and technological development. Central State University has sought land-grant status since 1890 when the federal government designated the first set of Historically Black College and University (HBCU) as land-grant colleges. On January 29, 2014, U.S. Sen. Sherrod Brown (D-OH) and U.S. Representative Marcia Fudge (OH-11), senior members of the Senate and House Agriculture Committees and members of the Farm Bill Conference Committee, announced that Central State University was added to a distinguished list of HBCUs focused on expanding opportunities for agricultural research and education, commonly referred to as "1890 Universities." The new status enables the university to expand its research and extension capacity in the areas of science, technology, engineering, agriculture and math (STEAM) and enlarge our outreach and support of sustainable agriculture.

How Does This Impact Us?

The 1890 Land-Grant Research fund enabled our CSU Bee Research Lab to use cutting edge technologies and tools in modern genetics and genomics to do important research on honey bee genetics and breeding. Only when we know the gene markers and genetic components of mite resistant traits such as grooming, will we be able to breed and select faster and better honey bee stocks for American beekeepers and sustainable agriculture. In addition, working closely with students at CSU can enable us to train the next generation of researchers from underrepresented minority populations to become pillars of the agricultural workforce.

Working with pollinators allows us to help beekeepers and contribute to agriculture as a whole. Doing research is a slow process that requires a lot of teamwork but with both focus and patience it can be incredibly rewarding. BC

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A queen waking up after instrumental insemination. Photo by Hongmei Li-Byarlay

Inseminated queens at CSU. Photo by Hongmei Li-Byarlay

BEE VET

State Apiarists and Veterinarians

Dr. Tracy Farone

Over the holidays, I had the opportunity to reach out to several State Apiarists to discuss ways they believe veterinarians could help to serve honey bees and the beekeeping industry. Joan Mahoney, the State Apiculturist for the New York's Department of Agriculture; Barbara Bloetscher, State Apiarist for the Ohio Department of Agriculture; and Kim Skyrm, Chief Apiary Inspector for the State of Massachusetts's Department of Agricultural Resources (with contribution help from the entire MA Bee team: Paul Tessier, Shay Willette and Jessica Glover) all graciously agreed to share their thoughts on the matter. I asked a few basic questions, but we also touched on a few more sensitive subjects. I was excited to listen to what they had to say, give my two ears and (mostly) keep my mouth shut for a month.

Q1. Are there any existing collaborations between state apiculturists and veterinarians in your State in the care and treatment of honey bees?

Joan – Yes, when beekeepers request antibiotics to treat non-symptomatic colonies exposed to American Foulbrood (AFB), the New York State Department of Agriculture and Markets refers them to veterinarians who are able to provide the necessary prescription.

Barb – The Ohio State University College of Veterinary Medicine has invited me and The Ohio State University State Apiculturist to give talks to the veterinary students who are interested in the apiary program. Both undergraduate and veterinary students have invited us to speak to their clubs and participate in the OSU Food Animal Medicine Student Symposium Hands-On Workshop-Wet lab they have in early Spring. I have also spoken at the Midwest Veterinary Conference on honey bee diseases. OSU offers an externship for graduating veterinary students to experience areas of interest. Thanks to one persistent student, the OSU Apiculturist and I have "shared" one or two students each season three different years. The intern works with the Apiculturist on different studies and spends a day or two with me in the field, inspecting colonies. They have all commented on how much they appreciated the opportunity.

Kim – Yes! Apiarists or Apiary Inspectors visit beekeepers to perform health inspections of honey bee colonies and used equipment. If during an inspection, the inspector discovers visual symptoms of European Foulbrood (EFB), then a sample is taken from the colony and sent to the lab for analysis. Inspectors provide a report of the findings from the inspection and the lab provides results for the sample directly to the beekeeper. If lab analysis confirms the presence of EFB, then inspectors recommend treatment using an antibiotic. To obtain the antibiotic, inspectors instruct the beekeeper to contact a local veterinarian and provide the documentation received from the inspection including the report and lab analysis. The veterinarian then meets with the beekeeper and establishes a veterinary-client-patient relationship (VCPR) and issues a prescription for the antibiotic to the beekeeper. The inspector and the veterinarian follow up with the beekeeper to ensure the medication was successful and EFB controlled. As part of their role, Apiary Inspectors must ensure compliance for the treatment and management of contagious or infectious diseases and EFB is typically listed as a regulated disease.

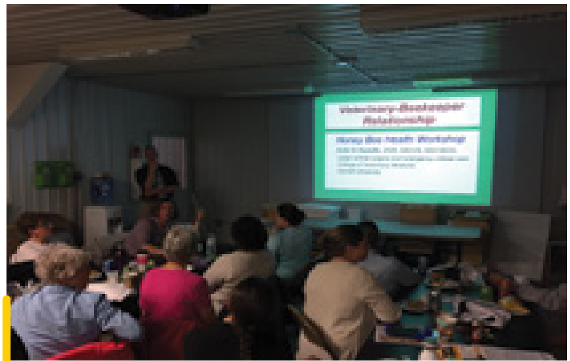
One area we feel has expedited this process is that we supply beekeepers with free sample kits that provide the materials and instructions they need to take samples for EFB/AFB, *Varroa* mites/Nosema from their colonies and send directly to labs for analysis. This has really sped up disease detection and diagnostic services in our state. We started this component of our program services in 2018 and it has been so well received and popular in our state that we have given out over 3,000 of these to date for beekeeper use. In addition to supporting our program in finding incidences of health issues, it has also allowed veterinarians to get quick lab analysis for samples to enable them to respond faster when needed.

Q2. What services from veterinarians could be of the most assistance to State Apiculturists? To beekeepers/the beekeeping industry? Could you use some help BEYOND providing VFDs and prescriptions for three antibiotics?

Joan – With the development of vaccines for AFB and RNAi treatments for *varroa* mites on the horizon, greater veterinary involvement will be beneficial to beekeepers.

Barb – It would be very helpful for beekeeping organizations such as ABF, AHPA, HBHC and all State

Barb and Hailey (vet student) inspecting. Photo credit: Barb Bloetscher



Veterinarian beekeeper talk at Betterbee in NY. Photo credit: Joan Mahoney

and local beekeeping associations to have a vet on their board and as a speaker every year. We would like veterinarians to explain their role in prescribing VFD's for bees and the reasons that the FDA is taking this role more seriously. The Honey Bee Veterinary Consortium provides names of veterinarians who work with beekeepers, but I don't think it is widely known. In addition, every vet school should invite bee knowledgeable veterinarians to share ideas and solutions.

I have witnessed beekeepers spend several hours teaching a veterinarian basic beekeeping knowledge only to have the veterinarian charge him for the vet's time. Seems like it should be the other way around! I think beekeepers and the veterinarians need to understand each other's perspectives so that we can work together better.

Kim – Our biggest challenge is finding veterinarians who can assist beekeepers in accessing the antibiotics necessary for the treatment of EFB. There are only a few veterinarians who are aware of the existence of apiary programs and the prescription needs for beekeepers. My suggestion is that if you are an interested veterinarian, please advertise your willingness to be of service to the beekeeping community by contacting local bee groups and sharing your information with them as well as on the "Find a Bee Vet" listing on the Honey Bee Veterinary Consortium website. We have been lucky in Massachusetts to have a few veterinarians who have been willing to take on this role and "bee" diligent about responding quickly to beekeeper needs and providing support, but we have a lot of beekeepers, and these wonderful veterinarians could use additional support too!

Q3. Beyond possible antibiotic treatment for AFB and EFB, do you think it is important for veterinarians to have a solid understanding of honey bee management, biology, nutrition and pathology to serve these animals and beekeepers?

Joan – Yes, in New York, we recognize that veterinarians should understand honey bee health and have been working to educate and train veterinarians. Dr. Scott McArt, PhD, from Cornell University and Dr. Christopher Cripps, DMV from Betterbee have been working together, along with Drs. Robin and Rolfe Radcliffe, DMV and Dr. David Peck, PhD, to hold workshops aimed at giving our veterinarians a solid understanding of honey bee management and diseases. Additionally, Cornell has added curriculum in their College of Veterinary Medicine to ensure that honey bees are part of veterinary training.

Barb – Yes, I see the need for veterinarians to show beekeepers why prophylactic use of antibiotics hurts the honey bee industry by weakening the bees and spreading disease to other apiaries. Some State Apiary Inspection Programs do not receive the support needed to stop the spread of AFB and EFB. If the veterinarians can also guide beekeepers toward proper use of antibiotics and to burn, when necessary, it would help support the state programs.

Kim – We do not recommend antibiotic treatment for AFB – this pathogen is too virulent and pathogenic to be treated – infected colonies should be destroyed. Honey bees are no different from any other managed animal in that they require care; therefore, veterinarians are uniquely suited to partner with beekeepers to provide support. It is imperative that veterinarians have a working knowledge of honey bee management, biology, nutrition and pathology to best assist these amazing organisms and the beekeepers who manage them for pleasure and profit. I have always found both beekeepers and veterinarians to *bee as (com)passionate* and fascinated with the art and science of beekeeping as well as intent to ensure bee health and sustainability of the population.

Q4. In some States, honey bees and State Apiculturists are housed in the Plant Division or Bureau of the Department of Agriculture. Do you think there could be any benefit for honey bees to be classified as animals (by State governments)? Could this realignment bring more attention, recognized status and possible funding to honey bees as an agricultural animal or would that cause too many bureaucratic issues?

Joan – In New York we have explored this. After the recent retirement of our director of the Division of Animal Industry and a new in-

AFB/EFB kits Kim Skyrm provides to beekeepers to take samples. Photo courtesy of Kim Skyrm.

Kim Skyrm inspecting nucs. Photo courtesy of Kim Skyrm

coming director, we discussed the move but thought it best to continue to house honey bee work in the Division of Plant Industry. The New York State Department of Agriculture and Markets is a small agency, so communication between divisions is continuous.

Barb – Oh boy, I don't think I know enough of the politics to answer this, but honey bees are livestock, and are maintained as livestock. Maintaining healthy colonies is crucial for agriculture so perhaps the beekeeping industry would be taken more seriously and receive funding from multiple sources. Through time, these programs evolve and move around. No doubt when the apiary programs were first developed, the plant industry was mostly agricultural and the bees are the means to achieve a yield, so being in the plant division made sense.

Kim – You may have heard the recent California ruling that bees are now classified as "animals" (i.e., fish). In short, yes, for some states/territories there are many benefits to classifying bees and insects under the umbrella of "animal". The need for this depends on the language in each state/territory legislature. Ultimately, the root of this question is about support. Honey bees, beekeepers who manage them and veterinarians who provide support would all benefit if Apiary Programs across the country were more adequately funded with a sustainable budget and full-time staff. This would not only allow for better services to beekeepers but also a team of folks working together (including veterinarians) who are focused on honey bee health full time, year-round. Getting the word out about the vital role of Apiary Programs and the services they provide is hard given that budgets are never static, and bees should always be considered a top priority. Honey bees and beekeepers deserve attention now and, in the future!

Q5. Do you think there is a way to correct, modernize and update honey bee diseases' focuses to realize the current and actual threat level of all diseases in honey bees to create more support in staff and funding? (i.e., CCD and AFB playing a lesser overall role with *Varroa*, viruses, nutrition, Nosema, etc. gaining larger and additional attention).

Joan – Yes. This year in New York State, we saw a decrease in AFB; however, *varroa* mite losses, coupled with viruses and drought conditions, are expected to lead to many more colony losses than AFB. We need to focus on beekeeper education and continued development of queens with resistant, hygienic traits. Such traits have been shown to reduce *varroa* levels and virus levels, as well as AFB infections.

Barb – Education is the key. We need to teach and emphasize the best strategy to solve beekeeping problems and lead people to the best resources so that they are less tempted to "go fishing" online. Beekeepers don't consider *varroa* mites to be the serious vector that it is. We may consider AFB to be serious, but since "everyone" has *varroa*, it is just a problem that constantly hinders our success. As long as 40% of our colonies are dying every year, it is obvious that *varroa* needs to be monitored all season and treated with labeled products as needed. *Varroa* control should be a priority in colony management.

Kim – Knowledge and exposure is key. No other entity inspects more honey bee colonies, visits more beekeepers, submits more lab samples or communicates with the beekeeping community than Apiary Inspectors. Keep in mind that many of the major honey bee health issues were also initially discovered by Apiary Inspectors or collaborators working closely with these entities. Given this, I always say if you want to know about honey bee health in your area, talk with an Apiary Inspector. "My" responses were a whole hive effort from the entire MA Bee team: Paul Tessier, Shay Willette and Jessica Glover!

Q6. How would you like to see apiculturists and veterinarians work together to serve beekeepers in the future. What do you think is ideal... possible... and practical?

Joan – Apiculturists and veterinarians should keep lines of communication open and provide each other with regular updates. Apiary inspectors should continue conducting inspections with veterinarians serving as a resource and providing guidance and medical services as needed.

Barb – I think the first step is to communicate more. I would like to have veterinarians attend beekeeping meetings and speak, or at least have a booth to answer questions.

The perception is that veterinarians have not been taught the importance of managed honey bees. Mammal livestock and poultry have been considered the important "animal" livestock and where the money is. Honey bees were seen as a production agriculture input and not as a vitally important industry. Beekeepers do not promote themselves well as livestock managers but if you think about it, beekeepers make up for losses by making splits. You can't do that with animals. If growers lost 40% of their herd, we would all be in serious trouble, yet statistics show that beekeepers continue to lose 40% of their colonies every year. This is not a sustainable practice. We don't get ahead, we just stay "even".

The comments I have heard from hobby, sideliner and big commercial beekeepers is that beekeepers have been their own "veterinarians" since the beginning of beekeeping. They have "done everything a veterinarian would do" (with the help of USDA, Universities and dumb luck). "Why do 'we' need a real veterinarian when we know more than they do?" We need to communicate this issue so that both parties understand how we can work together to improve beekeeping biosecurity. Honey bees have the potential to be flying pest/pathogen carriers as colonies are moved around the state and the country. We all have the same goal – to maintain healthy colonies. Beekeepers need to be able to recognize serious bee diseases, as do veterinarians. We need to know when to use antibiotics and when to burn.

The beekeeping industry needs to be universally recognized as being critical to pollinating our food supply. With veterinarians assisting with maintaining strong colonies and stressing the importance of using them to produce optimal crop yield, I think organizations and growers will realize how much we depend on the beekeeping industry.

Kim – Ideally, every state/territory would have a fully funded and staffed Apiary Program. Apiary Inspectors would provide inspection services and lab analysis for beekeepers and collaborate with veterinarians to ensure honey bee health is maintained regarding the use of antibiotics. Every state/territory would have a list of several eager veterinarians who have advertised their availability and willingness to provide services to the beekeeping community. Veterinarians would work collaboratively with apiarists to monitor honey bee health, support beekeepers real time and follow up to ensure that recommendations and treatments were successful.

Possibly and practically, apiarists would inspect beekeepers and provide recommendations and veterinarians would assist with prescription and treatment plans. It's fairly simple in the need and execution of these roles but could be complex in the ability of states/territories to direct funding and visibility to ensure these groups are able to collaborate and provide service.

I appreciate these knowledgeable folks sharing their input and experiences! Thanks Kim, Joan and Barb! For me, they are largely preaching to the choir, and I can happily say that in the last five years, I have personally witnessed positive strides in many of the concerns they bring up. However, we still have some things to figure out, improvements to be made and some time to pass to appreciate current investments. I believe this is a conversation that will continue to develop into the future. Like most things, it's all about developing positive relationships and accomplishing common goals. BC

A Couple of Resources:

List of State Apiarists: **https://www.blueskybeesupply.com/state-apiarists/** Accessed 12/28/22.

Apiary Inspectors of America (AIA) **https://apiaryinspectors.org/**

Kim Skyrm taking samples of deadout. Photo courtesy of Kim Skyrm

Shay Willette and David Saleh inspecting nucs. Photo courtesy of Kim Skyrm.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Off the Wahl Beekeeping

RIDDING CRITTERS OF THE BEEYARD

Richard Wahl

Much has been written about invasive pests inside the beehive such as *varroa* mites, wax moths and hive beetles. There is not as much about those animals and critters which exist outside the hive that present a hazard to our bees or can become invasive. So, in this issue, I will delve into a few of the outside arthropods, birds and beasts that can pose a threat to one's beehives depending on your proximity to their habitats. Some of this is a result of my own experiences in beekeeping management with a few asides that we would never expect to encounter here in SE Michigan. Possibly, you will find a few remedies here that will help if your hives are being invaded by uninvited guests.

Arthropods

Honey bees as well as other bee species and ants fall under the phylum classification (Arthropoda) of invertebrate animals such as insects, arachnids and crustaceans, that have a segmented body and jointed appendages, usually an exoskeleton molted at intervals and a dorsal anterior brain. Included in this phylum, other bee species such as wasps, yellow jackets and bald faced hornets are attracted to the honey in beehives. Since I covered how to make a wasp trap out of a two liter soda bottle in the December issue, I will not repeat that topic here. Suffice it to say that my experience is that honey bees do not seem to be attracted to solutions in a wasp trap that do attract other types of invasive bees. Although the Fall season is when most wasps and yellow jackets are most actively seeking out honey from beehives, placing a trap out in the Spring, once your honey bees become active, may enable the capture of overwintered female queen yellow jackets or wasps before they begin to establish nests that will be populated by many more invasive bees in the Fall. Ants are another insect in this classification that can decide to invade the beehive. I have found ants establishing themselves in my one inch thick foam insulation slabs just under the outer cover. On one occasion, I had not removed the screen taped to the top of an inner cover and ants decided to set up housekeeping and the laying of eggs between the inner and outer covers where the bees had no access.

There are several ways in which to dissuade ants from visiting your hives. If the beekeeper can spot the trail of ants moving to and from the hive to their nest, the nest can be treated with any number of non-chemical ant repellents. Ants give off a pheromone just as bees do so their partners can follow a trail to a food source, in this case the beehive. Diatomaceous earth kills ants by absorbing the oils in their exoskeletons. Diatomaceous earth isn't a poison. Food-grade diatomaceous earth can be found online. A glass cleaning spray mixed with liquid detergent (dish soap) can be sprayed on areas where ants seem to crawl, like on beehive legs or stands. Cinnamon or black pepper can be sprinkled liberally around the hive base or even on top of the inner cover as ants avoid the smell but bees don't mind it. Any of these exterior applications will need to be reapplied after a rain as the rains will wash away powders or sprays. Any grease or lard type substance can be spread on hive stand legs to keep ants from crawling up onto the hives. I am aware of a few beekeepers who use a product called Tanglefoot, which is in this grease category, which claims to be non-chemical. If the beehive sits on legs each leg can be placed in a bucket or can and be surrounded with water to form a moat. Adding a few drops of detergent to the water decreases the surface tension so ants cannot build an ant body bridge across the water. This can happen if legs are too close to the container edge. A few ants in the hive are nothing to worry about. The honey bees will keep ants out of any portion of the hive that they populate and can easily reach, although the much smaller ant can still find crevices and cracks in which to reside and steal a bit of honey or nectar when the opportunity allows.

Ants on inner cover in a beehive

Mice, Voles or Shrews

As the weather turns colder, mice may search for a warmer space to make a nest. The beehive is a perfect place that also provides honey and nectar as a food source. During a colder part of the year, when bees are clustered and not as active, these small rodents may determine a beehive is a nice place to nest. They will chew out a corner of the bee frames and bring in nesting material. Urination may add a bad odor near the nesting area which they will not vacate until bees become more active on warmer Spring days. Although voles and shrews do not nest in hives they are insect eaters and will feast on bees if given the opportunity. In each case, the best solution is a preventative screen placed over the hive entrance that allows space for bees, but is not large enough for these small critters. For mice, a ½ inch wire mesh may be sufficient. But if your voles or shrews are of a smaller type the entrance holes may need to be reduced even farther to ¼ inch. In either case, once the weather warms and the bees become active enough to protect themselves, the entrance screens should be removed to allow the bees the space to do everything they want to do, such as removing dead bee bodies from the hive. This bee action can be assisted by using a curved ½ or ¾ inch flat slat to pull any dead bees out of the hive from the bottom entrance once or twice during those warmer Winter days. This goes a long way toward avoiding dead bees in the hive molding and spreading any inherent diseases.

Mouse nest in hive frames. (Photo by Judith Stanton)

Birds

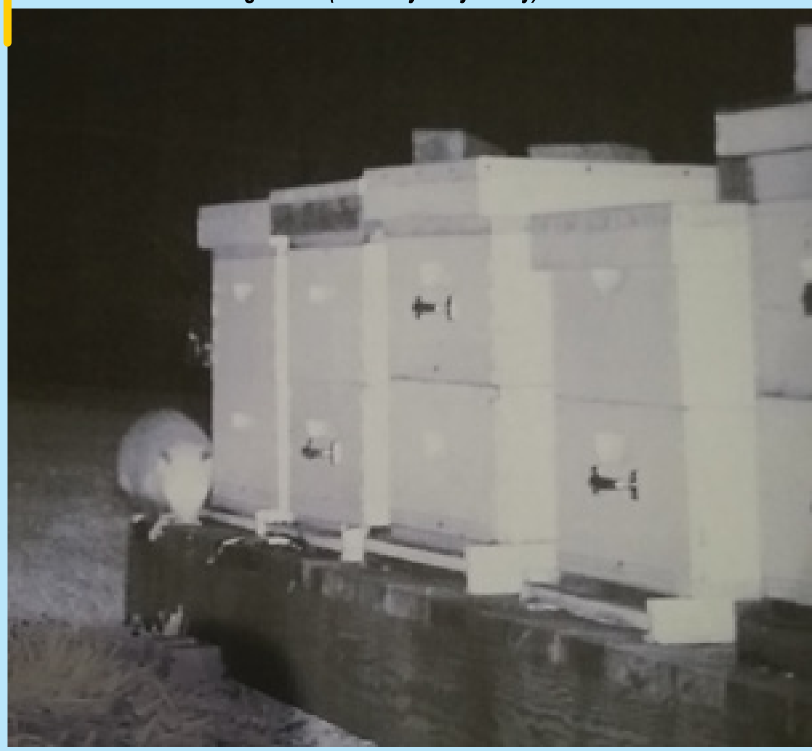
Although there is no way to completely protect foraging honey bees from birds, I did find a solution for a group of barn swallows that were nesting under a barn eave just above the areas of my hives. I watched as they would swoop down and grab bees in flight while building their mud nests under the eave one Spring. Since there were no eggs or chicks in the nests at the time I knocked the nests down with a long pole. I had purchased one of those swivel head plastic garden owls and then set it on top of a hive in the middle of my beeyard. The swallows had a fit screeching at the owl predator the rest of the afternoon and did not come back the next day or any time thereafter to date. I noticed that small birds in general do not seem to frequent my apiary area with the plastic barn owl set out on the top of a central hive each Spring. I fastened a weight to the owl base to keep it from blowing over in winds.

Plastic owl sitting on a beehive.

Skunks, Possums and Raccoons

One Winter during my early beekeeping years, I noticed that the western most hive seemed to have fewer bees each time I checked on those one-or-so-a-month warmer Winter days when you can take a quick look to see if more food supply is needed. I did not notice until Spring inspections that there were scratches from a small critter on the side of the hive near the bottom entrance with no live bees to be seen. One Spring morning the smell of a skunk was a clue as to what type of interloper I had. The skunk would scratch on a hive which irritated the lethargic bees in colder weather and then provide a nice Winter banquet of bees slowly exiting the hive. I believe I lost two or three hives to the varmint that Winter. In Spring, it had finally gotten warm enough for the bees to become more active and able to sting the skunk with the anticipated odor that would be the skunk's response. That Winter my bottom board hives were sitting flat on a cement pad. I have since made sure they are raised a bit which provides the bees a better opportunity to sting curious creatures under their belly as they stand on hind legs scratching to encourage bees to come out. Most animals have a much keener sense of smell than we humans. This animal attribute can be used against smaller creatures that invade the beeyard. I have a neighboring beekeeper who had problems with opossums. Even though the neighboring beekeeper erected a three foot chicken wire fence, the possum would still climb over the fence to get to their hives. Doing a bit of research it was found that possums have a strong sense of smell and will avoid areas with mothballs or bleach odor. Dropping a few mothballs a few feet from the hives seems to have negated any more problems with possums. I have read that this also works to keep skunks and raccoons away and have since used this technique around my hives. The trick is to not place the mothballs too close to hives as the smell can also deter the bees.

