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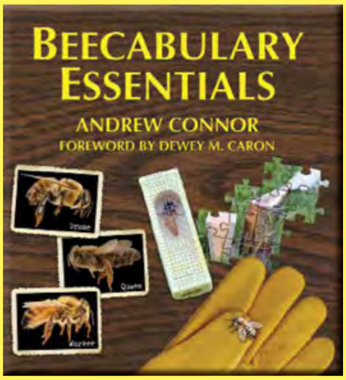

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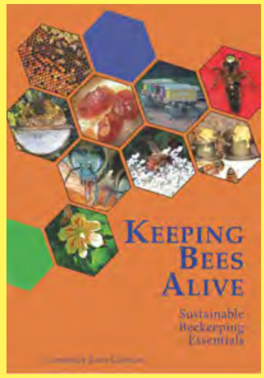

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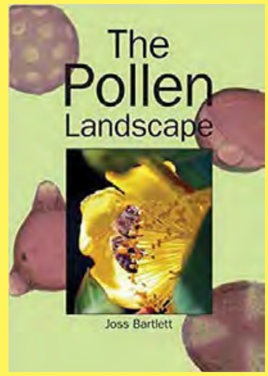

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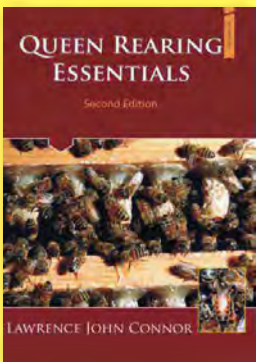

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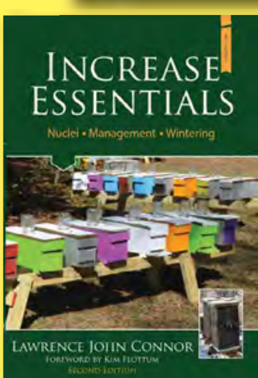

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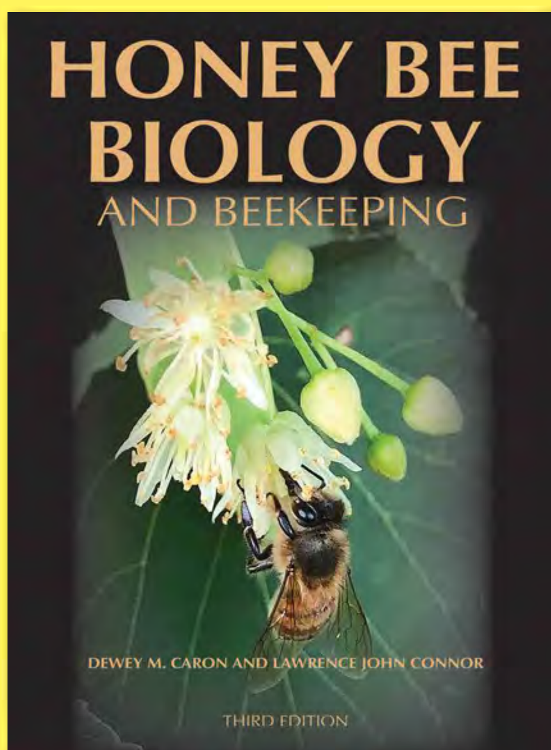

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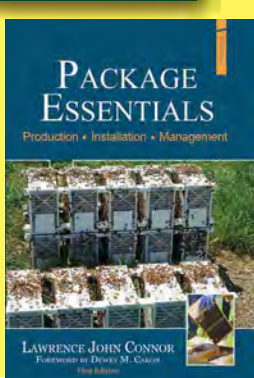

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Bee Culture

March Features . . .

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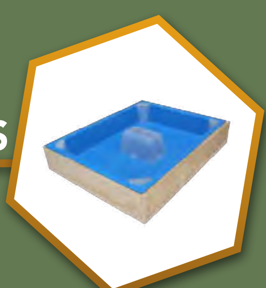

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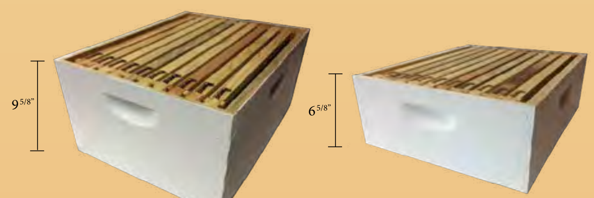

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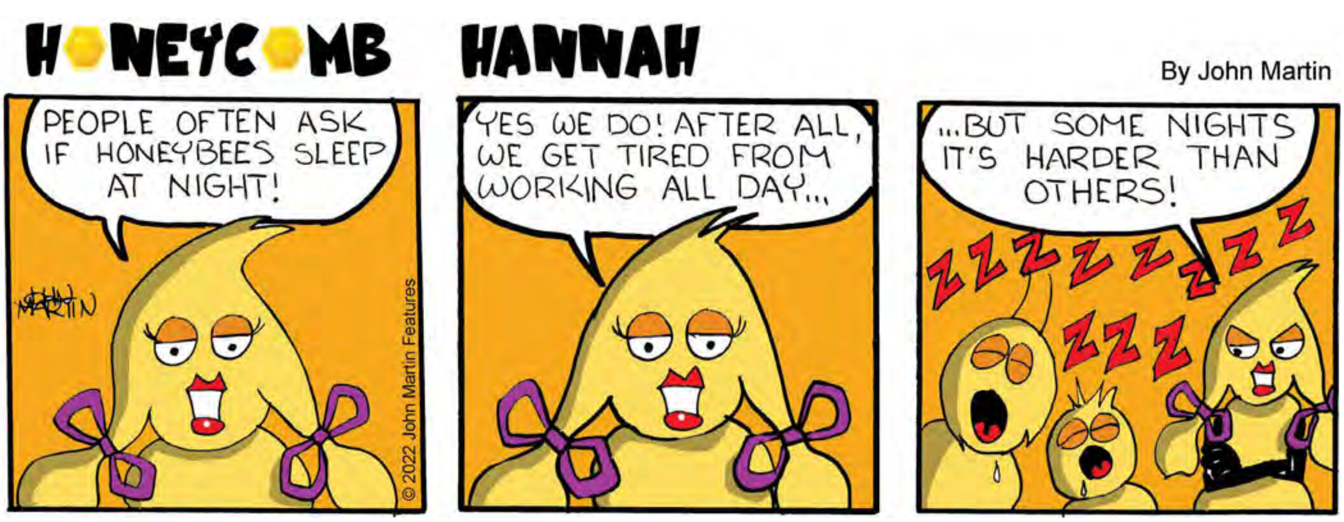

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Part 4 – Build a Wide Queen Excluder

Whenever you build a piece of bee equipment that doesn't match the standard Langstroth dimensions, you need to either modify or completely build any supporting equipment. When a modified Dadant (MD) hive was built for Jerry Hayes (*Bee Culture* editor), a compatible queen excluder was needed. The following steps describe a method to combine two all-metal queen excluders into one MD (20" x 19⅞") sized queen excluder.

Parts

1) 16 ¼" x 19⅞" all metal Queen Excluder (2)
2) 2' Copper wire

Construction

Directly overlapping the edges of the excluders will not work! The resulting excluder will have a double thick edge at the areas where they overlap. To eliminate the uneven edges where the sections overlap, the support bars are joined inside the edging. The interior section - the queen exclusion bars - are then reinforced at the joint with copper wire.

Please read all the directions and understand the concept before starting this project.

Note: A bottom board is used as a measuring jig to help layout the cuts needed for the new queen excluder.

Step 1: Remove one of the 19⅞" edges from the first (master) excluder.

Use an angle grinder or a hacksaw to remove the long edge of a queen excluder. Make the cuts as close to the queen exclusion bars as possible. After removing the edge, smooth the protruding support bars so they are even with the queen exclusion bars.

Objective

The following steps describe the marking and removal of a three bar section of the first (master) excluder. Then a second excluder (extension excluder) is cut to size and has a matching three bar section of its edge removed so it can fit into the master excluder's removed section. The edging is then reformed and the adjacent bars are soldered together with copper wire for strength and to keep the bars aligned.

Note: See the drawing "Joining Two All Metal Queen Excluders" for a visual representation of the results needed.

Note: See the drawing "Joining Two All Metal Queen Excluders" for an identification of the "SUPPORT" bars and the "QUEEN EXCLUSION" bars.

Step 2: Mark the overlap.

Lay the master excluder cut in the previous step on the bottom board. Then position the second excluder (extension excluder) on top of it. Align the edge of the extension excluder on the bottom board so it overlaps the master excluder at the cut. Mark the top (extension) excluder where the cut edge of the first (master) excluder lines up. Then place a second mark on both excluders three wires in where the excluders overlap.

Step 3: Remove three queen exclusion bars from the master excluder.

Bend back the edging that covers the three bars that overlap, then remove these three bars *completely*. This includes the support bar that is wrapped inside the edging.

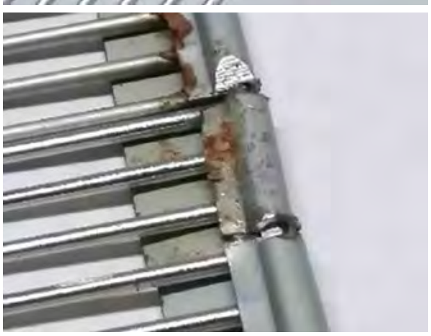
Note: You will need to partially cut the edging to be able to completely remove these bars.

Step 4: Cut the extension excluder to length.

After *remeasuring* the extension excluder, cut the extension excluder to length and smooth the exposed support bars. Then remove the edging back to the overlap start mark. This should expose three queen exclusion bars.

Step 5: Insert the extension excluder into the master excluder's edging.

Slip the exposed queen exclusion bars of the extension excluder into the void left when you removed the queen exclusion bars from the master excluder. Then reform the edging of the master excluder over the exposed bars of the extension excluder.



Step 6: Join the excluder sections.

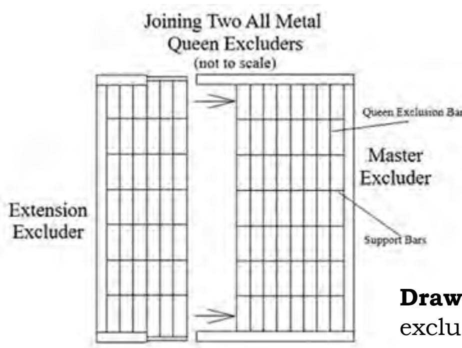
Use copper wire to join the two excluders where the queen exclusion bars and support bars meet. The joints should match up with a minimal distance between the queen exclusion bars. Use some soldering flux and solder the copper wires in place. Then cut any excess wire from the joint.

Note: #14 house wiring ground wire works great for the joining wire.

Not hard work, just a little tricky manipulation is needed to create a queen excluder of any width.

Get a copy of Ed Simon's second book *Build Bee Equipment* with detailed drawings, construction hints and how-to-use instructions for over forty beekeeping tools and equipment from **www.LULU.com**. Under the LULU sales section, search for "Beekeeping".

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



Drawing – Joining two all metal excluders

NEXT MONTH

Region 1
- Add super at dandelion bloom
- Make splits to avoid swarming
- Feed to support Spring forage
- Alcohol mite check
- Check hive weight
- Are they alive???
- Put feed on
- Requeen time
- Cull old dark comb
- Reverse hive bodies
- Clean out dead colonies
- Time to see if what you did in August worked

Region 2
- Make splits
- Add supers if necessary
- Are hives queen right before flow?
- Build nuc boxes
- Alcohol mite check, treat if over three out of 100
- Do a complete hive inspection
- Remove comb over three years old
- Look for queen cells
- Inspect, inspect, inspect

Region 3
- Start rearing queens with cell punch
- Split and feed
- Alcohol wash for mites/treat
- Clean deadouts
- Inspect, feed, sample, treat
- Put supers on
- Place swarm traps around yard
- Check for queen cells
- Equalize colonies

Region 4
- Install packages
- Split strong colonies
- Do you have enough boxes and frames/foundations?
- Super hives
- Rotate brood boxes
- Is queen laying?
- Swarm control on strong colonies
- Requeen time
- Remove Winter wraps
- Alcohol mite wash

Region 5
- It's still winter here!!
- Alcohol wash on nice day/treat?
- Feed
- Mite check
- Inspect hive for queen laying and diseases
- Do colonies have enough weight?
- Remove Winter wraps
- Feed syrup and pollen sub

Region 6
- Split colonies
- Feed
- Requeen defensive colonies
- Check hive weight
- Requeen
- Alcohol mite wash and treat if needed
- Check colonies for disease
- Super now

Region 7
- Inspect colonies for pests and diseases
- Alcohol wash for mites then treat
- Equalize colonies
- Swarm management time
- Make splits, make nucs
- Check food stores
- Feed for colony build up
- Check queen(s)

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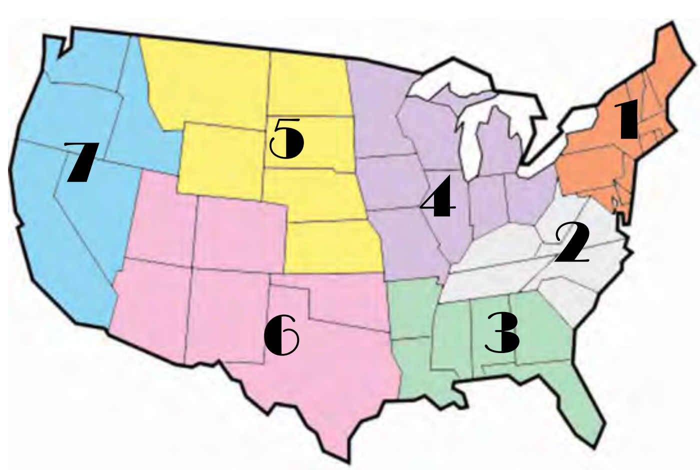

MARCH – REGIONAL HONEY PRICE REPORT

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55 Gal. Drum, Ambr	2.53	2.16	1.92	5.02	2.35	2.25	2.48	1.95-17.50	3.10	3.10	2.36	1.77
60# Light (retail)	243.10	202.75	221.00	192.31	230.00	184.69	221.67	160.00-330.00	215.58	3.59	210.77	182.22
60# Amber (retail)	237.82	195.25	221.00	186.79	230.00	193.79	225.80	167.37-311.00	213.34	3.56	209.98	190.55
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS												
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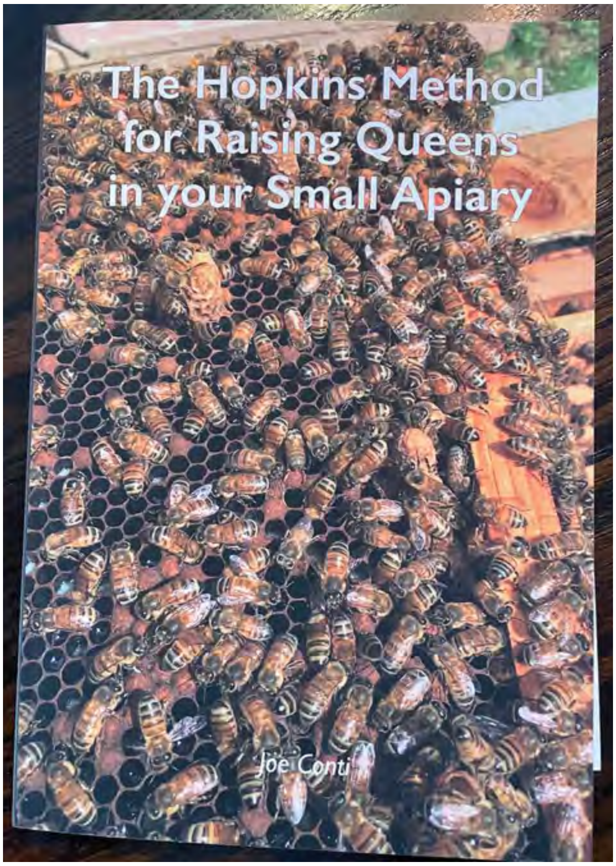
1# 24/case	162.03	193.70	100.00	120.12	185.00	96.92	144.00	45.00-325.00	145.14	6.05	143.77	117.68
2# 12/case	153.97	180.00	118.00	116.97	-	108.00	156.00	78.00-312.00	147.75	6.16	137.04	110.14
12.oz. Plas. 24/cs	118.27	149.92	103.50	104.48	109.68	102.00	114.00	72.00-240.00	116.61	6.48	117.37	83.66
5# 6/case	170.62	189.83	87.00	121.17	-	109.50	-	87.00-330.00	154.41	5.15	151.85	105.45
Quarts 12/case	232.11	175.75	128.50	153.83	186.12	145.94	189.00	108.00-330.00	175.19	4.87	167.97	153.01
Pints 12/case	103.48	111.95	76.00	95.80	111.50	96.00	96.00	72.00-180.00	100.71	5.59	101.76	87.55
RETAIL SHELF PRICES												
1/2#	6.33	5.84	6.00	5.54	3.94	3.85	-	2.69-10.00	5.97	11.93	5.61	5.44
12 oz. Plastic	7.27	7.44	6.62	6.64	6.46	5.45	6.20	4.00-12.00	6.88	9.18	6.90	6.29
1# Glass/Plastic	9.57	9.57	8.54	7.80	8.27	7.52	9.00	5.50-18.00	8.89	8.89	8.93	8.39
2# Glass/Plastic	16.62	17.42	15.13	14.50	14.75	11.50	15.50	6.99-30.00	15.78	7.89	15.31	14.53
Pint	11.94	12.20	8.99	10.64	12.00	8.95	9.80	5.00-24.00	10.93	7.28	11.35	10.34
Quart	23.31	20.94	16.50	18.54	21.40	15.33	20.04	11.00-42.00	19.95	6.65	20.34	17.88
5# Glass/Plastic	34.64	36.16	30.31	27.37	18.96	21.95	34.68	14.94-60.00	31.88	6.38	34.17	29.99
1# Cream	12.77	8.50	8.00	10.26	10.75	8.00	14.00	6.14-21.00	11.46	11.46	11.45	10.46
1# Cut Comb	16.25	-	11.25	13.58	10.00	-	15.31	8.00-25.00	14.11	14.11	14.60	13.49
Ross Round	13.65	7.00	15.00	14.25	-	7.95	13.75	7.00-20.00	12.95	17.27	12.03	11.50
Wholesale Wax (Lt)	9.32	6.10	7.13	10.24	6.20	4.50	6.00	3.50-36.00	8.36	-	7.47	6.65
Wholesale Wax (Dk)	8.56	6.13	5.75	5.83	6.20	3.50	6.00	3.00-14.00	6.55	-	6.37	6.43
Pollination Fee/Col.	95.56	58.63	185.00	130.00	80.00	-	100.00	6.75-225.00	101.41	-	91.79	69.09

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.

Books for Spring –

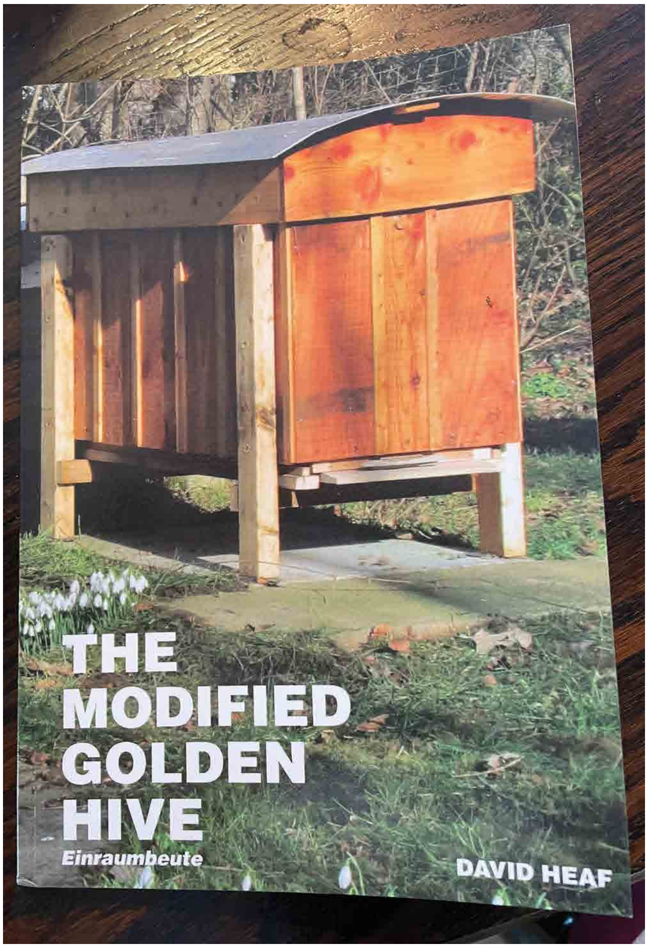


The Hopkins Method for Raising Queens in your Small Apiary. By Joe Conti. Published by Northern Bee Books. ISBN 978-1-914934-25-4. 38 pgs. 9.5" x 6.5". Color throughout. $14.00 from the publisher or Amazon.

Joe Conti has a MS degree in Wildlife Ecology from the University of Florida and worked as a Wildlife Biologist specializing in wildlife diseases at both the Universities of Florida and Georgia. He has published on a variety of issues related to wildlife, including a recent article in the American Bee Journal on this queen rearing technique.

The two photos below show how fundamentally simple this technique is to raise a few queens. Basically, you remove a frame, from the hive you are going to use, or from another with different genetics, and place it in a shallow super equipped with appropriate holders to keep the frame a bee space above the frames in the box, but lying on one side, not hanging in the super. The hive is rendered queenless a short time beforehand. The bottom side of the comb containing eggs and larvae is then very close to the brood nest of the hive, and accessible to the bees to pick and choose which larvae they will use to raise their new queen from. Another super is added above the box with the frame, and when ready, the frame is removed and the queen cells removed from the comb and placed in a queenless colony to finish. No grafting, no cell bars, cell cups, queen cages, or other tools or equipment needed. It is a remarkably easy technique to use, and, without expensive equipment or a stressful management schedule to follow. You'll have to build the box that holds the frame, and all that is required is a notch on each side to hold the frame lug, and something to keep the bottom of the frame even with the top. And a simple nail does that nicely. But that's all the equipment you will need.

Kim Flottum



The Modified Golden Hive, by David Heaf. Published by Northern Bee Books. Isbn 978-1-914934-24-7. 9.5" x 6.5", color throughout, 37 pgs., $14.00 available from the publisher and Amazon.

Horizontal hives with frames are becoming increasingly popular in Europe and North America. One of these is the golden hive or Einraumbeute, developed at Mellifera Association in Germany, based on Dadant-size frames rotated ninety degrees in the box. The resulting deep format allows for a vertically uninterrupted brood nest and a deep honey crown that is good for wintering.

The author, who lives in the UK, switched from using UK National hives, using conventional management to what he felt was a more natural style, and equipment, using a conventional Warre style hive. The Golden Hive is similar in design and management.

This book describes modifications to the golden hive to buffer the colony against heat/cold extremes as does a tree cavity. With the help of many pictures, details are given of how to make the hive, followed by highlights of running it untreated for varroa over six seasons. A few other modified golden hive projects are also mentioned.