Possum at far left visiting a hive. (Photo by Judy Tobey)



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Bigger Beasts

Livestock such as cows and steers do not normally pose an interference with bees. However it is not unheard of for livestock to use a beehive as a scratching post and knock the resulting hive over. This will normally result in a quick retreat by the bovine if bees are active in warmer weather and proceed to sting the errant scratcher. A common need for both bees and livestock is water. In order to prevent altercations between bees and any type livestock, a water source for the bees near the hives is a good policy. Also, fencing off the beehive area so that curious livestock cannot get near the hives is a good plan. Horses are another consideration. Darryl Gabritsch wrote a very nice piece for *Bee Culture Magazine* in the February 2018 issue on *Honey Bees and Horses,* so I will not reiterate his informative article here. Fortunately in my portion of SE Michigan, we do not have a problem with bears. Bears have a liking for larval bees and honey and are able to smell out hives even if some distance away from their home range. The only method I am aware of for those who may live in bear country is to maintain a substantial electrified fence to keep bears at bay. The electrified fence will require three or four strands of electrified wire. Michigan State University, in cooperation with Michigan Department of Natural Resources, designed and tested an electric fence option for black bears that can be found at: **https://www.michigan.gov/dnr/-/media/Project/Websites/dnr/Documents/WLD/Bear/apiary_brochure.pdf.**

Rabbits, Deer and Elephants

I would be remiss if I did not mention critters that do not necessarily bother beehives, but do like to eat those plants that bees rely on for nectar and pollen. It stands to reason that if bees are attracted to pollen producing plants that these same plants would attract herbivores or animals that rely on plants for their diet. My own experience is with deer and rabbits who like to munch on the same flowering plants and tree saplings that would eventually provide a nectar source for bees. One year, I did not fence my raspberry patch with chicken wire fencing and the rabbits chewed off the three to four foot raspberry shoots to the snow cover of about six inches. That Summer, I got no raspberries since the tall overwintered shoots provide the following Summer's raspberry crop. When I first planted sapling basswood and some apple trees in my backyard years ago, the deer chewed on most of the saplings. A six inch wire mesh fence around tree saplings solved this problem and also prevents the deer from rubbing on two-to-three-inch diameter older trees to mark their territory or to remove yearly antlers. Deer also like to nibble on some of the early Spring flowers like tulips. I have several tulip beds at the front of my house and every five or six years dig and replant as they get crowded and decrease in blossoms. One year, I saved the smaller bulbs and transplanted them in a back vacant garden spot to grow into bigger bulbs. In their second year of growth, they were all nibbled to the ground by deer. This was not the case the first year when they were not touched as I had cut several bars of Lever Brothers soap into eighths and placed pieces every six to eight feet throughout the tulip bed.

Placing soap bar pieces in the bed in following years negated the rabbits having their Spring breakfasts on my tulips. I also have found that placing ¼ chunks of soap bars in tube socks and tying two or three of these to my apple tree saplings has kept the deer from munching on them. Lever Brothers or Irish Spring soaps seem to have the strongest odor and work the best. I have read of a beekeeper in another state that used fencing to keep deer out.

Spring tulip bed in front of house.

The issue there is that the fences needed to be ten feet high to keep deer from jumping over them. He solved this problem using electrified two wire fencing with a second electrified single wire about five feet farther out. It seems deer avoid a double fenced area, not able to discern how high the second inner fence reaches.

One four legged herbivore that we do not need to worry about in our area is the elephant. Research done by Dr. Lucy King in Kenya has found that if beehives are placed every ten to fifteen feet (32 to 49 meters) apart elephants can be kept away from crop areas. Connecting wires between the hives assists in disturbing bees if any portion of the wire is moved or jarred. Exiting bees will sting the elephants in the most sensitive areas around their eyes, behind their ears and even on and in their trunks. Once an elephant has experienced a sting or two, they will retreat from just the sound of the bees leaving a hive and seem to be able to pass this cautionary retreat response on to their offspring. I am sure most of those reading this are not dealing with elephants. But hopefully this article has provided you with a few techniques that will help protect your bees from any type of predator. As always, your experience may vary based on your environment, state of your hives and the type of critter with which you are dealing. Best of luck to you all with your bee and critter management as we very soon move into our next beekeeping season. BC

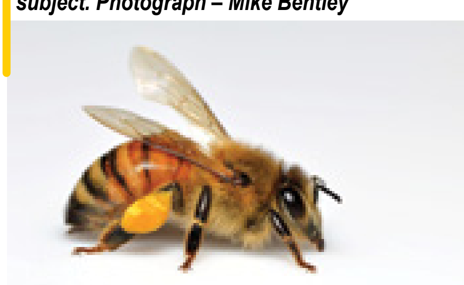
From the University of Florida Honey

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

Figure 2. The David J. Mendes Honey Bee Laboratory at the UF HBREL. This laboratory has a number of peripheral rooms that support research on honey bee toxicology, molecular biology, etc. Photograph – Jamie Ellis

I hope you have been enjoying the series my colleagues and I have been writing about the University of Florida (UF) Honey Bee Research and Extension Laboratory (HBREL). Our goal is to administer dynamic research, extension and teaching programs focused on the western honey bee (Figure 1). We have been using this article series to give you a sneak peek into the life of the faculty, students and staff of Land Grant University (LGU) honey bee programs. In my first column in the series, I provided a general overview of LGUs and noted that faculty working at LGUs can have responsibilities in research, teaching and extension. In February, my colleague Dr. Cameron Jack discussed the honey bee teaching program at the HBREL. I believe Dr. Jack, who teaches nine different courses on honey bees at UF, has one of the most comprehensive teaching programs focused on honey bees in any academic institution globally. Our team also conducts vibrant extension and research programs. My colleague Amy Vu (UF State Specialized Program Extension Agent – Apiculture) will spend April and May discussing LGU extension programs and introduce you specifically to what our UF program has to offer. That leaves me, this month, to discuss honey bee research programs.

Figure 1. The western honey bee, our test subject. Photograph – Mike Bentley



What is science?

Science is the systematic method with which one attempts to understand the physical/natural world. This is accomplished through experiments in which observations are made and theories tested, with the theories ultimately being supported/refuted through the process of experimentation. There are some things science cannot address. I found a great list of the limitations of science at a U.C. Berkley website (Google: "U.C. Berkley – What science cannot do"). From that list, science does not make moral judgments. Second, science does not make aesthetic judgments. Third, science does not tell you how to use scientific knowledge. Finally, science does not (and cannot) draw conclusions about supernatural explanations/events/conditions. I know many folks are intimidated by scientists – thinking we are overly academic, not in tune with the real world, out to disprove the existence of God, etc. In fact, most scientists are just normal humans whose brains really like to solve problems related to the natural world.

Individuals who engage in the practice of science are called scientists or researchers. Scientists do not just sit around and "think" our way to answers. If we did, we would all be philosophers sitting by the fire, wearing our tweed jackets, smoking our pipes and thinking the day away. Instead, scientists use research to answer questions related to the natural world. [*Note 1*: philo (from the Greek word philein, meaning love) + sophia (wisdom or knowledge); *Note 2*: philosopher = one who loves knowledge/wisdom; *Note 3*: Professors usually have a PhD, which stands for "*philosophiae doctor*"

Bee Research and Extension Laboratory

Research on Honey Bees

Jamie Ellis

Figure 3. One of the research apiaries at the UF HBREL. Photograph – Jamie Ellis

Figure 4. The Jester Bee Observation Hive Room at the UF HBREL. This room is used to support honey bee behavior research. It can accomodate 12 observation hives. It is red lit to minimize disturbance to the colonies being observed. Photograph – Jamie Ellis

in Latin, or "doctor of philosophy" in English. I really like this imagery because my PhD is in entomology, which literally translates to "lover of the knowledge/wisdom associated with insects". I think that about sums this up.]

Faculty at LGUs have a responsibility to conduct research that adds to the human understanding of the natural world and research that ultimately leads to application. This is true, also, for faculty who study honey bees. I always have been a scientist, even if I did not know it during my childhood years. My work as a beekeeper and professor is rooted in my desire to understand how honey bees and their colonies function and how they support ecosystem health and sustainability. This includes research in the laboratory (Figure 2) but also in the field (Figure 3). This is true of most of my research colleagues globally.

How is research conducted?

You likely learned about the scientific method in your elementary or middle school science classes. If so, you will remember that there are multiple steps within this method, steps that one follows when trying to address a question related to the natural world. I know it may seem cliché, but scientists really do follow these steps to address questions related to their discipline.

Step 1 – Make an observation. All research starts with an observation that someone makes. Sometimes, the observation is 100% novel. Other times, the observation is made during the execution of an ongoing research project. As an example, a colleague of mine, Dr. Peter Neumann (Professor, University of Bern), was a postdoc in the same research laboratory in which I was a PhD student in South Africa. At the laboratory, Dr. Neumann spent considerable time watching small hive beetle/honey bee interactions in glass observation hives, similar to those we manage in the Jester Bee Observation Hive room at UF (Figure 4). Before I moved to South Africa, Dr. Neumann had already discovered that small hive beetles hide in cracks/crevices around the honey bee nest, and then honey bees station guards at these hiding sites, effectively keeping the beetles in prison. Dr. Neuman had communicated his findings (i.e. his observations from a previous study) to me and I wanted to see this behavior for myself. So, I established an observation hive and watched bee/beetle interactions at these prison sites. One day, while watching the interactions, I noticed that small hive beetles appeared to come to the edge of the prison, rub antennae with the bees and cause the bees to regurgitate honey on which the beetle would feed. I was specifically looking for this behavior because my PhD supervisor (Professor Randall Hepburn) had noticed seeing it himself. This took me to the very next step of the scientific method.

Step 2 – Ask a question. An observation, in science, often causes one to ask a question about what has been observed. From the example above, I asked: "Why would a honey bee and small hive beetle touch mouthparts while rubbing their antennae on one another?"

Step 3 – Form a hypothesis about the question. You all probably know that the word "hypothesis" is defined as "an educated guess." Many folks focus exclusively on the "guess" part of this definition, but I feel the "educated" part is just as important. What does this mean? Think about my question "Why would a honey bee and small hive beetle touch mouthparts while rubbing their antennae on one another?" I could "guess" that they are talking to one another, perhaps speaking to one another in a coded language. I could also "guess" that they are kissing one another, having discovered their love for the other during the imprisonment. Both of these qualify as "guesses" but certainly fall short of the "educated" part. A hypothesis is an educated guess about why something is happening. The "educated" part comes from prior observations, usually already published in the literature. I am sad to report that I did not do my homework when I was a PhD student. I just took a "guess" and said that I suspect the beetle is getting fed by the honey bee. However, had I done a background literature search, I would have discovered that some other members of the small hive beetle family live with other social insects, and some of these beetles can trick their hosts into feeding them. That, then, would have made my guess educated, in other words, I would have had an educated reason to believe that the beetle can successfully trick bees into feeding it. Incidentally, many scientists consider "conduct a background literature search on the topic to discover what is already known" a separate part of the scientific method, essentially a step that would occur between my Steps 2 and 3. However, I argue a literature search is simply part of forming a hypothesis that is equal parts educated and guess. The hypothesis does not have to be right. Many great scientific discovers have happened when a hypothesis was wrong. That said, hypotheses do have to be testable! Otherwise, they are useless to science.

Step 4 – Make a prediction. This step is pretty simple. It is a result we anticipate if our hypothesis turns out to be true. This step is getting us to the experiment, so it is the prediction we are making with an experiment in mind. For example, I had hypothesized that small hive beetles can trick honey bees into feeding them. Thus, I predicted that if I fed dyed sugar water to honey bees, the dyed sugar water would end up in small hive beetles that otherwise had no direct access to it. This is the conceptualization of a project that I developed to test the hypothesis.

Step 5 – Test the prediction. This is a key step of the practice of science. We could have simply stopped at Step 4 and announced that we had the answer. However, announcing the answer does not mean we actually had the answer. This step includes experimental design, the controls (positive controls, negative controls, etc.), the treatment groups, data collection/observation, data analysis, etc., all the necessary parts of a well-designed study. Hypotheses are made to be tested. I had hypothesized that bees can feed small hive beetles. I predicted that I would see dyed sugar water in the guts of small hive beetles that had close contact with bees that were fed dyed sugar water. This, then, lends itself directly to experimentation. I created a two chambered observation hive. I placed two deep frames with bees in the bottom chamber and I placed adult small hive beetles in the top chamber. The two chambers were separated by screen mesh. I fed the bees in the bottom chamber sugar water that had been dyed red. My colleague (Dr. Christian Pirk, Professor, University of Pretoria) collected the beetles in the top chamber after a little time, squeezed them and looked for dyed sugar water. Sure enough, we found dyed sugar water in the guts of beetles that otherwise had no direct access to this water. I suspect that they had coerced the bees to feed them the sugar water through the screen mesh!

Step 6 – Reflect on and communicate the results. Science does not exist in a vacuum. I always tell my students that their results do not exist unless they are disseminated. In this step, the scientist reflects on any number of questions. What were my results? What did I find? What larger implications might exist? What remains unknown? Did my results support or refute my hypothesis? What other situations might explain what I found? What future studies should I conduct to understand this system better than I currently do? These questions help you place your work in context and even allow you to reflect on observations you made, observations that may lead to new questions. After you have done all of this, you have to tell someone what you found!

Figure 5. Kathryn Naherny (UF HBREL – undergraduate student scientist) disseminating research information to other scientists through a poster presentation. She is joined by Amy Vu (right) and Dr. Cameron Jack (left), both of the UF HBREL. Photograph – UF HBREL Staff

Communication of results

There are multiple ways that scientists can share the results from their research projects. The first way is communication of the results at research or extension meetings. A research meeting is one likely to be attended only by scientists in the discipline. In the honey bee world, that includes meetings such at the American Bee Research Conference, EurBee, Apimondia, Annual Meeting of the Entomological Society of America, etc. These meetings are attended by scientists, sometimes in the thousands, each presenting a lecture or poster (Figure 5) of their research. In this case, the scientists are communicating their results to peers, i.e. other academic, government or industry scientists.

An extension meeting is one attended by specific target audiences for continuing education purposes. For example, the target audience could be beekeepers attending the annual meetings of the American Beekeeping Federation, the American Honey Producers Association, any of the U.S. state beekeeper organizations and even local/regional beekeeper organizations (Figure 6). These beekeepers are eager to hear about the latest research advances, especially if the advances lead to positive changes in their beekeeping operations. The information communicated by scientists at these meetings is usually delivered in lecture format, but there may be some hands-on workshops as well. This activity is not research *per se*, but rather falls under the category of extension. My colleague, Amy Vu, will teach you all about extension the next two months.

These days, research can be communicated through websites, videos, fact sheets, online presentations and social media. The latter includes Facebook, Twitter, Instagram and more (you can find our laboratory's social media accounts: @UFhoneybeelab). Scientists are getting incredibly creative at disseminating information, allowing information to flow freely, quickly, (and sometimes in need of fact-checking) to the masses.

Finally, and most importantly, science is communicated in peer-reviewed research journals. Honey bee scientists are invited by beekeepers to speak at many local, state and national beekeeping organizations. These same scientists are under university pressure to publish the results in refereed journals. This is something that is hard for many folks unfamiliar with science to appreciate. Publishing a refereed manuscript is the output by which faculty are judged by their administrators. Frankly, universities value refereed manuscripts more than they value likes on Twitter, presentations at industry meetings and electronic factsheets. Thus, I feel it is important to spend a little time talking about a refereed manuscript, given the great emphasis put on this method of research communication.

A refereed manuscript published in a peer-reviewed journal is simply code for "other scientists look at and scrutinize your work before it is published". Refereed manuscripts all have the same basic organization. The layout of the standard refereed manuscript follows the steps of the scientific method. I list the key (though not all) parts of a typical reach manuscript below.

Figure 6. Dr. Jose Marcelino (UF HBREL) disseminating research information to beekeepers through the UF Bee College. Photograph – UF HBREL Staff

1. Title – This is a concise, hopefully catchy, summative statement of the research project.
2. Authors/author affiliations – This is a list of scientists involved in the work. Generally speaking, the "first" author is the one who conducted the research or worked most on the project. Typically, the last author is the one in whose lab the work was conducted. The remaining authors may be listed in order of level of contribution to the research, alphabetically, etc. The authors then list their employers or other affiliations in the affiliations list.
3. Abstract – This is a concise summary of the project. It includes a few sentences on project introduction, methods, analysis and discussion. This is often limited to 200-300 words, depending on the journal to which the paper is submitted.
4. Keywords – These five to 10 words summarize the key topics or themes of the study.
5. Introduction – This section is a discussion of your observations, hypothesis and prediction. Essentially, it is a summary of Steps 1-4 of the scientific method.
6. Materials and Methods – This should be a near exact description of how the hypothesis was tested. Any scientist in the field should be able to read the M&Ms and be able to repeat the study exactly. This outlines the scientist's approach to Step 5 of the scientific method.
7. Results – This section includes information on exactly what was found during the study. This is also the section in which the scientist(s) presents the data and data analyses, usually in table or figure format. This is also included in Step 5 of the scientific method.
8. Discussion – This is where the authors place their results in a larger scientific context. It includes some speculation, supporting literature analyses and even future predictions. The authors may choose to outline additional projects that would be good to do in the future. This is part of Step 6 in the scientific method.
9. Acknowledgments – Here is where the authors thank the individuals who helped with the study in any capacity. This may include technicians, beekeepers, statisticians, the funding agencies, etc.
10. References – This is a list of all of the research articles cited throughout the manuscript. This list allows readers to double check the assumptions made throughout the manuscript and the authors to acknowledge the scientific contributions of others in the same field.

What makes these manuscripts "refereed"? Once the science authors have developed their manuscript, they submit the manuscript to a peer-reviewed journal. Scientists try to match the subject of their article with the aims/scope of the journal to which they choose to submit their article. For example, I would not submit a manuscript on honey bee toxicology to a quantum physics journal. Instead, I would submit it to a journal that publishes honey bee, insect, toxicology or similarly themed manuscripts. The editor of the journal receives the submission, reads it and forwards it to two (or more) international scientists who are experts in the field. If I write and submit an article on some aspect of honey bee toxicology to a journal, the editor is going to forward the manuscript to two or more honey bee toxicologists. These individuals, now serving as the "peer reviewers" or "referees," will read the paper to see if it is worth publishing in the target journal. They review the introduction, determine if the hypothesis is reasonable, ascertain if the correct experiments were conducted to address the stated hypothesis, scrutinize the data analysis and correct faulty assumptions/conclusions in the discussion. They also comment on table/figure utilization, author understanding of the subject, presentation of the information and even grammar. They complete sometimes lengthy reports and forward those to the journal editor whose uses the reviewer reports to determine if the paper: (1) can be accepted as is (no other changes needed, publishable as written), (2) needs minor revisions (the authors need to make minor changes and resubmit), (3) needs major revisions (the authors need to rework entire sections of the manuscript), or (4) should be rejected (the paper does not fit the theme of the journal, the science is bad, the experiment was poorly performed, etc.). The editor has full authority to determine the fate of the manuscript. Some journals, such as Nature/Science, have incredibly high rejection rates. Others do not. Scientists hope that their manuscripts are scientifically rigorous and stand up to the scientific scrutiny of the international experts.

There is a reason that manuscripts undergo peer review. Anyone can publish anything nearly anywhere. I can publish my research in a bee journal or other periodical with no scrutiny. I can speak about my research at bee conferences, and you might believe it. I might post our findings on social media and beekeepers everywhere follow my suggestions. However, science advances best when expert peers review one another's research to see if it is meritorious and appropriately conducted. The peer review process is science's quality control. It is not a perfect system (and I could discuss this forever) but no other alternative is as good. Faculty at LGUs are expected to conduct research, yes; but more importantly, they are expected to publish it in peer-reviewed journals. Failure to do that, and the research remains unvetted and in danger of dying in someone's lab journal. Research is only over the finish line once it is published in a peer review journal. At that point, it moves into the court of public opinion, scrutiny, trial and error (which you could argue is a more informed refereed process), but only after other scientists took their pound of flesh first.

Basic vs. applied research

I fall into the camp that believes research is best represented as a spectrum, where basic research is on one side of the spectrum and applied research is on the other. You get hybrids of the two as you move from one to the other. In my experience, most research is not purely basic or strictly applied. What do I mean by this?

Well, scientists almost always discuss applied research at beekeeper meetings. Applied research (at the risk of using the words in their own definition) is research that leads to some sort of application. This is exactly the type of research most beekeepers want from their LGU's bee scientist(s). Applied research includes testing various pollen patties in colonies to determine their impact on brood and bee production, finding new strategies to control *Varroa*, developing a new hive style that improves colony overwintering success, etc.

Basic research, on the other hand, has no immediate application and simply answers questions that help us understand a system we are studying. These types of projects often are not discussed at beekeeper meetings. Basic research with honey bees might include determining how honey bees find new nest sites when swarming, how a particular compound acts as an acetylcholinesterase inhibitor in honey bees and how small hive beetles trick honey bees into feeding them.

Now, an astute reader will notice that there likely is no such thing as purely basic research. You could argue that all basic research could, someday, end up having a practical application. What seems basic now may end up having an important application later. I can even show you that with the three examples of basic research that I provided previously. You could argue that knowing how honey bees find nest sites could lead to the development of optimum hive styles. Knowing how a compound acts as an acetylcholinesterase inhibitor in honey bees could lead to the production of safer compounds to use to control *Varroa*. Finally, knowing that bees feed small hive beetles could lead to the development of control agents that are delivered in sugar water, through bees, and to the beetles.

How is research funded?

Research costs money, sometimes lots of money. Before I was a professor, I assumed that universities pull up to your laboratory with a dump truck full of money that they dump right at the front door. In fact, I assumed they did this monthly, providing you all the funds you will ever need to conduct research. Well guess what? That does not happen. I was also under that faulty assumption that everything in a university laboratory was bought/paid for by the university. Surely, you only needed to make a reasonable equipment request to your administrators and they would trip over themselves wanting to get you what you need. That, too, was incorrect.

Do not hear me wrong. Administrators at LGUs are among a laboratory's biggest advocates and will certainly help carry the financial burden when they can; but they often cannot, meaning that the laboratory leader has to be the chief fundraiser for the laboratory. I will list a few key ways that research is funded at LGU laboratories, with a promise to discuss these in greater detail in the forthcoming July article in this series.

(1) Competitive grants – This is a very common method used to fund research. A grant is a monetary award given by an agency to a scientist or group of scientists to conduct a specific series of research projects. To receive the award, the scientist had to develop a proposal, usually in response to a "request for applications" (RFA) made by the agency. For example, the USDA National Institute for Food and Agriculture (NIFA) has a specific funding program on pollinator health. They put out a RFA once a year. The RFA will include specific instructions on how to develop a proposal and what they want to fund. The scientist, in turn, will develop a proposal that aligns with the

goals of NIFA outlined in the RFA. The proposal contains background information, hypotheses to be tested, methods the scientist plans to use to test the hypotheses, expected results, a budget, list of collaborators, letters of support and *a lot* of other information required by the agency and the scientist's host institution. Proposals are *considerable* work to develop, taking significant time, resources and energy.

The scientist(s) must submit the proposal by a specified deadline, at which time the sponsoring agency organizes a review panel of scientists that reviews the merits of many proposals, rank them and provides the rankings to agency staff. The staff then works their way down the ranked list, awarding funds until they run out of funds to award. The funding rate of proposals, especially among the federal granting agencies, is low, often <10%. Some of the best grant writers in my department write seven to eight proposals per year, only getting one or two of those funded. Even still, there are many sources of funding for honey bee research. Such funding agencies include USDA NIFA, National Science Foundation, National Institutes of Health, Project Apis m (PAm), USDA APHIS, etc. I will share a lot more about grants in my July article.

(2) Contracts – A contract is when a company, individual, organization, etc. approaches a scientist about conducting very specific work that the organization wants conducted. For example, one of the beekeeping equipment supply companies may have developed a new type of pollen patty that they wanted tested by a scientist. Perhaps a wildflower seed company wants someone to test their new seed mixture to see how attractive it is to pollinators. A chemical company may have developed a new compound and want to know its impact on bees in the field.

In these and other similar cases, the scientist will develop a scope of work (SOW, a scaled down proposal) that includes the problem that will be addressed, how it will be tested and a budget. The scientist provides the SOW directly to the interested party who will determine whether or not to fund the research directly. Contracts usually are not competitive. A company/industry representative or individual approaches the scientist directly, asking them to perform the work and agreeing to fund them through a contract.

I will make a quick note here to share that for grants and contracts, *money does not flow directly to the scientist*. Instead, the funding agencies/individuals provide the money to the institution, which then enters a contractual agreement with the funding agency/individual to perform specified work as outlined in the SOW or research proposal. I share this to note that some beekeepers worry that contracts lead to nefarious work by the scientist (i.e. that the company/individual/etc. is "buying" services and favors from the scientist). This simply is not true. All work of this type is done through contracts mutually agreed upon by both parties, with the scientist's institute (rather than the scientist themselves) being the responsible party and the receiver of the funds. There is significant scrutiny and oversight by the scientist's home institution. Can there be abuse? Yes. Yet it is not nearly as common as some folks suspect.

(3) Unrestricted free gifts – This final way to receive money for research is, essentially, the donation route. Individuals, groups, businesses, etc. can make a monetary donation to a scientist's program. I will stress that this money does not go to the scientist's personal bank account. Instead, it goes through the university's development office (fancy title for their fundraising arm) and routes to the scientist's home department for their programmatic use. These donations can range from $100 to $1 million or more. Often, the larger donations can be used to create "endowed" positions. Endowed positions usually come in three types: endowed professor, endowed chair, eminent scholar, with the money needed to create each position being greater as you move up the chain. Endowment money will be safely invested by the university, with the funds generated from it yearly (usually about 4%) going to support the scientist's research program. To illustrate this, a $1 million endowment will generate ~$40,000 for the scientist to use each year. Smaller donations are not used for endowments and, instead, are spent by the scientist however they see fit.

Why is this called an "unrestricted free gift"? This is a very important question, and the answer distinguishes this type of money source from those of a contract or grant. The "free gift" part means that the money was given to the scientist's program (again, through the university) with no strings attached. The individual/company/group making the donation cannot demand anything in return. The scientist is not agreeing to conduct a specific research project as a condition of receiving the funds. The money is simply a donation made to support the scientist's program however they see fit to use it (equipment, supplies, new colonies, staff salary, etc.). Endowments are the one exception to this as the donor can specify, in general terms, how they want the funding spent. For example, they may only want it to be used to support graduate student stipends, or work on honey bee disease/pest control.

Honey bees as research models

Honey bees are one of the most studied insects on earth. There are research laboratories focused on honey bees in many (maybe most) countries, with some countries (such as the U.S.) having dozens or more of such laboratories. The scientists at those laboratories may study honey bees from a beekeeping/colony health and production perspective, as model research organisms, or both. This goes back to my discussion on basic vs. applied research. As I noted then, beekeepers interact with bee scientists most from an applied research perspective, when the scientist shares about a specific project they conducted on behalf of beekeepers. However, honey bees and their colonies are remarkable research models for scientists who investigate basic research topics as well.

Honey bees have something to offer nearly anyone interested in any of the scientific disciplines (Figure 7, next page). Neurobiologists may study honey bee colonies to gain greater insight into how the human brain function. Ecologists may study honey bee contributions to healthy and sustainable ecosystems. Mathematicians may want to model the honey bee nest architecture. Biologists may be interested in a particular type of honey bee behavior. Apiculturists (the name given to scientists who study honey bees

Figure 7. A collage of scientists in action. Photograph – UF HBREL Staff

from a beekeeping/production perspective) may be interested in controlling a particular bee pest or search for a way to improve queen health and longevity. The list goes on and on. I love attending research meetings where honey bee scientists present their work. You would be amazed at what scientists study regarding honey bees, their colonies, social organization and environmental impact. There are many careers waiting to be had in the honey bee research world!

Honey bee research at the UF HBREL

I have spent considerable time talking about science and research in general. I will conclude this article discussing what members of the UF HBREL study. My team and I plan to discuss some of our research in future contributions to this article series. Thus, I will not go into great detail about any one project here. I will also share that my complete library of refereed publications (i.e. a list of all the research projects I have published) can be found by visiting this link **https://entnemdept.ufl.edu/honey-bee/research/honey-bee-husbandry/publications-by-year/** or Googling "UF honey bee lab" and then clicking through this pathway: research (top of page) > publications by year. As a quick cheat, you can find refereed manuscripts for other scientists at their institutional website or by going to Google Scholar (a Google search engine just for refereed manuscripts) and searching the scientist's name + "honey bee" (for example: James Ellis honey bee)(Figure 8). Now, on to what my team and I study at UF…

Figure 8. Using Google Scholar to find a list of refereed manuscripts for any scientist. You can get to Google Scholar by searching "scholar" in Google. That will take you to a new search page. Once there, type the name of the scientist in question and then add "honey bee" after their name.

1) Honey Bee Husbandry – Improving the sustainability of beekeeping. Most of the research in this category (the largest of all our research efforts) encompasses four research emphases: (1) integrated pest management control of honey bee pests/diseases, (2) understanding the proximal causes of colony losses, (3) the impacts of pesticides on bees and (4) understanding the spread and mitigating the threat of African honey bees. Correspondingly, my team and I have published on the impacts of pesticides on honey bees, the spread, biology and control of honey bee pests/pathogens, honey bee nutrition, African honey bees and honey bee colony losses. Furthermore, we have co-led the development and compilation of research methods on honey bees, their pests/predators and hive components.

2) Honey Bee Natural History, Biodiversity and Conservation – Understanding the relationship between honey bees and their environment and working to conserve honey bee populations for the benefit of healthy ecosystems. This represents a newer field of investigation for my team. We are keenly interested in the health of wild, natural populations of honey bees, particularly in southern Africa. The studies in this category fall within our basic research interests. We are developing/refining methods that can be used to differentiate between the various subspecies of honey bees. Thus far, we have published the sequenced mitochondrial genomes of a number of *Apis* species and *Apis mellifera* subspecies. Additional projects in this area include understanding why honey bees nest where they do, the epidemiology of wild honey bee colonies, the contributions of honey bees to natural ecosystems, honey bee natural history, how complex behavioral interactions develop between honey bees and their nest invaders and general biodiversity topics. We hope our growing efforts in this subject area produce an interest in honey bee conservation in light of the high gross loss rates of managed colonies.

3) Integrated Crop Pollination (ICP) – Determining the contributions of unmanaged bees to the pollination of various cropping systems and working to conserve native pollinators through sound ecological principles and understanding. Admittedly, I do less work in this area now than in the past. However, our past work here encompassed efforts to study the impact of native pollinators on U.S. agriculture and to understand native pollinator ecology in general. The results from this research may someday allow us to develop targeted conservation practices for native pollinators and make recommendations to Florida and U.S. farmers about how to enhance native pollinator biodiversity on their farms. Ultimately, we want to help growers achieve adequate pollination of crops by integrating current practices focusing on pollinator management and general wellbeing. My colleagues and I published research on ICP, including defining and introducing the topic to science. Furthermore, we determined the contributions of unmanaged pollinators to some Florida crops, determined how native wildflowers impact pollinator populations, worked to understand aspects of the biology of two native bees in Florida and even created a citizen science project to introduce the public to the topic of pollination.

The UF HBREL's research has a broad impact for beekeepers, the industry, growers and the public. Our team actively manages 30+ research projects at any given time. The results of these projects are peer-reviewed scientific publications in refereed journals, better positioning for future grants, enhanced extension programs, fulfilling instructional efforts and immediate and long-term solutions to identifiable research needs. Thanks for joining me on this journey through a look at honey bee research. BC

Minding Your Bees And Cues

Being Heard

Becky Masterman & Bridget Mendel

A check in with our favorite farmer and pollinator promoter, Keith Johnson, reminds us that we have some work to do. Today we're sharing a few ideas that Farmer Keith thinks might help beekeepers promote bee health. From connecting to local government to reaching out about federal legislation, the more beekeepers promote bees and other pollinators, the better.

Let them know you are a beekeeper

Last year's midterm election winners are now in office and it is a good time to introduce (or reintroduce) yourself. Politiwatch, a non-partisan tech non-profit, has an excellent search engine that will connect you to your local, state and federal representatives. From this site, you can navigate to websites where you can find the phone numbers, emails and letter addresses for those representatives: (**https://whoaremyrepresentatives.org/**).

Once you reach out, what should you say? It doesn't have to be long (just sincere) to be impactful! Share who you are, and why you are concerned about the health of pollinators. In particular, underline that increasing habitat is a number one issue that you would like addressed!

2023 Farm Bill

Don't let the name of this bill confuse you. If you eat, you are impacted by some part of the farm bill. Farm bill legislation is voted on every five years and the 2018 bill even has its own Wikipedia page (**https://en.wikipedia.org/wiki/2018_United_States_farm_bill**). This comprehensive legislation guides many programs overseeing many issues like nutrition (including the Supplemental Nutrition Assistance Program or SNAP), crop insurance, trade, horticulture and forestry programs. One area of the bill that has enormous potential to support bees and wildlife is the conservation programs. This year the Farm Bill is up for renewal and its conservation programs need your support.

If you bring up conservation programs with Farmer Keith (he usually gets there first though, he will tell you that enrollment in

A check in with farmer Keith Johnson is always informative. Keith's passion for farming and pollinators makes for an interesting perspective on bee advocacy issues. Photo credit: Rebecca Masterman

Time to send a letter (or email)? Reaching out to your representatives is a great and easy way to support your bees. Photo credit: Rebecca Masterman

these programs is down. These programs incentivize farmers and private landowners to keep land out of production and instead adopt practices that support wildlife. Signed into law by President Ronald Regan in 1985, peak enrollment was at 36 million acres in 2007 (**https://www.agweb.com/opinion/history-conservation-reserve-program**). Unfortunately, enrollment has been under 25 million acres since 2014 (**https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Conservation/PDF/35_YEARS_CRP_B.pdf**). Eleven million acres of potential conservation reserve program (CRP) habitat have been lost in under 20 years.

If you want to impress Farmer Keith, follow farm bill news and connect with your senators and representatives to let them know that you want them to promote and increase conservation programs in the 2023 farm bill.

Connect with your state and local agencies

We live in a state where each state-level agency and many cities have pro-pollinator directives. Although Minnesota has done an excellent job with promoting pollinator health with regard to habitat and pesticide use, there is always room for improvement. Farmer Keith's advice when reaching out to your local and state agencies is to ask them how you and your beekeeper friends can help support their work supporting pollinators. You might be surprised about programs that already exist and are available to help efforts to increase pollinator habitat. We were (**https://bwsr.state.mn.us/practices/pollinator/index.html**)!

Join the Farm Bureau and/or Farmers Union

Both the Farmers Union and the Farm Bureau are organizations that advocate for farmers. Because they lobby for their members' interests, membership could be in the best interest of beekeepers. Per the Minnesota Farmers Union website, one of the legislative priorities for 2022 was supporting pollinator habitat and research to promote crop pollination. Check out your state Farmers Union to see if pollinators have made the list of their legislative priorities (**https://nfu.org/join/**). While the Farm Bureau recognizes the importance of honey bees for crop pollination, when it comes to neonicotinoids their policy opposes a ban and encourages cooperation among regulators and stakeholders. Whether you agree or disagree, consider joining the bureau and let your voice be heard. As Farmer Keith says, the Farm Bureau and Farmers Union advocate for their members. Join and they will advocate for you (**https://www.fb.org/about/join**).

Research and Extension

Honey bees also need your help in the form of supporting research. We suggest checking in with your local university bee research and extension programs for an update on their work. Your support does not necessarily need to be financial. Staying connected with these groups might result in the opportunity to have your bees help answer research questions or simply give you the opportunity to share communications with other beekeepers.

Effort

Advocating for all the bees (honey and native) is a lot of work. After writing this to-do list of how we can work harder for our bees, it reminds us of how it is easy to feel behind in management tasks throughout the beekeeping season. So, our solution is to share the burden with other beekeepers and join a beekeeping club. Beekeeping clubs are a way to streamline bee advocacy and stay informed about emerging issues, whether political or biological. Remember, the club advocates for its members, so become a member!

Acknowledgments and Suggestions

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

If you thought *Varroa* was bad, we suggest reading John Miller's article titled *It's Worse Than You Think* in this issue. We all need to be aware and ready for threats to bee health.

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 bee advocacy success stories or thoughts, please send an email to mindingyourbeesandcues@gmail.com.

Bees and Women
Iona Fowls

Nina Bagley

Gleanings in Bee Culture ***1908 – This is the photo that got me interested in the Fowls family. Chalon Fowls in the middle. Iona Fowls to his right and to the left is Violet. Behind her is their mother Caroline. The young lady next to Iona is a hired hand to help with extracting the honey. They are in front of their honey house.***

Iona Fowls was born on September 7, 1882 in Oberlin, Ohio. She had an older sister Violet and a younger brother Arba. Their parents, Chalon and Caroline, who were also born in Ohio, were commercial beekeepers. Little did Iona know that she and her sister would continue the occupation of beekeeping by handing it down through the generations.

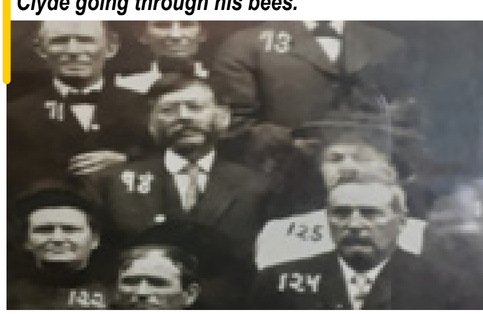
Her father, Chalon, with the help of his wife, started beekeeping around 1890 in Oberlin, Ohio. He married Caroline, bought a farm and had a family. He may intended to have lots of sons to help with the farm work, but the Fowls had two daughters and one son. Chalon and Caroline's first daughter Violet was born in 1878.

Four years later Iona was born. It would be some time before their brother Arba was born in 1892, and he would take a different direction, becoming a carpenter instead of a commercial beekeeper. And so the beekeeping work fell on his older sisters to help their father with his apiaries. Chalon had five apiaries, including one in the back of his home near the Lake Shore Railroad. These apiaries lie in four directions from the village, one was near Wellington, Ohio. To transport the honey, it was an eighteen-mile trip coming and going by wagon or trolley to the Fowls home, which made the workday even longer. Mr. Fowls would then store the honey in the back of his house.

He had a room equipped with the latest honey-extracting equipment from A.I. Root Co. of Medina, Ohio. The Root Company was the only company that manufactured this type of machinery. The machine, called the Novice, is operated by a gas engine, saving his two daughters' work. It was formerly done by hand. During 1910, Chalon Fowls extracted nearly ten tons of honey, and his season was not yet over. From his apiary on East College Street in the village, he took 500 pounds of comb honey. He was finding the need for more room to store the barrels of honey. So Mr. Fowls built a pipeline into his basement, emptying it into a large tank. A float on the tank rings a bell, letting him know when the tank is full. The heavy honey crop in 1910 was due to the vast amount of white clover during June and July. His daughters ran the extracting machine. The girls were expected to help, and help they did! Violet worked in an orphanage teaching, but her father needed all three women to help run the extracting machince and extract the honey. Hence, she quit her job and returned to the family's East College Street home to help.

Chalon Fowls and his two daughters had made beekeeping their sole business. They succeeded in it unvaryingly, year after year, becoming financially well off. Owning his own Model T Ford the family would take vacations to West Palm Beach, putting up a tent along the way and camping out for the night. The Fowls had a banner on the Model T, which waved in the wind, advertising they came from Oberlin, Ohio. In 1917, A. I. Root Company and the magazine, *Gleanings in Bee Culture,* was growing, so management gave H.H. Root, the younger brother of A.I. Root, the managing position, then promoted A. I. Root's son Ernest Root to the managing editor position.

(Left) Chalon Fowls #98 and wife Caroline #122 at a bee convention. (Right) Iona's husband Clyde going through his bees.



Ernest was a student at Oberlin College and had been around bees his whole life. He remembered while in college, Mr. Fowls would come and talk about bees. He also remembered his daughter Iona had been helping her father with the bees since childhood. Ernest was looking for an assistant editor. So, in addition to the editorial staff at the Root Company, Ernest hired Miss Iona Fowls as his assistant editor! She made him look good, and he knew it! He admired her energy, especially the knowledge Iona had gained from her father, giving her the skills that made her a good beekeeper. Her area was in "The Department of Questions and Answers" for *Gleanings*; she would prepare the answers and then give them to Ernest to publish. It was very seldom that Ernest had to make corrections.

When Ernest was sure he had to have an assistant, he knew the person should be an experienced beekeeper who had successfully cared for bees on a commercial scale. He was certain Miss Fowls was more than qualified. In addition, to her ability in beekeeping, she graduated from Oberlin College, having a B.A. and M.A. degree. Iona, a brilliant teacher in math and physics, was considered full of energy and a hard worker. She also had experience as a teacher during her mid-twenties. She taught high school in Darlington,

Huber Wheeler and his 1952 Jeep that Clyde used and his son Huber used for beekeeping. Gregg Wheeler is now using it. The truck was handed down through the generations.

Iona's grandson, Gregg Wheeler, extracting honey.

Wisconsin. She was thirty-five years old and not yet married when she became assistant editor writing for *Gleanings* in 1917.

Miss Fowls contributed her knowledge and experience in beekeeping and this is why Ernest Root had put her personally in charge of their beeyards; nine different apiaries containing over eight hundred hives. She worked at A.I. Root until 1921. Meanwhile, both sisters still lived at home on East College Street in the village of Oberlin, Ohio, working for their father.

A man named Clyde P. Wheeler asked Miss Iona Fowls to marry him. It's quite likely that Clyde may have worked for his future father-in-law at some point. Clyde was nine years younger than Iona. He was a commercial beekeeper and had a degree from Oberlin College. He was an honorable man who served in World War I. The two were married in 1921 in Oberlin, Ohio. Iona became Clyde's assistant, and the following year, she became pregnant with their first child at forty. So in 1922, H.H. Root took over as assistant editor for *Gleanings*. Their daughter Wilda was born in 1922 in Oberlin, Ohio. Two years later, at forty-two, she had her son Huber.

Iona's mother, Caroline, passed away in 1930. Her Father, Chalon, died in 1934. Both parents are buried in the Westwood Cemetery in Oberlin, Ohio. Iona's father was one of the pioneers of Oberlin and a prominent commercial beekeeper.

Iona, at fifty-two, had been married for fourteen years, raising her family and being an assistant beekeeper to her husband. Clyde is very active in the beekeeping community. He was elected president of the Ohio State Beekeepers Association in 1929 and appointed to the first county apiary inspector's position in 1930. Iona continued handing down the tradition of beekeeping to her children, assisting her husband in the apiaries and caring for the family.

Iona's daughter, Wilda lived in Fulton County, Ohio, with her husband Chuck for over fifty years. She held a ham radio license, raised a family and continued the family tradition of being a teacher. Iona's sister Violet never married and lived with Wilda's family until she passed away in 1974 at the age of ninety-six.

Iona's son Huber, graduated from Michigan State University. Being raised in a family of beekeepers, he was an all-around outdoor enthusiast. Huber took a break from school to serve his country in the U.S. Navy from 1943 to 1946. He married Vera Petty in 1950. Huber worked for several years for the Ohio Conservation Department.

Huber and his wife moved to Madison, Wisconsin, where he worked as a biologist with the Wisconsin Conservationist Department. Retired in 1974, he moved the family to River Falls, Wisconsin, to become a full-time beekeeper. He was active in the Pierce County beekeepers club and held office for the Wisconsin Honey Producers Association. Iona and her husband Clyde preceded their son Huber to Wisconsin and paid cash for a farm in River Falls, Wisconsin. Making a go at beekeeping and maple syrup production in Wisconsin, Iona and her sister Violet were very accomplished, and it's apparent that Iona's children had been as well. Iona's husband, Clyde, passed away in August 1965 doing what he loved – working bees. He was seventy-five years old.

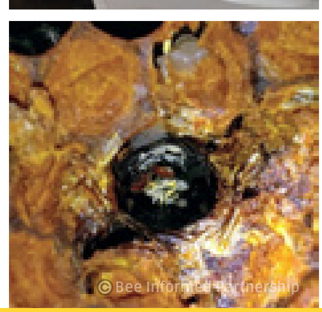
Iona continued as a member of the bee clubs in Ohio and Wisconsin, living with her son and daughter going back and forth from Wisconsin to Ohio. She spent the last six years of her life in the Provincial House in Adrian, Michigan (a nursing home facility). Iona passed away in 1980 at the age of ninety-eight and was buried next to her husband Clyde at Greenwood Cemetery in River Falls, Wisconsin.

Her son Huber, along with his wife Vera, carried the beekeeping torch for another thirty-seven years until Vera's passing in 2012. Huber died in 2019 just shy of ninety-five years old. They are survived by their sons John and Gregg. The tradition of beekeeping has been passed down to his son Gregg, Iona's grandson, who lives in Wisconsin, like his father and grandparents before him. Gregg is a beekeeper, while his wife Joan bottles and sells their honey online and at various markets. Their son Caleb also helps in the field when possible, making him the fifth generation to participate. Their honey label is the picture of Gregg's great-grandfather Chalon, his great-grandmother Caroline, his grandmother Iona and great-aunt Violet in front of the honey house in Oberlin, Ohio.

Family photos are used on their honey jars.

The picture of his family is why I wanted to write about the Fowls. I came across the picture some years ago and found it fascinating – a beekeeping family rich in history, handed down through the generations. The days of old need to be shared so we can remember what was and not take the honey bee for granted. I want to thank Gregg Wheeler, Huber Wheeler's son, Iona's grandson and Chalon's great grandson for the family pictures and helping me with my research of his families' beekeeping history. BC

Nina Bagley
Ohio Queen Bee
Columbus, Ohio



ABF Conference 2023

Charles & Karen Nielsen Lorence

This was the 80th anniversary of the American Beekeeping Federation convention. About 500 participants from throughout the country attended.

The American Beekeeping Federation had their 2023 convention in Jacksonville, Florida from January 4-7, 2023. About five hundred people attended including a few international people. We were all delighted to attend. Even the weather cooperated. Now we are all anticipating the 2024 convention in New Orleans.

Three speakers were showcased, one of which was Diana Cox Foster who runs the pollinating insect research unit out of Logan, Utah. Their studies include other pollinating insects in addition to honey bees. How does the presence of the honey bee impact other native bees? All require pollen and nectar. How much food is available and how many mouths are there to feed? What is the interaction between pesticides, pathogens, poor nutrition and parasites? These were some of the topics she addressed.

Another speaker was Dr. Sam Ramsey who addressed the *Tropilaelaps* mite hereafter referred to as 'Tropi'. This is not the first we have heard about it but it is another parasitic mite and we must worry about it coming to America from Southeast Asia. We beekeepers frequently wonder why the *varroa* gets into hives. It is the perfect home for them with perfect temperature and perfect food source. Actually, bees prefer to be away from other bees. What do we do? We put them near each other, enabling them to reproduce.

Varroa and 'Tropi' share one feature and that is that they reproduce rapidly and easily and it only takes one mite. *Varroa* and 'Tropi' DO live in the same hive. We don't know if they compete or if they cooperate. We need to learn to 'think like the mite.' Heat treatment including solar cells is being tried at this time.