Kim Flottum

FOUND IN TRANSLATION

Climate Effects on Bee Disease

Jay **Evans**, USDA Beltsville Bee Lab

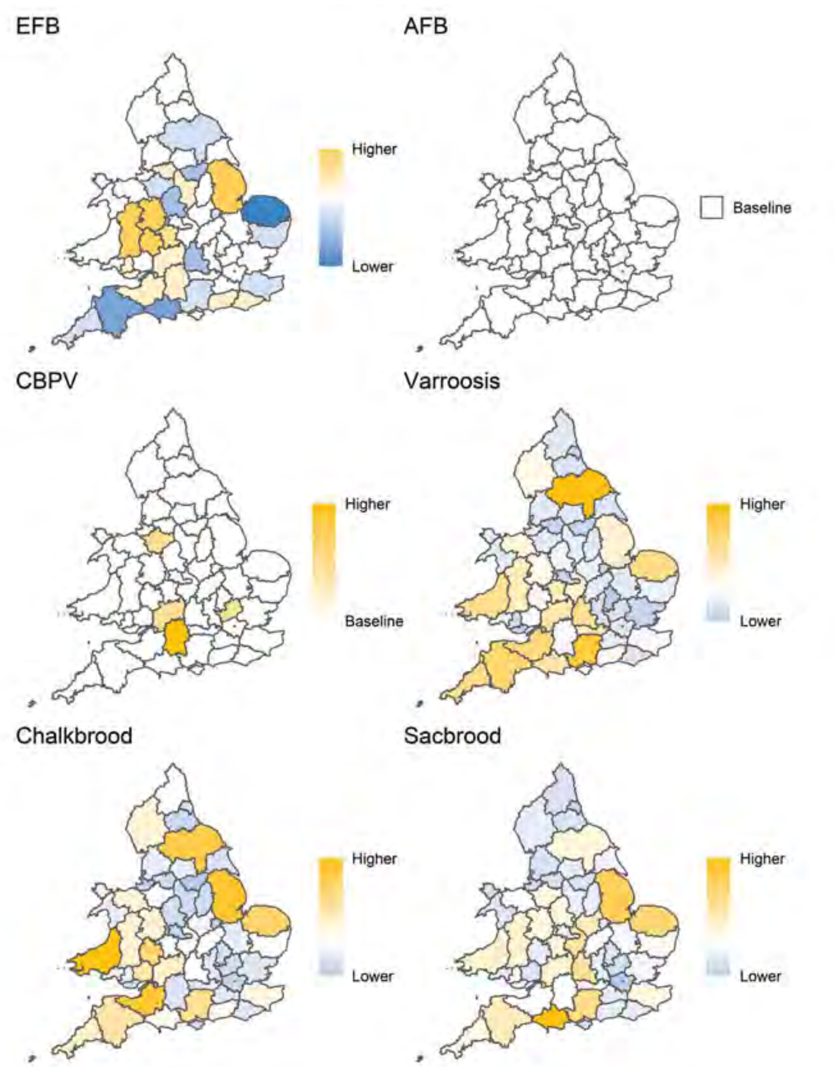
Western honey bees can thank humans for their current range and abundance to an extent that is rare in the insect world. They join human body lice, crop pests, and several household insects as species that are strongly wedded to our habits. Fortunately, in the case of honey bees this marriage has been good for both partners. One way that humans affect honey bee health is through the climate experienced by colonies. Historically, honey bees dealt with the climate they were born in or swarmed into. They could regulate their hive climate with choices of homes and behaviors but they were not likely to experience serious climatic change other than seasonal changes and short-term 'weather'. Currently, the movement of colonies across climatic regimes and the storage of bees in controlled environments puts more pressure on the beekeeper in terms of choosing an optimal, or at least tolerable, climate for their bees across the seasons. In the longer term, human impacts on climate trends and extremes will present bees with new challenges and opportunities. A recent paper from the United Kingdom tackles the impacts of climate on honey bee health and provides some short-term predictions for how climate affects disease and the responses beekeepers might make. At the same time, this paper points to the complex soup that reflects disease risk in honey bee colonies and discusses how anticipated changes in the climate might stir that soup.

Ben Rowland and colleagues at Newcastle University and the UK's National Bee Unit dug into a decade of bee disease records in England and Wales and pitted those records against national county-level climate data (Rowland, B.W., Rushton, S.P., Shirley, M.D.F. Brown, M.A, Budge, G.E. *Identifying the climatic drivers of honey bee disease in England and Wales Sci Rep* 11**,** 21953 (2021) **https://doi.org/10.1038/s41598-021-01495-w**). With insights from over 300,000 bee inspector visits and climate data reflecting temperature, wind, and rain, they had a lot of potential connections to explore. They chose to focus on American and European foulbrood, Chronic bee paralysis virus, *varroa* mites, chalkbrood disease, and sacbrood. Their results corroborate some beekeeper and researcher hunches and also point to areas that need more exploration before management changes are suggested. The two bacterial brood diseases show contrasting patterns. AFB simply plods along, at low frequency and without regard to climate, time or much of anything except for a weak seasonal pattern. As beekeepers have been warned, AFB is a disease of neglect, popping up when frames of symptomatic larvae are left in contact with other colonies… location, location, location. EFB also shows local flareups, often traceable to both neglect and the emergence of new lineages, as shown by prior work from this very group (e.g., Giles Budge and colleagues *Molecular epidemiology and population structure of the honey bee brood pathogen* Melissococcus plutonius ISME *J* 8, 1588–1597 (2014) **https://doi.org/10.1038/ismej.2014.20**). However, EFB also proved to be connected with local weather patterns. Cases of EFB increased with higher rainfall, arguably because bees were confined to the hive..possibly for days on end, since this was England. The authors also argue for a link between protein stress and EFB, since those bees were less able to collect fresh pollen. Interestingly, from this large dataset EFB cases have decreased in the UK over the past decade, and perhaps even the past two decades, despite increased beekeeper concerns with EFB. As in the U.S. (**www.apiaryinspectors.org**), the UK tightly regulates both AFB and EFB through its inspector programs, arguably helping to keep these diseases in check. In the U.S., true EFB outbreaks are matched by high frequencies of 'EFB-like' syndromes, a topic for another day.

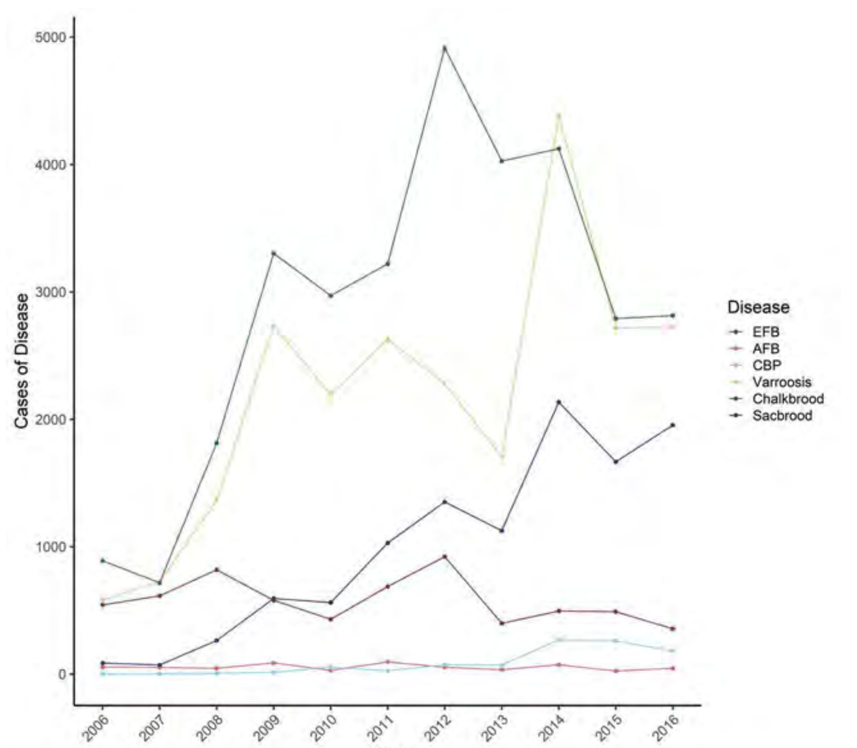
Varroa levels were inferred from inspector reports that mentioned 'bad *varroa'*, 'Deformed wing virus' and 'parasitic mite syndrome' along with direct mite counts. *Varroa* trended up with higher temperatures, perhaps reflecting greater productivity by colonies and hence higher brood numbers for reproducing mites. *Varroa* also increased over the ten-year span and the authors suggest this reflects increased resistance by mites to chemical miticides. The data also show the expected seasonal changes in *varroa* numbers, with mites trending up from Spring to Fall. Sacbrood disease showed similar trends to *varroa*, an odd result since the sacbrood virus is not vectored by mite parasites. Sacbrood was also higher in areas with higher apiary density, likely reflecting the risks of horizontal transfer across apiaries. Interestingly, a second virus, Chronic bee paralysis virus, did not vary with season, density or any climatic measures. This virus only showed a steady increase in frequency over the ten-year period. Finally, chalkbrood disease was more prevalent with lower temperatures and varied significantly by season across the surveyed regions. Chalkbrood also seems to be on the increase in the UK once other variables are accounted for.

A sobering result from this study (depicted in Figure #4 of the study) is the disconnect between raw inspection data by county and the relative importance of each agent (disease risk) once other confounding connections are ruled out. Observed disease incidents are of course what beekeepers and inspectors act upon and they have huge importance, but to understand what leads to outbreaks (or to escapes by bees of serious disease) one has to simultaneously look at seasons, interactions, and local weather. The key weather effects were found at the point of diagnosis/inspection and for two months prior. Not unexpected and this linkage supports the premise that the measured factors are nearing the correct ones.

A highlight of this study is that they successfully leveraged tons of data collected directly from colonies with 'the rest of the world'; from economics to satellite images and local weather stations. This connection of big datasets mirrors efforts in the United States from the USDA National Agricultural Statistics Service (**https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Bee_and_Honey/**), the Bee Informed Partnership (**www.beeinformed.org**) and newer efforts such as Beescape (**beescape.org**). Connecting these diverse sets of information, which will involve computers and some clever soup tasters, will help inform the challenges our bees face in any climate.



Above: Total risk of disease INLA



Above: Yearly disease cases

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A Closer Look

Honey Bee/Varroa Mite/Virus Complex

Clarence **Collison**

Viral diseases of honey bees are a major problem causing serious economic losses worldwide.

"Viral diseases of honey bees are a major problem causing serious economic losses worldwide, especially in combination with *Varroa* mites. To increase the understanding of the relationship among viruses, mites and colony decline, the tripartite relationships among bees, viruses [Kashmir bee virus (KBV) and sacbrood virus (SBV)] and *Varroa* mites were investigated systematically. By using ELISA (enzyme-linked immunosorbent assay) and RT-PCR, (reverse transcriptase polymerase chain reaction; allows identification of pathogenic organisms that are difficult to culture by detecting their genetic material, RNA) the presence of KBV and SBV was studied comparatively in different developmental stages and castes of bees. The results demonstrated that KBV may persist as a viral genome with extremely low levels of viral-capsid proteins and that KBV and SBV can co-infect honey bees. This study indicated the presence of KBV and SBV RNAs in both queens and eggs by RT-PCR, suggesting a route of transovarial transmission. Horizontal transmission is also very likely among adult bees and from adult workers to larvae through contaminated food resources, because both viruses have been detected in all developmental stages and food sources (brood food, honey, pollen and royal jelly). Furthermore, it was demonstrated that mites were another possible route of horizontal transmission, as both viruses were detected in mites and their saliva. This study, for the first time, detected co-occurrence of viruses in *Varroa*, further underlining the importance of the mites in vectoring different bee viruses. These results indicated that multiple infection routes exist for honey bee viral diseases (Shen et al. 2005b)."

"*Varroa destructor* infestation of colonies carries and/or promotes replication of honey bee viruses like the Deformed wing virus, the *Varroa* destructor virus-1, the Acute bee paralysis virus, the Israeli acute bee paralysis virus and the Kashmir bee virus that have been well described and characterized; but viruses exclusively associated with *Varroa* were not found. To look for viruses that may associate with- or infect *V. destructor* they performed deep sequencing (RNA-seq) of RNA extracted from honey bees and mites in *Varroa*-infested untreated colonies. The analytic procedures they used enabled identification of new viruses unique to *Varroa* and absent in *Apis mellifera*: an Iflavirus and a virus with homology to *Ixodes scapularis* (deer or black-legged tick) associated virus 2, that they named *Varroa* destructor virus 2 (VDV-2) and 3(VDV-3), respectively. They validated these findings sequencing the mite- and honey bee-viromes and in separate mites and honey bees randomly sampled. The complete genomes of VDV-2 and VDV-3 bear 9576 nucleotides and 4202 nucleotides, respectively. Phylogenetic analysis of VDV-3 suggests that it belongs to a new group of viruses (Levin et al. 2016)."

"Large-scale colony losses among managed Western honey bees have become a serious threat to the beekeeping industry in the last decade. Multiple factors contribute to these losses, but the impact of *Varroa destructor* parasitism is by far the most important, along with the contribution of some pathogenic viruses vectored by the mite. So far, more than 20 viruses have been identified infecting the honey bee, most of them RNA viruses. They may be maintained either as covert infections or causing severe symptomatic infections, compromising the viability of the colony. In silico analysis of available transcriptomic data obtained from mites collected in the USA and Europe, as well as additional investigation with new samples collected locally, allowed the description of three RNA viruses, two of them variants of the previously described VDV-2 (*Varroa* destructor virus 2) and VDV-3 (*Varroa* destructor virus 3) and the other a new species reported here for the first time. Their results showed that these viruses were widespread among samples and that they were present in the mites as well as in the bees but with differences in the relative abundance and prevalence. However, they have obtained strong evidence showing that these three viruses were able to replicate in the mite, but not in the bee, suggesting that they are selectively infecting the mite (Herrero et al. 2019)."

"Deformed wing virus (DWV) is a bee-pathogenic, single- and positive-stranded RNA virus that has been involved in severe honey bee colony losses worldwide. DWV, when transmitted horizontally or vertically from bee to bee, causes mainly covert infections not associated with any visible symptoms or damage. Overt infections occur after vectorial transmission of DWV to the developing bee pupae through the ectoparasitic mite *Varroa destructor*. Symptoms of overt infections are pupal death, bees emerging with deformed wings and shortened abdomens, or cognitive impairment due to brain infection. So far, three variants of DWV, DWV-A, DWV-B, and DWV-C, have been described. While it is widely accepted that *V. destructor* acts as a vector of DWV, the question of whether the mite only functions as a mechanical vector or whether DWV can infect the mite, thus using it as a biological vector, is hotly debated because in the literature, data can be found that support both hypotheses. In order to settle this scientific dispute, Gisder and Genersch (2021) analyzed putatively DWV-infected mites with a newly established protocol for fluorescence in situ hybridization of mites and demonstrated DWV-specific signals inside mite cells. They provided compelling and direct evidence that DWV-B infects the intestinal epithelium and the salivary glands of *V. destructor*. In contrast, no evidence for DWV-A infecting mite cells was found. Their data are key to understanding the pathobiology of DWV, the mite's role as a biological DWV vector, and the quasispecies dynamics of this RNA virus when switching between insect and arachnid host species (Gisder and Genersch 2021)."

"*Varroa* mite vectoring has resulted in the emergence of virulent Deformed wing virus variants. The basis for such changes in DWV is poorly understood. Most importantly, it remains unclear whether replication of DWV occurs in the mite. In this study, *Varroa* mites were exposed to DWV type A via feeding on artificially infected honey bees. A significant, 357-fold increase in DWV load was observed in these mites after two days. However, after eight additional days of passage on honey bee pupae with low viral loads, the DWV load dropped by 29-fold. This decrease significantly reduced the mite's ability to transmit DWV to honey bees. Notably, a negative-strand DWV RNA, which could indicate viral replication, was detected only in mites collected from pupae with high DWV levels but not in the passaged mites. They also found that *Varroa* mites contain honey bee mRNAs, consistent with the acquisition of honey bee cells which would additionally contain DWV replication complexes with negative-strand DWV RNA. They proposed that transmission of DWV type A by *Varroa* mites occurs in a non-propagative manner (Posada-Florez et al. 2019)."

"Deformed wing virus is just one of many insect RNA viruses which infect a wide range of hosts. Mordecai et al. (2016) reported the genome sequence of a novel Iflavirus named Moku virus (MV), discovered in the social wasp *Vespula pensylvanica* collected in Hawaii. Phylogenetic analysis showed that MV is most closely related to Slow bee paralysis virus (SBPV), which is highly virulent in honey bees but rarely detected. Worryingly, MV sequences were also detected in honey bees and *Varroa* from the same location, suggesting that MV can also infect other hymenopteran and Acari hosts (Mordecai et al 2016)."

"Aggregations of 27 nm virus-like particles were observed in electron microscopy images of sectioned *Varroa* destructor mite tissue. The scattered occurrence of individual particles and accumulation of the virions in lattices in the cytoplasm gave an apparent indication that the virus replicates in the mite. Sequence analysis of the RNA of the purified virus revealed a genome organization with high similarity to that of members of the genus Iflavirus. Phylogenetic analysis of the polymerase showed that the virus was related most closely to Deformed wing virus (DWV) and Kakugo virus (KV) of bees. The name proposed for this virus is *Varroa* destructor virus 1(VDV-1). To determine whether VDV-1 replicates in mites, a selective RT-PCR was done to detect the presence of the negative-sense RNA strand. The virus isolate and the closely related DWV could be discriminated by two primer sets, each specific to one virus. Both viruses replicated in the population of the mite species studied (Ongus et al. 2004)."

"*Varroa* destructor virus-1 is known to cause high rates of overwintering colony losses in Europe. Using next generation sequencing, Ryabov et al. (2017) identified VDV-1 in honey bee pupae in the US. They tested 603 apiaries in 2016 and found that VDV-1 was present in 66.0% of them, making it the second most prevalent virus after DWV, which was present in 89.4% of the colonies. VDV-1 had the highest load in infected bees compared to other tested viruses, with DWV second. Analysis of 75 colonies sourced in 2010 revealed that VDV-1 was present in only 2 colonies (2.7%), suggesting its recent spread. They also detected newly emerged recombinants between the US strains of VDV-1 and DWV. The presence of these recombinants poses additional risk, because similar VDV1-DWV recombinants constitute the most virulent honey bee viruses in the UK (Ryabov et al. 2017)."

"A survey of six bee viruses on a large geographic scale was undertaken in France by using seemingly healthy bee colonies and the PCR technique. Samples of adult bees and pupae were collected from 36 apiaries in the Spring, Summer, and Autumn during 2002. *Varroa destructor* samples were collected at the end of Summer following acaricide treatment. In adult bees, during the year deformed wing virus (DWV) was found at least once in 97% of the apiaries, sacbrood virus (SBV) was found in 86% of the apiaries, chronic bee paralysis virus (CBPV) was found in 28% of the apiaries, acute bee paralysis virus (ABPV) was found in 58% of the apiaries, black queen cell virus (BQCV) was found in 86% of the apiaries, and Kashmir bee virus (KBV) was found in 17% of the apiaries. For pupae, the following frequencies were obtained: DWV, 94% of the apiaries; SBV, 80% of the apiaries; CBPV, none of the apiaries; ABPV, 23% of the apiaries; BQCV, 23% of the apiaries; and KBV, 6% of the apiaries. In *Varroa* samples, the following four viruses were identified: DWV (100% of the apiaries), SBV (45% of the apiaries), ABPV (36% of the apiaries), and KBV (5% of the apiaries). The latter findings support the putative role of mites in transmitting these viruses. Taken together, these data indicate that bee virus infections occur persistently in bee populations despite the lack of clinical signs, suggesting that colony disease outbreaks might result from environmental factors that lead to activation of viral replication in bees (Tentcheva et al. 2004)."

"To determine the roles of *Varroa* mites in activating or vectoring viral infections quantitative comparison of viral infections between bees with and without mites by dot blot analysis and enzyme-linked immunosorbent assay (ELISA) were performed. Under natural and artificial mite infestations, bee pupae contained significantly higher levels of Kashmir bee virus (KBV) and deformed wing virus (DWV) RNAs and KBV structural proteins than mite-free pupae. Moreover, in mite-infested bee pupae, DWV had amplified to extremely high titers with viral genomic RNA being clearly visible after separation of total bee RNA in agarose gels. Linear regression analysis has shown a positive correlation between the number of mites introduced and the levels of viral RNAs. The detection of viral RNAs in the nymph and adult mites underline the possible role of *Varroa* in virus transmission. However, most groups of virus-free adult mites (9/12) were associated with bee pupae heavily infected by viruses, suggesting that the elevated viral titers in mite-infested pupae more likely resulted from activated viral replication. Based on these observations and their concurrent research demonstrating suppressed immune responses in bees infested with mites, they proposed that parasitization by *Varroa* suppresses the immunity of honey bees, leading to activation of persistent, latent viral infection (Shen et al. 2005a)."

"*Varroa* mites and viruses are currently the high-profile suspects in collapsing bee colonies. Therefore, seasonal variation in *Varroa* load and viruses (Acute-Kashmir-Israeli complex (AKI) and Deformed Wing Virus (DWV)) were monitored in a year-long study. The viral titers in honey bees and *Varroa* mites from 23 colonies (15 apiaries) under three treatment conditions: Organic acids (11 colonies), pyrethroid (nine colonies) and untreated (three colonies) were investigated. Approximately 200 bees were sampled every month from April 2011 to October 2011, and April 2012. The 200 bees were split to 10 subsamples of 20 bees and analyzed separately, which allows them to determine the prevalence of virus-infected bees. The treatment efficacy was often low for both treatments. In colonies where *Varroa* treatment reduced the mite load, colonies overwintered successfully, allowing the mites and viruses to be carried over with the bees into the next season. In general, AKI and DWV titers did not show any notable response to the treatment and steadily increased over the season from April to October. In the untreated control group, titers increased most dramatically. Viral copies were correlated to number of *Varroa* mites. Most colonies that collapsed over the Winter had significantly higher AKI and DWV titers in October compared to survivors. Only treated colonies survived the Winter (Francis et al. 2013)."

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ABRC 2022 Proceedings - Conference Abstracts

Part 1 - Long Talks

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Plenary Talks

Grooming behavior: insights on a honey bee defense mechanism against mites

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Self-grooming is a behavioral immune response of honey bees (*Apis mellifera*) to the ectoparasite *Varroa destructor*. Self-grooming and associated traits (e.g. mite population growth and the proportion of mutilated mites), have been used in breeding programs to select for *V. destructor* resistant honey bees. In a recent study, self-grooming was used to evaluate colonies selected for low and high mite population growth (LVG and HVG). Differences in self-grooming between the selected genotypes included time of first grooming, number of differentially expressed genes (DEGs) and viral levels. The selection of resistant bees through self-grooming can be challenging, as the trait is affected by environmental stressors, such as the exposure to the insecticide clothianidin. Sublethal doses of clothianidin decreased the proportion of intense groomers. Also, the effect of the neurotoxic insecticide affected the lipid composition of the honey bee brain, including lipids related to energy metabolism and the stability of nicotinic acetylcholine receptors (e.g. CL18:3/18:1/14:0/22:6 and PC16:0/18:3). Additionally, genes associated with the pathway GPI-anchor biosynthesis were found differentially expressed, indicating an effect of clothianidin on neural processes affecting motor control and self- grooming. Self-grooming appears to be an effective quantifiable behavioral trait to study behavioral immunity and neural processes in honey bees.

Is DWV-B taking over from DWV-A, and does it matter?

Paxton RJ
Martin-Luther-University Halle-Wittenberg

Arguably the most serious threat to honey bees worldwide is Deformed wing virus (DWV), transmitted by *varroa* mites and found as two widespread genotypes, A and B. DWV is often associated with colony death and may account for the apparent increase in colony mortality over the past two decades. The originally described DWV genotype A (DWV-A) has been shown to have spread across the world 'out of Europe', likely accompanying the dispersal of *varroa* mites through transport of queens and colonies. A second genotype B (DWV-B) has more recently been described, a genotype that we have shown to be apparently more virulent in adult honey bees than DWV-A. Here I provide evidence for its rapid worldwide spread, which is likely not due to under-recording, as well as its marked increase in prevalence, not only in the USA but also in many European countries. Using evidence from my own group and others, I show that DWV-B may be spreading, potentially at the cost to DWV-A, and that it is likely spilling over into wild bee species. This is a cause of concern for the health of both honey bees and wild bee species in the coming years.

Chemical Ecology, Behavior and Nutrition

Mandible differences between high and low mite biters: a multifaceted approach

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Varroa destructor mites present a major threat to honey bee (*Apis mellifera*) populations worldwide. Recent research showed a significant difference in mite-biting behavior from breeding stocks (ankle-biters) in Indiana when compared to commercial colonies to defend against *Varroa* mites. The mandibles of these bees are morphologically different in the long edge, and appear to be smaller in size therefore more efficient at mite removal. To examine the molecular mechanisms underlying the mandible differences, we are analyzing the transcriptome of the mandibles themselves at two developmental timepoints to look for candidate genes that regulate the differences in mandible morphology. In addition, we are examining metal ion incorporation into the mandibles of bees. Metal ion incorporation into insect cuticles directly influences their hardness in insects and other invertebrates, and could contribute to the morphological changes observed in high biting bees. Taken together, these data present a complete picture of a mechanism of mite resistance in honey bees. Our new knowledge in molecular mechanisms will provide unique information and foundation for future genetic research to improve breeding and selection of mite-resistant bees.

Exploring the role of beeswax foundation to promote comb honey production and economic profit for hobbyist beekeepers

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University of Nebraska-Lincoln Bee Lab

Managing honey bees provides economic revenue either as the main source of income for commercial beekeepers or as supplemental income for many small-scale or hobbyist beekeepers. Beekeepers commonly generate profit from extracted liquid honey, however, the average price of honey ($5-8/lbs) can fluctuate greatly with the market. Hobbyists have to contend with lower prices and fewer opportunities to commercially sell their products and therefore cannot compete with larger operations. Comb honey, or honey that is still contained in beeswax cells, is a "higher quality" or value-added specialty product (averaging $15-20 per 12oz or 0.75lbs) because it is more labor intensive and energetically costly for bees to produce. These are also reasons why the production of comb honey decreased tremendously, particularly among larger operations, after extraction of liquid honey had been widely implemented. This experiment seeks to evaluate the role different amounts of wax foundation (full, half, or none) plays on encouraging bees to build comb cells and compares economic costs and benefits of using the three sizes to stimulate comb honey production.