State honey queens represented for Florida, Iowa and Wisconsin with Florida's queen being chosen as the American Honey Queen and the Iowa queen as the American Honey Princess.

Finally, Jay Evans spoke about Understanding and Managing Honey Bee Diseases. We need the colonies to be resilient. Stressors such as climate, disease, chemicals, even goats (because they eat all the forage) impact them. Our researchers are trying to find nature antidotes with over 500 natural ones yet to be tested. Our last resort should be medication.

The break out sessions were well attended and extremely interesting. Commercial beekeepers, sideliners/small scale beekeepers and package bee/queen breeders were all in break out sessions. Since so many of us in this state are small scale/sideliners, I might add that a few favorites were Becky Tipton's value added product demonstration, wax rendering and how to make creamed honey. Also included, were comb honey production, encaustic painting, queen rearing, therapeutic uses of honey, overwintering bees in climate controlled environments and establishing markets.

Always a highlight of the convention is 'Kids and Bees'. This open house for community children was attended by over 600 kids and their teachers/parents!

The foundation luncheon, delegate luncheon and auxiliary luncheon showcased their respective interests. The trade show brought in some new and unique companies this year. There was a push for plastic foundation and plastic beeswax coated frames, extracting equipment on display, insurance and purveyors of gadgets. There was an absence of glass and plastic bottle purveyors. Pollinator friendly plants was a high priority booth.

Mark Killion represented his father, Gene, as we all honored the Killion family and their contribution to the beekeeping industry but especially to the section box product of comb honey. The proceeds of a silent auction of Killion memorabilia as well as the auction of Mark's donated honey will go to a scholarship for a worthy entomology student.

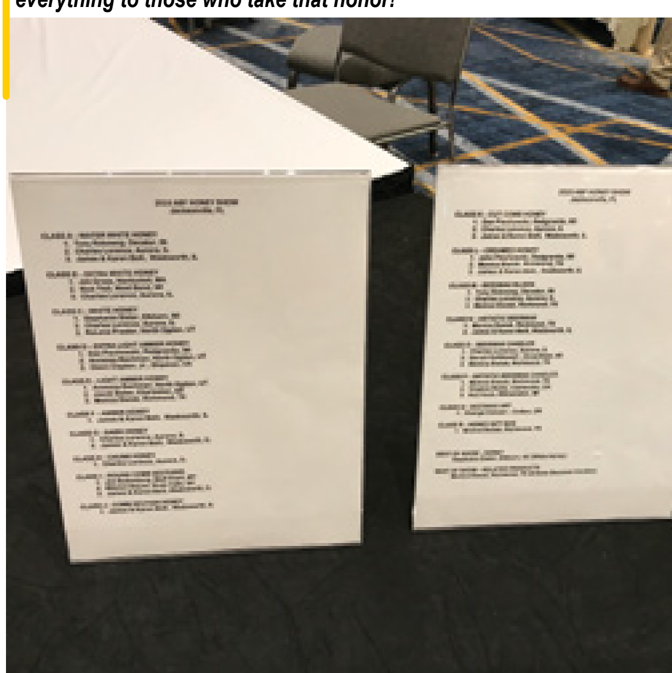
Our queen candidates this year represented Wisconsin, Iowa and Florida. Throughout the convention, they circulated amongst the group, sharing their experiences in beekeeping. Selena Rampolla was the Florida Honey Queen and became the winner for American Honey Queen; Iowan, Allison Hager, became the American Honey Princess. In addition, Wisconsin was represented by their 2022 honey queen – Shannon Lamb. Please remember that our queen and princess are now available for appearances at your events. Contact Anna Kettlewell to schedule them for your clubs or events. Outgoing American Honey Queen, Lucy Winn, was a phenomenal candidate this past year.

Kids and Bees was a popular place for kids to learn about bees and beekeeping. About 600 kids from the community came to tour the exhibit.

The National Honey Show displayed the best honey in America and was entered by individuals from throughout the country. Stephanie Slater from Wisconsin earned BEST IN SHOW with her extra light extracted honey. Her jars were auctioned off at the banquet on the final night and brought $840 per jar! The money will go to the legislative fund.

The convention will be held in New Orleans in January of 2024. Plan to join us! BC

The honey contest gave participants an opportunity to bring their honey and beeswax products to be judged competitively against other professional beekeepers. The winning honey was then auctioned off. Participants take the competition very seriously and winning is everything to those who take that honor!



Beekeeping Critical Thoughts – 2023 Hive Life Conference

Earl Hoffman

The 2023 Hive Life Conference was held in Sevierville, Tennessee at the Sevierville Conference Center on January 5-7, 2023.

Please allow me to share some observations and critical thoughts on the second annual Hive Life conference.

I have attended both Hive Life conferences, last year's and this year's.

My intent, is to not repeat the excellent reviews and discussions on the event, but to inject thoughts on WHY is the Hive Life Conference so successful? Please feel free to expand your thoughts on your next Bee Conference.

Just like real estate, it's location, location, location. Tennessee is in the middle of the Eastern part of the United States of America. It's a one day drive on average, while some drove for two days to be at the conference. Yes, it does have a major airport nearby in Knoxville, TN, but most beekeepers prefer to avoid the airports like the plague (How many of my small pocket knifes has TSA stolen from me? I have lost count.).

Please let me share a few of my observations with you. Individually, each of these observations may seem trivial and of no significance, but all rolled into one big conference, they are the magic that makes the Hive Life Conference in Sevierville, Tennessee special.

- An abundance of clean, moderately priced hotels in the Sevierville, Pigeon Forge, Gatlinburg area.
- Lots of things to do in the area, before the conference, during the conference and after the conference.
- Parking at the Hive Life Conference was more than enough and it was free!
- "Free" fresh great tasting coffee all day long, with a ton of snacks all day as well.
- The catered lunch meals were fantastic, more than enough and they tasted home cooked, at a great low price. And they fed almost two thousand people in less than two hours each day. WOW.
- The Conference Center in Sevierville, Tennessee is one of the largest and cleanest facilities I have ever enjoyed. The Conference Center staff was friendly and abundant.
- The restroom facilities were more than great, they were clean and open. Service was always there.
- Lots of pre-orders and business to business traffic. I wish you could have seen the massive loading dock area. It was buzzing with activity before, during and after the conference.
- Millions and millions of dollars of bee equipment and inventory was at hand. Many sold out of equipment.
- Almost one hundred (100) vendors and exhibitors!
- Loading dock area was not managed by any logistics firm. This reduced the cost to use the facility by magnitudes. Vendors had free will to move and transport equipment as needed.
- During three (3) long intense days at the conference, I detected NO unhappy beekeepers; they were all excited to be at the Hive Life Conference
- Fantastic honey show and competition, the largest in North American in over fifty (50) years with over five hundred (500) entries with world class judges. Better, in my humble opinion, than Apimondia 2019.
- The event schedule gave break time between speakers and everything was in the same building.
- Name badges had your meal ticket printed on it and it was double sided (smart?). I could read the names.
- Total cost to sponsor and pay vendor fees was about half what other conferences charge.
- No drama detected, most were happy to be there.
- Speakers were and are great beekeepers with years of experience. They shared their wisdom each time they spoke. Lots of useful information was shared by all.
- Lots of Master Beekeepers and enthusiastic sideliners in attendance.
- This event was a low cost educational opportunity.

Everyone said that they will be back next year. They were not disappointed. Hive Life Conference: under promise and over deliver. That's the way they roll.

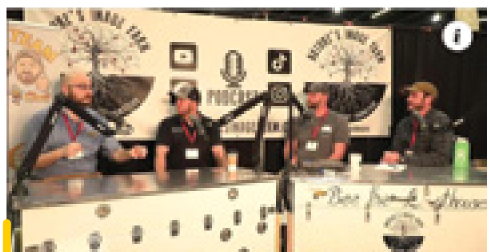
Please consider these Critical Thoughts the next time you attend a Bee Conference. BC

Respectfully, EAS Master Beekeeper - EARL HOFFMAN

Vendor area example

Honey show

Lecture Hall



Group Talk

Vendor area example

Pins marking where the attendees are from

Attendees with speaker Bob Binnie.

Speaker Ian Steppler with audience.

Speakers Bob Binnie and Ian Steppler.

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IF BEES DISAPPEAR then what?

Ed Erwin

No Bees – No Sex (for Some Plants)

It has been purported that Albert Einstein said: "If the bees disappeared off the surface of the globe, then man would have only four years of life left. No more bees, no more pollination, no more plants, no more animals, no more man."

Do I believe this to be the case – no. But if that should happen it would be disastrous for the world as we know it.

Plants Need Sex to Reproduce

Sex has always been difficult for plants because they cannot move. Their reproduction takes place by pollination. Pollination accomplishes plant fertilization and the production of fruit, seeds and young plants. One method of pollination is the wind, which blows pollen from plant to plant. However, when pollination relies on the wind, 99.99% of the pollen goes to waste. Most trees, such as pine, rely on the wind for pollination. If you live in an area with pine trees you know how much pollen these trees produce!

The other method of plant pollination is accomplished by pollinators in search of food, such as nectar and pollen. During their visit to the flower, they may brush up against the male part of the flower (stamen) and then deposit pollen to the female part of the same or another flower (stigma). Once the pollen is received by the flower it can produce fruit or seed.

The earth didn't have flowering plants until approximately 145 million years ago. Plants of the Jurassic period were primarily green forests of tree ferns and conifers, such as pines and cedars. Since pollen is very nutritious, insects were attracted to the plants. During this time, the earth began to warm allowing plants to evolve and produce flowers. The flowers further evolved to produce bright colors, scents and the secretion of sugar-rich nectar, to attract insects. The first flower looked similar to a magnolia tree flower and its first pollinators were probably beetles. Interestingly, this first flower has evolved into over 350,000 species. Pollination by insects is called entomophily.

Research has shown that bees evolved from carnivorous wasps approximately 130 million years ago and pollen feeding, known as pollinivory, allowed bees to rapidly diversify. Bees have become the masters of gathering nectar and pollen. The evolution of both flowers and bees, developed into a symbiotic relationship where two organisms cannot survive without the other. These small creatures provide huge benefits.

Evolution of the Bee

Today there are over 20,000 known species of bees, most of which are 'solitary' bees (bees that live alone and not in a hive). The honey bee evolved in Afro-Eurasia approximately 25 million years ago. Today, bees are found on every continent except Antarctica. There are bees in every habitat on the planet where plants or flowers are pollinated. The honey bee accounts for 85% of all the pollination of flowering plants.

Since 2016, bees have been dying off at record rates, known as Colony Collapse Disorder (CCD). This disorder affects honey bee colonies and is characterized by sudden colony death, with a lack of healthy adult bees inside the hive. Although significant research has been focused on solving this issue, the cause is not known. Researchers suspect that multiple factors may be involved including: loss of habitat, decline in biodiversity, pesticides and other agricultural chemicals, climate change, pathogens, pests and parasites all contributing to the single catastrophe. Since 2016, the annual loss of honey bee hives is over 40%.

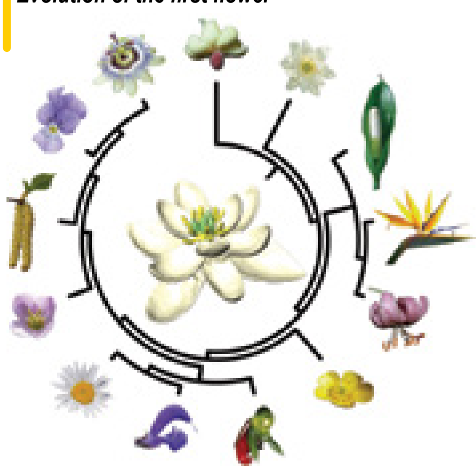
Fortunately, beekeepers can create colonies by purchasing additional queens from honey bee queen suppliers and splitting one colony into two. In each hive there is one queen, tens of thousands of females (worker bees that can't lay fertilized eggs and produce new bees) and up to 200 males (or drones) in the Summer. The drones only mate with virgin queens from other hives.

Pollinators and the Environment

As the world's most important group of pollinators, bees are a crucial part of agricultural production and natural ecosystem functions. Although most consider soil, water and sunlight necessary to produce plants on earth, at least 30% of the world's crops and 90% of all plants require cross-pollination to spread and thrive, which the bees provided.

In simple terms, pollination allows plants to produce more plants. Without pollinators, plants would slowly reproduce, if at all. Pollination provides genetic diversity resulting in stronger

Evolution of the first flower



First bee

plants. Pollinators are essential to the environment. Without them, we would lose many plants species, ecosystems and the animals that rely on those plants. Plants also provide nutrients to the soil and energy in different ways. When they are consumed by herbivores, they are converted into microorganisms or consumed by carnivores. When the carnivores die they are recycled as energy back into the soil supplying nutrients to the plants.

When pollinators produce an increase in plants, they in turn increase oxygen production and carbon dioxide consumption. This carbon dioxide is converted into carbohydrates, a key resource for honey bees. Without this consumption of carbon dioxide the climate would change and the planet would become inhospitable.

Without plants there is a greater risk of soil erosion leading to carbon being released from the soil. More plants equals less soil exposure and carbon retention. This is known as Carbon Sequestration, defined by the USDA as "the process by which atmospheric carbon dioxide is taken up by trees, grasses and other plants through photosynthesis and stored as carbon in biomass (trunks, branches, foliage and roots) and soils." With the plants dependent upon honey bees for pollination and plants disappearing, there is a clear connection to the increase of carbon in the atmosphere. According to Lewis Ziska, a plant physiologist at the U.S. Department of Agriculture's (USDA) Research Service in Maryland, "the increase in CO_2 will also reduce the protein content in leaves so insects will need to eat more leaves to get the same amount of protein."

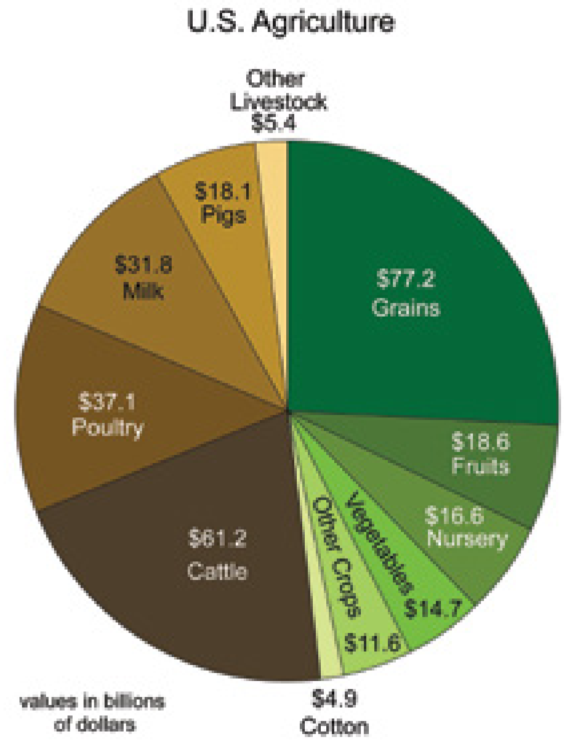
Bees need pollen to provide the protein they need. However, unlike insects that can consume additional leaves, bees cannot control the quality of pollen and consume more. A poor quality of pollen will lead to a shorter lifespan of the bees and could lead to a collapse of the colony.

Effect of Honey Bee Loss on Food Supply

Let's take an imaginary trip to a world without honey bees and see what would happen to our global food supply.

Honey Will Disappear

Humans have been harvesting honey for about 9,000 years. In the U.S. there are about 120,000 beekeepers, also known as apiarists. Americans use an average of about 1.5 lbs. of honey per person annually. About 35 percent of this is consumed in homes, restaurants and institutions. The remaining 65 percent is used in the production of baked goods, cereals, beverages and processed foods. Although there are over one hundred thousand beekeepers in the U.S., this honey production only meets about half of the U.S. demand, leading to honey importation. Honey is also used for its medical, dietary and cosmetic properties. Worldwide, honey production is over four billion gallons per year. It takes 12 honey bees working their entire lives to produce one teaspoon of honey, so annual honey production would require approximately 315 trillion bees.



Value in agriculture

Honey is the only food source produced by an insect that humans eat. Worker honey bees gather floral nectar and transform it into honey by reducing the moisture through a dehydration process. When a foraging bee returns to the hive with nectar, it is passed through approximately 200 bees who process the nectar in their honey corps (small nectar gathering stomach), and in the process they add enzymes to reduce the disaccharides (sucrose) and monosaccharides (fructose and glucose) turning the nectar into honey. This process known as hydrolysis, takes one water molecule to convert each sucrose molecule, demonstrating the bees need of a fresh water source.

China annually produces the largest amount of honey in the world – approximately 24%. Although they are the largest producer of honey, their honey has been banned from the European market by the European Union since 2002. Their honey has been tainted with poisonous agricultural contaminants such as pesticides, antibiotics, heavy metals and adulteration with industrial sugars. The antibiotic China used has been banned in food by the U.S. Food and Drug Administration when it was demonstrated to cause DNA damage in children. In some cases, honey from China was contaminated with lead from improper storage containers.

Chinese honey brokers have been known to create a counterfeit product made of a mix of sugar water, malt sweeteners, corn or rice syrup, jaggery (a type of unrefined sugar), barley malt sweetener or other additives with a bit of actual honey.

Chinese labor costs are approximately \$15/person/day making it difficult for U.S. beekeepers to compete. The U.S. has imposed various tariffs to level the playing field. In order to get around the banning and tariffs, Chinese honey is generally labeled "made in Thailand", the Philippines, Russia, India, and more recently Vietnam and traditional laundering points in Asian countries.

Many Fruits, Vegetables and Nuts will No Longer be Available.

Back to looking at the global food supply. One hundred crops that supply 70% of the world's food supply, are pollinated by bees. Without bees helping to produce these crops, supermarkets would have tremendous trouble filling the produce section. If you could find fruits and vegetables, they would be very expensive. Everyday items today would turn into luxury items. The next time you go to a grocery store and pass through the fruit and vegetable section, imagine every third item being gone. That's the magnitude of this loss to our diet and nutrition. Globally, pollination by bees accounts for 235-577 billion dollars in annual food production sales.

The most valuable cash crop fruit grown in the United States, as far as cash crops go, is the orange. Oranges are the most cultivated fruit tree in the world. Christopher Columbus brought the first orange seeds to the New World in 1493. Over 70 million tons, or 224 trillion oranges, are grown annually worldwide. The top orange producing countries by millions of tons are Brazil: 35.6, USA: 15.7, China: 14.4 and India: 10.8.

The second most valuable cash crop fruit grown in the United States is "The Forbidden Fruit," the apple. The first apple cuttings and seeds were brought to the U.S. from Europe in 1607. Today, there are 2,500 varieties of apples grown in the United States. In the U.S., there are approximately 8,000 apple growers with orchards covering 430,200 acres. Apples require cross-pollination with other varieties. Without bees, the cross-pollination would need to be done by humans. China is the leading producer of apples with over 1.2 billion bushels. The United States produces 240 million bushels a year.

Broccoli, carrots, pumpkins and other squash-type vegetables would become extremely hard to produce without bee pollination. Like many of your favorite fruits, they would just become too rare and expensive to use everyday, so it would be likely that they would disappear completely.

No bees, no... almonds, which are one of the most nutritious and versatile nuts. Also almond milk, almond oil, almond extracts, shampoos and almond bakery goods would no longer be available. Eighty percent of the world's almonds are produced in California. Approximately 800,000 acres are planted with almond trees in California. In late February and early March, the almond tree begins to produce blossoms that are ready for pollination. Each year approximately 20,000 beekeepers bring in honey bee colonies on semi-trucks loaded with 400 to 500 colonies each, to pollinate the blossoms. This pollination requires more than a million colonies, or 50 billion honey bees.

Almonds

Depending on the number of bees in the hive, beekeepers charge pollination fees ranging from $165 to $240 per colony.

After the almond bloom is over, the beekeepers move colonies up through the Pacific Northwest pollinating apples and other Spring-blooming crops. By May, the colonies are moved to North Dakota to produce honey and pollinate clover, canola and sunflowers.

Other crops that are ninety percent dependent upon honey bees are avocados, blueberries, blackberries, grapes, raspberries, melons, peaches, cherries and cranberries.

Several varieties of coffee, such as Robusta, are dependent on pollinators. Of the worldwide coffee production, Robusta accounts for around 40% of all coffee production. The presence of bees can improve the quality and size of coffee beans. Without bees, the viability of coffee would be difficult and expensive.

Pollination by Humans, Robots and Drones

Hand Pollination

Without honey bees, pollination would need to be done by humans. One way to pollinate would be by hand. First, understand that the flowering stage to pollinate a plant lasts only about two to three weeks, so the pollination would need to be done quickly. Pollination by hand requires a person to use a brush to 'paint' the feminized pollen on the developing buds. In a study done on this process, it was determined that in the U.S., to hand pollinate two acres would cost about seven thousand dollars in labor alone. To pollinate the nations almonds fields it would take tens of thousands of people at cost of over 2.8 billion dollars.

Hand pollination is performed in the Hanyuan county in China, known as the "world's pear capital." This hand pollination became necessary after farmers started using more pesticides, causing a complete loss of the bee population.

Robot Pollination

Robotic Pollination is another area being researched. The University of West Virginia has created a moving pollination machine called "The BrambleBee". It uses state-of-the-art localization and mapping techniques and tools that enable visual perception, path planning, motion control and manipulation.

The BrambleBee

Hand pollination

It can only pollinate bramble plants such as raspberries and blackberries in a greenhouse environment. Bramble plants have thorns and produce edible fruit.

The drawback is that it only works on self-pollinating plants. Once it reaches the plant it "jostles the plant" causing the pollen to shake free and hopefully fall on a blossom. The BrambleBee will not work on tree crops, like almonds or non-self-pollinating plants. Based on the limited use of robots, we need to figure out how to protect bees, not replace them.

Drone Pollination

Work has also taken place with utilizing flying drones to pollinate plants. The latest versions cost around $100/unit. Still in its infancy, they must be manually steered. The use of drones will require self-steering and the need to communicate with each other to avoid collisions. Large swarms of drones will be necessary. Drone pollination is still 20 to 30 years away.

Walmart is hedging its bets. Walmart has filed six patents to develop and use pollination drones, aka, robot bees. The drones would be capable of pollinating flowers and crops the same way a bee would. Cameras and sensors on the drone would identify pollen in one flower before moving to the next flower. They want to ensure foods such as apples, pumpkins and almonds remain on shelves in the event of a bee extinction.

Dairy Products Would Begin Disappearing

Dairy cows eat about one hundred pounds of food per day and require a complex diet. They are a major consumer of bee pollinated plants. One of their main food sources is alfalfa, which requires bees for pollination. Without dairy cattle, milk, butter, yogurt, ice cream and cheese will just disappear. Worldwide there are 74 million acres planted in alfalfa. North America produces forty-one percent of worldwide alfalfa on 29 million acres. Although the majority of beef comes from beef cattle, seventeen percent of all beef comes from dairy cows. Humans consume about 75 pounds of beef every year. Sheep and goats also eat pollinated plants.

Clover is another crop important to dairy cattle. Brought to North America as early as 1664 as a forage crop, it is extensively cultivated as fodder plants. Fodder crops are a main source of nutrients for livestock and provides increased production. Livestock fodder crops are also a food source for honey bees and the foliage and seeds are consumed by wildlife. Clover is an important cover crop because it cuts fertilizer costs and enhances soil health, which reduces the need for herbicides and pesticides. Clover also prevents soil erosion, conserves soil moisture and protects water quality.

Cotton will Become an Expensive Luxury

Although cotton crops do not completely rely on bees for pollination, it has been shown that when bees are present during the flowering period it increases the strength, length, quality and quantity of the cotton fiber lint.

Cotton was introduced to Florida in 1556. Today, the USA is the biggest cotton exporter in the world with revenues of $25 billion a year and 200,000 employees. Cotton provides approximately 95% of the world's natural textile fiber demand. Seventy-five percent of the world's clothing products contain at least some amount of cotton. Cotton is one of the least expensive textile fibers in the world. Without the bees, cotton crops would be less profitable and would probably lead to only man-made materials being available.

Besides the clothing industry, the loss of cotton would affect the production of our paper money (75% cotton) and toilet paper.

Several cooking oils will also no longer be available: canola, coconut, almond, sesame and cottonseed oil are all pollinated by bees. The word Canola is a contraction of "Canadian" and "ola (oil)." Brand name shortening Crisco will not be available. It's name is a modification of the phrase "crystallized cottonseed oil".

What Will We Eat in a Post-bee World?

Anemophily, is the process of pollination transported by air currents from one individual plant to another. Some plants require pollination by an enormous numbers of pollen grains. About 12% of the world's flowering plants are wind-pollinated.

Without bees, our diet would consist of grains, such as wheat, rice, corn, rye, barley and oats. Several nuts like walnuts, pecans and pistachios would supplement your diet. Your vegetables would be potatoes, tomatoes, onions and carrots since they don't rely heavily on bees for pollination.

Although beef would be expensive, some meat products will be available, including pork, poultry and fish.

Svalbard seed vault

Svalbard Global Seed Vault

There is some hope that most of the non-pollinator plants will not go extinct because of the world's largest secure seed storage. The facility is part of the international system for conserving plant genetic diversity guided by the United Nations for food security and sustainable agriculture. Located in the Norwegian island of Spitsbergen, in the remote Arctic Svalbard archipelago, it contains 1,081,026 seed samples. Most of these seeds are anemophily, very few are dependent upon pollinators.

The Cost of Food will Skyrocket

Bees are the lifeblood of the food chain. A single bee colony can pollinate 300 million flowers each day. Within three months, worldwide crop yields would plummet. This would cause the Destruction Domino Scenario wherein bees pollinate plants, which then get consumed by animals and these animals are consumed by humans. Herbivores, would be affected first because they depend solely on plant species.

The loss of the plants eaten by animals would cause the cost of feed to increase, resulting in higher food prices. In fact, this has already happened in Scotland. During the Winter of 2012, Scotland lost almost one third of their honey bee colonies, which, in turn caused food prices to soar.

Over the last six years, the bee industry spent $2 billion to replace 10 million hives. The almond industry makes around $500 million a year. Higher fees cost almond growers an extra $83 million a year. They pass those costs on as higher prices.

Malnutrition –
Our Diet Would Suffer

By the end of the first year, without honey bees, we would have a very bland diet, less diverse and less nutritious. Malnutrition will be a big worldwide issue. We need different nutritional foods and vitamins to stay healthy and complete our full range of physical and mental activities. Health complications would arise due to malnutrition and medical costs would soar with them.

Loss of Important Vitamins and Minerals

Bee-pollinated crops provide the majority of lipids, which are molecules that contain hydrocarbons and make up the building blocks of the structure and function of living cells. These crops also provide a large portion of the minerals calcium, fluoride, iron and vitamin A, C and E. Without vitamin E, our immune system will become weaker and the lack of vitamin C could cause a scurvy epidemic. Foods that are pollinated by bees also contain nutrients that lower the risk of cancer and heart disease. Without them, we become sickly, tired and weak. The loss of pollinators would place a great number of people into a vitamin A deficiency that is important for many bodily functions, including proper vision, a strong immune system, reproduction and good skin health. Pollination loss would also create a folate deficiency. Folate is a B vitamin that your body needs to work properly and is especially important for healthy pregnancies.

Medication

Many medicines humans use, both conventional and alternative, are derived from flowering plants. The willow and aspen trees used to make aspirin are pollinated by bees. Opium poppies used to produce morphine are also pollinated by bees. The manufacturing of many important drugs and medical treatments could be affected by a sudden loss of our bee population, leading to shortages and in some cases, complete unavailability.

Many vegetables will be substituted increasingly by staple crops like rice, corn and potatoes, eventually resulting in an imbalanced diet.

There Might be a Worldwide Economic Crash

According to Bayer, a German multinational pharmaceutical and biotechnology company that specializes in agriculture seeds, "every season, pollination from honey bees, native bees and flies deliver billions of dollars (U.S.) in economic value. Between $235 and $577 billion (U.S.) worth of annual global food production relies on their contribution." With such an impact on the economy, it begs the question: if these critical insects were public companies, how might they stack up in the global marketplace?

Without bees the world is going to take an enormous economic hit. There are going to be entire industries like coffee, cotton and food production that may no longer exist.

To understand the overall impact you need to look at the 'Crop Value Chain' (see image below). This chain of crop activities include: land preparation, planting, cultivation, harvest, storage, marketing process, market and consumer. Each step involves countless people, which has an impact on our economy.

Alfalfa is a $10 billion per year industry. Coffee is a $81 billion per year industry in the world. The value of crops pollinated by honey bees is valued at $54.75 billion dollars. In the U.S., there are 2.05 million farms, of which 97% are family owned. Many of these farms will no longer exist.

Worldwide Famine

Without bees, most plants can't grow or reproduce. Large-scale desertification, which is the process by which natural or human causes reduce the biological productivity of drylands (arid and semiarid lands), could occur. Huge landslides could wipe out entire villages, and severe drought could starve the survivors. Freshwater would start to disappear, since trees are needed for water retention, and there would be a lot less trees. Studies have shown the devastating impact the continued loss of pollinators like honey bees could have on millions of people in the developing world. Seventy percent of the world's poorest people live in rural areas and depend on agriculture for their livelihood.

Bees are among the hardest working creatures on the planet providing an important ecosystem service of ensuring pollination and the reproduction of many cultivated and wild plants, crucial for food production, human livelihoods and biodiversity.

A world without bees could struggle to sustain the global human population of 7.7 billion people.

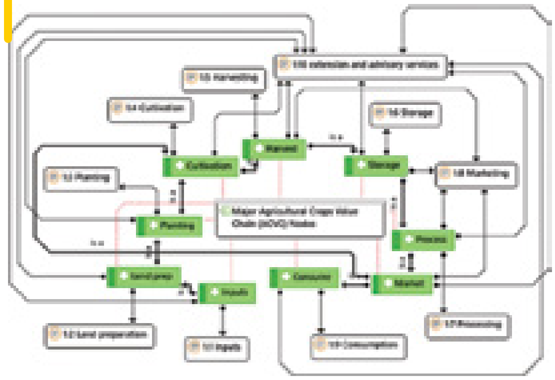
Famine would be very likely in developing countries. Humankind will survive because food crops like wheat, rice, soy and corn grow without insect help. It would however take time to switch over to these crops. Without bees it would be hard to maintain our current population, which is still growing.

Food availability will drop drastically and costs will increase, which would result in less access to food for many people.

If all bees died, it may not be a total extinction event for humans, but it would be a disaster for our planet.

It's almost impossible to overstate how important the role bees play in the global food supply and natural balance of the planet. It's important not just for us that bees survive, but for every living thing on the planet. BC

Crop value chain



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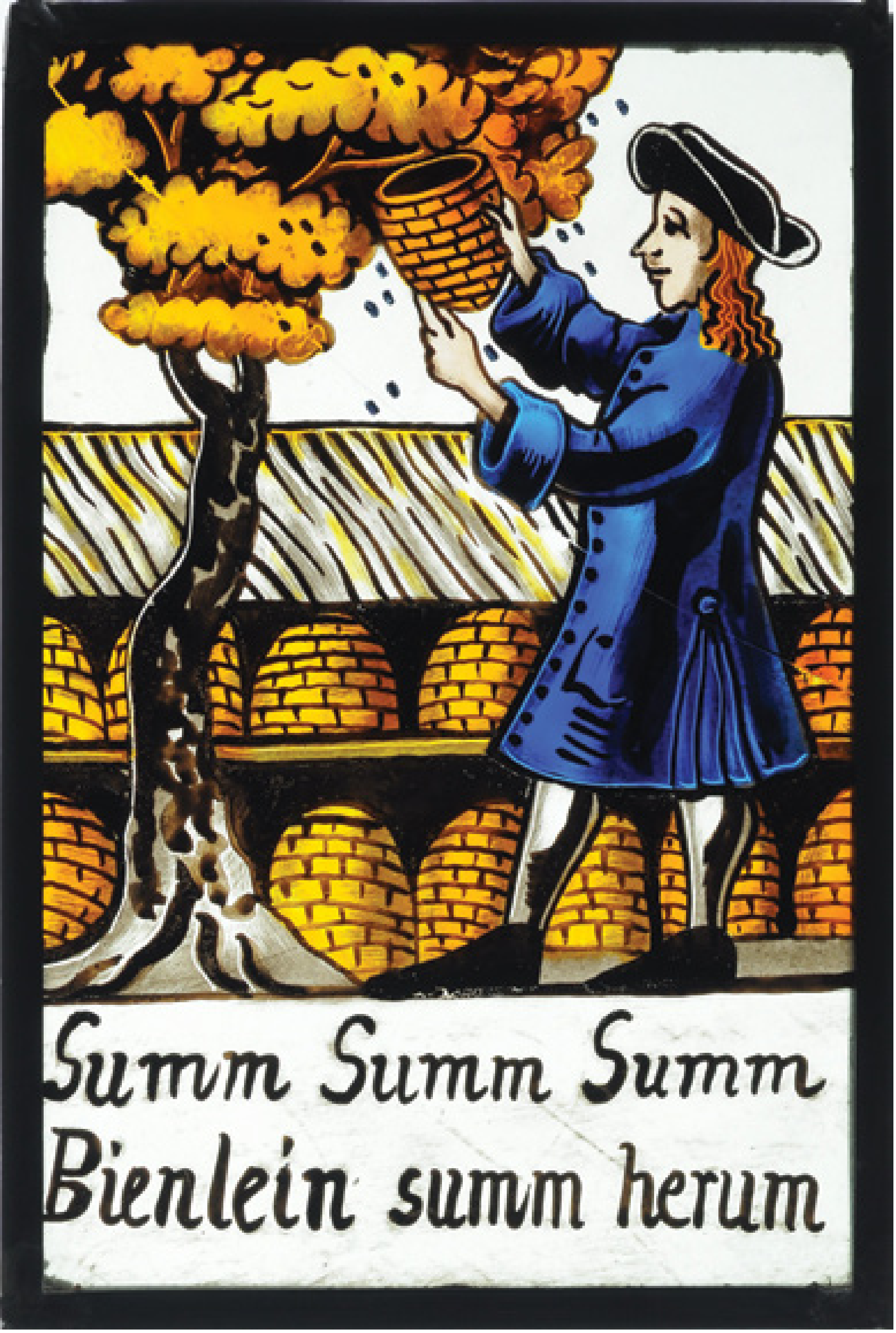

Traditional Beekeeping

Pablo Montesinos Arraiz

Unlike what happens with other farm animals, honey bees have traditionally been exploited with the criterion that they are animals that do not need much attention and that their use from the productive point of view is achieved with little effort and technical assistance to hives (Whitehead, 1948; Bartolini Crespi, 1992; Sepulveda Gil, 1980; Mace, 1974; Harrison et al., 1976).

This pattern of work that prevails in the way most beekeeping operations are carried out is reinforced because honey bees obtain their food from flowers and can reproduce and perpetuate themselves without any human intervention. Hive inspections in traditional beekeeping are notoriously seasonal. The beekeepers inspect the hives three to four times in each season of the year, always depending on the response of the colonies to the environmental conditions and the handling performed in the last inspection, increasing the number of inspections in Spring and Summer due to the intensity management required by the hives in those months (Cale et al., 1976).

However, the widespread phenomenon of hive collapse and the problem of the presence of the Asian hornet (*Vespa velutina*), has forced beekeepers to increase the frequency of visits to apiaries to try to control and prevent these problems. On the other hand, in those countries where Africanized bees were established, beekeepers had to implement other techniques and ways of working with bees in order to carry out their beekeeping operations. These management characteristics that are complementary to the traditional ones used in Europe and the United States of America (Michener, 1975; Wiese, 1977; Taylor and Wlliamson, 1975; Winston, 1977; Taylor and Leving, 1978; Rinderer, 1985) as a matter of fact, are not different regarding the way to evaluate and analyze the hives as from the inspections of routine.

The beekeeper's work has traditionally been to provide their bees with adequate and safe hives to help the growth of the bee population so that they can accumulate sufficient reserves of honey, the main product of the hives, to be harvested. Thus, much of the work with the hives is devoted to placing or removing frames with honeycombs or stamped wax in the brood chamber and/or in the supers, depending on the conditions of the hives and the season of the year (Root, 1976). There are beekeepers who also obtain the by-products of the hives: pollen, propolis, bee nuclei, and even poison; and very few breed queens for their own use or for sale.

During the flowering months, beekeepers usually only inspect the supers to specify the disposition in which the bees are distributing and storing the honey. They usually only go to the brood chamber if the supers have little or no honey, or if they see few bees on the combs or going in and out of the entrance of the hives. They do this to see if there is a queen, egg laying and brood. On the other hand, the rest of the months, in which there is no entry of nectar and pollen or this is not significant, the inspection of the supers is discretionary. The beekeepers inspect the brood chamber to observe egg laying and if possible to see a queen; assess the number of combs with open and/or sealed brood and also to remove the damaged combs and clean the bars of the frames.

When the nectar flow is abundant it is very important that hives have enough supers. The first supers can have empty combs or frames with stamped wax which will be carried by the bees to combs that will fill up with nectar (Root, 1976; Cale et al., 1976).

Furgala (1976), points out four fundamental principles of beekeeping management: each colony must have a young queen of proven genetic quality; it must have an adequate reserve of honey and pollen; must be disease free; and must be protected from extreme weather conditions and inhabiting a well-built hive. And so, depending on the beekeeping management carried out with the hives and the observations of the beekeepers during the routine inspections and according to the season of the year, the beekeepers will implement the necessary techniques and/or management methods.

It should be noted, however, that in the traditional beekeeping management carried out by beekeepers, there is perceived lack of strategies in the way of collecting the information that comes from the hives during routine inspections. As a consequence, beekeepers reached wrong conclusions about the conditions in which the hives are, applying inappropriate techniques and beekeeping management. When inspecting hives, beekeepers do not usually follow a protocol of action; they tend to do it messily and randomly. Beekeepers lack of proper ways to collect what they see in hives during inspections, also lack a frame of reference to help them to analyze and evaluate the information collected.

What do beekeepers look at first when they start to inspect a hive and how do they interpret it? What succession of actions are performed so that the information collected in the inspection of the hives is structured in a logical and orderly manner, so that it can be analyzed with the certainty that it has been well processed in obtaining it, and can lead to a right beekeeping management?

Just as it is necessary for beekeepers to follow a protocol and have a reference procedure when they inspect the hives, they must have a homogeneous criteria that allows them to assess everything that happens in the hive in the same way.

Ordinarily, during routine hive inspections, beekeepers check for the presence of the queen either by direct observation of her and/or her egg laying. They inspect the combs in the brood chamber, especially the central ones, to see how many are occupied by egg laying, open and/or sealed brood. To estimate the quality of the queen's egg laying, they use terms such as "very good", "good", "regular" or "bad". However, the same egg laying of a queen can receive a very different assessment depending on which beekeeper it is; thus the egg laying can be very good for one, regular for another or even excellent for a third beekeeper.

Now, what does "very good egg laying" mean? What is "a regular egg laying"? What is "a bad egg laying" or "an excellent egg laying"? On what criteria are beekeepers based to make such assertions? When beekeepers observe egg laying, do they quantify it? If so, how do they do it? Under what principles? Are beekeepers basing it on the number of eggs in a comb? How many combs with eggs correspond to a good or regular egg laying, for example? How do they determine all those measurements? What methodology do beekeepers use?

When it comes to describing queens, beekeepers often characterize them using terms such as pretty or ugly; good or bad; young or old; black, very black or yellow; large, medium or small. Likewise, these definitions of aspects or qualities, ages, colors and sizes of the queens, which can be found as a result of a routine inspection of hives, show a great variety in their conceptualization, according to the criteria of each beekeeper.

Consequently, as beekeepers do not have defined sustainable and commonly used reference frameworks in beekeeping to classify the egg laying, race, age and size of queens, is not possible to achieve rigorous reproductive and phenotypic valorations of the queens. This is the reason why the evaluations carried out by different beekeepers, when considering the same queens, do not usually coincide.

Other evaluations that beekeepers make when they check their hives have to do with the population of adult bees, the number of combs with open and/or sealed brood and the store of honey and pollen. Aspects that lead them to determine how a hive is in general at a given moment.

Knowing the general conditions of the hives is of the utmost importance, since it shows how the colonies are responding to the prevailing environmental conditions at a certain moment of the annual cycle; especially from flowering changes, if there is a shortage or enough nectar and pollen in the field. They are also an indicator of the management that has been applied to them, as a result of decisions based on previous inspections.

To assess hives for general condition, beekeepers often classify hives using various terms such as "excellent", "superior", "very good", "good", "regular", "poor" and "very poor". This classification is carried out according to the number of bees that are observed on the combs at the time of the inspection, the number of combs with egg laying, sealed brood and open brood and the combs with pollen and honey in the brood chamber and the supers.

Regarding the open and/or sealed brood, how does the beekeeper assess this biomass? Based on what criteria do they calculate it? What method do they use? Do they quantify the open and sealed brood, or do they estimate it subjectively? And how does the beekeeper determine if there is a balance between open and sealed brood, and

if it is in proportion to the egg laying? With what do they compare the hives or what reference values do they have to affirm that they improved or worsened or that they remain the same as the last inspection performed on the hives? A beekeeper can estimate that a hive is in optimal conditions and for others, it may be in good or regular condition. From this, it follows that beekeepers have disparate estimations of the general condition of the same hive due to the obvious differences in the evaluation criteria.

How does the beekeeper know if the population of bees in a hive has increased or decreased? How do they quantify the number of bees to know if they have increased or decreased? How many combs do the bees occupy? On the combs, can beekeepers estimate increases or decreases in the population of adult bees at a given time? So, there are notorious differences in appreciation and evaluations of the parameters that are fundamental to evaluate the behavior of the colonies from the zootechnical point of view.

It should also be mentioned that beekeepers do not usually identify their hives with numbers. The purpose of the identification is to know with certainty which hive it is at any time that the beekeepers are in the apiary, or even outside it, when they read the registers to know which hive it is in each circumstance. A hive can not be referred to as "the one with the brood chamber of this or that color, or the one with the stone in the center of the lid is the one that is orphaned or the ones with two small stones are the ones that are going to be harvested." This way of identifying hives, in addition to contravening professional zootechnical management, makes routine work with bees difficult. Likewise, it brings with it confusion when wanting to implement beekeeping registers and is out of keeping with the rigor and seriousness that beekeeping operations must have.

From what has been stated in the previous paragraphs, it can be concluded that the evaluations and analyzes of the hives carried out by beekeepers based on routine inspections of the hives respond to personal and subjective criteria that are so different and at the same time so individual and specific for each beekeeper; that it is very difficult to find points of agreement that support these evaluation criteria. Consequently, it becomes evident that beekeepers do not have reference frameworks that allow them to compare their observations and estimate the veracity and degree of normality of the biological behavior of the colony.

All the traditional beekeeping management described in which beekeepers perform routine inspections of hives has, in summary, the following characteristics:

1. Imprecision and vagueness in the definition of the terms, situations and development of honey bee hives for production purposes.
2. The routine inspections of the hives and the analysis and evaluation of the information collected is not based on rigorous zootechnical criteria and biological principles that allow them to be contrasted with the normal functioning of the colonies, lacking organization, hierarchy, scientific reasoning and uniformity of criteria in the way of collecting and evaluating information.
3. There is an absence of a common beekeeping language, written and oral, clear and simple, that facilitates technical communication among beekeepers, and is used in beekeeping registers. The beekeeping language must be understandable by anyone who works in beekeeping and facilitate a more precise and real vision of the general and particular conditions of the hives.
4. Beekeeping registers kept by the beekeepers differ in the information they contain and the nomenclature used; since each beekeeper expresses it in their own way, without following codified and permanent drafting rules. Therefore, the information in these registers can only be read and interpreted by the beekeeper in question. BC

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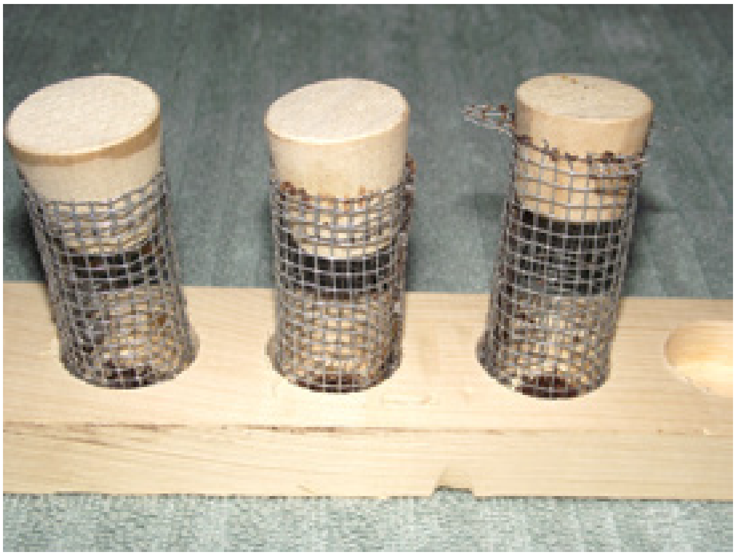
BUILD A QUEEN CAGE – ROLLER

Ed Simon



When raising queens, it may become necessary to store virgin queens for later mating or sale. Once mated, queens need to be stored until they are used or sold and delivered. By isolating queens within individual cages, you can use them at your convenience and reduce the amount of equipment needed. Queen containment cages and a "Queen Bank" provides a safe and convenient storage.

Objective

Provide an inexpensive way of isolating multiple queens so they will not kill each other.

Parts

1. 1/8" hardware cloth
2. Soldering equipment or Epoxy
3. Wood dowels – multiple diameters

Note: There is a grain to woven hardware cloth. The wires that run the length of the cloth is called the "WARP". The cross wires are called "WEFT". "WARP" wires are usually straight whereas the "WEFT" wires are seldom straight. These standard weaving terms will be used during the following explanation.

Construction

First, we will build two jigs and then build a tubular hair roller style cage that is used to store the queens and then build a wood stopper or cap for the cage.

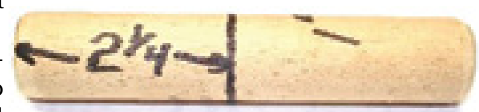
Preparation

Let's assume that you will eventually create multiple roller cages. Using jigs creates consistency. They also help keep parts in alignment during assembly. The following construction steps are for a one-inch inside diameter hair roller care with a working length of 2¼". For different diameter or length cages, use different diameter dowels and adjust the dimensions accordingly. Once these jigs are created, save them for reuse. They will provide consistency across different assembly sessions.

Step 1 – Cut a cage template (jig)

Cut a four-inch by four-inch square piece of scrap wood that you can use to lay out the basic cage.

Step 2 – Make a cage jig



Cut an appropriate size dowel to a length of around five inches. Then bevel the ends slightly so you can slide it in and out of the cage without it getting caught. Add markings for the diameter and length so you can use it again with consistent results.

Step 3 – Cut the basic cage

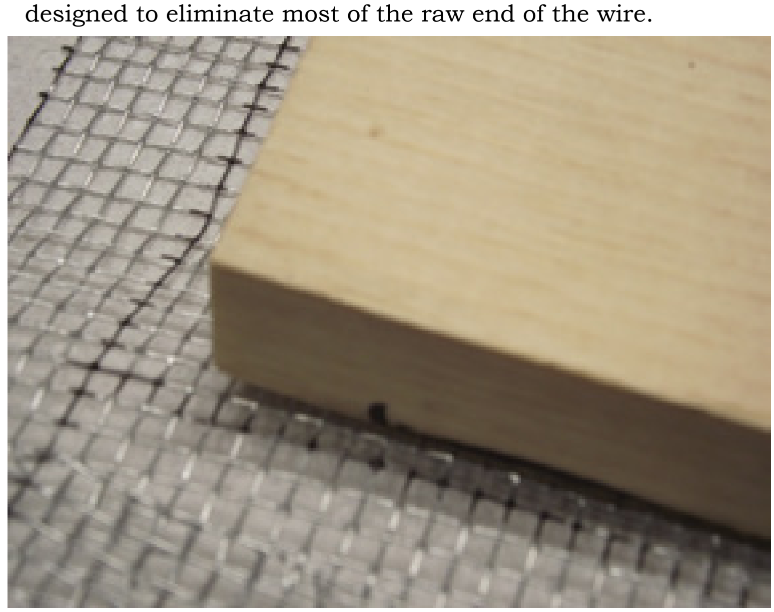
Using the template jig created in step 1, mark cutting lines on a piece of hardware cloth. Very seldom is the hardware cloth wires straight or square. Align the cage template the best you can with one of the wires. Then, use a felt tip marker to draw the cut lines.