Determining the mechanism of honey bee (*Apis mellifera*) premature self-removal behavior

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The honey bee (*Apis mellifera*) is an economically important pollinator and a tractable system for studying the behavioral consequences of eusociality. A sterile worker's own genetic fitness is best served by acting in the interest of her colony, even if that behavior curtails her lifespan. Stressed honey bees typically leave the colony to forage early, which leads them to be unproductive foragers. Precocious foraging behavior can even lead to colony collapse when expressed at high levels. In this study, we tested the hypothesis that developmentally stressed honey bees remove themselves prematurely from their colony and subsequently die. To confirm that this behavior is a reaction to severe stress, and not caused by a parasite or pathogen, we stressed bees with either temperature stress or *Varroa* mite parasitization during pupation. Stressed bees, as well as control counterparts, were tagged upon emergence and introduced to an observation hive. We then observed the colony for premature self-removal of tagged workers. We found that stressed bees self-remove at a significantly higher rate than their unstressed counterparts. Stressed bees also have smaller hypopharyngeal glands than their unstressed controls, indicating that this is a stress driven behavior and potentially a form of extremely accelerated precocious foraging.

Sublethal treatment of insect growth regulators induces precocious foraging and alters collected pollen quantity in honeybees

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Commercial honey bee colonies have experienced rapid declines in the past two decades due to a synergy of stressors, such as pesticides. Chronic stress can have lasting physiological changes in worker bees, such as the accelerated depletion of internal nutrient stores. Experimental reductions in abdominal lipid have been linked to a behavior known as precocious foraging, wherein worker bees forage earlier in their adult lifespan. Precocious foragers have been speculated to be less effective, but the relationship between precocious foraging and reduced pollination services requires further investigation. In this study, we found that bees treated with sublethal quantities of pyriproxyfen, an insect growth regulator, forage earlier than untreated controls. Additionally, we found that bees treated with another insect growth regulator, spirodiclofen, return with less, yet fattier, pollen than untreated controls. Our results suggest a slight yet significant reduction in forager yield due to pesticide stress, an effect that can further compromise colony health.

A mixed-use landscape in Virginia provides sustained foraging resources for honey bees

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Virginia Tech

Poor nutrition due to habitat loss has gained attention as a possible stressor contributing to the well-reported declines in managed honey bee colonies. Scientists, policymakers and concerned citizens have coordinated their efforts to mitigate habitat loss by providing supplemental forage for hungry bees. However, additional information related to the temporal and spatial availability of honey bee forage can help to develop management plans that better meet their needs. We used dance decoding to monitor honey bee foraging from April – October in 2018 and 2019 within a mixed-use landscape in Virginia. We aimed to 1)identify temporal trends in communicated foraging distance and 2) identify attractive land characteristics within our study area. We observed a 63% increase in communicated foraging distance in June 2018 and a 64% increase in communicated foraging distance in June 2019; however, median yearly communicated foraging distances were relatively low in both 2018 (727 m) and 2019 (694 m). Additionally, honey bees expanded their foraging into distant forested areas during June in 2018 and 2019, indicating that forests provided quality forage during this time. Taken together, our results suggest that our relatively diverse study area provided sustained floral resources throughout the two honey bee foraging seasons.

You are what you eat: Effect of Fall feeding regimen on the overwintering success and gene expression profiles of honey bees

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In Fall, beekeepers generally remove stored honey from managed honey bee hives and replace it with artificial feed. This feed, which is often sucrose syrup (SS), high fructose corn syrup (HFCS), or invert syrup (IS), is a much-needed carbohydrate source that will sustain the colony over the Winter. In this study we examined the effect of these feeding regimens on colony survival and molecular markers of metabolic health in workers. Full-sized colonies were either allowed to keep their honey (control) or have their honey removed and replaced by one of the three artificial feeds (SS, HFCS, or IS) in Fall. In March, overwintered adults and newly emerging, callow worker bees were sampled from each feeding regimen. Overwintering success was significantly higher in colonies that kept their honey and those that were fed IS compared to those that were fed HFCS or SS. Moreover, vitellogenin and ILP-2 were up-regulated while ILP-1 and JHamt were down-regulated in brain samples of bees that consumed honey or SS relative to those that were fed HFCS or IS. These findings were consistent across overwintered and callow worker samples, the latter of which had no direct access to the feed available in the colony.

Flowers contributing to colony weight gain and honey production in an agriculturally intensive Midwestern landscape

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The Ohio agricultural landscape includes a variety of sources for honey bee forage, including crop plants, weeds, and supplemental plantings. Currently, there is little understanding of the complementarity of these resources in the honey bee diet. This study aims to identify the flowers contributing most to colony honey production in agriculturally intensive regions of Ohio, with specific focus on soybeans as a resource and the dietary contribution of pollinator plantings. Colonies at twenty-four apiaries in north-central Ohio were monitored in 2020 and 2021. Broodminder hive scales were used to track colony weight continuously, capturing periods of honey production. Nectar samples were collected from apiaries monthly and pollen metabarcoding was used to identify the plants contributing most during periods of colony weight gain. Results indicate colonies at all sites gained weight during soybean bloom with nectar samples composed largely of *Trifolium* (clover) and *Glycine* (soybean) nectar. In addition, *Vitis* (grapevine) pollen was detected frequently in samples during this period. This study provides insight into nectar resources for bees in this landscape and identified periods of nectar dearth. These dearth periods can then be targeted in supplemental plantings to include blooming flowers, maximizing honey bee colony health and productivity in this landscape.

Improving honey bee tolerance to *Deformed wing virus* infection by optimizing macronutrient ratios within artificial diets

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It has been shown that the health of honey bees infected with pathogens can be improved by ensuring proper nutrition. However, commercially available pollen substitutes vary widely in their macronutrient protein (P) to lipid (L) ratios, and it is unknown what target ratio can help bees better deal with pathogen infection. The purpose of this study was to determine what P:L ratio had a positive impact on the survivorship, physiology, and overall health of honey bees infected with a common honey bee pathogen: *Deformed wing virus* (DWV). We conducted cage assays where both infected and non-infected cohorts of bees were fed one of four diet treatments: a high P: low L diet (40P:10L), a low P: high L diet (20P:30L), an intermediate diet ratio at which non-infected honey bees were previously found to self-select for (30P:20L), or no diet whatsoever. Differences in diet consumption, survivorship, pathogen load, and physiology were compared between our different experimental groups. The purpose of this study is to identify at what macronutrient ratio honey bees can better tolerate infection with a viral pathogen in order to better tailor commercially available pollen substitutes for managed colonies on altered and changing landscapes.

Stockpiling pasture legumes and forbs for late Summer honey bee forage on non-irrigated pastures

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Western Oregon is home to over 80,000 honey bee colonies. While honey and pollen flows are adequate through to the end of July, beekeepers have difficulty preparing colonies for Winter owing to a lack of forage in the latter half of the Summer. We have been working together with the National Honey Board to develop late-Summer bloom in dairy and sheep pasture systems, where pastures are grazed during Winter and Spring and are currently left dormant during the dry Summer. We investigated the nectar output in pastures where we incorporated perennial forages (forage chicory, hubam sweet clover and birdsfoot trefoil) and self-regenerating annual forages (balansa and berseem white clover), following Spring closures from sheep grazing on non-irrigated pastures. In spite of severe drought, we demonstrated tremendous nectar output from the self-regenerating annual forages. On the other hand, the bloom from perennial legumes was lower than expected.

Developing a methodology to detect honey bee foraging using bioacoustics analysis

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Detecting bees in crop fields is critical for assessing pollination activity and for choosing appropriate time periods to apply pesticides to minimize bee exposure. There are currently several methods for detecting pollinator presence and activity, including pan traps, manual collection, and visual observation. However, there are limitations to the utility of existing methods, including the bias of pan traps against large bees and the limited duration of observation possible using manual approaches. I am developing a methodology to record the audible wingbeats of foraging honey bees (*Apis mellifera*) in soybean (*Glycine max*) fields and quantify periods of honey bee foraging by identifying the wingbeat frequency specific to honey bees, 234±13.9 Hz. I outline the technological and practical challenges of this new methodology, as well as how those challenges might be addressed and overcome by future work. Successful refinement of this methodology would provide a useful tool for measuring activity of honey bees and other flying insects in other crops or ecosystems.

Nutritional triggers of migration and swarming in *Apis cerana*

Klett K, Ihle K, Spivak M

My goal is to understand the physiological mechanisms underlying swarming and migration in *Apis cerana. Apis cerana* undergoes a yearly colony growth period, culminating in swarming. Conversely, *A. cerana* colonies undergo migration, in which the entire colony moves to a new location when resources become scarce. I tested potential nutritional triggers of swarming in *Apis mellifera* in Minnesota before testing them on *A. cerana*. Reproductive swarming is a complex, multi-stage group decision. A reduction in queen pheromone dispersal and crowding have been identified as triggers of swarming, yet causal mechanisms have not been demonstrated. I hypothesize that protein intake via pollen collection, and resulting nutritional status in individual bees, may be physiological triggers of swarming. I marked 7d and 14d old bees weekly, for two months, from colonies that eventually swarmed or did not swarm. I weighed pollen collected in traps over a 24 hr period every week and measured quantities of vitellogenin using qPCR as a nutritional indicator. After repeating this experiment with *A. cerana*, I will test the hypothesis that colony migration, in contrast to swarming, may be triggered by a reduction in protein intake, leading to the movement of the colony to areas of higher resource availability.

Pests, Pathogens and Beneficial Microbes

Effects of plant natural products on honey bee *(Apis mellifera*) health and gut microbiota

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Honey bees are exposed to many different plant derived compounds both naturally (e.g. propolis, phytochemicals in nectar and pollen) and via management (added essential oils in dietary supplements or for treatments). Since animal microbiota are influenced by host phytochemical ingestion, more research is necessary to understand these dynamics in honey bees. This project aims to understand how phytochemicals may modulate the gut microbiota and what these changes could mean for bee health. Cages of newly emerged bees were provided sucrose syrup containing different concentrations of i)Brazilian or ii)Louisiana propolis extract, or iii)lemongrass, iv)spearmint, or v)thyme oil and pollen paste ad libitum for seven days. Control syrups contained either emulsifiers, kanamycin, or just sucrose. Abdomen samples were collected on day 7 and day 14 for microbiota analysis via taxon-specific bacterial 16S rRNA quantification and culture-based approaches. Bees fed sucrose, Brazilian propolis, and lemongrass had the longest median lifespans while bees fed thyme and spearmint had the shortest. Results of the influence of these diets on gut microbial communities will also be presented. The results will help elucidate the impacts of naturally-encountered and beekeeper-applied phytochemicals on honey bee physiology and health.

Developing a method for rearing *Varroa destructor* in vitro

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Varroa destructor is a significant mite pest of western honey bees (*Apis mellifera*). Developing a method to rear and maintain populations of *V. destructor* in vitro would provide year-round access to the mites, allowing scientists to study its biology, behavior and control more rapidly. In this study, we determined the impact of various rearing parameters on *V. destructor* survival and reproduction in vitro. To do this, we collected *V. destructor* from colonies, placed them in gelatin capsules containing a honey bee larva, and manipulated the following conditions experimentally: rearing temperature, colony source of honey bee larva, behavioral/developmental stages of *V. destructor* and honey bee larva, and mite:bee larva ratio. *Varroa destructor* survival was significantly impacted by temperature, colony source of larvae, and mite behavioral stage. In addition, *V. destructor* reproduction was significantly impacted by mite:larva ratio, larval developmental stage, colony source of larva, and temperature. The following conditions optimized mite survival and reproduction in vitro: using a 4:1 mite:larva ratio, beginning the study with late stage uncapped larvae, using mites collected from adult bees, setting the rearing temperature to 34.5°C, and screening larval colony source. Ultimately, our data can be used to improve *V. destructor* in vitro rearing programs.

DO NOT ENTER: Keeping small hive beetles at bay through olfactory cues

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Small hive beetles (*Aethina tumida*) are invasive pests that enter *Apis mellifera* colonies and inflict feeding damage. *Apis mellifera* colonies emit many volatiles, including the key alarm pheromone component isopentyl acetate (IPA); *A. tumida* adults use these volatiles to locate hives. We hypothesize that one way to keep *A. tumida* adults from invading apiaries is to obscure responses to IPA through use of repellent molecules, which we are testing at antennal and behavioral levels through electroantennography and olfactometry. Thus far, electroantennograms (EAGs) have been performed using IPA and several repellent volatiles (paraffin oil control). EAG results allowed for calculation of half-maximal effective concentrations (EC50) for IPA (5.6ppm), picaridin (16.6%), piperidine (15.9%), pyrrole (1.19%), and pyrrolidine (0.26%). Mixing EC50 values of IPA and picaridin have resulted in significantly reduced responses compared to IPA alone. Dual-choice olfactometers are now being used to compare beetle behavior to EAG results. Thus far, slight preference for IPA was observed, while pollen patty (12g) was significantly attractive. Additionally, when 10mg of pyrrolidine were added to filter paper atop 12g of pollen patty, beetles significantly avoided this treatment. Ultimately, repellent compounds could mask attractive volatiles, preventing *A. tumida* adults from discovering apiaries.

Stable carbon and nitrogen isotope ratios in healthy and *Nosema*-infected honey bees

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Nosema ceranae infection in honey bee workers was studied through the measurement of stable carbon and nitrogen isotopes. For this study, mixed-age honey bees were collected and maintained in an incubator at 32°C. Bees were fed 50% sucrose solution with *Nosema* spores. At days 0, 6, 9, 12, and 26 post-inoculation (DPI), sixty bees were removed from each cage and anesthetized. Newly emerged bees were also analyzed. Sixty midguts from each group were placed by tens in microcentrifuge tubes and crushed with a pestle to release spores. Spore numbers were counted on a hemocytometer. The pellet tissue was dried and sent to the University of Arkansas Stable Isotope Laboratory for isotope analysis. Through ANOVA, we found significantly higher δ13C at 6, 9 12, and 26 DPI than for newly emerged and uninfected bees. However, δ15N was lower for newly emerged bees than for the mixed aged bees at 0 through 26 dpi. Statistically significant positive relationships of δ13C and δ15N with increasing spore counts were also found through linear regression. This indicates that the developing *N. ceranae* aggressively incorporates carbon as it develops. This result conforms to published literature which states that parasites are isotopically more enriched than their host.

Three's a crowd: How honey bees respond to infection with *Lotmaria passim* and *Nosema ceranae*

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Nosema ceranae and *Lotmaria passim* are two digestive tract parasites of the honey bee that have been associated with honey bee colony losses in Canada, the U.S., and Europe. Unfortunately, honey bee colonies are often co-infected with these parasites, and we have little information regarding how the two parasites interact to affect honey bee health. We have investigated the effect of both parasites (single and mixed infections) on honey bee mortality, humoural defense response, and foraging behavior. Results of a mortality experiment suggest that *L. passim* is less virulent than *N. ceranae*, with individuals inoculated with only *L. passim* surviving 10.4 days longer than those inoculated with only *N. ceranae*. Interestingly, mixed infections also appeared less virulent than *N. ceranae* alone, with individuals inoculated with both parasites surviving 0.75 days longer than those inoculated with *N. ceranae* only. We will also discuss the effect of single and mixed infections on individual honey bee behavior.

Comparative quantification of honey bee (*Apis mellifera*) associated viruses in wild and managed colonies

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The most detrimental threat to honey bee (*Apis mellifera*) health is the ectoparasitic mite *Varroa destructor*, which is linked to sizeable colony losses worldwide. *Varroa* is also a prolific vector of several honey bee-associated viruses. Wild honey bee colonies live in feral conditions and are thus not treated for *Varroa* control, which has enabled the natural selection of mite tolerant bees. To date, there is limited information about virus prevalence in wild Africanized honey bee (AHB) populations. The Welder Wildlife Refuge (WWR) is a unique site to study the viral landscape of wild AHBs in the Southern U.S. The goal of this project is to quantify honey bee-associated viruses in a wild population of AHBs, compare the presence of these viruses to that in the nearest managed apiaries. In 2013 we detected the presence of Deformed wing virus (DWV), Black queen cell virus (BQCV), and Lake Sinai virus (LSV). In 2016 we detected the presence of DWV, BQCV, and Sacbrood virus (SBV). All samples that tested positive for viruses contained extremely low copy numbers in both years. This study provides us the first information on the presence and levels of honey bee-associated viruses in a wild population of AHBs.

The effect of hygienic behavior, viral co-infection and blueberry pollination on the development of European foulbrood in honey bees in Michigan

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European foulbrood (EFB) has been an increasing problem for Michigan beekeepers. Here we examine the role that blueberry pollination, hygienic behavior, and viral co-infection play in the development of EFB. In May of 2020, 60 queen-right hives were selected from a commercial beekeeping operation in Michigan and split into two locations: in blueberry fields for pollination or a distant holding yard, away from blueberries. Hygienic testing was performed on each hive and workers were collected for viral testing and hive health metrics and EFB disease status were gathered three times over the season. We found high levels of viral co-infection, with no clear links to health outcomes. No statistically significant difference was found in the development of clinical disease between the two groups with 61% (17/28) of the colonies in the holding yard developing moderate to severe disease over the course of the season compared with 69% (20/29) of those in blueberry pollination. No relationship was found between hygienic behavior and colony health. This suggests that blueberry pollination is likely not an important factor in the development of European foulbrood and hygienic behavior is not important in preventing the development of this disease.

Hygienic Behavior in Feral and Managed Honey Bees (*Apis mellifera*) in Response to Parasitic Mites (*Varroa destructor*)

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*Varroa destructo*r is threatening both managed and feral *Apis mellifera* colonies worldwide. Some studies suggest feral colonies may have increased resistance to *V. destructor* because of their increased immunocompetence and due to disruption of *V. destructor* reproductive cycles through their more frequent swarming. Additionally, Africanized colonies have also been shown to demonstrate increased hygienic behavior by removing more dead/infected brood and grooming more intensely, making them potentially more *Varroa* resistant in subtropical areas. This study aims to understand whether there are differences in hygienic behavior between feral and managed *A. mellifera.* We wish to understand why, despite not being treated, feral colonies are able to survive with *Varroa*. Interestingly, there are few observed differences between the autogrooming behavior of managed and feral colonies through behavioral lab assays. And similarly, there are no differences in their mite biting behavior. However, there is a common trend of honey bees biting off specific mite legs (pedipalps) more than other legs—which may be a strategy to reduce mite infestations. These findings may help us understand how feral *A. mellifera* colonies combat *V. destructor* infestations.

Comparison of individual hive and apiary-level sample types for spores of *Paenibacillus larvae* in Saskatchewan honey bee operations

Zabrodski MW, DeBruyne JE, Wilson G, Moshynskyy I, Sharafi M, Wood SC, Kozii IV, Thebeau J, Klein CD, de Mattos IM, Sobchishin L, Epp T, Ruzzini AC, Simko E
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Three commercial honey bee operations in Saskatchewan with outbreaks of American foulbrood (AFB) and recent or ongoing antibiotic use were sampled to detect spores of *Paenibacillus larvae*. We compared spore concentrations in different sample types within individual hives, assessed the surrogacy potential of honey collected from honey supers in place of brood chamber honey or adult bees within hives, and evaluated the ability of pooled, extracted honey to predict the degree of spore contamination identified through individual hive testing. Spore concentrations in unaffected apiaries were significantly different from AFB affected apiaries in one of three operations. Only a few hives were responsible for the majority of spore contamination in any given apiary. For individual hive samples, brood chamber honey was best for discriminating clinically affected apiaries from those unaffected ($p = 0.001$). Honey super honey positively correlated with both brood chamber honey ($r_s = 0.76$, $p < 0.0001$) and bees ($r_s = 0.50$, $p < 0.0001$) and may be useful as a surrogate for either. Spore concentrations in pooled, extracted honey have predictive potential for overall spore contamination within each operation and may have prognostic value in assessing the risk of future AFB outbreaks at the apiary (or operation) level.

Genetics and Evolution

Breeding *Varroa* mite resistant honey bees in Canada

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The mite *Varroa destructor* is considered the main threat to honey bee health worldwide. In Ontario, *V. destructor* is responsible for most overwinter colony losses (>80%). *V. destructor* also is a vector of the deformed wing virus (DWV) that is transmitted to the bees. This dual parasitism shortens the lifespan of infested bees and contributes to the collapse of colonies. Beekeepers control mite infestations using synthetic miticides, but the mites soon develop resistance to their active compounds, compromising their efficacy. Accordingly, it is necessary to have alternative control strategies. One way of reducing the impact of *V. destructor* and DWV parasitism is to breed *Varroa*-resistant strains of honey bees. We are implementing a bee breeding program in Ontario, Canada, to select for lower and higher rates of *V. destructor* population growth (LVG and HVG, respectively), monitoring infection rates of DWV. Collaborative institutions are the Ontario Queen Breeders Association, the Ontario Beekeepers Association, and the University of Guelph. Preliminary results show a six-fold difference in mite population growth between the LVG and HVG colonies. Additionally, DWV levels and winter colony mortality are significantly lower in LVG colonies than in HVG colonies.

Genetic Progress Achieved during 10 Years of Selective Breeding for Honey bee Traits of Interest to the Beekeeping Industry

Maucourt S, Fortin F., Robert C., Giovenazzo P.
Laval University

Genetic improvement programs have resulted in spectacular productivity gains for most animal species in recent years. The introduction of quantitative genetics and the use of statistical models have played a fundamental role in achieving these advances. For the honey bee (*Apis mellifera*), genetic improvement programs are still rare worldwide. Indeed, genetic and reproductive characteristics are more complex in honey bees than in other animal species, which presents additional challenges for access to genetic selection. In recent years, advances in informatics have allowed statistical modelling of the honey bee, notably with the BLUP-animal model, and access to genetic selection for this species is possible now. The aim of this project was to present the genetic progress of several traits of interest to the Canadian beekeeping industry (hygienic behavior, honey production and spring development) achieved in our selection program since 2010. Our results show an improvement of 0.30% per year for hygienic behavior, 0.63 kg per year for honey production and 164 brood cells per year for Spring development. These advances have opened a new era for our breeding program and sharing this superior genetic available to beekeepers will contribute to the sustainability and self-sufficiency of the beekeeping industry in Canada.

How many species of honey bees (*Apis*) are there?

Otis GW
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At least 178 forms of honey bees have been given species names since Carl Linnaeus first named *Apis mellifera* in 1758. Subsequently, most of those taxa were combined until, by 1986, there was general agreement that there are just 4-5 species of *Apis*: the single species *A. mellifera* of Europe and Africa and 3-4 species in Asia—the dwarf honey bee, giant honey bee, and eastern hive bee. However, expanded research of the honey bees across Asia has led to recognition of between 7-14 species, with the number depending on the species concept that one follows. Several genetic studies over the last 15 years suggest that there is justification for 14+ species. The fallacy of basing species on male genitalic differences will be reviewed. Species concepts and how they influence our understanding of the diversity within the genus *Apis* will be briefly explained. Several exciting biological situations will be highlighted, as well as the future for understanding honey bee diversity.

Population Genomics of Managed and Feral Honey Bees

Carpenter MH, Harpur BA, López-Uribe MM
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Humans have intentionally selected, bred, and managed animals for over 15,000 years. In some cases, human-mediated selective pressures have generated subsets of the original populations containing unique phenotypes and genotypes: domesticated species. Honey bees (*Apis mellifera*) are a unique case because their reproductive strategy is rarely subjected to human control, allowing free mating between managed colonies and their sympatric feral or wild counterparts. Therefore, it is unknown if feral honey bees constitute a genetically distinct population from managed honey bees, or if feral stocks are escapees from nearby managed colonies. To answer this question, we conducted whole-genome re-sequencing on five managed stocks from across the United States and three known feral populations. We found that feral and managed stocks are closely related on the mitochondrial level, but whole genome sequencing reveals significant differences in genetic differentiation and ancestry.

A Tale of Two Stocks; Variance in chalkbrood symptoms between domestic honey bee (*Apis mellifera*) stocks

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Chalkbrood is a common fungal disease that affects honey bee (*Apis mellifera*) brood, and is caused by the cosmopolitan heterothallic fungus, *Ascosphaera apis*. Chalkbrood can cause serious economic damage to beekeeping operations, particularly when colonies are already stressed. There are no chemical treatments registered for chalkbrood disease control in Canada or the USA, and as such, prevention and control of the disease must be achieved through best management practices. Because *A. apis* spores are common and the active fungus may be asymptomatic, it can be difficult for beekeepers to know the prevalence of the disease in their colonies or beekeeping operation. Consequently, the use of highly-resistant honey bee stocks capable of mitigating chalkbrood infections are critical to prevent significant disease outbreaks, such as those reported by Canadian beekeepers during blueberry and cranberry pollination. We assessed social immunity traits—namely propolis production and hygienic behaviour—in various stocks of bees and determined their effect on chalkbrood expression. Our results indicate variability in chalkbrood symptoms across stock types. Hygienic behaviour differed between both stocks, with our Quebec stock averaging 84.03%+/- 3.9% and our Albertan stock averaging 69.48%+/-4.35%. However, neither propolis envelope nor hygienic behaviour were affected by disease status in this experiment.

Don't put all your honey on one stock: The role of genetics in virus and mite resistance

Cambron LD, Underwood RM, Given JK, Harpur BA, López-Uribe MM
The Pennsylvania State University; Purdue University

Honey bee viruses impact individual and colony health, and can be difficult to treat within and between colonies. One approach for fighting pathogens is to actively select for resistance traits. However, while several genetic stocks are available, there is a need for data-driven recommendations based on stock performance so beekeepers can make informed decisions about which stocks to introduce into their operations. To measure intra-colony variation and compare genetic stocks, we tested colonies from one of 10 apiaries located in Pennsylvania that were requeened in June (40 queens per stock) in a blind study where neither the beekeepers nor the molecular biologist had information about the origin of the stocks. Preliminary data shows a strong effect of colony on viral genes, and a significant difference between genetic stocks for expression levels of Deformed Wing Virus, Black Queen Cell Virus, and expression of the mite biting gene *neurexin*. These findings show a difference in virus and grooming genes between genetic stocks. Further analysis of the remaining colonies will provide detailed information on stock performance which will help beekeepers obtain healthier bees, best suited for the operation, and decrease colony and profit losses.

The grooming behavior between European Honey Bees and Asian Honey Bees

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The grooming behavior of honey bees is one of beneficial traits for breeding. Worker bees can perform either auto-grooming individually or allo-grooming as a group in a colony. High levels of grooming can help to remove mites (*Varroa destructor*) from the body of worker bees. Asian honey bees (AHB, *Apis cerana*) as original hosts of *Varroa* mites may display a higher level of grooming behavior than European honey bees (EHB, *Apis mellifera*). But it is unknown whether the foster environment affects the grooming behavior when workers of one species are placed in the colony of the other species. Hence, we designed two experiments using colored fluorescent powders to induce grooming behavior and observed the 8-day old worker bees. In the first experiment, results showed that AHB workers spent more time on allo-grooming as a group than EHB workers, which is consistent with previous reports. In our second experiment of foster environment, interestingly, the environmental change in the colony level affected the auto- and allo-grooming behavior of workers in both species after they were placed in the foster colonies. These results show that both genetics and environment may affect the grooming behavior of honey bees.

Beekeeping Management, Education and Outreach

Thinking inside the box: building beehives that stimulate propolis collection and support honey bee health

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Wild honey bee (*Apis mellifera*) colonies coat the rough inner surfaces of hollow tree cavities with propolis, a substance comprised primarily of plant resins. The resulting "propolis envelope" serves both structural and therapeutic functions inside the hive. Previous studies have shown that the presence of a propolis envelope leads to both individual and colony-level health benefits through the modulation of immune gene expression and increased colony strength. However, the smooth surfaces of the standardized wooden bee boxes currently used in beekeeping do little to stimulate bees to build a propolis envelope. As such, propolis has yet to be implemented as a tool to boost colony health in real-world beekeeping operations. In this study, we compared multiple hive textures for their ability to stimulate propolis deposition in stationary and migratory beekeeping contexts. We then examined effects on immune gene expression, colony health, and honey production. Our results provide support for the implementation of rough box hives as a means to stimulate propolis collection and support colony health in both stationary and migratory beekeeping contexts.

Times they are a' changin' - A decade of documenting changes in beekeeping practices

Steinhauer N, Wilson M, Fauvel AM, vanEngelsdorp D
University of Maryland, Department of Entomology

A principle aim of the Bee Informed Partnership (BIP) is to monitor the health of U.S. managed honey bee (*Apis mellifera*) colonies. We do this through various citizen science programs including survey and active field sampling. The Annual Colony Loss Survey taught us that between dead-outs and the combining and splitting of colonies, the average turnover – or "loss" – of colonies in a calendar year is 40% (Bruckner et al. 2021). The risk of colony loss varies by season, operation type, year, and region, but also according to the management practices beekeepers use (Steinhauer et al. 2021). Honey bees face many stressors, but good management offers a chance to prevent or rectify some of them. Survey results indicate that management of the ectoparasitic mite *Varroa* (*Varroa destructor*) in particular is associated with very different outcomes (Haber et al. 2019). BIP also employs effectiveness trials (pragmatic trials) using our networks of both backyard and commercial beekeepers to estimate the effect of different practices under "real world" conditions. However not all beekeepers are as likely to employ *Varroa* management (Thoms et al. 2018). Still, a decade of survey points to some encouraging shifts in beekeeper's practice, possibly the result of extensive extension efforts.

Spotted lanternfly honeydew honey: a unique new varietal from an introduced invasive insect

Underwood RM, Zhu F, Urban J
The Pennsylvania State University

The spotted lanternfly (*Lycorma delicatula*; SLF) is an introduced planthopper from Asia that was discovered in the U.S. in Pennsylvania in 2014 and has since spread to several other states. This invasive species feeds on phloem and excretes copious amounts of honeydew, which is attractive to honey bees (*Apis mellifera*). Control measures include application of the systemic insecticides dinotefuran and imidacloprid to SLF adults' preferred host, tree-of-heaven (*Ailanthus altissima*). Lanternflies feed on treated trees and, thus, can produce honeydew that contains pesticide residues, exposing non-target insects to these insecticides. Additionally, lanternflies feeding on tree-of-heaven as adults sequester the quassinoid ailanthone, which is known to impart a bitter taste in components of tree-of-heaven. If SLF honeydew contains this substance, it could explain the unusual taste of the honey that is being produced in SLF-infested areas. We have determined that the presence of SLF, and its associated chemical controls are leading to production of honeydew-based honey that can contain dinotefuran metabolites, imidacloprid, and ailanthone. However, contaminants have not been detected at levels of concern for honey bee or human health. As SLF have spread, so have reports of this distinct honey, so beekeepers should be made aware of this association.

Can irradiated royal jelly be used to rear *Apis mellifera in vitro*?

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The ability to rear *Apis mellifera* workers *in vitro* is an important method used to study the effects of pesticides, nutrition, hormones, etc. on bee development. In this assay, bee larvae feed on an artificial diet that includes royal jelly (RJ) often sourced internationally, raising concerns about pathogen spread. These concerns may be mitigated by irradiating the RJ prior to use, though this could affect RJ's value in an artificial diet. The purpose of our study was to determine if *A. mellifera* can be reared *in vitro* on a diet containing RJ irradiated at 25 kGy. Twelve-hour-old larvae were collected from eleven colonies and fed a diet containing untreated RJ, irradiated RJ, or an irradiation control. Statistically fewer larvae survived to adulthood when fed irradiated RJ (71%) than when fed untreated RJ (85%) or the irradiation control (78%). Feeding on irradiated RJ did not affect bee developmental time, though weight at emergence was reduced over that of the control group. Our data demonstrate that *A. mellifera* workers can be reared on a diet that includes irradiated RJ, but that additional diet refinements may be necessary to improve survival of these individuals to levels experienced by larvae feeding on untreated diet.

BIP Bites; BIP Tech Transfer Team Teasers

Fauvel AM, Steinhauer N, Wilson M
Bee Informed Partnership - University of Maryland

The Bee Informed Partnership (BIP) Tech Transfer Team provides inspecting, diagnosing, sampling, reporting and consulting services to commercial beekeepers across the U.S. A decade after establishing the first Tech Team region, we can tease out some interesting data regarding consistently lower *Varroa*, and higher *Nosema* loads and prevalence in BIP Tech Team beekeeper participants compared to the APHIS National average, as well as significant increases in honey bee hygienic behavior scores in California queen breeders. In addition to Tech Team regular services, the honey bee health field specialists conduct real-world condition field trials with our vast commercial operation network in collaboration with a variety of beekeeping industry stakeholders. From indoor wintering studies, to testing effectiveness of products such as probiotics and miticides, field evaluation of new genetic honey bee lines and surveying *Varroa*-vectored viruses across the nation, the Bee Informed Partnership Tech Transfer Team will share a few preliminary results.

How does learning environment affect knowledge and adoption of *Varroa* IPM?

Bruckner S, Mahood J, Steinhauer N, Wilson M, Williams GR
Auburn University

U.S. beekeepers commonly cite the ectoparasitic *Varroa* mite (*Varroa destructor*) as a major threat to their honey bee (*Apis mellifera*) colonies. However, many beekeepers do not implement existing field-tested Integrated Pest Management (IPM) practices recommended by extension agents and scientists, possibly because existing information resources are not aligned with their preferred learning environment. This study aimed to: 1)assess how two learning environments affect beekeeper knowledge gain and behavior change concerning *Varroa* IPM, and 2)identify their preferred information resources. To achieve this, we recruited beekeepers from the Southeast U.S., half of which experienced a fully online learning environment, whereas the other half engaged in an in-person experience. We found that both learning environments resulted in short term knowledge gain, but more in-person participants intend to change their behavior concerning Best Management Practices in *Varroa* IPM. This aligned to beekeeper preferred learning environments − attending classes and instructed workshops. Furthermore, beekeepers predominantly sought information from their clubs and fellow beekeepers through informal discussions. These insights are useful in promoting knowledge gain and behavior change by small-scale beekeepers via tailored information resources and educational opportunities.

A Bee's Eye View of Apiary Inspection: Updates on Honey Bee Health from the Apiary Inspectors of America (AIA)

Skyrm K
Apiary Inspectors of America/Massachusetts Department of Agricultural Resources

Apiary Inspectors and Apiary Programs are the regulatory authority for enforcing the laws and regulations of certain honey bee pests, parasites and pathogens. Given this, inspectors are responsible for monitoring and ensuring honey bee health by conducting field visits to apiaries where they inspect, identify, diagnose, and provide recommendations for treatment of issues. Apiary Programs are dynamic, often with inspectors also serving as educators, researchers, state fair superintendents, and coordinators for other-bee related activities such as Managed Pollinator Protection Plans (MP3). This presentation will provide information on how researchers can work with Apiary Inspectors as well as updates on member and organizational efforts from the past year along with inspection data and observed trends related to honey bee health.

Pesticides and Acaricides

Pesticide risk during apple pollination differs between honey bees and native wild bees

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Bees in agricultural systems are exposed to a wide variety of chemicals, many of which are highly toxic and have been linked to pollinator declines. Little work, however, has looked at how bee taxa differ in their levels of pesticide exposure and resulting risk during crop pollination. We collected five bee taxa across 20 New York apple orchards during bloom, including managed honey bees (*Apis mellifera*) and bumblebees (*Bombus impatiens*), wild bumblebee queens (*B. impatiens*), wild ground-nesting bees (*Andrena* sp. and *Melandrena* sp.), and wild wood-nesting bees (*Xylocopa virginica*). All bees were quantified for 93 common pesticides using HPLC-MS/MS. We found that bee taxa differed in the quantity and composition of pesticides they harbored with honey bees having the greatest risk from exposure. We assessed which pesticides were driving risk in each of the bee taxa surveyed, as well as if the landscape and crops surrounding the orchard were a driver of pesticide exposure and risk for different bees.

Pesticide risk to honey bees and native bees in sweet cherry production of Oregon

Carlson E, Sagili R, Melathopoulos A
Oregon State University

Apis mellifera L. colonies in agricultural environments may stray from a crop and forage on wild plants and other nearby food sources. This leads to a complex pesticide risk profile that includes the products applied to the crop and the potential for honey bees to be exposed to chemicals applied to other attractive plants within their foraging radius. When a diverse pollen sample is tested for pesticides, it is difficult to ascertain where the chemicals originated in the landscape. While a test of the composite sample provides a holistic view of pesticide exposure over a given period, it does not allow scientists and land managers to identify high-risk areas of the landscape. In this study, we investigate pesticide risk to honey bees in sweet cherry fields. Twelve cherry orchard sites were sampled for pollen at early and peak bloom; samples were analyzed for over 250 pesticide residues. We then sorted composite pollen samples into each species and identified the major plant species within each color of pollen. These sorted samples were tested again for pesticides and compared to the original composite test, allowing identification of the plant species which disproportionately contribute pesticide risk to the composite sample.

An evaluation of honey bee (*Apis mellifera* L.) worker behaviors when exposed to a pesticide-contaminated environment

Tokach R, Smart A, Wu-Smart J
University of Nebraska-Lincoln

Honey bees exhibit age polyethism and thus have a predictable sequence of behaviors they express through developmental time. Pesticide exposure can lead to behavioral acceleration, resulting in younger workers transitioning to performing more risky colony tasks, including precocious foraging. This, in turn, can lead to an imbalance in the number of workers performing colony tasks and eventual colony failure. This research examines the relationship between environmental pesticide exposure and colony failure by observing the task-specific behaviors of worker honey bees in observation hives. More specifically, this study assessed potential changes in behaviors of similarly aged workers within two treatment groups: 1)colonies located near point-source pesticide pollution, and 2)colonies embedded within a typical agricultural environment (control). Cohorts of newly emerged sister workers were routinely paint-marked and randomly incorporated into separate treatment hives to establish similar population structures that contained a range of age-marked individuals from newly emerged workers to older foragers. In 2021, worker bee tasks were monitored and assessed on a total of eight colonies three times a week for a month to determine potential impacts of pesticide-contaminated environments on worker performance and age-specific tasks critical for normal colony functions.

Toxicity of Spray Adjuvants and Tank Mix Combinations to Adult Honey Bees

Shannon B, Walker E, Johnson R
The Ohio State University

Spray adjuvants are a diverse group of agrochemicals that are added to pesticide tank mixes to improve the function of spray application. There is concern that significant honey bee colony losses that are reported during and after almond bloom in California are related to adjuvant and pesticide exposure during almond pollination. The aim of this research was to determine if adjuvants and field-relevant mixtures of adjuvants and pesticides applied during almond bloom can cause increased mortality in adult worker honey bees exposed to simulated spray applications. This study established the acute toxicity, expressed as LC50, of different adjuvants and adjuvant tank-mix combinations. Spray application was performed using a Potter Spray Tower on 3-day-eclosed adult worker honey bees. Tested adjuvants included Dyne-Amic, Kinetic, Surf-90, Induce, Cohere, Liberate, Activator 90, Nu Film P, LI 700, Choice, Latron B, and Attach; tested fungicides included Pristine, Tilt, Vanguard, and Luna Sensations; and tested insecticides included Intrepid. Results showed substantial bee toxicity of some adjuvants applied alone at field relevant levels. Results also showed a trend in increased toxicity of some adjuvants when applied as a tank mix with some pesticides. There is evidence that the toxicity of an adjuvant is related to a relatively higher application rate recommended on the label.

Novel method for *Varroa destructor* management: utilizing worker brood to control mite populations in honey bee colonies

Reams T, Rangel J
Texas A&M University

Parasitization of *Apis mellifera* by the mite *Varroa destructor* is one of the main causes for the decline of honey bee health worldwide. To reproduce, a female mite enters the comb cell of a bee larva before it is capped, undergoes development and reproduction within the cell, and exits the cell as the bee emerges. *Varroa* mites have shown a preference for invading drone cells during the reproductive phase, but will invade worker cells throughout the year, as the population of mites within a hive escalates. A mechanical method for mite control is the removal of capped drone brood, but this can only be done when drone larvae are widely present in the hive. Our study involves the manipulation of nurse bee visitations of worker cells by starving worker brood for several hours. We then measured the mites' invasion rates of starved and non-starved (untreated) worker brood. Our results show that starved worker brood have increased mite invasion compared to non-starved worker brood. These results show that starved worker brood could be more attractive to *Varroa* mites, and could be used as a potential control method throughout the summer, when drone larvae are not widely present in the colony.

Predicting the long-term effects of metal pollutants on the honey bee colony: A comparison of modeling approaches

Ricke D, Johnson R
The Ohio State University

Honey bees are regularly exposed to metals in the environment. Unlike pesticides, metals never break down, allowing them to accumulate in colonies over time. In contrast, our understanding of the effects of metals on honey bees is based on relatively brief laboratory assays. Consequently, there's interest in modeling approaches that can leverage short-term toxicological data collected from individuals to predict the cumulative effects of metals and other toxic substances on whole colonies. For the present study, we compare two approaches for predicting the long-term effects of metals on honey bees: a "traditional" approach based on dose-response curves and a state-of-the-art model of survival (the General Unified Thresholds Model of Survival, GUTS). Specifically, we compare how well each approach predicts the results of 20-day chronic toxicity assays using data from standard (10-day) assays. We then compare the predictions of each approach in the background of a preexisting colony population model. We've found that GUTS outperformed the traditional approach for two metals (Cd and Li) when predicting 20-day survival in the lab. Results were equivocal for a third metal (Zn). In addition, GUTS tended to predict lower rates of colony population growth under exposure to metals. These results indicate that prevailing approaches for predicting toxic effects may underestimate effects that accumulate over time.

Efficacy of new compounds against *Varroa destructor* and their safety to honey bees (*Apis mellifera*)

Jack C, Kleckner K, Demares F, Rault L, Anderson T, Carlier P, Bloomquist J, Ellis J
University of Florida

Acaricides used to control *Varroa destructor* are becoming increasingly ineffective due to resistance issues, prompting the need for new compounds that can be used by beekeepers. Ideally, such compounds would be highly toxic to *Varroa* while maintaining a relatively low toxicity to bees. We characterized the lethal concentrations (LC50) of amitraz, matrine, FlyNap®, carbamate 421, carbamate 408 and dimethoate (positive control) for *Varroa* using a glass vial assay. Additionally, the test compounds were applied to honey bees using an acute contact toxicity assay to determine the adult bee LD50 for each compound. Amitraz was the most toxic compound to *Varroa*, but carbamate 421 was nearly as toxic (within 2-fold) and the most selective due to its low bee toxicity, demonstrating its promise as a *Varroa* control. While carbamate 408 was less toxic to honey bees than amitraz, it was also 4.7-fold less toxic to the mites. Matrine was relatively non-toxic to honey bees, but also not effective against *Varroa*. FlyNap® was ineffective at killing *Varroa* and was moderately toxic to honey bees. Additional Tier 2 and Tier 3 testing is required to determine if carbamate 421 can be safely used as a *Varroa* control in honey bee colonies.

The causes of variability in honey bee residual toxicity tests

Swanson L, Bucy M, Melathopoulos A
Oregon State University

Residual toxicity statements on pesticide labels are informed by tests, whereby treated foliage is harvested at specified intervals of weathering to determine whether honey bee contact with this foliage results in mortality (EPA Ecological Guidance 850.3030). The information is of considerable importance to both beekeepers and pesticide applicators to determine whether toxic products sprayed at dusk would dissipate by the following morning. I completed a meta-analysis of 31 papers consisting of 1,299 individual residual toxicity trials of 136 insecticide active ingredients. I estimated the residual toxicity for each active ingredient by calculating RT25 (i.e., weathering time taken for cage mortality to be reduced to 25%) and determined sources of variation in experimental protocols that influenced RT25 values. I reported on discrepancies in RT25 values calculated from the literature compared to values recently published by the Environmental Protection Agency (EPA). I investigated whether discrepancies were the product of variation in the parameters of the test. I found that the age of bees used in test cages (R2= - 0.48) were associated with bee mortality and may be responsible for discrepancies from EPA results.

Apple orchards feed and contaminate bees during, but even more so after bloom

Steele T, Schürch R, Couvillon M

Honey bees provide vital pollination services to many crops such as apples. Previous studies have focused on the impact of bees on orchards during bloom, but fewer studies have examined the reciprocal relationship of orchards on honey bees, particularly across the entire foraging season. We investigated honey bee foraging in orchards in Northern Virginia by mapping 3,710 waggle dances across two years concurrent with pesticides analysis on the forager collected pollen. We found that bees foraged mostly locally (< 2 km), with some long-range events occurring in May after bloom (both 2018 and 2019) and in Fall (2019). The shortest communicated median distances (0.50 km and 0.53 km) occurred in September in both years. We determined that honey bees forage more within apple orchards after the bloom (29.4% an 28.5% foraging) compared to during bloom (18.6% and 21.4% foraging). This post bloom foraging also exposed honey bees to the highest cumulative concentration of pesticides compared to other times (2322.89 ppb pesticides versus 181.8 during bloom, 569.84 in late Summer, and 246.24 in Fall). Therefore, post bloom apple orchards supply an abundance of forage, but also the highest risk of pesticide exposure, which may have important implications for future management decisions.

Native Bees With Dr. Bug

Whizz! “What was that?” my son exclaimed as a tiny, fuzzy object shot past his head, much like a minuscule, fluffy guided missile headed to a hole near my home’s foundation. We looked closer and soon another mostly black with a golden thorax (plus a yellow abdominal stripe) bumble bee emerged and with the same focused determination, left the nest to find more pollen for provisioning her nest. While a commonly encountered bumble bee throughout much of North America, we felt privileged to have this *Bombus impatiens* (common eastern bumble bee) family make their home next to ours where we could watch them all season long.

Perhaps this thriving colony was related to the bumble bee queen I encountered the previous spring as I set up my new pandemic garden in my backyard. As I cleared the leaf litter to set up a raised bed garden, I noticed an unusually large (1 inch) bumble bee climb onto my lumber, stretching her legs and greeting the day after a long Winter’s slumber. As I drew closer to welcome this beneficial pollinator, she lifted a midleg as if to greet me! (See it here: **https://bit.ly/BimpatiensWave**.) It turns out that this “greeting” is actually a warning – stay back! Note to future self: bumble bee stings don’t hurt as bad as honey bee stings initially, but the dull pain lasts longer. Fortunately, no bumble bees were harmed in the making of this story because they don’t have barbed stingers and this new Spring queen safely flew away.

Bombus impatiens *by S. Droege, USGS Bee Inventory and Monitoring Lab*

Bombus impatiens *by Tamra Reall*

New colonies of *B. impatiens* start with a young queen, called a gyne, who leaves her nest in the Fall. She mates with a single drone and then excavates a small, underground chamber to hibernate through the cold Winter months. Upon emerging in early Spring, she forages for nectar and seeks a suitable nesting site – an abandoned underground burrow left by a small mammal. She creates a honeypot near the nest entrance and fills it with nectar. She also deposits a lump of nectar-moistened pollen for easy access as she begins to lay eggs in cells, singly or many per cell, clustered throughout the nest. She will tend to the first round of brood until they can forage and tend to future offspring – a process of about four to five weeks. Worker bees vary in size, from ⅓ to ⅔ of an inch, depending on food availability. Yellow-faced drones are produced towards the end of the season and leave soon after emerging as an adult.

Foragers use a strategy called traplining – efficiently visiting food sources in a repeatable sequence regarding location and time of day. While they don’t waggle dance, they communicate good sources of food with nestmates. Like honey bees, they create honey although not in harvestable amounts.

Many colonies never reach the end of the season, unfortunately. Surprisingly, then, is that these bees are highly adaptable, nesting in urban, agricultural, wetland, and wooded habitats. In addition, they are “domesticated” for greenhouse pollination, which led to this species spreading further than their original distribution.

As seed catalogs arrive and I design my next garden, I’m adding some extra lavender, salvia, and impatiens – the flower for which this bumble bee may be named. *B. impatiens* also like asters, clover, goldenrod, and buttonbush, as well as many flowers of garden fruits and vegetables. I will know Spring has arrived when the queen greets me and the workers start flying, full of purpose and without regard to their admiring human audience. BC

Dr. Bug (aka Dr. Tamra Reall) is a horticulture specialist for the University of Missouri Extension. A former beekeeper and always a bee admirer, she seeks opportunities to share the beneficial aspects of these fascinating animals. To contact Dr. Bug, send emails to **BugNGarden@gmail.com**.

The High Art of Elevated Dumbery

Stephen **Bishop**

Some people think you can just do dumb things without any forethought, but learning how to do dumb things responsibly takes years of diligent practice. And some people, realizing how difficult it is to do dumb things responsibly, try to avoid doing dumb things all together. My wife is one of those people. She just let's me do all the dumb stuff and then reaps the rewards.

For instance, last week a smoke detector started chirping in the middle of the night and was disturbing her slumber. With a sharp elbow to my ribs, she then disturbed my slumber and said, "Fix it."

Our old farmhouse has twelve-foot ceilings, and I didn't feel like going to the barn to retrieve the ladder, so I did what any reasonably trained person in the art of doing dumb things would do. I erected a makeshift tower using chairs and advanced engineering practices (big chairs on bottom; small chairs on top), climbed it like King Kong, and then used a plunger to extend my reach and twist down the smoke detector (really, your standard plunger fits your standard smoke detector; try it). Then I went back to bed. The next morning when my wife woke up and saw the chair tower still standing, she was deeply impressed and said, "That was really dumb. I'm surprised you didn't fall."

What my wife didn't realize, however, was that tower represented years of study in the art of doing dumb things and stood as a monument to my specialization in elevated dumbery, or the branch of doing dumb things from heights.

I had been building and climbing chair towers ever since I was a little boy searching for hidden Christmas gifts. As a child, I climbed with natural aplomb, but getting down was sometimes a different matter. Once my neighbor Andy and I got stuck in the top of a magnolia, and my mom threatened to call the fire department. That got us down fast. Nothing negates the gratification earned in climbing to a treetop more than having one's mom request an embarrassing emergency rescue. Even Andy realized we'd be better off taking our chances with gravity than living with a rescue on our permanent record. After my mom motivated us "to get down now," it was no time before Andy was down and blissfully biking home with orders to say hello to his mom. Erstwhile, once my feet touched terra firma, I was ordered straight to my room. That just goes to show you that you're usually better off performing courageous climbs at a friend's house and being extradited than performing them in your own parent's jurisdiction.