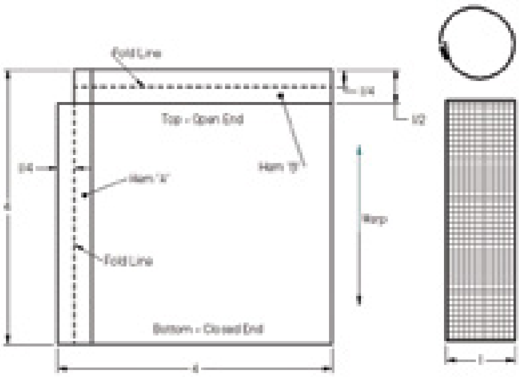
Note: Aligning the pattern with a warp wire is usually the best option.

Step 4 – Cut the basic cage body

Cut along the lines. Keep the cut edge as close to the wires as possible. This eliminates some of the nasty words later when you are forming the cage body.

Note: For safety, the following "Hemming steps" are designed to eliminate most of the raw end of the wire.





Step 5 – Remove the corner section from the cage body

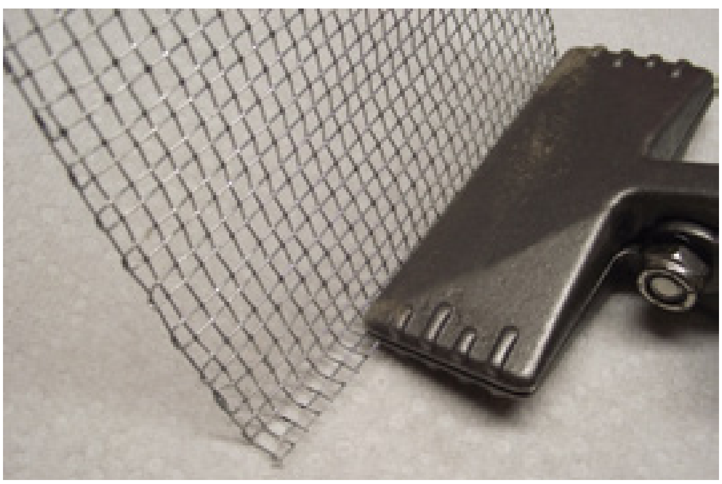
Cut a ¼" x ½" section from a corner of the cage body.

The corner cutout is so the wires will not overlap when the cage is hemmed. The measurement for this removal is easy. It is two holes by four holes.

Note: See the diagram for the basic cage layout.

Step 6 – Hem the cage body (Hem "A")

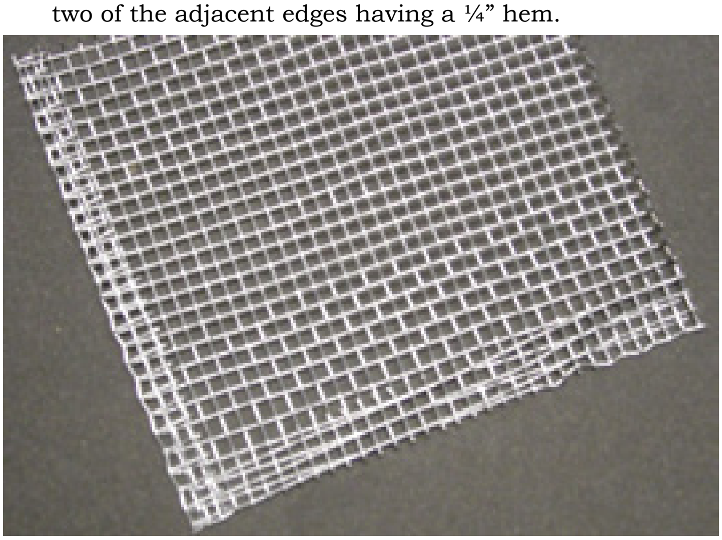
Using a warp (straight) wire for alignment, bend the hem at the ¼" (two hole) mark. This is an easy alignment since each hole in the wire is ⅛" and the warp is usually the straightest.



Step 7 – Hem the cage body (Hem "B")

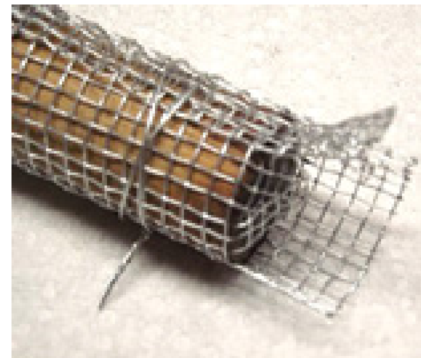
Bend the adjacent edge over to form the second hemmed edge. Unless you are extremely lucky, this will not line up with a weft wire. Make the hem as straight as possible with a 90° corner.

Checkpoint: You should now have a square with two of the adjacent edges having a ¼" hem.



Step 8 – Form a tube with the cloth

Using your fingers, roll the wire into a tube. Start with the unhemmed edge and work your way around the wire. Be sure to position the wire so the warp is parallel to your fingers. When finished, the rough edge should be on the inside of the tube with the hemmed edge on the outside. The smooth side of the hem should also be on the outside of the tube.



Step 9 – Form the cage bottom

Slide your jig into the tube. Hold the tube tight to the jig by either wrapping wire around it or clamping it with vice grips. The overlap at the side seam should be about ½". Position the end of the jig to within one-inch (one diameter) of the bottom edge of the cage. Then, cut the bottom end wire every three squares down to the dowel. Trim the sharp ends from the cuts. Then, bend the cloth to form the bottom.

Step 10 – Seal the bottom

Place the dowel in a vice and use solder or epoxy to form the bottom of the cage. Be careful to keep the hardware cloth wrapped tightly around the dowel.

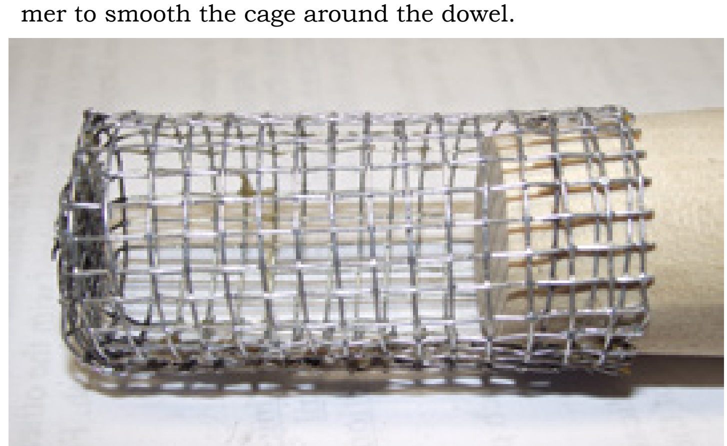
Note: If the bottom of the cage will not stay in place, use a small screwdriver to hold the tabs down until the solder cools or the epoxy sets.

Step 11 – Seal the side seam

Slowly withdraw the dowel while soldering or epoxying the seam. The seam does not have to be solid. Tacking at intervals will work. The last tack needs to be at the top end of the cage.

Step 12 – Clean it up

Remove any excess solder or epoxy and use a hammer to smooth the cage around the dowel.



Step 13 – Create a lid (stopper)

If you can find a cork that fits the opening in the cage, use it!

If the cork is too large, you can taper it with a sander to fit.

If no corks are available, a stopper can be made from a dowel. Select a dowel that is larger than the one

you used for the jig and taper the end to fit in the cage. Cut the dowel to length after you are satisfied with the taper.

Conclusion

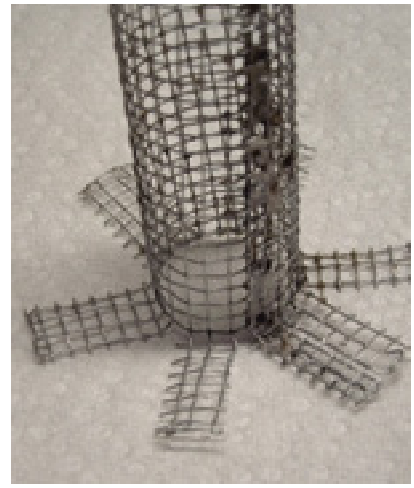
Making queen cages is not hard, although it does take some practice and probably results in some sore fingers. Once you understand the process, it is easy to work in batch mode and make ten or more at a time.

Usage

Cheap and easy to make, these cages are extremely handy when you need to isolate a queen and work great for banking your queens.

Thoughts

If you use the Hopkins System for queen rearing where a frame is laid horizontally over a colony, try making a second version of this cage. Don't hem the top edge, cut the hemming wires the same way you did to form the bottom of the cage. Then, bend the cute sides outward. The extra surface provided by these "braces" allow for greater adhesion to the wax.



The cage can then be places over a capped queen cell to trap the queen as she emerges.

See: "Build a Horizontal Frame Support" in the June 2011 issue of *Bee Culture* or in Ed's book *Bee Equipment Essentials.* BC

Get a copy of Ed Simon's book *Bee Equipment Essentials* with detailed drawings, construction hints and how-to-use instructions for dozens of beekeeping tools and equipment from **www.wicwas.com**.

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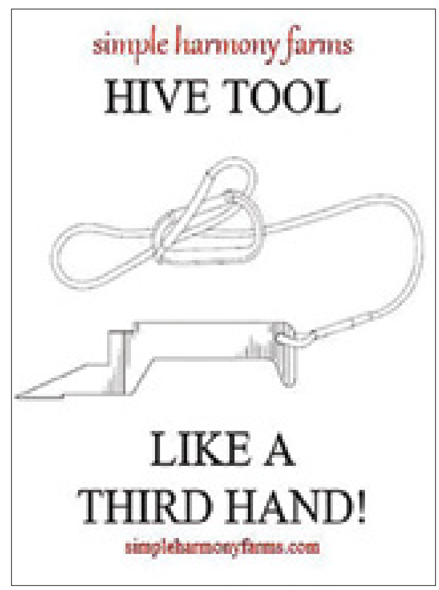


Small-Scale Pollination Pricing

David MacFawn

Note: all data, numbers, tables and equations used in this article was collected in late-2019/early-2020.

Crop pollination can be a viable line of business in addition to honey production for the small to medium size (less than 75 colonies) beekeeper. Pollination rates vary across the United States and by crop.[1] The beekeeper has to decide what their time and effort is worth and if they have the means to move the hives. The small-scale beekeeper can often do an excellent job pollinating vegetable crops since vegetable crops are usually fields less than 10 to 20 acres.

A price, volume, distance relationship exists in the pollination business. The more hives you transport, the further distance the beekeeper can move them for a given price. Eight to ten colonies can be hauled in a pickup truck single stacked. The number depends on if you have a short bed or long bed pickup. A utility trailer can also be used to keep from making multiple trips. The trailer can be left in the field locked to reduce lifting the hives.

The average pollination rate is typically one to two colonies per acre for most crops.[2] The grower will typically tell the beekeeper how many colonies they want. An agreement needs to be made as to when the beekeeper will move their hives into the field, and where the hives will be placed.

Sometimes the beekeeper may realize a super of honey if a nectar flow is transpiring during pollination. This super may be from the target crop or it may be from other sources. Hence, the beekeeper needs to take this into account when pricing as it still costs money to move colonies into a field for pollination.

Figure 1: Honey bee on cucumber blossom / curbit pollination (David MacFawn)

Since bees forage close to the hive upon moving, they will pollinate the crop and may also gather nectar from surrounding areas. Regardless of the honey quality, a super of honey may be used for sustaining the colonies if not extracted.

The beekeeper may want to consider eight frame equipment for pollination. Eight frame equipment is lighter than ten frame equipment and it is easier to get your hands around to lift. It also stacks better in a pickup truck or utility trailer; smaller footprint.

Some factors impacting pollination profitability include:

Mileage Cost

The distance traveled is a cost of business and impacts profitability. The smaller the number of hives transported at one time, at a given vehicle mileage rate and labor rate results in reduced profit margins.

Labor Rate

Labor costs impact profitability. Labor is required to care for the bees, transport of the hives and to load and unload the hives.

Number of Crops Pollinated and Nectar Flows

The number of times different crops are pollinated in a given year impacts how many times your equipment costs and colony maintenance / care are distributed. Often in the southeast, you can make a honey crop prior to pollination. Three or more nectar flows and/or crops pollinated is recommended.

Equipment Cost

Cost of equipment impacts profitability greatly. Cost of new equipment, whether expensed at one time or depreciated over a number of years, increases one's expenses. The beekeeper may want to consider good, used equipment to reduce initial equipment investment.

In the southeast, after initial assembly and painting (primer and at least two coats of high-quality paint), woodenware's average lifespan is eight to 10 years prior to refurbishment. It pays to maintain your existing equipment as much as possible. As long as the equipment is structurally sound, it is usable. Good quality duct tape can be used to seal holes during transport. One way you can reduce expense is make your equipment last as long as possible, i.e. longer than an average five-year depreciation period. New equipment costs money, even if it is initially totally expensed or depreciated. New equipment expenses can make the difference between making a profit or loss.

[1]*Cost of Pollination*, Released December 21, 2017, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA). ISSN: 2475-4315 **http://usda.mannlib.cornell.edu/usda/current/CostPoll/CostPoll-12-21-2017.pdf**

[2]*Insect Pollination of Cultivated Crop Plants*, United State Department of Agriculture Handbook 496, S. E. McGregor, Stock No. 001-000-03549-5, July, 1976.

Depreciation Period

The depreciation period duration impacts the amount of equipment that is written-off every year. The shorter the depreciation period, the larger dollar impact during the years the equipment is being written-off.

Cost of Bees

How much colony replacement bees cost every year also impacts profitability. Three-pound packages with a queen costs anywhere from $80-$100 package producer direct, and the cost of a nucleus colony (NUC) was approximately $150-$165 in 2018. Splitting colonies and installing a mated queen or queen cells is a less costly method to increase your colony numbers.

Life of Bees / Mortality of Bees

How long your colonies survive impacts your colony replacement costs. You want your colony to live as long as possible to reduce your colony replacement costs every year. Colony mortality is reported being around 40% (Bee Informed Partnership 2017-2018 Winter).

Time Required to Work Bees

How much time per colony to work bees every year is a large impact on costs. You want to take the necessary time to maintain your colonies but at a minimal cost.

Cost of Sugar/Feed

Often during pollination, you may need to feed the colonies if they lose weight, such as on low producing crops like cucumbers. Beekeepers have the options of feeding white sugar or high fructose corn syrup (HFCS).

Travel Speed Resulting in Travel Labor

Travel speeds impacts your labor cost. While the beekeeper wants to minimize their labor, you want to do so safely.

Treatment Cost

Costs are associated to medicate your bees for *Varroa* in addition to other issues. This is a necessary expense to keep your bees healthy and is cheaper than letting your colonies decline. Along with the cost of medication comes the cost associated with travel to administer the medication.

Table 1 lists several possible per colony prices, total number of colonies and round trip distances as an example. The table is divided into depreciating equipment over five years on the left, and equipment fully depreciated on the right. Table 1 is for three nectar flows and/or pollinations. The beekeeper can spread their costs over more nectar flows and/or pollinations reducing their cost per nectar flow and/or pollinations. Note, Table 1 accounts for most major costs, but it really only has ball-park numbers since every person's circumstance is different. There is a niche market for the small pollinator with smaller size fields. Also note the distance traveled impacts profitability as does the per colony price and total number of colonies transported.

The below variable are global variables and can be changed at one place with the change rippling through the spreadsheet.	
Mileage Rate	$0.545
Labor Rate	$14.00
Number of Crops or Nectar Flows	3
Cost of Hive + One Super + Hive Stand	$150, or $0 if fully depreciated
Depreciation Period (Years)	5
Cost of Livestock	$80
Life of Colony (years)	2
Colony Mortality	40%
Hours per Colony per Year to Work Bees	3
0.25 hours to work colony x 12 times per year	
Travel Speed (mph)	45
Cost of Sugar per Pound	$0.40
Varroa Treatment Cost per Colony	$3.80
$38 for 10 pack of Apiguard, Thymol	

Table 2: Assumptions

Table 3: Equation Analysis

Entered Variables

Per Colony Price   Total Number Colonies : Volume   Total Round Trip Distance in Miles

Analysis of Cash

- Cash inflows
  - Revenues
    - Pollination rental = per colony price x total number colonies
  - Total Revenue
- Cash Outflows
  - Variable Costs
    - Treat colonies for *Varroa* four times a year. Cost per bloom = (*varroa* treatment cost per colony x four treatments per year x total number colonies)/ number of crops or nectar flows
    - Feed costs = cost of sugar per pound x total number colonies + pollen substitutes
    - Labor transport bees (three trips) = (round trip distance in miles/travel speed mph) x labor rate x three trips
    - Total labor work bees per year per bloom cycle = (hours per year to work colonies x total number colonies x labor rate)/number of nectar crops or pollination
    - Total cost of bees per bloom = (cost of bees/(1-mortality rate)/life of colony in years/number of nectar crops or pollination) x total number of colonies
    - $ mileage total round trip = mileage rate x total round trip distance in miles
  - Total variable Cash Outflow
  - Fixed Cost
    - Total depreciated cost of hives per bloom = (cost of hive/depreciation period/number of crops or nectar flows) x total number of colonies
  - Total Fixed Cash Outflow
- Total Cash Outflow

Remaining cash = profit = total revenue - total cost

Profit margin %

Hive Cost Depreciate over Five Years							Hive Cost Fully Depreciated						
Per Colony Price	Total Number Colonies : Volume	Total Round Trip Distance in Miles	Profit Margin	Total Revenue : Cash Inflow	Total Expenses : Cash Outflow	Profit	Per Colony Price	Total Number Colonies : Volume	Total Round Trip Distance in Miles	Profit Margin	Total Revenue : Cash Inflow	Total Expenses : Cash Outflow	Profit
$56.20	20	50	1.45%	$1,124.00	$1,107.69	$16.31	$56.20	20	50	19.24%	$1,124.00	$907.69	$216.31
$60.00	20	50	7.69%	$1,200.00	$1,107.69	$92.31	$60.00	20	50	24.36%	$1,200.00	$907.69	$292.31
$56.20	12	50	-2.93%	$674.00	$694.18	$(19.78)	$56.20	12	50	14.86%	$674.40	$574.18	$100.22
$60.00	12	50	3.59%	$720.00	$694.18	$25.82	$60.00	12	50	20.25%	$720.00	$574.18	$145.82
$56.20	8	50	-8.41%	$449.60	$487.43	$(37.83)	$56.20	8	50	9.38%	$449.60	$407.43	$42.17
$60.00	8	50	-1.55%	$480.00	$487.43	$(7.43)	$60.00	8	50	15.12%	$480.00	$407.43	$72.57
Required Profit Margin	Total Number Colonies : Volume	Total Round Trip Distance in Miles	Total Expenses : Cash Outflow	Profit	Total Revenue : Cash Inflow	Per Colony Price	Required Profit Margin	Total Number Colonies : Volume	Total Round Trip Distance in Miles	Total Expenses : Cash Outflow	Profit	Total Revenue : Cash Inflow	Per Colony Price
25%	8	50	$487.00	$121.75	$608.75	$76.09	25%	8	50	$409.43	$102.36	$511.79	$63.97
25%	12	50	$694.18	$173.55	$867.73	$72.31	25%	12	50	$574.18	$143.55	$717.73	$59.81
25%	20	50	$1,107.69	$276.92	$1,384.61	$69.23	25%	20	50	$907.69	$226.92	$1,134.61	$56.73
25%	25	50	$1,366.14	$341.54	$1,707.68	$68.31	25%	25	50	$1,116.14	$279.04	$1,395.18	$55.81
20%	8	50	$487.00	$97.40	$584.40	$73.05	20%	8	50	$409.43	$81.89	$491.32	$61.41
20%	12	50	$694.18	$138.84	$833.02	$69.42	20%	12	50	$574.18	$114.84	$689.02	$57.42
20%	20	50	$1,107.69	$221.54	$1,329.23	$66.46	20%	20	50	$907.69	$181.54	$1,089.23	$54.46
20%	25	50	$1,366.14	$273.23	$1,639.37	$65.57	20%	25	50	$1,116.14	$223.23	$1,339.37	$53.57
Required Profit Margin	Total Number Colonies : Volume	Total Round Trip Distance in Miles	Total Expenses : Cash Outflow	Profit	Total Revenue : Cash Inflow	Per Colony Price	Required Profit Margin	Total Number Colonies : Volume	Total Round Trip Distance in Miles	Total Expenses : Cash Outflow	Profit	Total Revenue : Cash Inflow	Per Colony Price
15%	8	50	$487.00	$73.05	$560.05	$70.01	15%	8	50	$409.43	$61.41	$470.84	$58.86
15%	12	50	$694.18	$104.13	$798.31	$66.53	15%	12	50	$574.18	$86.13	$660.31	$55.03
15%	20	50	$1,107.69	$166.15	$1,273.84	$63.69	15%	20	50	$907.69	$136.15	$1,043.84	$52.19
15%	25	50	$1,366.14	$204.92	$1,571.06	$62.84	15%	25	50	$1,116.14	$167.42	$1,283.56	$51.34
10%	8	50	$487.00	$48.70	$535.70	$66.96	10%	8	50	$409.43	$40.94	$450.37	$56.30
10%	12	50	$694.18	$69.42	$763.60	$63.63	10%	12	50	$574.18	$57.42	$631.60	$52.63
10%	20	50	$1,107.69	$110.77	$1,218.46	$60.92	10%	20	50	$907.69	$90.77	$998.46	$49.92
10%	25	50	$1,366.14	$136.61	$1,502.75	$60.11	10%	25	50	$1,116.14	$111.61	$1,227.75	$49.11
5%	8	50	$487.00	$24.35	$511.35	$63.92	5%	8	50	$409.43	$20.47	$429.90	$53.74
5%	12	50	$694.18	$34.71	$728.89	$60.74	5%	12	50	$574.18	$28.71	$602.89	$50.24
5%	20	50	$1,107.69	$55.38	$1,163.07	$58.15	5%	20	50	$907.69	$45.38	$953.07	$47.65
5%	25	50	$1,366.14	$68.31	$1,434.45	$57.38	5%	25	50	$1,116.14	$55.81	$1,171.95	$46.88

Table 1: Data Comparisons

Table 2 lists the assumption this analysis is based on. This is a small-scale pollination pricing analysis. Assumptions include:

Region 2: AL, DE, GA, KY, MD, NC, SC, TN, VA, WV. 2017

Tree Fruit
Apple 51.6
Peach 39.9
Melons
Cantaloupe 64.1
Watermelon 60.3
Berries
Blueberry 55.9
Vegetables
Cucumber 51.4
Pumpkin.............. 66.6
Squash 47.3
All other 1 .... 56.8
Total 56.2

Region 3: AR, FL, LA, MO, MS, NM, OK, TX. 2017

Melons
Cantaloupe 54.6
Watermelon 55.7
Berries
Blueberry 57.8
Vegetables
Cucumber 16.3
Pumpkin.............. 52.1
Squash 28.6
All other 1 .... 41.2
Total 45.5

- Beekeeper has vehicle and homeowner's insurance. Verification of coverages needs to be determined.
- Beekeeper already has bee suits and other miscellaneous equipment.
- Assumes no hired help. The beekeeper is doing the pollination themselves.