In college, I finally got serious about elevated dumbery. In fact, whoever decided to add brick latticework to the side of the freshman men's dorm should have just put a three-story rock-climbing wall. I graduated with a degree in English, but, to be honest, the experience climbing has probably proven more valuable.

If I had to estimate the value in bees I've gotten from catching swarms or doing cutouts on a ladder, it wouldn't be unsubstantial; it would at least be enough to pay the first installment for a decent orthopedic surgeon when the time comes that I do fall. And I suppose the older I get, the closer I get to that time. Once when I was clinging to the top of an extension ladder that was wavering unsupported in midair, I thought the time was nigh. Above me was a swarm hanging from a limb. Below me was my wife's poppaw who was holding an A-frame ladder steady, to which the bottom of the extension ladder was securely latched with a few strands of old bailing twine. Never have I ever been so happy to safely walk down a ladder again. I promised myself that I would never do anything quite so dumb again at an elevated position.

I'm not sure what the life expectancy is for a beekeeper who does elevated cutouts, but I know enough to know now that when someone calls with a cutout in a second story soffit, I let the young guys take it because I figure they're a lot further away from finding out what that expectancy is. I may be well-educated in the high art of elevated dumbery, but I ain't stupid. So just remember this: Discretion is the better part of valor, especially when bees, ladders, and saws are involved.

Stephen Bishop does dumb stuff in Shelby, NC. You can sign up for his weekly blog post at ***misfitfarmer.com*** *or follow him on Twitter @TheMisfitFarmer.*

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The Future of Commercial Beekeeping

John **Miller**

Many years ago, a futurist/motivational speaker named Ed Barlow spoke to the National Honey Board. I was an Alternate Member, Producer Region three at the time; but was fortunate enough to hear the presentation. His remark, 'The future won't necessarily be bad. It will be different.' Stays with me to this day. Since the late 1980's the future has not necessarily been bad or good. We can spend pages and pages on our opinions of the future. Change is constant.

Pictured is a new device in use at Bullseye Farms, near Woodland, CA. The InsightTrac device cameras tri-angulate, while trolling through an almond orchard on tracks – 'looking' for stick-tights. Stick-tights are almonds in the shell, that refuse to release from the tree when shaken, during harvest. Stick-tights are an almond grower's affliction. That big, long, orange-tipped barrel fires a pellet at stick-tights. Why? Stick-tights harbor Navel Orange Worm [NOW]. NOW's set up housekeeping in stick-tights, raise a family that in the Spring spread throughout the orchard. Growers face dockage when NOW infest harvested nuts. Walnut growers also fight NOW.

Beekeepers are interested in models SL-100 & SL-150 Mag Laser Boresighting System. It's the future.

An almond grower seeks to maximize crop quality and minimize crop dockage. After harvest, stick-tights represent a hygienic cost to the grower. A grower may elect to chemically control NOW with a pesticide application – an increasingly expensive and difficult process in California. She may hire a 'polling crew' of perhaps dozens of employees walking through the orchard with 20 foot poles, physically knocking the stick-tights from branches; or may employ a device like the Mag Laser System. None of the solutions are cheap.

Orchard hygiene is now a leading almond orchard expense.

In the recent past, a designer and inventor, Anna Haldewang mused on the challenge of stick-tights. She was visiting Mel Machado's [Blue Diamond Grower Relations] office in Ripon, CA. A prototype device was assembled. It was big, ugly, buggy [in a techy way], and temperamental. V 2.0 was better. Over 20,000 images of almond trees, tree rows, stick-tights, branches, scaffolds, and an occasional blackbird were logged into the 'training' of the device.

The skeptical approach challenges ideas and inspiration. 'I don't know if this thing is going to work'. A lot of stuff does not work. Everyone has a brilliant idea that will not work. Creating the future isn't simple, and it isn't cheap – and sometimes does not work.

About twelve years ago, at Miller Honey, we came up with a contraption to mechanize dividing hives. It was a terrible thing. It was fast, and brutal. It was featured in a documentary called More Than Honey, by Marcus Imhoof. I'm not proud of the device.

Beekeepers invest a lot of labor and expense making up Spring divides. It's how we sustain an unsustainable hive count.

In the future, a device will mechanize hive divisions.

200 parent hives present, on pallets; and are placed on a conveyance.

Hives will enter the process and scanners, cameras, lasers, and chemical sensors – all with 20,000 images of learned observation will 'work the hive'. Instead of a hive tool, smoke, muscle strength, sweat-strained eyesight, experience and subjective analysis – hives will pass across a conveyance.

During conveyance, hives will be dis-assembled with the smooth precision of mechanical handling. Levers will dislodge frames without dislodging bees. Scanners will evaluate frames; brood coverage, stage of brood development, resources; including pollen, and stores of honey. Chemical sensors will identify brood diseases [if any] and appropriately segregate or pass on frames. Lasers will scan for the Queen – dispatching her; so every single nucleus will be receptive to a replacement Queen. Phoretic *Varroa* and *Tropilaelips* will be laser dispatched. Chemical sensors will document presence and abundance of mites. The physical well-being of frames will be analyzed, removed, replaced, or repositioned to optimal placement, based on 20,000 learned images of broken ears, end bars, bottom bars, mouse damage and cell structure.

'Nucs' will be assembled, with the precise amount of brood, bees, feed, pollen, filler frames, feeder [filled] in positions one to nine occupy the hive body. Nine day-old Queen cells will be placed *securely* in the optimal position. [Mated Queens with perfectly punctured candy face down are an option.] Nucs will be fitted onto a pallet, cover correctly placed, and gently stacked four pallets high; one atop the other, and conveyed to the loading site. An automated forklift removes completed stacks.

The operator receives the output data. 2.3 net nucs per parent hive were harvested from 200 parents. Process analytics provides relevant data of disease, pestilence, and wellbeing.

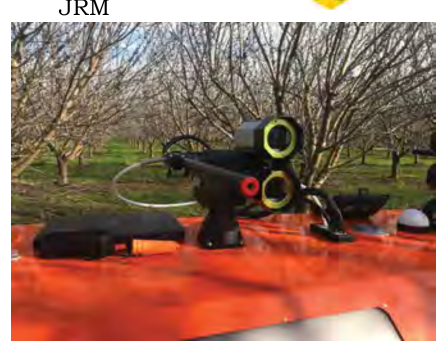
The process occurs daily, every day, rain or shine – for 30 days, without interruption.

The process occurs indoors. The indoor storage building optimizing the wintering experience for hives now fulfills a second vital commercial beekeeping activity. The building is dark. The climate is controlled. The concrete is smooth, clean and never tips a stack. The harrowing labor intense dividing experience is replaced. The building houses replacement hive bodes, new frames, pallets, feeders, cell incubators, the necessary hardware is indoors, accessible, dry, in good repair, automatically inventoried, and replenished. The equipment is standard, universal, interchangeable. Syrup is held in a single tank, a single pump, measured, unspilled.

For inspiration, tour a distribution center. I don't know who will make this work – but it will.

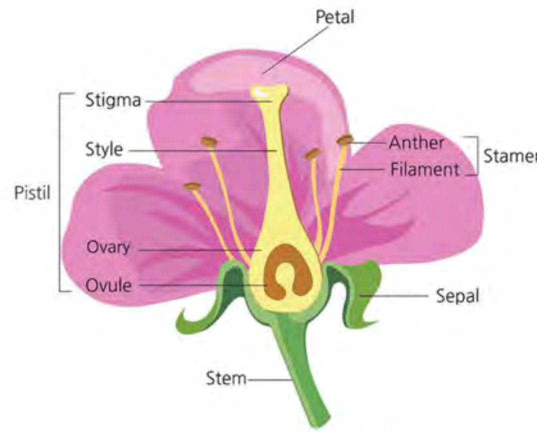
Designers and inventors like Anna Haldewang are inspiring. A young generation of beekeepers are going to make this work. 'The future won't necessarily be bad. It will be different.'

JRM



Self-Pollinating Almonds

Joe **Traynor**



There has been some confusion between the terms self-fruitful and self-pollinating almond varieties.

Self-fruitful varieties will set an almond with their own pollen – they do not need pollen from a different variety. There are currently a number of self-fruitful almond varieties and more are on the way. Currently, the best known ones are Independence, developed by Zaiger Genetics and sold by Dave Wilson Nursery and Yorizane, developed by the USDA and sold by Duarte Nursery and other California nurseries.

The flowers on these self-fruitful varieties are characterized by their female stigmas (one stigma per flower) that protrude one to several millimeters above the more numerous pollen-producing male anthers below. Nature has provided this spatial distance between stigmas and anthers to make self-pollination more difficult since self-pollination can lead to a less hardy final product. Almond trees in the current discussion (almond growers harvest the seeds before they are allowed to germinate; there is no "right to life" movement for baby almond trees). The distance between stigmas and anthers on current self-fruitful almond varieties is an impediment to achieving maximum or optimum pollination (pollen transfer). Nature had no way of anticipating (and likely didn't care) that this would be a future problem for growers of self-fruitful almond varieties. In some years there could be enough of a breeze to make the flowers self-pollinating in addition to being self-fruitful by pushing pollen from anthers to stigmas when the pollen is released by the anthers (anthesis). Tests have shown that bees can increase yields on the Independence variety by as much as 20% or more. No mention was made of wind conditions when these tests were run – slight breeze, windy or calm. The Almond Board currently recommends that Independence growers rent bees at low stocking rates. It is likely that growers of Independence, Yorizane, et al would not have to rent any bees if there were orchards with standard varieties (stocked with bees) within a mile or two of their orchards.

French prune varieties grown in California are self-fruitful with a flower structure like almond flowers (stigmas slightly above anthers). Prune growers used to rent bees but most don't because setting too many prunes can reduce marketable sizes and create a thinning bill. It has been suggested that wind, provided by a helicopter or by an empty spray rig, one or more times during prune bloom could accomplish the pollination job (see the article *Do Prunes Need Bees?* in the August 1979 issue of *Gleanings in Bee Culture* now called *Bee Culture*, pp 423, 424). This article suggested using an empty spray rig, or a helicopter to blow pollen to the desired target (the flower stigmas) and concluded that "In the absence of bee activity, wind (natural or man induced) could accomplish the pollination job". The same tactics could turn self-fruitful almond varieties into self-pollinating varieties.

For these new self-fruitful varieties, the cost of using an empty spray rig, a helicopter or in 2022 an aerial drone to blow almond pollen around one or more times during bloom should be weighed against the cost of renting a nominal number of bee colonies; renting bees could well be cheaper.

BIP Bits:
Become a Better Beekeeper

Rachel **Kuipers** & Jeri **Parrent** & Nathalie **Steinhauer**
Bee Informed Partnership

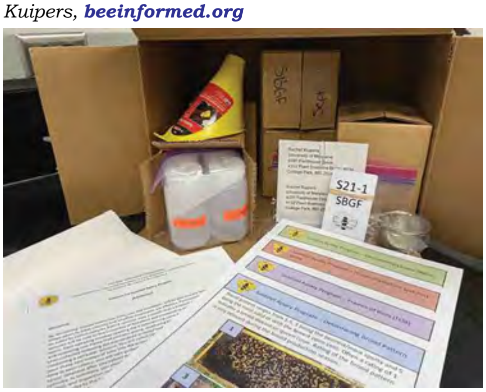
Here at Bee Informed Partnership, we are excited to announce that registration for the 2022 Sentinel Program is open now through the end of April! Don't delay - register today by completing the quick and easy online registration form at: **beeinformed.org/sentinel-sign-up/**

Feature Figure
A Sentinel Apiary Program participant collecting samples and performing colony health inspections. © 2021, Rachel Kuipers, ***beeinformed.org***

What is the Sentinel Apiary Program and How Does It Work?

Bee Informed Partnership's Sentinel Apiary Program is a citizen-science project designed to help participants regularly monitor their colonies for *Varroa*, *Nosema*, signs and symptoms of common pests and diseases, and overall colony health. In addition to helping beekeepers improve colony health and survival rates, the information collected from the Sentinel program also provides this invaluable information regarding regional and national honey bee health metrics to researchers and beekeepers. The program also offers a number of educational resources available to beekeepers, regardless of their participation status.

Figure 1
Sentinel Kit Contents
Each Sentinel kit comes with the supplies shown here that the beekeeper will need to sample their colonies throughout the season. The kit also contains additional educational resources to assist beekeepers with their inspections. © 2021, Rachel Kuipers, ***beeinformed.org***



Beekeepers who register for the Sentinel Apiary Program receive a kit containing the instructions and supplies that they will need to participate (Figure 1). From May to October, Sentinel beekeepers inspect and sample the same four, eight, or 12 participating colonies monthly with materials provided in the Sentinel kits.

The samples and beekeeper notes collected by Sentinel participants are sent to the University of Maryland Honey Bee Lab where they are analyzed for *Varroa* and *Nosema* loads. When lab processing is complete, the results and inspection notes are combined into a report that tracks their apiary health over time. The combination of lab results, inspection data, and management notes collected from the same colonies over time is extremely valuable for tracking seasonal and geographic trends in colony health and disease.

This past season, there were 92 Sentinel participants who sampled over 500 colonies across 129 unique locations. The University of Maryland Honey Bee Lab processed 2,312 samples from Sentinel colonies throughout the season. That's a lot of samples—a record for the program! We also reached eight of the nine NOAA climatic regions, as well as the non-continental U.S. (Figure 2).

Figure 2
Distribution of Sentinel apiaries during the 2021 season. In 2021, there were 92 program participants located in 27 US states and Guam. © 2021, Nathalie Steinhauer, ***beeinformed.org***

Sentinel Results Reveal Real Benefits

Sentinel program results from the past several years show that Sentinel participants tend to have colonies with lower average detectable *Varroa* loads than the national averages reported from the National Honey Bee Disease Survey (NHBS), a USDA-funded annual survey organized by the University of Maryland Honey Bee Lab in collaboration with the Apiary Inspectors of America. This lower average is due in large part to the timely management actions taken in response to the results Sentinel participants receive from their monthly colony health monitoring and testing efforts.

Results from the 2021 season were consistent with those from previous years: Sentinel participants had colonies with lower average *Varroa* loads throughout the season than the national average reported for colonies sampled as part of the NHBS (Figure 3, next page). *Varroa* were detected in

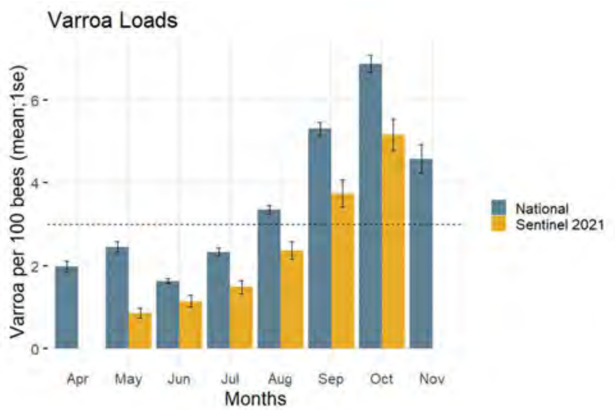


Figure 3
2021 average (error bars represent ± one standard error) monthly Varroa *load for Sentinel program colonies (orange bars) and the USDA National Honey Bee Disease Survey colonies (gray bars). Sentinel colonies tend to have lower average detectable* Varroa *loads in their samples than the national average. April and November Sentinel data were excluded from analysis because there were fewer than 30 samples per month. © 2021, Nathalie Steinhauer,* ***beeinformed.org***

Figure 4
Maryland's Montgomery County Beekeepers Association members inspect a colony before collecting a sample for the Sentinel Apiary Program. © 2021, Maureen Jais-Mick, ***montgomerycountybeekeepers.com***

over 60% of Sentinel samples. *Varroa* loads peaked in October, with detectable levels in 82% of samples—half of which were above the 3% action threshold. This is on par with previous years of data.

2021 Sentinel Program Highlights

To continue to improve community building and information exchange within the program, in 2021 BIP began holding monthly Zoom meetings and webinars for Sentinel participants, where Sentinel beekeepers from across the country came together to share their experiences, ask questions, and learn from BIP's own honey bee health experts, as well as one other. We also expanded our publicly available educational resources with instructional videos demonstrating how to perform colony inspections that are available on our YouTube channel where you can find a variety of educational resources - subscribe now!

In 2021 BIP's incredible IT team introduced changes to the BIP mobile app so Sentinel participants were able to use it to upload their inspection notes directly from their bee yards to our database. The IT team also designed an online dashboard where Sentinel participants were able to directly download their reports and raw data.

We also began building connections with bee organizations across the country through our new sponsorship program, in which groups sponsor Sentinel participation for their members by subsidizing the program via discount codes. By sponsoring discounts for their members, these organizations were not only able to increase the accessibility of the program for their members, they helped other beekeepers in their communities by monitoring a greater number of colony health metrics.

Expanding the Sentinel Apiary Program

In response to the success of our beekeeping organization sponsorhip program, in 2022 we are continuing our efforts to expand this exciting opportunity. Clubs choose their sponsorship level: they can cover the full cost of participation, a percentage of the cost, or a set amount per kit, as well as the number of participants who can take part. Sponsoring organizations may have access to the online dashboard tool that displays their members' results, depending on the sponsorship level and permission of the participating members. Furthermore, in addition to our existing four- and eight- colony kits, 12 colony kits are also available—perfect for bee clubs with multiple yards. And individual kits of any size can now be used across multiple apiaries.

BIP's Sentinel Apiary Program registration fees are priced at-cost, so the discounts these organizations provide to their members increase the affordability and accessibility of the program for their members, while helping to cover the costs needed to keep the program up and running. We are incredibly grateful to the individuals and organizations who have made these collaborations happen—thank you! If your local club is interested we would love to talk with you about sponsorship opportunities. Contact Sentinel Program Coordinator Rachel Kuipers at **rkuipers@umd.edu**.

Clubs choose their sponsorship level: they can cover the full cost of participation, a percentage of the cost, or a set amount per kit, as well as the number of participants who can take part. Sponsoring organizations may have access to the online dashboard tool that displays their members' results, depending on the sponsorship level and permission of the participating members.

BIP's Sentinel Apiary Program registration fees are priced at cost, so the discounts these organizations provide to their members increase the affordability and accessibility of the program for their members, while helping to cover the costs needed to keep the program up and running. By increasing the number of Sentinel participants in a geographic region, this also improves the amount and resolution of colony health data for that area, which helps all beekeepers. If your local club is interested in joining the Sentinel Apiary Program, we would love to talk with them about sponsorship opportunities. For more information, contact Sentinel Apiary Program Coordinator Rachel Kuipers at **rkuipers@umd.edu**.

Register Now!

We're excited about the new changes we've made to the Sentinel Program and to see what the upcoming 2022 season will bring! Once again, make sure to visit the Bee Informed Partnership's Sentinel Apiary Program webpage (**beeinformed.org/sentinel**), where you can register to join the Sentinel community, learn more about the program, review reports from past years, and so much more!

Happy Beekeeping! BC

Young Harris College

University of Georgia Beekeeping Institute Reaches 30-year Milepost

Keith **Delaplane**
Professor and Director, UGA Honey Bee Program

Delaplane is the young, dark haired assistant professor on the left.

Thirty years ago I was a young dark-haired Assistant Professor eager to make my mark in the world of honey bee research and outreach. My new post at the University of Georgia was a hybrid of two earlier positions, one in research and teaching held by Professor Al Dietz and the other in beekeeping extension held by Mr. Rodney Coleman. These two beekeeping luminaries for years prior to my arrival had built their outreach efforts around an annual "Beekeeping Shortcourse" that was to serve as the model and inspiration for what was to come. I never had the good fortune to attend a Beekeeping Shortcourse, but I heard all about it from enthusiastic beekeepers and from Professor Dietz himself.

The Beekeeping Shortcourse was a model of simplicity and efficiency. On a Spring Saturday morning students converged at a big lecture hall in the Bio Science Building, home to UGA's Department of Entomology. Al would persuade his colleagues in the department to give up a Saturday morning and talk to beekeepers about their latest research. In this manner beekeepers heard first-hand about the pioneering pheromone work of Dr. Murray Blum, parallels between honey bees, wasps, and carpenter bees described by Dr. Bob Mathews, and the complex honey bee sting apparatus as revealed by Dr. Henry Hermann. Al's own graduate students were pressed into service, each marched in front of the friendly audiences to describe their discoveries in honey bee nutrition or their experiences with the African bees of South America – just then making headlines in the States.

After lunch the Shortcourse reconvened at the UGA Horticulture Farm, five miles out of town and home, then and now, to the UGA Honey Bee Lab which I venture to say is the leading candidate for "most beautiful bee lab in America," nestled against a picturesque irrigation pond, a blueberry orchard, and a patchwork of experimental veg and ornamental plots. Al (or rather, his students) pitched tents all around the pond, each the site of a topical demonstration. Students walked clock-wise around the pond in 45-minute rotations, after which each would have seen how to install a package, hive a swarm, and inspect a colony. In Al's steel storage shed students found stacks of supers and sweaty volunteers showing how to extract honey. The lab itself was opened up for exhibitions on equipment building, microscopy, and finer crafts such as candle making and alternative hive products. By the end of the day, participants got in their cars and drove home, renewed in their enthusiasm and eager to put into practice their new-found knowledge.

I never got around to doing the Shortcourse my first year. Instead, I got wrapped up filming a how-to documentary on beginning beekeeping for the local affiliate of the Public Broadcasting Service. That television series, A Year in the Life of an Apiary, went on to achieve nation-wide distribution and acclaim. It's still available on YouTube and for me marks one of the earliest and highest watermarks of my career. But after my second year at UGA came and went and there was still no sign of the Shortcourse re-emerging, I was beginning to feel the weight of expectation pressing in on me from all quarters.

The first inkling of a new idea began to take shape after I was invited by Dr. Tom Sanford, my counterpart one state south, to speak at his annual University of Florida Beekeeping Institute. It was in fact Tom's "Institute" that I copied when time came around for me to name my own event.

Tom was an alum of UGA, a former student of Al Dietz's, so it was natural that his Institute mirrored Al's Shortcourse in many details. Now having personally witnessed what all the hoopla was about and feeling more professionally secure after the success of the television show, I was primed to revisit the idea of resurrecting an outreach education showpiece.

The second prompt happened when a county agent in north Georgia invited me to his office to make a presentation to his local beekeepers. It was occasion for a serendipitous meeting. Sitting in the audience was Dr. Paul Arnold, nearly the same age as I and a faculty member at nearby Young Harris College where he oversaw the biology program. Paul and I quickly established rapport and shared similar interests in biology, bees, and pollination ecology. The next day back in my office in Athens it hit me like a thunderclap – let's do a two-day workshop at Young Harris College. The campus is a lovely gem nestled in the beautiful Blue Ridge Mountains at the foot of Georgia's highest mountain Brasstown Bald. The entire region is famous for its iconic sourwood honey. And in Paul Arnold I was to discover the very archetype of an ideal collaborator – energetic, interested, invested, and competent at every detail. A quick call to Paul, and before the day was over the date was set and a rough agenda taking shape.

The first Young Harris College / University of Georgia Beekeeping Institute was held June 19-20, 1992. Attendance was around 50; the two-day registration fee was $25 and dormitory housing $15 per person per night. The stamp of the earlier Shortcourse was all over it; from the start there was attention to scientific theoretic background combined with practical application. But I also wanted it to be something new – its own thing. Removing it from Athens to the scenic Blue Ridge Mountains was one big step. That simple move infused the event with a "weekend getaway" feel, yet the College ambience and Paul Arnold's scientific resources reinforced a cultural commitment to delivering science-based information. The local county Extension Director Robert Brewer was brought into the fold and was to provide years' worth of connections to local bee hives, venues to accommodate the growing crowd at the annual shrimp boil, and bluegrass bands to entertain them.

By its tenth anniversary the Institute had patently evolved into something more than another beekeeping workshop. Sparing no expense, I had begun inviting guest lecturers from anywhere, including the very biggest names in bee science in the U.S., Canada, England, France, South Africa, and Brazil. Word was spreading, and by 2006 Young Harris College was host to the annual EAS shortcourse and conference, all orchestrated by the bright and resourceful Jennifer Berry, then in her sixth year as manager of the UGA Bee Lab and serving as EAS President.

And so year after year, the Young Harris Institute was bringing the world's best bee scientists and educators to the beekeepers of Georgia and the Southeast. Standing tall among these foreign guests is Michael Young of Belfast, Northern Ireland. Having distinguished himself as a decorated chef and senior judge in the British system, Michael partnered with Paul, Robert, and me to begin teaching the British honey judging standards at the Young Harris Institute. Michael became an annual favorite at the Institute, delighting crowds with his charisma, cooking skills, and unerring aesthetics on honey and beeswax showmanship. Retaining the name "Welsh" in honor of the British group that initially sponsored us, the Welsh Honey Judge program today is expanding throughout the eastern half of the country under the direction of Mr. Brutz English. Certified Welsh judges are distinctive in their white

smocks and trilby hats, but more importantly they foreground a more "sensory" approach to honey and its products than the more analytical methods used in American style shows. Think "wine tasting" versus "chemistry class."