Table 3 contains the equations this analysis is based on to generate Table 1.

Small-scale pollination (less than 75 total colonies) can be a viable added business in the southeast in addition to honey production. It is a niche market that large-scale pollinators have difficulty servicing profitability. While all the variables are important, equipment costs can determine if the beekeeper makes a profit or not. Utilizing used equipment should be considered to reduce equipment costs. Also, three or more nectar flows and/or pollination events are necessary to make money to spread your costs over. The beekeeper has to determine what their time is worth and how much they can charge per colony rental. The small-scale beekeeper can often pollinate vegetable crops well since vegetable crops are usually smaller size fields. In the southeast, a beekeeper can often make a honey crop in the Spring and do two or more pollinations in late Spring, Summer and Autumn. It takes time to develop pollination contacts and a pollination business.

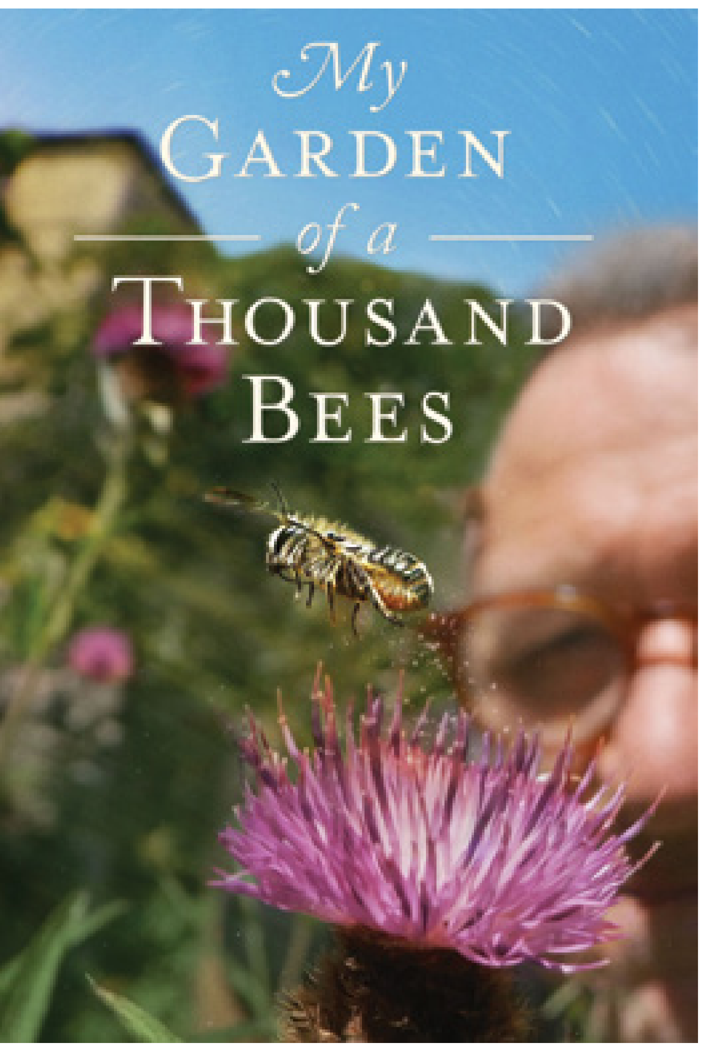
Everyone's financial situation is different. If you are interested in receiving the spreadsheets used to create the data in this article with up-to-date financial details like federal mileage rate, etc., contact David MacFawn at **dmacfawn@aol.com**. BC

Documentary Review

Mark Winston

The video documentary **My Garden of a Thousand Bees** is, quite simply, a spectacular film, replete with jaw-dropping visuals depicting a microcosm of wild bee natural history found in an urban backyard in Bristol, England.

My Garden was filmed by Martin Dohrn, an experienced filmmaker with 30 years of nature documentaries under his belt. He found himself isolating at home when the British government implemented their March 2020 COVID-19 lockdown. Most of us in similar situations took up sourdough bread baking, musical instruments, paint-by-number canvases and elaborate jigsaw puzzles, in between binge-watching streaming television channels. Dohrn took a different path; he went outside to the unkempt, messy mix of meadow and hedges in the tiny yard outside his townhouse and began filming.



The result is astonishing, but don't just take my word for it. *My Garden* has been highly rewarded with awards, winning four at the Wildscreen Panda Awards including the Golden Panda for best natural world storytelling. It's also won two awards at the Jackson Wild for best onscreen personality (likely for Dohrn, who is quite engaging, but possibly for the bees themselves) and for cinematography, and been nominated for four Grierson Awards and an Emmy.

Filming bees is not a trivial task; they are small and fast, moving in and out of focus quickly and unpredictably. Dohrn had to devise game-changing techniques in low-light and macro filming, using a device he called the Frankencam that uses miniature lenses with micro-motion control to film small things in the wild. It took tremendous patience to sit absolutely still behind the camera to catch the fleeting but epic moments of bee life he eventually recorded. "Absolutely still" is no exaggeration; Dohrn recounts how even blinking could make the camera shake and images lose focus.

The results are stunning. I've been involved in making a number of films about bees, worked with some excellent videographers, and have probably viewed every documentary and movie made in the last 40 years with wild and managed bees as their stars, but *My Garden* reaches a whole new level of visual and storytelling brilliance.

Individual bees move quickly in and out of Dohrn's visual field without blurring, yet somehow backgrounds and landscapes are sharp and distinct. The camera's focus is precise, clear enough to see individual hairs on the bees' bodies, and even single pollen grains dislodged as bees forage on flowers. Motion is often slowed, revealing behaviors too rapid to adequately appreciate with the naked eye. His minuscule cameras come equipped with tiny microphones providing excellent sound pickup, so bee movements are accompanied by audio that enhances our experience as we immerse ourselves in closeups of bee behaviors.

The visuals alone would be well worth viewing, but Dohrn is a consummate storyteller, using the amazing visuals to uncover some fascinating natural history stories about the wild bees we come to know in the film. Of the more than sixty species he finds over a Summer, we get to know yellow-faced (genus *Hylaeus*), sweat (*Halictus*), bumble (*Bombus*), honey (*Apis*), scissor (*Chelostoma)*, hairy footed flower (*Anthophora*), nomad (*Nomada*), mason (*Osmia*), wool carder (*Anthidium*) and leaf cutter (*Megachile*) bees intimately.

Early on, we become acquainted with the hairy footed flower bee, both females and males. The females' location was more predictable than most bees, because they create what Dohrn calls "perfumed bee highways" as they scent mark their route to find their way to productive flower patches and back home to their nests.

It's the male hairy footed flower bees that are most remarkable, however. The males live in a world more chemical than visual, with hairy legs that are remarkably perceptive. We see males landing on wasps, flies and other bees, using their legs to taste and identify potential mates, quickly leaving if they've landed on something not a female hairy footed. When they do land on a female, Dohrn slows down the encounter so we can see the males sensually stroking the female's antennae with his front legs. We watch as she visibly calms, presumably recognizing the interloper on her back by scent as a potential mate rather than a predator.

Like Dohrn, we soon became enamored of our male hairy-footed friend, but alas, he is to meet a tragic fate. A green-fanged spider awaits near a potential nesting hole for a female hairy-footed bee. When the male flies over to explore the hole, seeking a potential mate, the spider strikes at lightning speed, and the male hairy-footed flower bee becomes food.

The red-tailed mason bee is another remarkable subject of Dohrn's camera. She nests in empty snail shells, a behavior that's well-known but I doubt has ever been filmed with the exquisite detail revealed by Dohrn's Frankencam. The bee first turns and turns the shell, digging it into the ground and positioning it so the entrance is obscured. She adds leaf pulp and mud, and then spends hours choosing hundreds of blades of dried grass to bring back to the shell, weaving them together to build a strong protective tent that disguises the nest from parasites.

Dohrn's most intimate portrait is of a leaf cutter bee, Nicky, whom he could identify individually because she had a small nick at the end of one wing. We see Nicky cutting leaves she uses to line three tunnels in which she lays eggs, and out gathering pollen that she packs onto her abdomen for transport back to the nest. There's drama as well; a crab spider grabs Nicky, but she manages to sting it and escape, which I imagine elicited a collective sigh of relief from the audience when *My Garden* was viewed in theaters. Like Dohrn, we've become fond of Nicky.

Changing our perceptions of fellow humans from general stereotypes to an individual with unique behaviors and history, someone we know as a unique person rather than "the other," is a classic way to build empathy. Dohrn uses individualization to good advantage as he personalizes bees, building a case for preserving bees without ever having to lecture us about it. He surprises himself by his affection for Nicky, and for another bee, One-tenna, who has half of one antenna missing. Dohrn muses that "bees are not all identical;" by the end of the season his becoming involved with individual bees "changed my view of insects altogether, changed my view of the world altogether."

Whether it's caring for individuals, or the remarkable behaviors revealed by Dohrn's breathtaking videography, he's undergone a shift by the end of the film. He's amazed "that so much diversity can exist in such a small space, as spectacular as anything I've ever seen before, transporting me to another universe, another dimension of existence." We in the audience have accompanied Dohrn on his journey of discovery, with greater understanding and wonder for what goes on in a simple patch of flowers.

But will it be enough? Will the legacy of the film be action to save the bees, or will its impact be limited to a historical record of what we lost by not responding effectively to human-caused environmental tragedies?

The statistics are stark for the demise of both managed and wild bees, indeed for all insects. For honey bees, an average of 43% of all U.S. colonies have died each year for the last five years. A 2017 report from the Center for Biological Diversity noted that half of the wild bees in North America and Hawaii are in decline, with one in four wild bee species at risk of extinction. Globally, 40% of wild bee species are rated as threatened, and a 2021 report in the journal *One Earth* indicated that 25% of known wild bee species globally have not been seen since the 1990s, either having become rare or gone extinct. And the declines are not just for bees; a well-known 2017 German study published in *PLOS ONE* found that the biomass of all flying insects has declined 75% since 1992.

The causes of bee, and insect, decline are well-known, although the importance of each factor may differ between regions across the globe. Habitat destruction, largely due to agriculture and forestry, pesticide use, diseases (particularly viruses) and climate change are the four most-cited culprits, and there's general agreement among scientists that these are the leading factors decreasing insect populations. Most also agree on the economic impacts, particularly for diminished bee populations whose diversity and abundance are so important for pollination, with crop losses estimated in the tens of billions of dollars annually.

Can we stabilize bee populations, or even better reverse the decline so that bees will prosper once again? The required actions are obvious but daunting, including a global overhaul of how we produce food and manage forests, transitioning to sustainable and/or organic systems without reducing productivity. And then there's climate change, an earth-wide problem that is proving resistant to our dependence on fossil fuels and foot-dragging by governments in implementing the drastic actions necessary to reduce the carbon dioxide and other emissions that are causing climate perturbations.

Globally, our way forward may look grim, and perhaps we won't dig ourselves out of the environmental mess we're making of the world we depend on. Still, there must be a screw loose somewhere in my psyche, because, in spite of the evidence, I remain optimistic that we can and will do better, and that bees will rebound.

Perhaps a good place to start is to foster home gardens that insert awe into our daily lives, changing lawns into meadows and hedgerows blooming with a profusion of flowers from early Spring through late Fall. Perhaps, as Dohrn did, we could all spend some time each day noticing the minuscule, appreciating the wondrous anatomies and behaviors of the many bees whipping in and out of our vision, reveling in the interdependent relationships between plants and bees that model how we, too, might better understand our reliance on healthy ecosystems.

Backyard by backyard, that's how to begin the fight to reclaim our planet as a place where wild bees, and we humans, can thrive. Dohrn has done us a great service by offering a glimpse into his own backyard, a space that "just lets some of the wild back in," tiny in area but immense in what we can learn by dwelling in its glory.

The film can be streamed for free in the U.S. on **PBS**, is available for rental or purchase at **Amazon.com**, and for purchase at **https://shop.bbc.com/products/my-garden-of-a-thousand-bees-23480**.

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.

Buyer Beware When Considering the Purchase of Nucs

B. Worthy

Beekeepers have many options when deciding how to enlarge their apiary or add new genetics to their beekeeping records. One popular choice is to purchase nucs or nucleus colonies. You can buy a nuc from local beekeepers or other states; in fact, some serious beekeepers purchase queens from other states then sell nucs from those queens' progeny. A common definition of a nucleus colony is a colony, or nuc, in a smaller hive, consisting of bees in all stages of development, as well as food, a laying queen and enough workers to cover three to five combs. When placed into a full-sized hive body and given supplemental feeding, the nuc should expand rapidly into a strong colony.

However, you will soon learn that "anything goes" as far as what is actually sold. Beekeeper complaints range from a box with one frame of brood and four frames of mixed plastic and wax foundation; frames with no foundation; ragged old black comb; no food stores; or a handful of bees with a sick looking queen. Some colonies used for pollination that are too weak to be transported forward are shaken out and scavenged so that the old black comb is sold to low bidders to use and sell as needed. Its "Business ROI" (Return on Investment). If the buyer of the final nuc complains, it is not perceived as a big deal, because meanwhile the seller has made a lot of money from their total sales. Other complaints include a queenless colony, a queen that is DOA or a cluster of laying workers. One person bought a nuc with a green drone frame in it!

The origin and history of the queen can vary from a strong queen with a pedigree of Winter hardiness and vigorous brood to a queen with unknown parentage or that of a second or third swarm. It could possibly be a queen from a state with vastly different climate conditions or one that was pushed for production and has not bred well. Prices vary significantly between "local" and "A.I." (artificially inseminated) versus queens from other sources. The catch is knowing that you are paying for what you receive.

The buyers may assume that they are purchasing a queen from a local overwintered colony, but they are actually getting a queen from a package, from colonies used for pollination or a queen that was mass produced in another state. The nucs fail, then the beekeeper has spent a great deal of money for nothing or worse, introduced disease to their apiary. Meanwhile, time has passed with no colony(s) growing and producing.

The key to knowing from whom to buy and if the nuc(s) are worth the price, is to do a little homework-It's worth the effort! Start by asking some basic questions and do some investigating. Ask other beekeepers from whom they bought nucs and how the colonies performed. Ask beekeepers who are not club members or work with the nuc producer. Ask the producer how many colonies and yards they have and how well they overwintered, or if the state (region) has an inspector, learn the size of the nuc producer's operation. Reputable, serious queen/nuc producers recommend that one should have at least 40 colonies and at least two apiaries. Is the beekeeper or their apiaries registered with the state/region? How long has the beekeeper kept bees? Determine if the producer knows basic bee biology and has a solid *varroa* mite management program. How often does the producer monitor the colonies? What mite control products are used? Are the products from different chemistry families? Does the producer target the control strategy at the proper times or do they depend on vaporizing or other quick fixes? Are other products used to control pests that are not legal/labeled for use in beehives? Don't get stuck buying sick or physically challenged colonies!

Does the producer know the requirements to raise healthy, fat queens? Each queen cell requires frames of young nurse bees and substantial quantities of nectar. Raising queens during a nectar flow is far superior to any other time of the season, despite the amount of syrup fed to the bees. What months were the queens made? If it has been cold and raining all Spring, the chance of producing enough quality queens to build nucs is highly unlikely. The queens have not had a chance to mate and the colonies have not grown enough to produce enough workers to feed and nourish queens. Someone selling nucs from overwintered queens in cool, wet Spring months is most likely supplementing with queens purchased from warmer states.

The more serious concern is introducing disease to your apiary. Experienced beekeepers caution that package bees should always be placed on foundation initially in case they have bacteria in their crops which is then deposited into drawn comb. When purchasing nucs, one can only hope that the nucs or colonies from which the nucs were made were inspected, but truthfully only a percentage of colonies are inspected and when multiple yards are involved, only a portion of the apiaries are inspected. Also, colonies that had been treated with an antibiotic may not show symptoms when they were inspected. In addition, frames from storage may be swapped into some nucs if needed that may contain bacterial spores or chemical residue.

It is important to know which yards and when the colonies were inspected and if possible, to purchase nucs from those yards. If not possible, make sure to inspect the nucs before purchasing them. Even if the lid is nailed or screwed down, or if weather is inclement, take the time to look at the frames and evidence of a brood pattern. It is sometimes hard to tell who the originator of the nucs is and how long that colony or nuc box has been around. Check and make sure that the colony is queenright and that all stages of healthy brood are present.

If you are buying a nuc with a purchased queen, she will be in a queen cage. You still need to have larvae and capped brood to care for the queen, as well as one to two frames of honey when she is released. If you are getting a nuc with its own queen, she should be loose in the nuc. If the queen is in a cage, leave the nuc and find another producer. Keep in mind that a locally produced queen in a nuc usually sells for a higher price than a purchased queen from another state. If the nuc contains a swarm caught recently or a month ago, the cost should be that of the box and value of the frames.

It is wise to place newly purchased nucs in a quarantine yard until they have cycled through two generations. Look at the larvae and developing brood. Are the larvae floating in royal jelly or dry? Do the larvae look dry, rubbery, brown or yellow? These are symptoms of European foulbrood and should be sent to a designated diagnostic laboratory. What do the pupae look like? Brown or sunken pupal cells can be symptoms of American foulbrood. Both can be found in purchased nucleus colonies and will cause chronic illness and heartache in the apiary.

Do the emerging bees look healthy? How prolific is the queen? Is her laying pattern normal? A strong nuc may need to be transferred to an eight or 10-frame within a week. Continue to monitor the colony(s), then if no disease is detected, the colony(s) can be moved to another yard.

Any colony can contract American foulbrood or European foulbrood at any time because the bacteria are always present on other bees, flowers, abandoned apiaries and the environment. Nucleus colonies made under stress or during poor weather are especially prone to EFB. Symptoms of PMS (parasitic mite syndrome) and other mite related illnesses often don't show until later. The important point is monitor new colonies weekly or every two weeks and check all colonies monthly. Check the brood and make sure that the queen is healthy. If a problem arises, act, don't wait for it to dissipate. Ask the inspector or an experienced, successful beekeeper for help.

Part of the fun in beekeeping is learning and growing but deceptions arise from those who are unprepared or too trustful in their beekeeper "friends" or club members and don't learn how to protect themselves. Successful beekeepers are often tempted to sell nucs after a few years to keep their apiary size to a manageable level; others think that selling nucs will make them "easy money" and may not have a desire to sell a good product. Many don't care because with 40% losses every year, the market is still great.

Visit their apiary and talk with them. If you can buy local nucs, do so but mainly buy nucs from beekeepers who have figured out how to successfully grow their colonies and have a sound management program. If you spend time with them and manage your own colonies well, you will soon be enjoying the sweet scent of success. BC

References

https://canr.udel.edu/maarec/nucleus-colonies/#:~:text=A%20nucleus%20colony%2C%20or%20nuc,five%20combs%20(Figure%2017).

https://edis.ifas.ufl.edu/publication/IN869

https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw682_2.pdf

Frame with American Foulbrood (AFB).

Frame of plastic foundation and "parallel comb" found in a nuc box.

Healthy nuc overflowing with bees.

FOR THE EAGER HONEY PRODUCER –

THE CLASSIC SYSTEM OF TWO-QUEEN COLONY HONEY PRODUCTION

An old technique for the modern mega-management beekeeper

Beekeeping then and now

Happily, beekeeping has kept up with many modern-day advances, but that evolving characteristic means that beekeeping today is not the same as beekeeping was many decades ago. Advances in protective equipment, improvements in honey processing equipment, introduction of new pest complexes and large migratory operations are only a few of the myriad of changes that have been occurring in our beekeeping industry.

I surmise that one of the biggest changes is that modern beekeeping is now primarily known for pollination while honey production is now the second factor for which beekeeping is known. That is exactly opposite of what beekeeping priorities were thirty or so years ago.

In the golden years of beekeeping past, honey production was the *Number 1* goal of dedicated beekeepers. Nectar flows determined the beekeeper's management schedule and then, when possible, supplemental pollination services were sometimes provided. In many instances, neither the grower nor the beekeeper felt that it was financially feasible to use added honey bee populations. That concept has radically changed. Priorities have evolved.

As a young beekeeper all those years ago, I was familiar with the beekeeping priorities of the day. Yes, even then, liquid honey ruled, but even that emphasis was a change from what honey production was decades before my time. I roughly estimate that eighty to one hundred years ago, comb honey was preferred to liquid honey because it could not be adulterated with sugar syrup. Comb honey was *"pure."* Books were written about comb honey production. Talks were presented at meetings. Techniques abounded.

While comb honey is still produced in newly developed plastic containers, the old tried and true way of producing honey in basswood section boxes has seemingly died a long, slow death. Basswood boxes for comb honey production are only available from a few remaining vendors – if you can find them at all. The loss is not horrendous, but it is significant.

An aside...

In this vein of bee things that are gone, a rarely lamented change is the move from 60# metal tins to common white plastic buckets. The tins could be tightly stacked on a truck while round buckets do not stack tightly. But current plastic buckets have more comfortable handles than the small metal handles on honey tins. But you should know that the change was rapid. It seems to me that in just three to four years, metal tins were dropped from catalogs to be replaced by plastic buckets.

Listen along here!

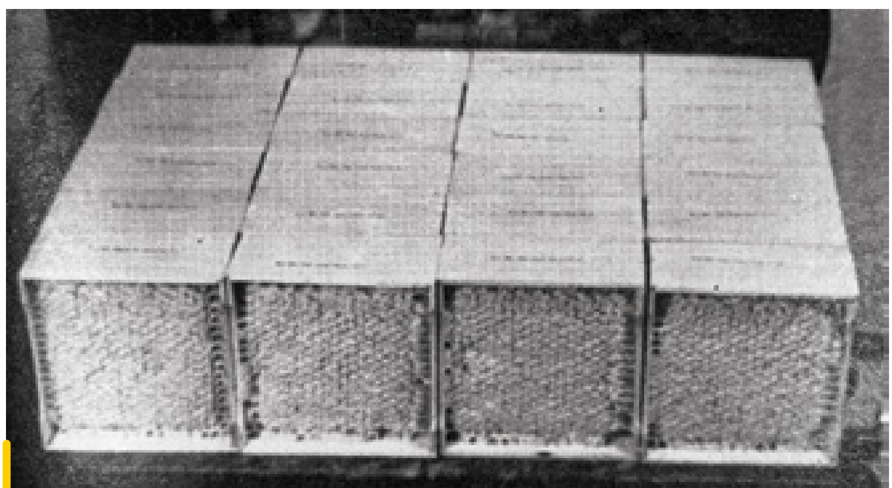
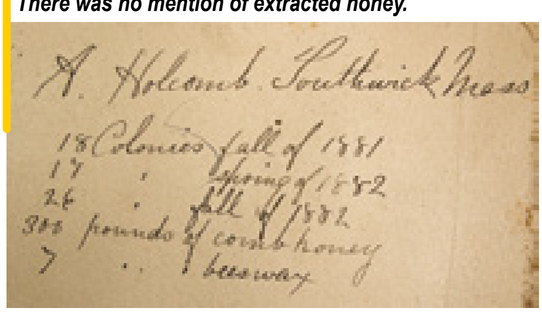


Figure 2. Basswood section boxes of comb honey. C. Killion photo, 1951.

It always bothered me that perfectly good nectar sources – basswood trees – had to be harvested to produce the unique wood that would bend into a box shape. But in obvious ways, moving from basswood boxes to plastic containers has only brought us different challenges. I suppose that could be a discussion for another time, but not today.

My belabored point is that beekeepers once produced comb honey in basswood boxes and now we don't. That technology is gone. That's a big change that took decades to develop.

Figure 1. A post card from Amasa Holcomb, Southwick, MA, that was sent to Dr. C.C. Miller in 1883. Note that 300 pounds of comb honey were produced in 1882. There was no mention of extracted honey.