The Welsh expansion phase prompted another addition to the Young Harris offerings – the Georgia Master Beekeeper program. I modeled this system after the templates established by my predecessors Roger Morse, John Ambrose, and leadership of EAS. Initially nested solely in the annual Institute, the Georgia Master Beekeeper program has been pushed by popular demand to partner with local bee clubs to offer entry-level testing and exams throughout the year. Master beekeeper programs have different "personalities" around the country, and the Georgia program mirrors many others in honoring entry-level certification from sister programs. Holders of such certificates may apply for candidacy to our second grade, Journeyman. But the Georgia system is distinctive for its emphasis on *science-based* ambassadorship for the cause of bees and beekeeping. The Journeyman stage is brutal; students must pass sections on disease and insect identification with scores no lower than 100%. The highest grade, Master Craftsman (MC), requires significant participation in a university-supervised research project and an oral exam (joined every year by a distinguished guest professor) to drill into the student's practical and theoretic knowledge. Two of our Master Craftsmen, Bill Owens and Cindy Hodges, are authors of refereed scientific papers; Amy Weeks has published popular articles on beekeeping in developing countries, and an MC candidate, Julia Mahood, is a nationally recognized authority on the use of unmanned aerial vehicles in tracking drone congregation areas. In spite of its rigor and bottlenecks, the Georgia Master Beekeeper program has generated an intensely invested corps of 1068 citizen scientists drawing from 21 states and two countries.

Today the Young Harris Institute continues to serve as home to the Welsh Honey Judge and Georgia Master Beekeeper programs and an annual venue for the best beekeeping lecturers in the English speaking world. Leadership has shifted over the years with the retirement of Robert Brewer and expanding roles for Jennifer Berry and Georgia county extension director and Master Beekeeper Keith Fielder. But it has never budged from its core mission inherited from the annual Shortcourse – to match theoretical knowledge with practical training at every level of experience. The Institute provides a weekend's reprieve surrounded by natural beauty, friendly temperatures, and like-minded people bonded by their shared love of the honey bee.

We approach our 30th anniversary this May 18-21 with grateful appreciation for the legions of volunteers and instructors who have made our success possible. It's an understatement to say we are pulling out all the stops to make this year's Institute the best ever. In a nod to both the tried generations and the new, our guest lecturers this year include Michael Young (Belfast, N. Ireland), Jay Evans (USDA Beltsville), Andony Melathopoulos (Oregon State University), Brock Harpur (Purdue), and Margarita López-Uribe (Penn State). We'd like to have the chance to impress you, and hope you consider joining us for this special year.

Electromagnetic Radiation

And Honey Bee Health - Part 2

In the February edition of *Bee Culture* we looked at some of the scientific evidence of harm that radiofrequency electromagnetic radiation (RF-EMR) emitted by our modern communication devices like cell phones, WiFi, cell towers, smart meters can have on insects and honey bees. We continue this exploration this month beginning with a look at queens.

Queen Exposure

The impact of radiofrequency electromagnetic radiation (RF-EMR) on queen bees appears to be significant. The detrimental impacts include poor queen cell production, reduced successful emergence of queens, reduced weight gain, reduced egg laying and subsequently, poor brood production, decreased Winter survival and increases in queen failure and queen loss. (Greenburg et. al. 1981; Sarma and Kumar 2010; Sahib 2011; Odemer 2019) It should be noted that all these observations could be caused from reduced foraging and nutritional stress caused by the decreased cognitive function in EMR exposed worker bees noted in last month's article.

Real world multi-stress situations

It is clear that the EMR we rely on everyday has the potential to stress biological organisms but most of us and the wildlife around us are exposed to multiple simultaneous stressors daily. This led one group of researchers to look at the combined effects of both EMFs and pesticides together on honey bee colonies. Three apiaries were established: one control site removed from direct human induced stress, one pesticide stress site, and one multi-stress site which added to the same pesticide exposure the presence of EMFs from a high voltage electric line. The multi-stress site exhibited the worst health conditions which included the potential for greater susceptibility for disease, queen issues and biochemical anomalies. (Lupi et. al. 2021).

Evidence of Potential Genetic Damage

It is well established that electromagnetic radiation significantly effects living organisms. The effect is so pronounced that some predict the use of EMFs for medical treatments, referred to as electromedicine. (Becker 1990) Unfortunately, not enough health and safety research has been done on the safety of the non-ionizing radiation emitted by our communications technology. This is partly because it has always been believed that the primary danger from non-ionizing radiation is the heating of skin and that EMFs do not have enough energy to alter DNA directly. Additional research has proven this assumption to be false.

One disturbing study found that when honey bees were exposed to a Samsung F400 mobile phone with a carrier frequency range of 900-1900 MHz, the bee stomach cells became damaged after just 10 minutes of exposure, and were completely decayed after 20 minutes. (Mahmoud and Gabarty 2021) Other observations indicating electromagnetic radiation may cause genetic disorders in drone semen (Kumar et. al. 2012) has the potential to further complicate queen issues.

Evidence suggesting that EMFs can alter DNA, and damage or destroy cells, is important because historically such agents have often been shown to cause cancer and birth defects in people.

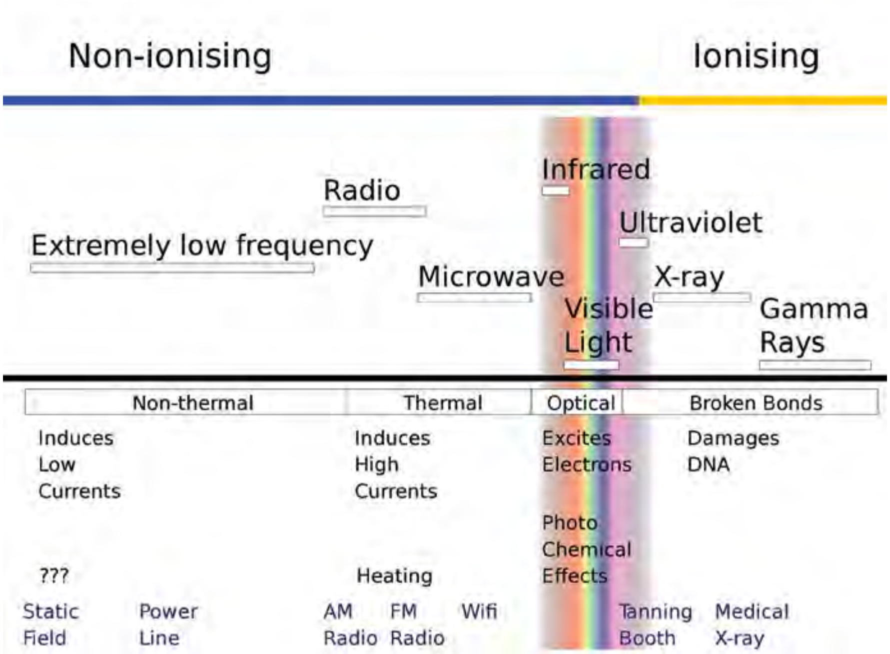
Human Exposure

Mice are often used as a proxy for humans in toxicological research and the study of EMR is no different. In one early study twelve pairs of mice were divided into two groups and repeatedly mated five times while in locations of an antenna park with different power densities ranging between 168 nW/cm2 and 1053 μW/cm2. Researchers found that over the generations there was a progressive decrease in the number of newborns which culminated in irreversible infertility. (Magras and Xenos 1997)

More recently, an American National Toxicology Program study (2016-2018) found a clear link between the near-field RF radiation from cell phones and malignant gliomas of the brain and schwannomas in the heart of rats. (Soffritti & Giuliani 2019) Additional rodent studies further support cancer findings with researchers concluding that there is clear evidence that RF radiation can cause various forms of cancer and should be classified as likely carcinogenic to humans. (Hardell & Carlberg 2019)

The initial potential for carcinogenic risk to humans from non-ionizing radiation exposure came way back in 1979 when a study showed that children exposed to extremely low-frequency electromagnetic fields were at risk of developing leukemia. (Wertheimer & Leeper 1979) Subsequent research led the International Agency for Research on Cancer (IARC) to rate 50/60 Hz EMF as a possible carcinogen and in 2001-2002 the World Health Organization (WHO) classified powerfrequency magnetic fields as possibly carcinogenic for childhood leukemia (Class 2B). By 2011 radiofrequency electromagnetic fields (RF-EMF) were classified as possibly carcinogenic for certain brain tumors (Class 2B) associated with wireless phone use. (WHO/IARC 2011). The Class 2B category includes a variety of substances including lead, car exhaust, dry cleaning chemicals, DDT, and methyl mercury.

Natural forms of electromagnetic radiation are not typically harmful at natural intensities and common exposure rates. Natural background Radio Frequency Electromagnetic



Different types of electromagnetic radiation. Source Wikipedia

fields (RF-EMF) exposure during normal cosmic activities is no more than 0.000001 µW/m2. Current health guideline recommendations for much of Europe is 9,000,000 µW/m2 at 1800 MHz, while in the USA it is 10,000,000 µW/m2. This is much, much more than the natural background exposure rate (Johansson 2019). Current safe exposure rates are based on technical arguments and modeling based calculations that are decades old and focus on a single six to 10 minute acute exposure in an environment free of any other similar radiation for the rest of your life. Real-world exposures are 24/7 with an endless variety of electromagnetic background field and signal exposures. In case you're wondering, harm from direct or indirect exposure to electromagnetic radiation from our modern-day gadgets are no-longer covered by insurance companies.

No Scientific Proof

It is not clear under what circumstances EMFs will cause damage despite the clear potential for harm. Thus, more research is warranted but, that research needs to be focused and comprehensive. As a recent review of over 450 studies concluded "We recommend that in future studies, effects of EF, MF and EMF in the IF range should be investigated more systematically, i.e., studies should consider various frequencies to identify potential frequency-dependent effects and apply different field strengths…". (Bodewein, et. al. 2019)

Industries are fond of using doubt and a lack of scientific certainty to counter concerns about health and the environment from the effects of their products and business practices. As we have reviewed in this two-part article, there is quite a bit of proof of potential harm from EMFs to bees and beekeepers. Unfortunately the large well-funded cell phone industry PR machine has successfully buried it, put pressure on journals not to publish damaging studies, and has had their disinformation specialists plant falsehoods that are often repeated by lay people and sincere, well-meaning experts and professionals which sows doubt and confusion. These are all actions we have come to expect from industries that deal with health and safety issues as a political and public relations problem and allow profits to take precedence over science.

Just as big tobacco was able to manipulate studies, capture much of the regulatory and legislative processes to prevent and slow meaningful action, and use public relations and the media to spread misinformation favorable to their bottom line, the pesticide industry, fossil fuel industry and now WiFi/Internet-reliant industries are following the same playbook. Make no mistake, there are huge financial interests working to make sure no clearly negative conclusions are made with regard to the effects of EMFs on people, bees or the environment. Not only is the wireless industry one of the largest and fastest growing industries on earth, but many of today's biggest and most profitable corporations (e.g. Microsoft, Apple, Amazon, Facebook, Google) and the governments whose economies are heavily reliant on them and the jobs they provide, are counting on society to use more wireless/internet communications technology and not less. The beekeeping industry has even jumped on board with growth in the use of wireless in-hive monitors that track everything from temperature and humidity, to weight and the sounds a colony emits.

Political leaders who rely on corporate donations, regulatory agencies, and the wireless industry will cite studies showing contradictory results and the lack of a scientific consensus as evidence that there is no scientific proof of adverse effects of electromagnetic fields on humans, animals and plants. This is despite the warning of one of the industries own scientists that "The risk of rare neuro-epithelial tumors on the outside of the brain was more than doubled…in cell phone users"; there was an apparent "correlation between brain tumors occurring on the right side of the head and the use of the phone on the right side of the head': and "the ability of radiation from a phone's antenna to cause functional genetic damage [was] definitely positive…" (Hertsgaard and Dowie 2018) Again, this situation echoes the experiences of the tobacco, fossil fuel and the pesticide industries all of which were told by their own scientists at one time or another that their products cause severe harm to environmental and human health but chose to cover up and ignore it.

Part of the trouble with trying to get a handle on the EMR issues is that it is not clear at what frequency and intensity EMR will cause harm in a given situation. Poor study designs, low sample sizes, and numerous undocumented variables such as the number of frequencies subjects are exposed to during trials and their intensity; make it easy for policy makers and regulators to dismiss concerns.

Given what we already know about the potential dangers of the other G's like 2G, 3G, and 4G as well as similar exposures from radio and television towers, smart household devices and power lines, to not proceed with caution before immersing ourselves and the rest of nature in more and more artificial electrical fields such as 5G is irresponsible.

Cautionary approaches

Honey bee scientists are increasingly relying on radio-frequency identification (RFID) tags to track the movement of individual honey bees during studies. They have to be careful however as some researchers have found that honey bee mortality increases when exposed to RFID radiations. It is recommend that bees not be exposed to the EMR from an RFID tag for more than about two hours. (Darney et. al. 2016)

Meanwhile, what can beekeepers do to protect our bees from RF-EMR exposure? While the ubiquitous nature of cell phone transmission towers makes them hard to avoid, beekeepers can at least keep their bee yards away from high voltage power lines.

It would be prudent for us beekeepers to also take precautions to also protect ourselves where possible by limiting cell phone usage and keeping phones as far away from our bodies as reasonably possible. When making or taking a call, make it a habit to hold the phone away from your head and use the speaker phone, or use non-electric headphones or earbuds that plug into the phone (bluetooth systems give off their own EMR). Folks who use their phone as an alarm clock should consider using the airport mode setting to prevent prolonged exposure while they sleep.

An alternative to WiFi is fiber optic cable. A home wired with fiber has faster, more reliable internet with less of an environmental footprint, while eliminating the high frequency radiation exposure associated with cell phone hotspots and WiFi computer access. Just plug your phone in to your home's fiber network to access information and make calls through the internet. Also consider limiting your purchases of "smart" devices, or at least reduce their use as much as possible. Finally, be wary of WiFi and EMF shielding products that claim to protect you from radiation. I have tested some with my TriField meter and they do not always work.

Given what we know about EMR, caution should be taken when transporting bees. While the EMFs given off by this electric car stayed mostly in the low zone, the needle on the TriField meter would ccasionally peg all the way over to the right suggesting that transporting bees over long distances in an electric vehicle may be problematic.

Ross Conrad is the author of Natural Beekeeping: Organic Approaches to Modern Apicuture, 2nd Edition and co-author of The Land of Milk and Honey: A history of beekeeping in Vermont. Ross will be teaching an organic beekeeping for beginners class on Saturday and Sunday May 7-8th in Lincoln, Vermont and an advanced beekeeping class on Saturday May 21st in Middlebury, Vermont. For more information email **dancingbhoney@gmail.com** *or call 802-349-4279.*

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BEE VET

Immunity, Vaccines & Honey Bees: Part 1

Dr. Tracy **Farone**

As a veterinarian, I have administered thousands of various vaccines to a variety of animals over the years. As in humans, these vaccines are typically developed over decades of research and trials and are administered according to the individual's risk, including age, immunological status, potential exposure risk, economic feasibility, and geography. As a veterinarian, I have been vaccinated for a few more things than the average person due to my occupational risk. Rabies, for example. Yes, there is a human vaccine. Most veterinarians are vaccinated for Rabies because in our profession, we are likely to be exposed directly to this disease, a disease with nearly a 100% mortality rate. A nearly 100% mortality rate? Wow, why isn't everyone vaccinated?

The answer is three-fold:

1. Because we vaccinate our canines for Rabies. By controlling this zoonotic disease in the domestic dog population (which is the most common exposure risk for humans worldwide), we greatly eliminate exposure risk in humans. Unfortunately, in developing countries with little or no canine vaccine programs, about 60,000 people world-wide die each year of Rabies.
2. Because we have very effective therapeutics that can prevent the disease after exposure, if applied early. Due to the longstanding, successful public education on Rabies, most folks know that if you are bitten by an animal, it should be examined for Rabies, and you should see your doctor asap. Even if you are bitten by an animal that is positive for Rabies, we have a combination of therapeutic vaccines and immunoglobulins (antibodies) that will prevent the virus from taking hold.
3. Because of #1 and # 2, the actual risk vs. benefit does not support the use of the vaccine in the general human population. Possible side effects of the vaccine outweigh the actual risk. On average, in the US, only zero to three people die of Rabies annually, usually due to bat exposures. You are at least nine times more likely to be killed by lightning (source **weather.gov**).

Vaccines can be a wonderful tool in the control of infectious diseases, when applied appropriately.

Types of Immunity

To understand how vaccines work, it is important to understand how our immune systems work. I'll do my best to give you a brief synopsis.

There are three arms of defense in our immune systems, innate immunity, humoral immunity, and cellular immunity. Innate immunity is our first line of defense against any pathogen. Innate immunity includes the natural barriers of our body like our skin (or exoskeleton if you are a honey bee), respiratory and gut linings, natural microbiota, as well as non-specific reactions to any foreign invader, including certain inflammatory pathways, fever, enzyme activity, and our white blood cells recognizing and eating up non-specific, irregular stuff.

Humoral immunity largely involves antibody production that can help the body identify and eliminate pathogens from the body. Cellular immunity largely involves special blood cells called T-cells that recognized infected cells and can target the cells and/or pathogens within them. Both humoral and cellular immune systems have the ability to "remember" previously encountered pathogens and are therefore much more effective in eliminating the specific pathogen in any future encounters. "Immunity" has been achieved!

How we obtain immunity can also vary. We classify immunity obtainments as natural or acquired. Natural immunity can be passive or active. Passive, natural immunity comes from our mommas, usually passed through the placenta or milk. Passive natural immunity helps to protect fragile newborns from the rough and tough world, but it may not last very long. Conversely, active, natural immunity, we earn all on our own. We "naturally get" the disease. When infected with a pathogen we may or may not become ill and assuming we survive, our bodies typically develop immunity. Active, natural immunity usually provides a robust and often long-lasting immune response, but in some cases, there is a pesky risk of death, particularly with immune-compromised patients and/or diseases with high mortality rates.

Acquired means something outside of yourself has been given to you to help develop immunity. Acquired immunity can also be passive or active. Acquired, passive immunity occurs typically when a patient is given pre-formed antibodies as a therapeutic to help fight off a disease. Acquired, active immunity occurs when a patient is given a vaccine and develops immunity to the particular pathogen.

How Vaccines Work & Types of Vaccines

Vaccines are typically administered using oral, injectable, or nasal routes. Most vaccines have been developed for viral diseases, but we also can develop vaccines for some bacterial and parasitic infections. Vaccines can be used as a tool to accomplish three things:

1. Eradication of a disease. This means there is no active disease left in the population on Earth! This is an extremely rare accomplishment, which has only occurred twice in the history of man or beast out of the thousands of known diseases that inflict us. Most people would guess and guess correctly that small pox is one of them. But the second one is a bit tougher.... It's Rinderpest...tricky, huh? Rinderpest is/was a cattle disease that was absolutely devastating to the cattle population particularly in Africa and therefore devastating to the human food supply and econ-

omy. What's next? Well… we're still working on Polio and maybe the Guinea Worm.

2. Elimination of a disease. Elimination means a previously existing disease is no longer present in a population in a certain geographical area, but it's still present in other parts of the World. Examples of diseases eliminated from the United States include Yellow Fever, Polio, and Malaria. This does not mean that the disease cannot re-emerge in the area if precautionary measures are ignored.
3. Control of the disease. Control of a disease means that the disease is still present in a population, but it is reduced and manageable within the health care system, has a relatively low mortality rate, and/or has become endemic. This is the typical expectation and usually what happens with most diseases and vaccine use.

Vaccine forms have varied and evolved over the years. "Live" vaccines are typically "attenuated", which means the vaccine contains a weakened form of the actual pathogen. Attenuated live vaccines have many advantages in that they provide a robust immune response of both humoral and cellular immunity, but since the vaccine is still a form of the pathogen, there is a low risk of the disease developing and live vaccines are not recommended to be given to immunocompromised patients. Examples of live attenuated vaccines include flu vaccines, MMR, polio, smallpox, and Chicken pox/ Shingles.

Some vaccines are in the "killed" or "inactivated" form. These vaccines may induce a less robust immune response but are safer since the pathogen is killed and there is no risk of disease development. Killed vaccines are recommended in immunocompromised patients and with pathogens that are extremely virulent. For example, Rabies is a killed vaccine, as is the vaccine in development for American Foulbrood (AFB). For good reason!

Even with rigorous trials, vaccines are not always perfect. All vaccines can have side effects. Sometimes they are taken off the market for one reason or another, including safety concerns, lack of efficacy, and economics, or better, safer vaccines are developed to replace them. The risk vs. benefit of a vaccine must be weighed with a consult from a patient's doctor.

Next month I will discuss how our knowledge of immunity and vaccination can be applied to control honey bee diseases along with an interview from Dr. Annette Kleiser, PhD, CEO, and founder of DALAN Animal Health, who is a key researcher in the development of honey bee vaccines. BC


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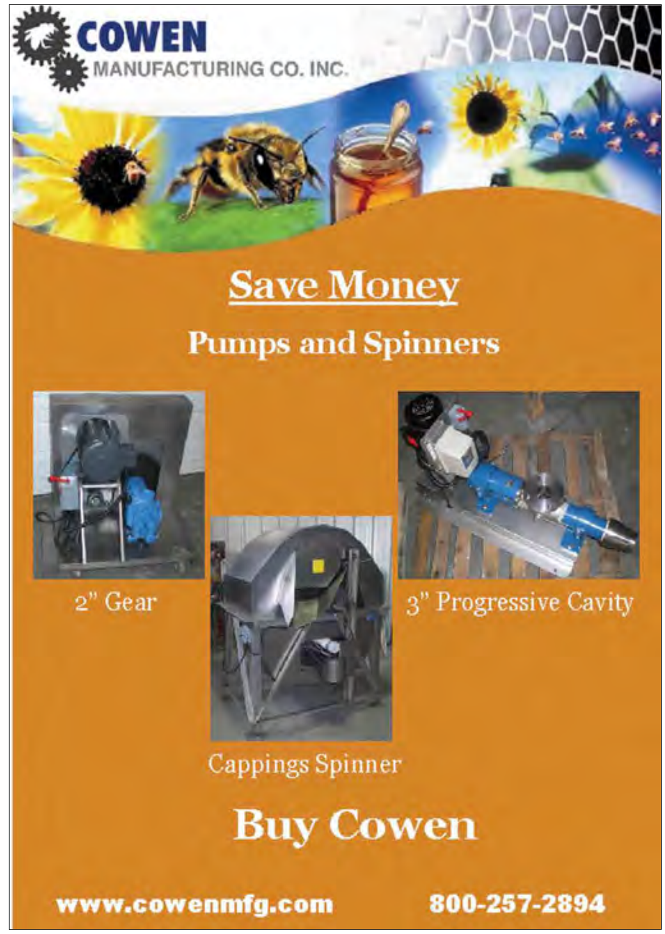
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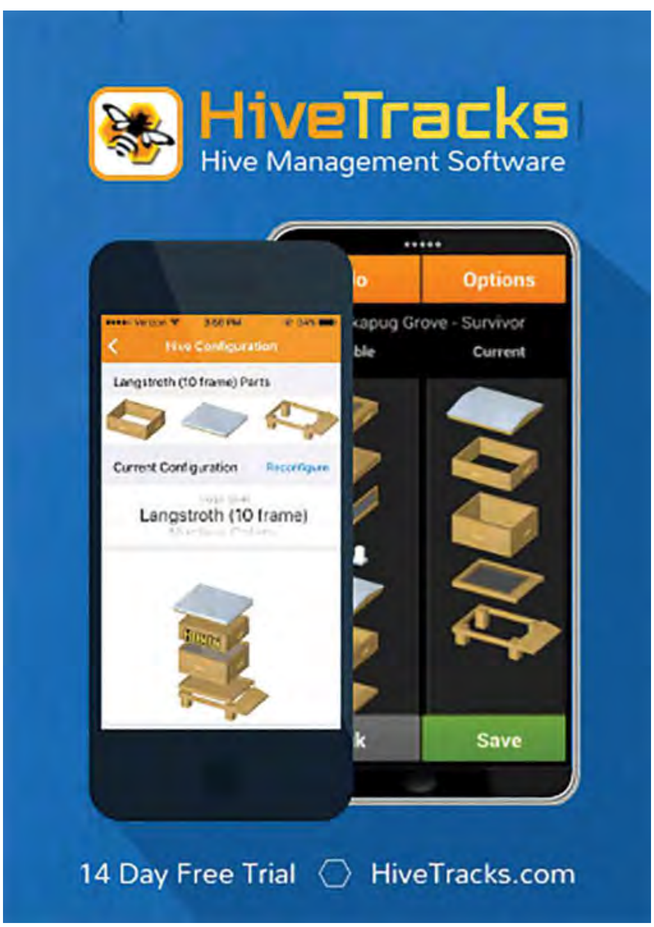
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Minding Your Bees And Cues

Exploring our Clover Fixation

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

We're obsessed with clover. Because clover fixes a lot of things, including nitrogen. And before we go a second further, let's address the element in the room: what is nitrogen, why is everyone always talking about it, and why does it need to be fixed?

Nitrogen is a super abundant gas. (Sorry, we lack advanced degrees in chemistry so are going to leave it at that, after which things get metaphysical). But we can say for sure that nitrogen is everywhere. More specifically, it makes up about 78% of the earth's atmosphere. For plants, nitrogen is totally essential. It's key for plants to make proteins! It's key for plants to make chlorophyll which they need for their life-affirming hobby, photosynthesis!

Sadly, plants can't just grab nitrogen out of thin air. To make a very complex process (that you should google) simple, ambient nitrogen needs to be "fixed" into chemical forms that are useful to plants. Farmers may add fertilizers, composts or manures to their soils to get nitrogen into the soil in a way that's palatable to plants.

But pulses and beans and rhizomatic roots! The legumes we fondly call La Familia de Frijoles have the ability to fix nitrogen in soils (though actually it's certain bacteria with which legumes have a symbiotic relationship that do the fixing. Big shout out to biology for making everything complicated).

So, nitrogen fixation is super important for all plants and the farmers that grow them. And for growers, planting pulses as cover crops or between rows provides a few other fixes: legumes can help retain moisture in the soil, reduce runoff and erosion, compete with weeds, and provide nutrition for grazing animals should there be any. And now for the biggest fix of all: dinner for bees. In fact, the word "clover" is probably connected to the Germanic word "klaiwaz," meaning "sticky sap," an ode to the abundant honey made from clover's sweet blossoms.

There are many plants that share the common name of clover and they all belong to the taxonomic Family Fabaceae (everything from those lucky four-leafers you looked for at recess having not been picked for any kickball teams, to those green split peas the soup of which had to eat before you left the dinner table). True clovers are in the genus *Trifolium*, which includes species native and non-native to North America (Taylor 1990). Some of the native clovers, (*T. trichocalyx and T. anoemum*) are listed on the Federal Endangered Species List as their associated indigenous landscapes are disappearing (**https://ecos.fws.gov/ecp/report/species-listings-by-tax-group?statusCategory=Listed&groupName=All%20Plants**).

Honey bee foraging for pollen at a red clover (Trifolium pratense).
Photo credit: Judy Griesedieck Photography

As you would expect, the clover plants from which honey bees gather the most nectar and pollen fall into the non-native *Trifolium* clovers (shoutout to roving humans for making everything complicated!). The true clovers on every honey bees' Top five include Dutch white clover (*T. repens*), Alsike clover (*T. hybridum*), crimson clover (*T. incarnatum*), and red clover (*T. pratense*). These clovers are used as cover crops for soil health, and bees appreciate it. Also beloved is Kura clover (*T. ambiguum*), a rhizome rooted plant that is used as an agricultural living mulch, forage, hay and nectar source with some plots surviving over 20 years.

Another genus in the Fabaceae Family that we call clover is *Melilotus* (you can practically hear the honey dripping off the name), home to the yellow (*M. officinalis*) and white (*M. alba*) sweet clovers both of which have been identified as potential threats to native plant communities (Van Riper *et al.* 2009). Conservationists are rightly concerned that these tall (reaching five feet), sweet clovers block sun from shorter native plants and increase soil nitrogen to unfavorable levels for natives. Planting sweet clover specifically for our bees is a great idea if we have the land and a management plan, but sincere care must be taken to keep sweet clovers well away from conservation efforts, and to manage their spread.

What can we say? One gal's weed is another gal's best honey crop. A University of Maryland study asking about the value of native and non-na-

A new plot of yellow sweet clover, Melilotus officinalis. *While bees find this flower as an excellent source of nectar, it is also of great concern to many who worry about its invasive tendencies. Ask your local experts if this plant is right for your plot.*
Photo credit: Keith Johnson

tive plants in pollinator plots with seed mixes included sweet clover and three *Trifolium* species in their seed mixes and demonstrated that clover plants were visited frequently by a diverse group of bees during their expansive flowering seasons. Despite the value of the non-native plants for bees, the authors warn of the potential for these plants to disrupt native bee and plant communities (Seitz *et al.* 2020).

While clovers can seem like a triple win benefiting everyone from soil microbes to bees to bovines, it's... complicated... to get it right. "Bloom and let bloom" may be our collective motto, but clover planted under or near crops that get sprayed (like vineyards or fruit trees) is best mown *before* the spray, even if blooming, so bees aren't tempted to forage there (McDougall *et al.* 2021). As beekeepers, it's essential to talk to the mowers that be about letting their intentional and unintentional clovers bloom, knowing that livestock or crop considerations may get priority.

We are totally fixated on clover, and not least because it tends to do well in many contexts and does not require much talent to grow. We also love the intoxicating scent of it, the giddiness of knowing our bees are feasting, filling up supers. So definitely plant some clover this spring, but pledge to manage it well. Here's to a year of tall hives and big, big jars of honey.

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Links with more information about clover:

https://www.backyardecology.net/clovers-native-clover-conservation-clover-yards-and-more/

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_043029.pdf

https://www.dnr.state.mn.us/invasives/terrestrialplants/herbaceous/whitesweetclover.html

https://extension.sdstate.edu/yellow-sweet-clover-information-and-management

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_043029.pdf

https://fyi.extension.wisc.edu/forage/experiences-with-kura-clover-in-agricultural-systems-in-wisconsin/

https://hort.purdue.edu/newcrop/CropFactSheets/KuraClover.html

Links with more information about cover crops:

https://mccc.msu.edu/wp-content/uploads/2020/07/Cover_Cropping_for_Pollinators_and_Beneficial_Insects-2.pdf

https://mccc.msu.edu/what-are-cover-crops/

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Authors

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 clover success stories or other thoughts, please send an email to **mindingyourbeesandcues@gmail.com**


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Maine Newsletter

Jerry **Hayes**

Small Hive Beetles (SHB)

More info than you really need.

One of the challenges in being a beekeeper with decades of KSA's, Knowledge, Skills and Abilities (or simply Old) is that we have lots of confirmed data and lots of real-life experiences. Here is some information that hopefully makes sense in your contemporary journey with SHB.

Insecta: Coleoptera (beetle) Family: Nitidulidae (sap) *Aethina tumida* i.e., the Small Hive Beetle. The SHB is a native of Sub-Saharan Africa. The Nitidulids (or sap beetles), such as the familiar picnic beetle feed on plant fluids/saps, fermenting fruits, fungi etc., but SHB also need high protein diets when they are trying to reproduce. They scavenge on feral African Bee colonies, which are a tropical/sub-tropical insect that doesn't have to stay in one location, always preparing for the next winter, unlike our European Honey Bees have had to do for the last 400 years-to genetically adapt to living through long, cold, hard Northern European Winters. African honey bees can 'abscond' i.e. the whole colony leaves a hive location to escape predators and pathogens in the comb, or look for more flower resources. Absconding is not 'reproductive' swarming where part of the colony leaves to spread its genetics around in a new area and the other part of the colony stays behind in the original hive location. African Honey Bees can abscond dozens of times per year because survival is not totally dependent on honey stores.

SHB have made some amazing adaptations to take advantage of feral honey bee colonies in Africa that have of course, been transferred to the U.S. While African honey bees abscond due to constant predation from humans, honey badgers or other pests, SHB can continue to reproduce for a while, on the abandoned comb. SHBs can also force the issue, because they can produce a similar queen-like pheromone that can cause the Queen to slow egg production. As the colony population drops to the point that the bees can no longer protect their colony, the SHB move in and become active predators resulting in the African Bee colony absconding.

The first reported sighting of SHB in North America happened in 1996 when a beekeeper in South Carolina noticed several small black beetles in a colony established from a recent swarm. The beekeeper collected samples of these beetles he had never seen before and sent them to Clemson Univ. for ID. An insect taxonomist tried to ID them but did not have enough of the 'keys' needed to identify the genus or species. In 1998 an apiary in Florida was destroyed by beetles that were properly ID'd as SHBs. The adult SHBs collected two years earlier in South Carolina were then ID'd as *Aethina tumida*, SHB.

How SHBs were introduced into the U.S. is still unknown but global travel and trade has resulted in items being moved around and shared regularly.

Having been the Chief of the Apiary Section for the Florida Dept. of Agriculture and Consumer Services in the ealy 2000's I heard lots of early SHB stories from my predecessor, Mr. Laurence Cutts. Mr. Cutts told me that since SHBs were native to Africa, he invited a group of South African Commercial Beekeepers to come to Florida see what challenges Florida beekeepers were having and ask for their advice. A small group came and toured the State looking at management techniques, SHB impact and assessing the situation. After touring and talking to beekeepers for about a week, Mr Cutts asked the South African Beekeepers for comments and recommendations. Remember that the South African beekeepers had been managing SHB issues for decades and had a plan. When asked, the South African beekeeper entourage said, "you Florida beekeepers are the sloppiest, nastiest beekeepers we have ever seen!" The South African beekeepers would collect honey supers and extract within 48 hours and then put the supers back on the colonies for cleanup. Florida commer-

Small hive beetle larvae

cial beekeepers would collect supers, stack them in their warehouse next to the extracting room and extract as soon as they could, days or weeks later. This is a great opportunity for SHBs to start feeding without interruption by the colony. Some of the commercial warehouses had two to three inches of SHB larvae as well as the 'slime' associated by the beetles, produced by the yeast *Kodamaea ohmeri* on the floor. The employees were walking through this mess! South African beekeepers were not impressed.

SHB are looking for a safe, warm place that has lots of positive resources to reproduce like other organisms. Their Nitidulidae cousins must find some rotting fruit, sugary sap, or fermenting melons and maybe some pollen for protein so they can reproduce and lay healthy eggs. SHBs adapted so that they can obtain all their nutrients from honey bee colonies - honey for concentrated energy, pollen for protein, a dark, warm site for SHB larvae to develop, soft squishy honey bee eggs and larvae, plus royal jelly, making the bees' home a buffet smorgasbord of resources. So, SHBs adapted, and with their roundish, smooth, tank-like bodies that are hard for bees to grab and manipulate, developed a relationship with honey bee colonies first from Africa to now on several continents. This survival adaptive lifestyle became successful.

This is what we have learned approaching 30 years with this new honey bee colony predator.

SHBs are adapted to seek out honey bee colonies that are declining in health, vigor, and population. If a honey bee colony is weakening because of poor beekeeper monitoring and safe, efficacious control of our biggest honey bee health concern-*Varroa destructor* and the *Varroa*/Virus Legacy, the colony is a prime location for SHBs to reproduce. When a honey bee colony is sick for any of a variety of reasons, it is stressed and produces stress pheromone odors. SHBs have sensitive club-like antenna that can pick up those stress pheromones several miles away and follow them to the apiary or directly to the colony. They, meaning sometimes hundreds of SHB who independently picked up the weakening colony(ies) stress odor, will select a colony to wait in until the colony(ies) have weakened even more, then immediately begin laying eggs. Some may have already entered the weakening colony(ies), and other than the bees harassing them, are not in any danger. If they have been in the colony for several days, they also can pick up colony odors and have bees in the colony think they are one of them and feed them via trophallaxis. Sometimes if the colony is still strong enough, it can herd some SHBs and corral them in an area with a propolis wall around it. But this is only temporary.

When the SHB females begin to lay eggs, they can deposit hundreds in and around capped brood or beebread. Depending on hive temperature and humidity, an egg hatches after one to four to five days. When it hatches, the SHB larvae look different than the plump, fleshy Wax Moth larvae that you may have seen. SHB larvae are thinner with a tough cuticle and have three pairs of short strong legs at the front of the body. Wax moth larvae have the three pairs of true legs at the front of their body and four pairs of fleshy legs toward the back of their body called prolegs.

The SHB larvae are devious at seeking and finding food in the colony. This food is brood, which is high in nutrition, beebread, and honey. The SHB larvae obtain nutrition with the help of the yeast *Kodamaea ohmeri* which has a symbiotic relationship with the adult SHB- they work together. When *Kodamaea* is introduced to a colony, it starts feeding on honey and other resources and produces a thick slimy goo that helps it spread and pre-digest food for itself as well as a deterrent to honey bees trying to live in the colony. *Kodamaea* also produces an odor that attracts SHB outside of the colony as well. This is where our European genetically based honey bees are at a loss. African bees in this situation would have left that location long ago but, our European bees will hunker down and die in place or rarely leave as the SHB and slime displace them, driving them out of the hive. In seven to 10 days, the SHB larvae mature, then crawl out of the colony and drop to the ground. If the ground below the hive is moist enough, they may burrow down several inches to several feet to pupate into an adult SHB that emerges, and the life cycle begins again. If the soil is dry and not conducive to burrowing into the soil, the SHB larvae will crawl hundreds of yards to find a location along a tree line or field setting that is more favorable.

If your colony has become a SHB nursery and it is slimed and larvae are emerging, it may be too late to save it. You didn't manage, inspect regularly, sample and treat for *Varroa* and waited too long to correct the problem. That colony is now repellent to honey bees and basically unusable to them....and you.

In the Southern U.S., SHB adults can overwinter in the environment or inside a hive that is weakening. Here in the north, they overwinter inside the colony, specifically inside the cluster here it is warm and safe. Remember they can 'trick' the colony that they are one of them. And then in the spring they can assess whether that colony or others in the area are potential reproductive possibilities.

A variety of traps and chemical control measures are available to manage SHB. Having less SHBs in your colony is better than more. But.... if your colony is attracting SHBs what does that tell you about the colony health and your management of it?

Slimed

Pollen Digestion

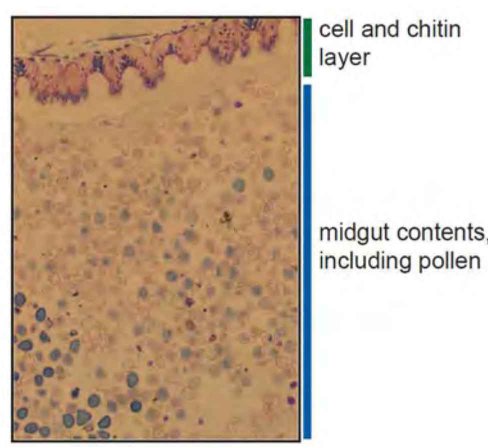
Figure 1
(A) *Forager working white clover* (Trifolium repens).
(B) *Forgaers on an anatomic front-mount pollen trap with visible pollen loads.*
(C) *Pollen pellets collected from the corbiculae of foragers returning to the colony.*

How do honey bees digest pollen?

Pollen supplies critical nutrients to many animals, including honey bees (Wright et al. 2018) and other bee species (Leach and Drummond 2018). *Pollen* is rich in protein, free amino acids, lipids, vitamins, and inorganic elements, all of which are found at much lower levels in honey bees' other food source floral nectar (Brodschneider and Crailsheim 2010; Nicolson 2011). Pollen *grains contain only a few cells* which are protected by an inner layer (intine) and a very tough outer layer (exine). These grains are dehydrated, made metabolically inactive for dispersal, and are known for their near indestructibility (Borg and Twell 2013). So how pollen-eating, or palynivorous, animals digest pollen has been a long-standing mystery. Before we get into pollen digestion, let's review pollen biology. Bees pollinating flowers transfer pollen from one flower to another (Figure 1). In order to fertilize new flowers, pollen grains produced by the anther / stamen of a male flower must first interact with a compatible stigma on a female flower. Then, the pollen grain initiates a process called germination resulting in the formation of a structure known as the pollen tube, which grows down the length of the style, descending from the stigma on a female flower. Upon reaching the ovule, the site of egg production in a female flower, the pollen tube ruptures, allowing for the joining of the male and female gametes, which completes the process of fertilization and therefore pollination (Borg and Twell 2013).

Currently, pollen digestion is thought to involve one or several of the following mechanisms: induction of partial germination (pseudogermination), mechanical disruption of the pollen wall, enzymatic breakdown, and osmotic shock (Roulston and Cane 2000). In bees, including honey bees, pseudogermination and osmotic shock are the most likely routes for pollen digestion (reviewed in (Peng and Dobson 1997; McKinstry et al. 2020)). Osmotic shock occurs when the changes in osmotic pressures in different regions of the digestive tract cause the pollen grain to burst as it travels. Most studies looking at bee digestive tracts suggest that pollen contents are slowly released as the grains travel. So, while osmotic pressure changes may influence release, the gradual leakage of pollen contents argues against a dramatic rupture. For example, Peng and colleagues (1986) found that there was not an immediate rupture of alfalfa pollen after transition from the crop (also known as the foregut and similar to a stomach) to the midgut even though that transition involves a significant change in the osmotic environment. They instead observed slow changes in the pollen grains including a slow swelling around the germination pores where the pollen tube would emerge, followed by the release of internal material (Peng et al. 1986) (for a picture of pollen grains in a honey bee digestive tract see Figure 2). The authors suggested that these changes were much more consistent with a pseudogermination mode of digestion, which occurs when pollen grains initiate but do not complete a germination sequence. They proposed pseudogermination as opposed to full germination because it's been known since the mid-1900s that honey bee-collected pollen *has reduced capacity to pollinate female flowers, in part due to loss of germination potential. One of the earliest reports on this topic showed a loss of this potential after only a few hours* (Singh and Boynton 1949). This has interesting implications for bee-mediated pollination, because it suggests that bee-collected pollen may be good for pollination when they are out in the field, but that bees may alter the pollen in a way that reduces its

Figure 2
Hematoxilin and Eosin stained sections of honey bee midgut tissue reveal pollen in various stages of digestion inside the lumen. The cell and chitin layer lining the digestive tract is at the top.



pollination efficiency perhaps while increasing its ability to be stored. For pseudogermination to be a possible digestion mechanism, pollen grains must retain the capacity to at least initiate the germination process. The Singh and Boynton study (and others like it) have demonstrated loss of germination potential by measuring pollen tube formation or fertilization potential, both of which are late events in the germination process. *During germination, a number of early biochemical events occur in pollen grains before the dramatic morphological changes are observed, such as pollen tube formation. A pseudogermination mechanism of digestion would require that some aspects of germination, such as metabolic activity, remain intact despite the loss of the ability to complete the process. However, these events have been hard to measure leading to a gap in the evidence supporting pseudogermination as a mechanism for pollen digestion.*

New methods provide evidence that honey bee-collected pollen still retains the ability to 'activate' even if it can't fully germinate

Luckily, a number of recent advances in our understanding of the cellular and molecular steps involved early in the process of germination may provide new ways to demonstrate the ability of honey bee-collected pollen to partially germinate. *For example, pollen germination has been shown to result in the production of an early* 'wave' of Reactive Oxygen Species (ROS), which is a common biproduct of metabolic activity that is also important for pollen function (reviewed in (McInnis et al. 2006)). In a recent study from my lab, we proposed that a burst of *ROS* in honey bee-collected pollen could provide additional evidence of retained metabolic activity and a potential pseudogermination mechanism operating during honey bee pollen digestion. *We used a number of microscopy techniques and biochemical assays to show that pollen loads gathered by honey bee foragers could produce ROS* (McKinstry et al. 2020). *We first collected pollen pellets from the pollen*

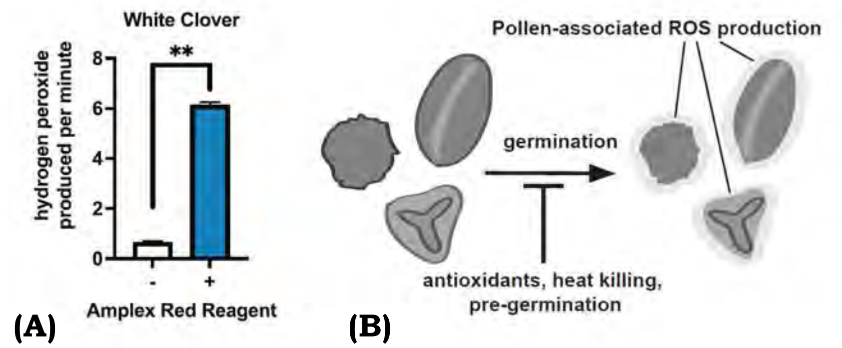


Figure 3
(A) *Results of Amplex Red Assay showing amount of hydrogen peroxide produced by white clover pollen after rehydration. Data shows µM H_2O_2 produced per minute represented as mean ± Standard Error of the mean **p<0.01*
(B) *Schematic showing how ROS produced upon germination can be inhibited by a number of conditions (further details in (McKinstry et al. 2020)).*

baskets (corbiculae) of the back legs of foragers returning to the colony or from a pollen trap (Figure 1). We then rehydrated them to allow germination and found robust ROS signals in pollen pellets using two biochemical assays that detect two different forms of ROS, either hydrogen peroxide (H_2O_2) or *superoxide anion. In Figure 3, we show results from the assay* detecting hydrogen peroxide from a pollen load that we then used DNA sequencing to identify as being from flowers of white clover (*Trifolium repens*). *In the case of the hydrogen peroxide assay, we further showed that the signal could be eliminated through various treatments. For example, treating the pollen with heat reduced the amount of ROS produced, demonstrating that the signal is dependent on active enzymes in living pollen. Other experimental manipulations are described in detail in McKinstry et al. (2020). Using a fluorescent dye that allows visualization of various types of ROS, we also showed that the signal was localized to pollen grains. These assays demonstrate that pollen collected from honey bee corbiculae possesses the ability to produce ROS upon rehydration.*

It was important to show that pollen grains could produce ROS inside the honey bee digestive tract where the pseudogermination must occur to be involved in digestion. We collected foragers from the colony, dissected their digestive tracts, and removed the food bolus, a chitin-coated sac containing consumed pollen. Using these food boli and the biochemical method that detects hydrogen peroxide, we found a robust signal of ROS in the digestive tract of individual bees. *Then, using the dye that allows visualization of ROS, we again observed that the signal was often present in structures that appeared to be pollen grains (Figure 4, page 71).* Finally, we fed bees that had been deprived of pollen for 24 hours either sucrose syrup alone or sucrose syrup supplemented with fresh pollen for one hour. We observed increased ROS levels (and increased pollen counts) in bees fed sucrose syrup with pollen compared to those receiving sucrose syrup alone for the same time period. *These results supported the idea that pollen could also produce ROS in the digestive tract of bees during the digestion process.*

Conclusions and future directions

Most studies of germination potential post-collection have focused on pollen tube formation or fertilization potential (Roulston and Cane 2000). As these are late events in the germination process, we sought to focus on metabolic activity associated with early germination processes to provide support for a pseudogermination method of pollen digestion in honey bees. Our results are consistent with earlier studies that found that bee-collected pollen showed a significant increase in oxygen uptake upon rehydration (Keularts and Lin-

Jonathan W **Snow**

in Honey Bees

skens 1968; Verhoef and Hoekstra 2012), supporting retained metabolic activity despite absence of pollen tube formation. There are a number of important questions left unanswered by our study. We observed highly variable levels of ROS production by pollen from different plant species and even differences in the levels of ROS in pollen from the same species. Understanding how experimental limitations and differences in the biology of different plant species might contribute to this variability will be important to disentangle. Also, the pollen-derived ROS we observed could have effects on the biology of the digestive tract in the honey bee by impacting the health of the midgut itself or the microbiome contained within it.

Despite these remaining questions, the evidence of retained metabolic activity in our study provides additional support for a mechanism of pollen digestion that includes pseudogermination in honey bees, and points to novel approaches for better understanding of pollen digestion in this species and other palynivorous insects. Further research will still be needed to determine whether pseudogermination is required for pollen digestion and whether osmotic shock plays a role in the process, with important consequences for understanding honey bee nutrition. BC

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

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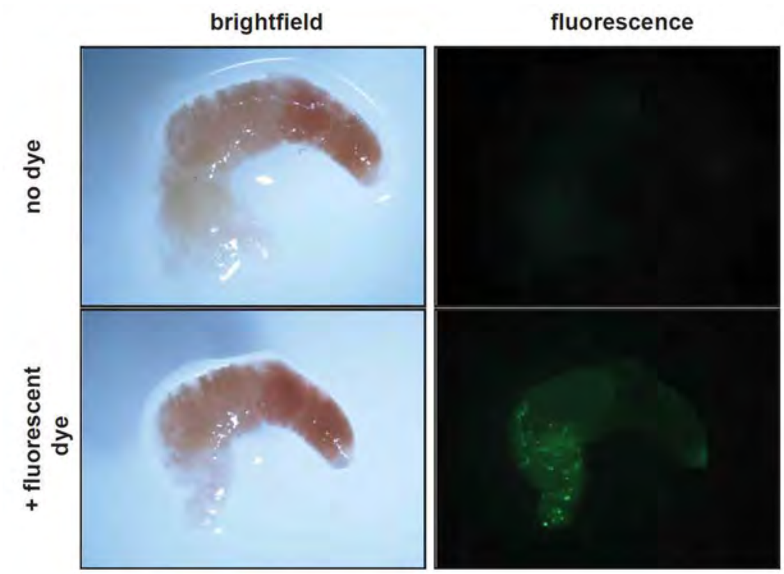

Figure 4
Food bolus dissected from honey bee forager and assayed for ROS presence using fluorescent dye (CM-H_2DCF). Left panels are brightfield images, right panels are fluorescent images for the same bolus with and without dye. Green fluorescence indicating ROS presence is associated with pollen grains.