A. Holcomb Southwick Mass
18 Colonies fall of 1881
17 " spring of 1882
26 " fall of 1882
300 pounds of comb honey
7 " beeswax

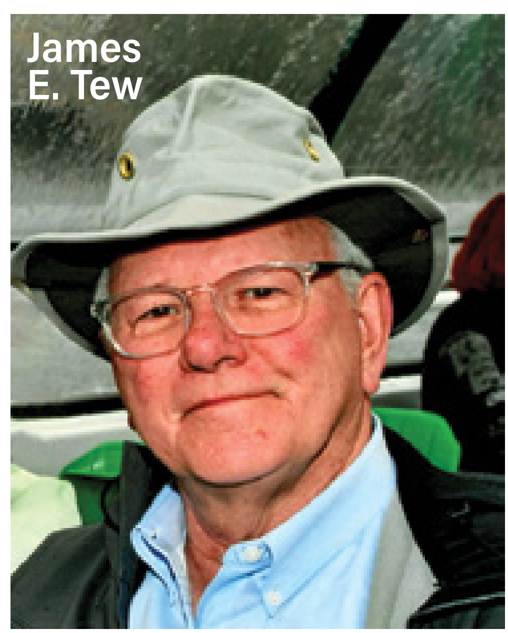


Figure 3. Double crates of honey tins. Each crate weighed 125 pounds.

Now, I can't even find a photo of a honey tin on the web. Things change. They always do.

The classic double-queen system of honey production

Everything I have written in this article, has been to get to this point. Why write about a dated technique that few modern beekeepers still use? It was the rage then but as with basswood comb honey boxes and metal honey tins, things change. But if you have the energy and the interest, this is a technique you can still use in your bee operation.

When I began beekeeping, one of the advanced concepts was to use two queens to build up an abnormally large population of worker bees just in time for the nectar flow. Just as the flow started, the colony, that had two queens, whose brood nest was separated by a double screen or a modified inner cover, produced a double bee population. Excessive honey crops were the desired results.

A disclaimer...

I have not tried to manage bees in two-queen colonies in about thirty-five years. Readers, due to my current energy and strength capabilities, I doubt that I will ever try again. Never in my entire beekeeping career have I been an accomplished two-queen beekeeper, but all the advanced beekeepers were giving it a try. Talks were presented at meetings. Success stories were staggering. You had to be there. At this moment, I do not know a single two-queen beekeeper. But in its day, this management scheme was widely touted.

To put this article together for you, I relied heavily on the pamphlet published by C.L. Farrar in August, 1958[1].

Quoting Farrar from his work,

"Two-queen colony management represents an intensive system of honey production designed to obtain the maximum yield from each hive. During any short honey flow (about two weeks) one large colony will produce more honey than two or more smaller colonies having the same aggregate number of bees. In single-queen colonies the production per unit number of bees increases as the number in the colony increases up the maximum (60,000 bees). This efficiency relationship remains high when populations are further increased through the use of a second queen. Because small colonies increase in population with time, their production efficiency over long honey-flow periods will rise. However, colonies with large populations throughout either long or short flow produce the greatest amount of honey, because their efficiency is high over the entire honey-flow period."

To emphasize his point, a large population of bees will produce more honey than the same population housed in two or more hives. Getting an abnormally large bee population – before the flow started – was the reason for using a second queen.

Everything about the double queen system was big. Big bee populations, big (tall) colonies, big honey and pollen crops, and big management inputs. The results were to be big honey crops with powerful colonies passing into the following Winter. A five-hundred-pound crop (yes, 500 pounds) was not considered impossible when using this technique. A fully functional double-queen colony could have the amazing population of twenty-five to thirty pounds of bees in it.

It's all in the management details

Pollen reserves

In 1958, our industry had not yet developed artificial pollen products. At that time, to produce large bee populations, a beekeeper would need extensive pollen sources. Obviously, your colonies cannot produce brood without pollen. That same pollen

Figure 4. An old photo comparing two-queen colonies with standard colonies. The small colonies were in bright sunlight while the tall colonies were deeply shaded. My photo editing skills were stressed.

[1]Farrar, C.L. *Two-Queen Colony Management for Production of Honey*. ARS-33-48. Available in archival form at: https://archive.org/details/twoqueencolonyma48farr/page/4/mode/2up

reserve later became important to wintering colonies. The desire was to produce large colonies going into Winter to have strong colonies for the two-queen system during the next season.

Queens

For this system, queens need to be purchased and be readily available. In 1958, they were and the cost was not as great as today. You should be wondering if allowing the split part of the colony to produce its own queen was an option. The is answer is, *"not really."* While it clearly could be done, valuable seasonal time would be lost while the bees were growing queens and not growing a worker bee population. It would seem to me that modern two-queen beekeepers would be confronted by queen availability during the early season of the year.

Hive equipment

Two queens with a double worker population naturally results in a tall hive. Due to that fact, the two-queen colony would need to sit on a firm foundation that was essentially on the ground. Hives that were seven deep boxes tall were not uncommon. Hive stands would not be used.

To forestall bees storing honey in the valuable brood nest area, supers were never allowed to be more than half full. As boxes were filled, they were removed and processed and then the wet equipment was returned to the tall hive.

Other than purchase costs and assembly labor, shallower equipment was not held in disfavor. The reduced weight of full supers was the obvious reason. But a lesser-known reason was that some researchers felt that bees wintered better in shallow boxes. It was felt that bees' wintering cluster had more interactive space to share Winter food stores in the spaces between the boxes. In fact, Dr. Farrar wrote, *"The size and shape of the hive units have little effect on production if enough (boxes) are used for brood rearing, food reserves, and the storage of surplus honey."* That is an interesting observation that goes beyond this honey production discussion.

Farrar added the comment that the most efficient management was possible when all brood boxes were uniform and therefore interchangeable. The same would be (mostly) true for super sizes.

Shallower supers were preferred to deeper supers. Apparently, bees fill and cap the shallower equipment faster than deeper equipment. Again, weight would be another prime reason for using shallow equipment.

Management points

To produce stronger colonies, you need to begin with strong colonies headed by young queens. Weak colonies had no place in the two-queen system. Make everything large. Beginning five to seven weeks before the flow, begin the two-queen development process. Two weeks later, make a strong divide from the original colony and either use a double screen or a screened inner cover to separate the split from the parent colony. In his paper, Farrar provides intricate details for quantities of brood and bees that will need to be moved to different locations with the developing mega-hive.

After the new queen was installed and was producing copious amounts of brood in the split above the screen inner cover (usually ten to fourteen days), the screened inner cover was removed. The colonies were kept separated by queen excluders.

Empty brood nest space was provided above the lowermost colony. A queen excluder was used above the bottom colony. This was a necessity. At this point, the beekeeper had a strong queen in the lower unit with an empty box of drawn comb (preferred to foundation) atop of the lower unit. The extra space allowed for continued brood production.

Above the lower queen excluder was the recently introduced queen with a second brood nest with a similar configuration of brood and empty brood nest space. Then yet another queen excluder was put above the second top colony between the top brood nest and the supers. The dual queen excluders confine the queens to their respective spaces and became an aid to keeping up with the two queens when the colony was opened to remove full supers and for inspection.

Most of the surplus honey storage occurred above the second colony in the top of the tall colony. Again, it is important to write that the supers were inspected and additional space

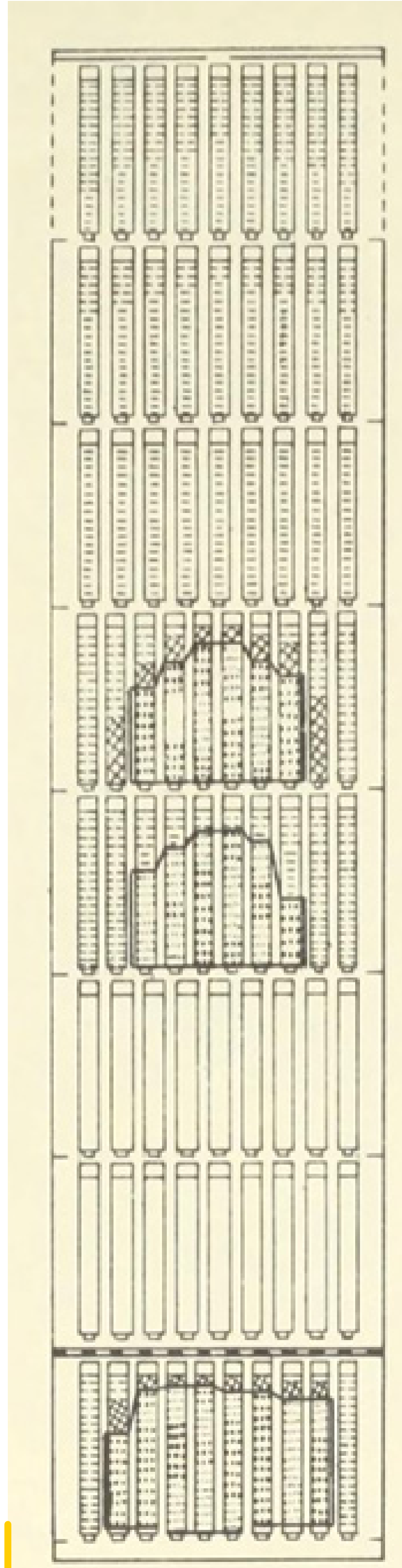
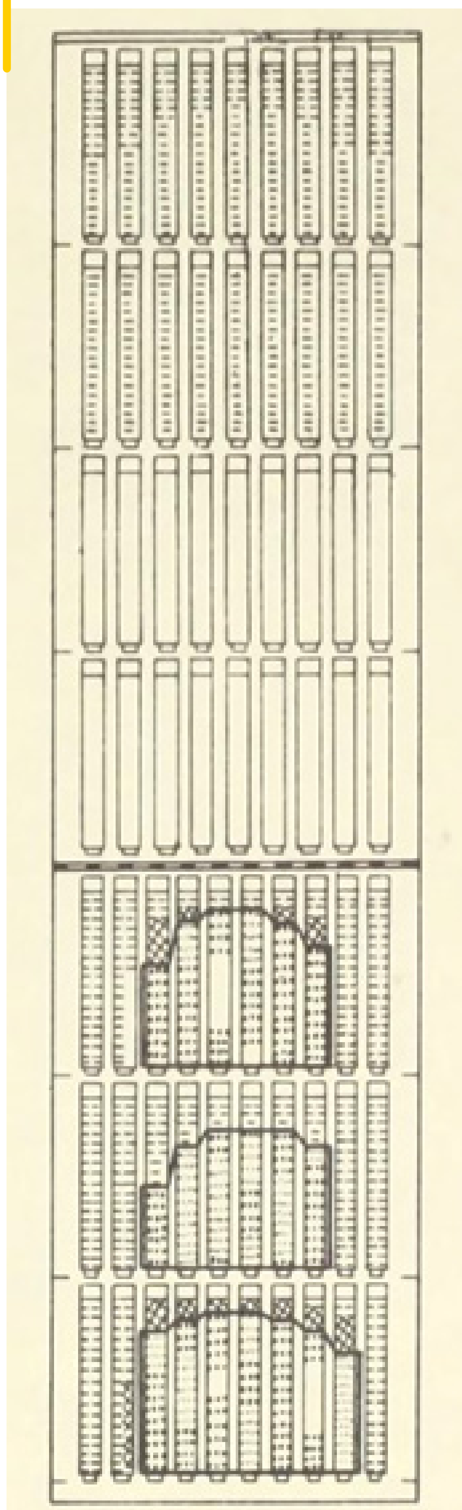


Figure 5. The position of the two brood nests in a full functional two-queen system.

was added when supers were only 50% full. The intent was to discourage the bees from storing honey in either brood nest area.

Swarming and supersedure were not thought to be any more relevant than swarming and supersedure in single-queen colonies. If swarming was becoming an issue in a two-queen unit, the recommendation to use the *"shook swarm"* technique to attempt to get things back into order. That sounds like a management headache.

Figure 6. Late season two-queen system with brood nests combined and excluders removed.



Not a technique for colony increase

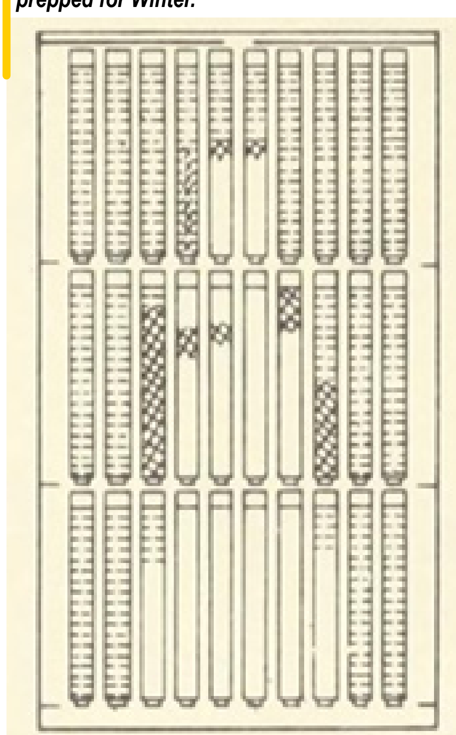
As I began to write this piece for you, I envisioned the two-queen system having the possibility of ending the season with two colonies. While I feel that could still be accomplished, Dr. Farrar discouraged using this two-queen system as a technique for making colony increase.

Indeed, as the season ended, he suggested just removing the excluders and allowing the bees to select the better queen. Presently, the current cost of queens would be a hinderance to that recommendation. Having a $40 queen only produce for a single season feels extravagant. However, outside of the two-queen system, this general setup could be used to assist a "weaker" colony in becoming stronger but is a totally different discussion.

The reason for this recommendation of not using the double-queen system for colony number increase was presented in his summary included in his paper. *"The larger pollen reserves accumulated after the colonies have been reduced to a single queen status make it possible to overwinter stronger colonies for the next season."*

Times have changed. I extensively discussed that. Does the development of modern pollen supplements obviate some of the old two-queen management recommendations?

Figure 7. Former two-queen system prepped for Winter.



This is not for the faint-hearted

After my experience all those years ago and after reviewing my sources for this article, I can clearly write that this is not a management scheme for all beekeepers. Only those beekeepers with the time and the penchant for intensive colony management should take it on. The payoff is great, but so is the labor and monetary input.

Then why bring it up?

Like so many other things and recommendations within beekeeping, managing bees for a double queen scheme is an idea dating back to the 1930s. Does it still work? It certainly worked at one time, but I can't speak for the present.

In the 1950s, herbicides were nonexistent. Queens were available and were not as costly. Honey was the *Queen of Beekeeping*. But we now have ready access to pollen substitutes and other improvements. So, I bring this subject up for those rarefied few of us who want to push the beekeeping envelope. That will not be me doing the pushing. If you try this technique, I would like to know how it works out.

For more information and instruction, in addition to the reference already provided, I refer you to the sources that I have provided below.

Current information on the two-queen system is included in:

The Hive and the Honey Bee. 2015. Pp 505-507.

ABC & XYZ of Beekeeping. 2020. Pp 679-680

As always, thank you.

If you are still reading, you are one tough beekeeper. A sincere *thank you* for your beekeeping dedication. I have not been able to do any more than introduce you to this old, advanced concept. I know you will have questions. I certainly do. BC

Dr. James E. Tew
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The Ohio State University
tewbee2@gmail.com

Co-Host, Honey Bee Obscura Podcast
www.honeybeeobscura.com

Brownies

Shana Archibald

Ingredients

- ☐ ¼ cup butter
- ☐ ¾ cup honey
- ☐ 1 egg
- ☐ 1 tsp vanilla extract
- ☐ ½ cup flour
- ☐ 1 tsp baking powder
- ☐ ½ tsp salt
- ☐ 4 tbsp cocoa powder
- ☐ ½ cup chopped nuts (optional)
- ☐ ½ cup chocolate chips (optional)

Directions

Makes 6-8 servings
Cook time: 20-30 minutes

Step 1
Preheat oven to 325°F

Step 2
In a medium bowl, cream together butter and honey. Warm butter works better.

Step 3
Beat in egg and vanilla extract.

Step 4
Stir in flour, baking powder, cocoa powder and salt.

Step 5
Stir in nuts and chocolate chips, if using.

Step 6
Grease a 9x9" baking pan.

Step 7
Pour batter into the greased pan, then even it out smoothly.

Step 8
Bake at 325°F for 20 minutes.

Step 9
Check consistency. If the edges aren't crispy, bake for another 5-10 minutes until crispy.
Enjoy with ice cream or by themselves!

CALENDAR

♦ILLINOIS♦

Save the Date! The **Mississippi Valley Beekeepers Association** will be hosting the ISBA Summer Conference in Quincy, IL on July 14th and 15th, 2023. It will be held at the Oakley Lindsay Center (300 Civic Center Plaza #237, Quincy, IL 62301).

Speakers include Kamon Reynolds, Randy McCaffrey, Natalie Summers, Jeff Horchoff, Cory Stevens, Elsa Gallagher and more.

There is something for everyone including vendors, breakout sessions and bluegrass music.

Keep an eye out for more details at **https://mvbees.com/**

♦IOWA♦

Central Iowa Beekeepers Association's (CIBA) annual Winter Seminar is Saturday, March 18, 2023 at the Iowa Arboretum and Gardens in Luther, IA.

Speakers include Dr. Judy Wu-Smart of the University of Nebraska-Lincoln; Dr. Mike Simone-Finstrom (via Zoom) of the USDA, ARS, Baton Rouge, LA; Andrew Joseph the Iowa State Apiarist; Kurt Rueber of the Iowa Department of Inspections and Appeals; and Pat and Peggy Ennis of P&P Honey in Goodell, IA.

This is a full day seminar with lunch included in the registration cost.

Details and registration process at **www.CentralIowaBeekeepersAssoc.org**.

♦MICHIGAN♦

Michigan Beekeepers Association and Michigan State University will be holding the 2023 Michigan Spring Beekeeping Conference on Saturday March 11, 2023 at MSU Kellogg Center in East Lansing, MI.

The keynote speakers is David Peck, Director of Research and Education at Betterbee.

The conference includes multiple tracks for beginners, all-day track on sustainable beekeeping and beeswax crafts.

Presenters include Meghan Milbrath, Mel Disselkoen, James Lee and Adam Ingrao.

The best local vendors will be there. They have all your beek needs.

Pre-conference virtual keynotes will be held on March 2 with Marla Spivak, March 7 with Frank Rinkevich of USDA and March 9 with Randy Oliver.

For more information, visit **michiganbees.org**.

♦OHIO♦

Lorain County Beekeepers Association is holding their Beginner Beekeeping classes again in 2023. The classes will be held from 7-9pm on March 3, 10, 17 and 24, 2023.

Each week will have a different topic:
March 3: Beekeeping Equipment
March 10: Managing your Beehive
March 17: First Two Months as a Beekeeper
March 24: Summer & Fall Management

For more information, visit **http://www.loraincountybeekeepers.org/**.

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- 4 and 5 frame Nucs available for sale with doing well bees. **fabianhillshoney@gmail.com**

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

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Image Contest - Splitting & Nucs

We've started an image gallery! This month, we want to see any and all pictures you have of **Splitting Hives and Making Nucs**. 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.

“Oh, fun time!” my cheerful pharmacist laughed when I informed her of my impending colonoscopy. For those of you who have yet to suffer this indignity, here’s what’s fit to print: The procedure is a big nothing. They put you out, and you wake up none the wiser. It’s the unholy day-before, at-home “cleanse” that’s unforgettable. Ask anybody who’s undergone one of these. I was at the pharmacy to pick up my cleanse kit.

Okay, you do what you have to. After 50, colonoscopies become an every five or ten-year ritual, depending on what they find up there. One doctor solemnly informed me that due to my septuagenarian status, this colonoscopy would be my last. I’m not sure what she meant by that, but I can guess.

The hospital scheduling department had proven inept at arranging what should be a slam-dunk procedure. They even got the date wrong. They had both me and the pharmacy thoroughly confused. I told the gal Marilyn, “If the hospital keeps blowing it, maybe I’ll get a vasectomy by mistake!”

To make matters infinitely worse, I had to cancel a fishing day with Paul to stay home and cleanse.

On a Beekeeping Today podcast last Fall, I blurted out the most indiscreet of pronouncements – that in overwintering a total of 200 honey bee colonies over the past three years, I’d lost only five. Because I’m superstitious, I’d kept that under my hat until that particular moment, when I lost my self-control. Yes, I did have a run of very good success, which I attributed to keeping mite populations reasonably low through the Summer and Fall, before giving my colonies an early December oxalic acid dribble, when they were largely broodless.

Bragging generally comes with a price. But I felt I had to drive home that the key to honey bee overwintering is effective mite control. It doesn’t seem reasonable that a bunch of insects could survive a Colorado Winter all huddled together in a simple wooden box. But they can and they do. You might get all worked up over-thinking hive insulation, but I wouldn’t bother. A few subzero nights won’t hurt your healthy colonies. *Varroa* surely will.

I shot off my mouth at precisely the same time that *Varroa* were secretly eating some of my colonies alive. A few perished, others merely weakened. But the damage was done. Now will the survivors make it through to March, when you read this?

Okay! Now did I learn anything at all in 2022? Well yeah!

Like never ever assume that your mites are under control. *Varroa* are having their way with your little darlings, until a test proves otherwise. And when you treat, you need to follow up with yet more testing, because sometimes the cure doesn’t take.

I confirmed my prior belief that Apivar (amitraz) treatments are losing their mojo. They used to be the best of the best. Now sometimes they work, and sometimes they don’t.

I re-learned that Formic Pro (formic acid) sometimes knocks down mite populations.

I was unsuccessful in killing *Varroa* with Hopguard (hops derivative) strips. I still have some unopened packages. Do you need any?

I learned that Apiguard (thymol) treatments aren’t always effective in cool Fall weather, when our Colorado nighttime lows can dip below freezing.

I learned that you need to pull your honey before you think you should, like in mid-August. If the bees bring in more nectar after you take off the honey supers, they can store it in the brood chamber, and maybe you won’t have to feed this hive before Winter. Now, with the honey off early, you have more mite treatment options, and if one doesn’t work, you have time before Winter to try another!

I learned that cutting up and packaging cut comb honey is a chore, but less so when you leave it on the hive too long, and the bees drag it down to the brood chamber.

From cramming lots of bees and brood into a single brood box for comb honey production, I learned how very resistant colonies with new queens are to swarming, and how extraordinarily productive such colonies can be.

We all know that some honey bee colonies are more resistant to *Varroa* than others. But don’t forget location, location, location. Some of my beeyards have fewer mite problems than others.

It dawned on me that mites are easier to deal with before they get out of control, and that they’re easier to suppress before the weather gets too hot and your hives get all stacked up with honey supers. So get on it and kill your mites early!

I figured out that if you kill the queen treating a high-mite hive, maybe that’s not such a bad thing. She’s probably the cause of the problem in the first place. This colony will likely raise a new ruler, which is a good thing, and that means the hive gets a brood break, which is a good thing. Better for you to unintentionally kill one queen than for *Varroa* to take down the whole colony.

Do I sound like a broken record preaching about *Varroa*? Good. Because colonies overrun with those little monsters are doomed. Point, paragraph, end.

I had my colonoscopy this morning. Afterwards when the doc stopped by my bedside, I said, “I guess this was my last one of these.” He begged to differ. “See you in five years,” he said, as he tossed his business card onto the bed.

Then he was gone, but not before I got the last word. “I can’t wait!” BC

Ed Colby

Lessons of 2022

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i
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WITH Caps
6 oz Panel Bears
$211.20 / 660 Ct. Case
No Caps
12 oz Panel Bears
$127.95 / 365 Ct. Case
No Caps
16 oz Panel Bears
$91.95 / 200 Ct. Case
No Caps
b DECO EMBOSSED JUGS
5 LB - $103.95 / 72 Ct. Case
3 LB - $127.95 / 126 Ct. Case No Caps
1 LB - $140.44 / 300 Ct. Case No Caps
c CLASSIC PLASTIC JARS
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No Caps
16 oz - $96.95 / 225 Ct. Case
No Caps
d SQUARE PLASTIC
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Lids now available in Gold, Black or White
f GLASS 12 OZ. HEX EMBOSSED CYLINDER
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g 12 OZ & 3 OZ GLASS SKEP JARS
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