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A Practical Bioassay to Assess Varroa destructor Resistance to Acaricides in Ontario

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The control of *Varroa destructor* populations in honey bee colonies is one of the biggest challenges that beekeepers face in Ontario. Beekeepers rely on constant monitoring, the use of cultural or mechanical methods (e.g. removal of drone comb), the use of organic treatments (e.g. formic acid, oxalic acid and thymol), and the use of synthetic acaricides (i.e. tau-fluvalinate/Apistan™, flumethrin/ Bayvarol™, and amitraz/ Apivar™) to control *V. destructor* parasitism (OMAFRA, 2021). The commercial presentation of synthetic acaricides consists of plastic strips impregnated with the chemicals; the strips are placed inside the brood chamber for six to eight weeks for the phoretic mites, which are attached to worker bees, to come in contact with the chemical (Véto-pharma, 2014; Vita beehealth, 2021). Synthetic acaricides have been used for three decades in North America to control *V. destructor* (Kamler et al., 2016), time during which cases of mite populations resistant to acaricides have been documented (Elzen et al., 1999; Elzen et al., 2000; Rinkevich, 2020).

Resistance to acaricides in *V. destructor* populations is first noticed by the repeated failure of a product to reach the expected level of control (Coles and Dryden, 2014; Dang et al., 2017). The development of acaricide resistance by *V. destructor* is a major concern for beekeepers, as high levels of *V. destructor* in the Fall (i.e. >3%) can translate into high overwinter colony mortality (Guzman-Novoa et al., 2010; OMAFRA, 2021). Thus, a constant surveillance of acaricide resistance is essential to establish informed strategies to control *V. destructor*, including the correct rotation of different active ingredients synthetic acaricides to treat honey bee colonies, as well as the use of additional methods of mite control (i.e cultural control). Methods to determine acaricide resistance have been developed (Pettis et al., 1998; Rinkevich, 2020; Bahreini et al., 2021). However, even when the tests are designed to detect resistance, they cannot measure the exact level of resistance and also presents logistical challenges like the use of highly parasitized colonies as well time consuming methods often carried out without complete chain of custody. Thus, we conducted preliminary trials to evaluate the use of a glass vial residual bioassay to determine the efficacy of three synthetic acaricides (tau-fluvalinate, flumethrin, and amitraz). The bioassay is aimed at reducing logistical challenges and to have more accurate estimations of resistance levels by determining the lethal concentrations (LCs) and discriminating concentrations (DCs) of acaricides (Elzen et al., 1999; Elzen et al., 2000; Maggi et al., 2008).

Here is what we did:

1. Mites were collected from three highly parasitized experimental colonies kept at the Honey Bee Reserch Centre, University of Guelph.

2. Dilutions of three chemical grade synthetic acaricides were prepared.

3. The walls of glass vials were impregnated with 200 µl containing 0 (control), 0.3, 0.5, 1 and 5 µg of tau-fluvalinate, or flumethrin, or amitraz.
4. Once the walls of the glass vials were dried, seven to nine mites were introduced into each vial and left there for four hours. Three repetitions were conducted (with an additional control with no solvent). A total of 54 vials and 443 mites were used for the study.

5. After four hours of exposure, the number of dead and live mites were recorded.
6. The proportion of dead mites in each treatment was used to analyze and determine a)differences between treatments on their efficacy to kill mites, and b)the concentration at

which 50%, 90% and 95% of the mites are killed (LC_{50}, LC_{90}, and LC_{95}).

Testing for synthetic acaricide resistance in mite populations in Ontario is necessary for beekeepers to make informed decisions when designing their Integrated Pest Management strategies in order to achieve adequate control of *varroa* levels and the survival of their colonies. Based on the results from this study, we will be able to make recommendations on the protocol to test for acaricide resistance under laboratory conditions, by determining discriminating concentrations for each chemical. Also, we will recommend a protocol for conducting trials in collaboration with beekeepers to facilitate mites for testing.

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Off the Wahl Beekeeping

ADDING BEES TO YOUR HIVE

Richard **Wahl**

Pre-Bee Arrival Preparations

Whether it's a purchased package, a swarm catch or a split, adding the bees to your hive can benefit from some pre-bee arrival preparations. Regardless of the source from which the bees come there are things that can be done to help your bees get off to a good start. As mentioned in a previous article siting the hive in a sunny location facing east or south with a windbreak on the west and north can be advantageous to later cold Winter wind concerns. A coat or two of paint can go a long way to preserving your hives as rain, sun and bad weather assault them through seasonal changes. I was once advised by an established beekeeper to only use a latex based paint and not an oil based paint due to the fumes that could be let off over time by oil based paint. I have not seen any studies that bees have a greater aversion to oil based paint, but why take the chance? Studies have shown that using varied paint colors on closely spaced hives can aid the bees in finding their way back to their own hive.

Different colored hives in S`ummer

Another type protection advocated by some beekeepers is to use a penetrating wood sealer. The label may call it a penetrating wood stain. Make sure the label also lists it as being non-toxic. There should not be too great a worry about any wood sealer that is used since it is only applied on the outsides of the hive supers. There are also companies that advocate hive woodenware be dipped in wax for greater protection. An easier and less costly way is to just use a paint or foam brush to coat the insides of the hive boxes with melted beeswax. I have not done this but find the bees often coat scratches or internal imperfections with propolis. I have found it beneficial to give plastic foundation a good coat of wax. This is easily done with a foam brush and some melted wax. In an experiment some years ago I inserted every other plastic foundation frame with a coating of melted wax with those in between not pre-coated with wax. A second deep with this every other coated frame arrangement was added to a single deep loaded with bees. I found the bees almost immediately began drawing comb on the wax coated frames while leaving the uncoated plastic alone until the coated frames were near completely drawn out. Only then did they move to drawing out the uncoated plastic frames even though working every other frame.

After a year or two of beekeeping there are usually drawn comb frames that had honey extracted from them or drawn frames from those emptied by the bees over winter. I have found it beneficial to the bees to reintroduce some of those frames to new hives early in the season. Giving bees a head start with previously drawn comb allows them to put more energy into brood rearing and pollen or nectar collection rather than comb building.

I mark my frames with the last number of the year in which they were filled out with comb. After four or five years I replace the oldest frames with freshly waxed foundation frames. Including at least one newly waxed foundation frame in five frame nucs and two or three in a new hive seems to encourage the bees to gather pollen or nectar and get the queen off to a faster start laying eggs. I have seen queens lay eggs in partially new drawn comb that has not reached its full depth if no fully drawn out comb is available. One of the earliest jobs of newly hatched brood is to build out cells of wax comb after a short period of time working as nurse bees. Newly hatched brood need to have something to do after serving time as nurse bees although bees adjust to whatever hive jobs are needed.

A previously empty drawn comb frame ready for insertion in a new hive, with the last digit of the year on the top right

Purchased Package Pointers

There are many sources from which one can purchase packages of bees. Numerous bee equipment companies or even local businesses can be found through the internet, social media or bee clubs. The three pound package is most common with a caged mated queen and a can of syrup for a food source during their transportation period whether by mail, truck or rail. (In the late 1800's the A.I. Root company shipped entirely filled railroad boxcars of bee hives throughout the country.) The cost of a package will vary between $150 to $300 depending on the race, shipping method and quantity. I think it is best to find a distributor in your area since those bees will already have been acclimated to your seasonal climate changes. My experience is the closer to your area from which the bees are obtained the greater the chance of them more easily acclimating to their new home and the better the chance of over wintering success.

Above
Empty wooden bee package with syrup can and empty queen cage.

Above
Empty plastic bee package

A three pound package will normally come in about a 16 x 6 x 8½ inch wood box that has screens on two sides or a plastic container that has perforations throughout. A hole in the top is just large enough for a quart tin can of sugar syrup. The bottom of the can has several small holes from which the bees can feed on the syrup during transportation. Along with the syrup a mated queen may be included in her own small cage normally screened on one side so outside bees can attend to her as well as the several bee attendants often included in the cage with her. As the bees cluster in the package it will look to be ½ to ¾ full of bees. After removing a thin wood cover from the wood box the syrup can may be hard to retrieve. A tap of the box on a hard surface will result in most bees dropping to the bottom and make the syrup can removal less damaging to bees clinging to the can. Needle nose pliers can aid in the syrup can removal after which the queen in her cage, usually attached to a ribbon or plastic strip, can be removed.

All this is done next to a hive set in place that has been readied with frames and covers. Three or four frames can be temporarily removed to make room for gently dumping the bees into the hive. It will only take twenty to thirty minutes for the bees to disperse through the present frames after which the remaining frames can be installed without crushing a pile of bees on the bottom. The queen cage can be sandwiched between two frames or a tack used in the attached strip to hold it in place dangling from a frame. Be sure the screened side of the queen cage is facing an open area and not against a frame's comb so bees can continue to attend to her. It will normally take the bees three to five days to chew through the candy insert in the queen cage that is found below one end of a removed cork insert. Removing the cork from the non-candied end may result in the queen escaping prematurely. The time it takes bees to chew through the candied end allows bees to acclimate to their new queen if they have not already done so. On several occasions the candy was so hard I found it necessary to poke a small wire through it to give the bees a start. Be careful not to poke in too far and damage the queen.

Swarms: Introducing a swarm to a hive follows much the same procedure as above. Most swarms I have caught were initially dropped into a five gallon bucket for transport to the hive's temporary location. I found it best to set a hive super with a full set of frames in the bottom box with an empty super above it where the bees can be dumped into the empty top super and allowed to migrate into the lower fully framed super.

Place the inner and outer hive covers over the supers even if the top one has no frames. The only time I had a swarm catch leave the hive is when on a very hot day I left the top cover with an open crack for ventilation. The bees did not seem to appreciate my effort for heat mitigation and I assume departed the hive later in the afternoon because of too much open space at the top. Once they have settled in, which might take a half hour or so, the empty top box can be removed or if a very large swarm, then filled with frames and closed with properly set inner and outer covers. On occasion I have had a dumped swarm return to their initial swarm site and after letting them resettle for an hour or two a second attempt to capture them was successful. Later in the day after dark or early next morning the hive can be closed and moved to its permanent location without fear of losing too many bees.

My first swarm catch found in a pine tree in 2010.

Splits: If your first Spring inspection finds the vast majority of overwintered hive frames covered in bees it is time to think about doing a split.

A hive ready to be split

A common practice in SE Michigan where I am located is to wait until the road side or country lawn dandelions are in full bloom before doing deep inspections or attempting a split. Inspecting or splitting before this natural event might not avoid an unexpected late Spring cold spell. This could preclude reformation of the bee cluster necessary for the required warmth to keep the cluster alive. A split can involve finding the existing queen and removing every other frame to the new hive and moving those frames to the center of both hives. The remainder of each hive can be filled with new frames on each side. Try to get a good mix of bees, brood, pollen and nectar frames into both hives so the returned queen and newly inserted queen get off to a strong start. I more often do a blind split not worrying about which hive has the queen. As long as there is a brood frame or two with eggs and newly hatched larva in both hives the bees in the queenless hive will form several cells to make a new queen. It will take about a month for the new queen to hatch, mate and start laying eggs. It is a quick way to make a split if time for finding the queen and/or time for the previously queenless hive to hatch, mate and start to lay eggs is not a concern. I like this method because it also provides a brood break which is a natural method to slow down the *varroa* mite life cycle. The mites will temporarily have no capped brood cells in which to reproduce as the new queen gets established.

The small brown dots are mites found on the screened bottom board a day after an oxalic dribble treatment on a new hive

Mites: After about a week, once the bees have settled into their new hive, it is a good time to think about that first mite treatment. Reputable companies selling bees make their best efforts to minimize any mite introduction with their bees. But especially with swarms, mites have become an ever present malady for nearly all bees in the U.S. It will take some time for the bees to increase their numbers and build up stores anyway, so mite treatments before honey supers are added will not hinder those treatments where it is recommended honey supers not be present on the hive during treatment. Always follow the package directions when treating for mites as there are required temperature ranges and time durations for best application efficacy. I like to replace one empty frame with a green drone frame at this time and I have treated with an oxalic dribble, or one of the newer common mite treatments such as Apivar or Formic Pro a week or so after adding bees to a new hive.

Each form of treatment has its specific time and temperature requirements and whether it can be done with or without honey supers on the hive. The oxalic dribble is a mild acid and special care must be taken with skin and eye protection with even greater cautions if the vaporization method is used. I have had best results when the dribble is applied in cooler temperatures, but not below 40 degrees fahrenheit. Apivar is a synthetic pesticide and requires honey supers not be on the hive during application and not be put on for a period of 14 days after application. Since it is recommended Apivar strips remain on the hive for 42 days, adding the 14 day post removed period totals a 56 day stretch without honey supers. Since it will take a new hive of bees this amount of time to build up through a second deep before adding a honey super, I find it better to be used early rather than later in the season when bees would be working honey supers that would need to be removed. Formic Pro on the other hand can be used with honey supers on the hive as the strips release an acid vapor in the hive that bees can tolerate but mites cannot. Formic Pro has a 14 or 20 day application option. However there is a daytime temperature window of 50 to 85 degrees fahrenheit that needs to be adhered to. Carefully follow the label directions with any mite treatment which may vary slightly depending on the manufacturer. I will discuss my preferences and experience with successes and shortcomings of various forms of treatments in a later article. These articles reflect my twelve year SE Michigan experience with bee management and yours may be different based on your conditions, experience or state of your hives.

Note from the Editor A great resource is *Tools for* Varroa *Management* from the Honey Bee Health Coalition. Google it up.

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Sister is helping her older brother do a hive inspection of his backyard beehive in Petaluma. Photo by Ettamarie Peterson

Teaching Young Beekeepers

Ettamarie **Peterson**

Many years ago, my son and his wife asked me if I would take on the job of being the Beekeeping Project Leader for Liberty 4-H so that my granddaughters could have that as one of their projects. Being a sweet (aren't all beekeepers sweet?) granny, of course I said yes! The girls are grown up now, but I am still the beekeeper project leader and love it!

4-H is part of the County Extension Services of the Land Grant Colleges across the United States. It was started to help children learn about agriculture. Children can join 4-H as young as five years old and stay in until they are 18. Beekeepers can be five years old. This is great because we need young beekeepers. I read somewhere that the average age to start beekeeping is 50 years old. We need to get young people involved! They are fascinated by bees and generally have not developed the fears adults have. One aspect of 4-H I really like is that siblings can all be part of the same project and often parents become involved with it in one way or another. Many of my young beekeepers have parents that find themselves acquiring bee suits and get up close and personal with the bees along with their children. I do have to remind them not to do much but watch and maybe help with heavy lifting.

The projects start in September of each year and the children renew if they want to continue for the next school year. Since beekeeping is really a year around job, my beekeepers keep working with their colonies and me all Summer as well. In the Fall the once-a-month meetings are focused on learning about the life cycle of the bees, their changing jobs, the roles of the workers, drones and queens and nutrition needs. They also learn about basic equipment needed. Fortunately, many beekeepers have donated used equipment to our project. This means they need to evaluate how good that equipment is and learn how to clean and sanitize it. They learn there are various ways to make frames with or without foundation. They choose which method suits their needs. Learning about the various sizes of boxes and deciding what they want to use are lessons we have early in the year. In November we make candles from donated wax. The children have a lot of molds to use as our collection has grown over the years. In December we make honey cookies or beeswax lip balm. That is always a fun evening! This year while making beeswax lip balm, one of my beekeepers decided she and her cousins that are also in the project should start a business. She pointed out that they had harvested honey, made candles and now lip balm so they would have products to sell. Not bad for children still in elementary school! In January we start talking about swarm season and how to catch swarms. None of my 4-H beekeepers have ever bought bees! I catch lots of swarms and some of them have, too. We have made some wonderful swarm traps they take home to hang in trees before the end of February.

Different subjects have come up during the year. If a colony collapses, the children are encouraged to bring it to the meeting so we can learn what may have gone wrong. One meeting I brought in some drone comb full of larvae that they opened and found lots of mites. What better way to learn how mites are developed! They have looked at combs with various queen cells and determined which ones hatched and which ones were chewed open. I have an observation hive that is on display in my barn where we meet. Every month they look at it and determine how it is doing. They become masters at finding the queen and spotting queen cells being built. Looking at monitoring boards and discussing what can be learned about the colony is a great activity. I encourage the children that have working colonies to bring their monitoring boards to the meetings. We also look at hives that had colonies that died to determine as best as possible what killed them. They get a first-hand experience learning about bee diseases and predators such as yellow jackets. Sometimes they neglect a dead-out hive and they get a great lesson in wax moth damage. I use all mistakes as lessons. Some of the mistakes are even my own such as the time I put too large a swarm in a catcher box and most of the bees died of overheating. It was a horrible mistake. Luckily the next day I was able to catch another swarm and was more careful transporting the bees.

A good activity to do with the young beekeepers is learn about what is required on honey labels and design their own. I ordered samples of honey labels to show them for ideas. They need to understand beekeeping has rules and regulations they must follow by law.

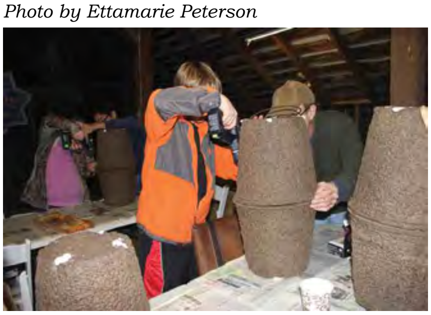
Record keeping is an important subject 4-H members learn. They are encouraged to keep track of their expenses, hive checks, production

Jessie and Arianna building frames. Interesting side note: Jessie is now an Ag Teacher in Lodi, California and Arianna volunteered to help beekeepers while she was at the University of Montana. (Jessie is my granddaughter) Photo by Ettamarie Peterson

of their honey if any, and hopefully any income the honey brings them. I have made a hive check sheet they can use to record what they see. This includes evaluating the temperament of the colony, its strength, the brood pattern, the honey and bee bread supplies, the queen and any signs of disease such as chalk brood. They learn before going into the hives for inspections, they should have a purpose and be prepared with the necessary equipment such as another super if it is that time of the year. When we do hive inspections, I take my camera along. If I am busy with the young beekeeper, I will hand the camera over to the parent to be the photographer. This is good for a couple of reasons. First, it keeps the parent busy and second, it makes them feel included. One of the most difficult things about being a beekeeping project leader is encouraging the children to ask and answer my questions while manipulating their hives and discouraging the parents to do those things. Most parents are good, but some get so excited or know so much they can't stand back quietly.

I do involve the parents in many ways. One year I took advantage of the skills a couple of dads had in wood working. They helped the young people build nucleus boxes. They pre-cut many of the pieces needed and taught them good carpentry skills. Each young beekeeper was able to take home a nicely made nuc box that afternoon. Another time we made a "Buzz Board", and I had a father wire it up. This was used by the children who came to the science and agricultural events. It said across the top, "What do I pollinate?" My beekeepers pasted different fruits and vegetables on the board. The children touched a screwdriver to a bolt on the picture. If the fruit or vegetable was bee pollinated, they would hear a buzz. My beekeepers were in charge of showing them how to do it and give them a honey stick as a reward. The Farm Bureau donated boxes of honey sticks for these events. This year one parent was a great help in our beeswax lip balm making as she is a quality control person in a cosmetic company. She taught us that the vitamin E was an antioxidant and kept the fats from going rancid. She also provided some interesting flavors to add to the lip balms.

Adult volunteer beekeepers helping the 4-H beekeepers turn pressed paper planters into swarm traps. Each young beekeeper took home a trap that evening.
Photo by Ettamarie Peterson



Children love to teach other children. The observation hive also goes to the events. My young beekeepers stand by it explaining what is happening in the hive and helping the children find the queen. At these events we also have lots of photos, bee equipment and pieces of honeycomb for education. The young beekeepers can show the children the different comb sizes and explain about worker comb and drone comb. 4-H members are encouraged to do public service and these events count in their record books.

Another public service my young beekeepers have done is spend a day at a local nursery putting little bee stickers on bee friendly plants. They had lists of plants bees need and went around the nursery finding the various plants. We also took the observation hive to the nursery at the owner's request. The public and the owner learned a lot along with the 4-H beekeepers.

Planting for bees around their homes and neighborhoods is encouraged. Last year they made seed balls to toss here and there. I asked for seed donations and had collected some seeds to use in this activity. A friend donated the clay we used to make the seed balls.

Working with young children can be a lot of fun. It is important to remember the younger children have shorter attention spans so make the meetings as hands-on as possible. Use the older ones to help whenever possible. I love watching the older children teach the younger ones.

Before becoming a 4-H project leader you must be screened by being fingerprinted and go through a training session to learn the rules of appropriate conduct and how to report any suspicions of child abuse. This training is now done on-line, and a certificate of completion is issued before you are certified by the County Director. The training is reviewed each year in the Fall. You will also be asked about your health and auto insurance coverage. Each local club has at least one community leader. That leader is very helpful in guiding you through the enrollment process and makes sure you have a list of the 4-H members that signed up for your project. A 4-H member from another club can come to your project if there is a cross-club agreement signed off.

Two of the youngest beekeepers doing a hive inspection with their mother watching. Side note: The mother got so interested that she took the free online bee course Penn State offered while she was off work during the Covid shut-down!
Photo by Ettamarie Peterson

As we beekeepers well know, beekeeping can be an expensive activity. I have been able to keep the cost down by letting other beekeepers know about the project. It is amazing how much used and hardly used equipment has been donated to the project. I received many used hive boxes, frames, wax, solar wax melters, two honey extractors, hive tools, smokers, and a variety of sizes of suits. Some of the hive boxes are not in the best of shape. Those are great for lessons on evaluating, repairing, and sterilizing used equipment.

There are many 4-H clubs in most counties but very few offer a beekeeping project unfortunately. We need more! Remember beekeepers do not all live in the country and 4-H is not just for country children. Beekeeping can be an intercity project. Go to **https://4-h.org** to learn more about 4-H and where your nearest club is.

Ettamarie Peterson has been the Liberty 4-H Beekeeping Project leader for many years and is looking forward to having her great grandson in the project in four years from now. His mother was one of the first beekeepers she had when she started the project. You can send an email to **ettamarie@petersonsfarm.com** if you have more questions.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This is a competitive scholarship open to young people ages 18-25 (at time of the conference - August 1-5, 2022), Ithaca College, Ithaca, New York.

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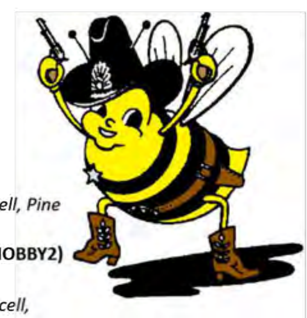
It pays for most of the one week EAS conferrence expenses.

Applications are due by April 30, 2022.

For info and application: Go to the Eastern Apicultural Society
https://easternapiculture.org/programs/master-beekeepers/master-beekeepers-scholarship/

Go to the Eastern Apicultural Society webpage, click on "Master Beekeepers," and click on "scholarship"



American Beekeeping Federation Activity

2022 AMERICAN HONEY QUEEN HAILS FROM PENNSYLVANIA

The American Beekeeping Federation is proud to announce that Lucy Winn was selected as the 2022 American Honey Queen at the American Beekeeping Federation Conference and Tradeshow in Las Vegas, Nevada. Lucy is the 20-year-old daughter of Stephen and Lauren Winn of Carlisle, Pennsylvania. She is a sophomore at the DeSales University where she studies business management and marketing. Her family keeps backyard beehives, which sparked her passion for beekeeping. At school, Lucy tutors local students in math. In her free time, Lucy loves to read, throw pottery, walk her dog, and keep bees.

Prior to being selected as the American Honey Queen, Lucy served as the 2020 and 2021 Pennsylvania Honey Queen. In this role, she promoted the honey industry in schools, through farmers' markets, fairs, festivals, and media interviews.

Lucy will spend the next year promoting the beekeeping industry throughout the United States in a wide variety of venues, including fairs, festivals, schools, media interviews, and virtual presentations. To schedule an appearance or presentation with American Honey Queen Lucy Winn, please contact American Honey Queen Program Chairperson Anna Kettlewell at 414.545.5514 or **honeyqueen99@hotmail.com**.

Lucy Winn

ABF Conference from Jerry Hayes

After months and months of limited travel and Zoom meetings I had a chance to attend the American Beekeeping Federation Conference and Tradeshow as we began 2022. What a great opportunity to actually get to see real faces, fist bump and even hand to hand, handshakes with all of the 'family' of Beekeepers, Researchers, Organization/Association Reps, and make many new friends. It was such a nice opportunity.

The General Session Conference was led off by President Joan Gunter who has done a solid job leading ABF. Joan's term has expired and Dan Winters is now the ABF President. He will do a solid job as well. Each day then began by outstanding Keynote Speakers, Dr. Dave Tarpy NCSU, Dr. Jamie Ellis UF, and Dr. Judy Wu-Smart UNL to set the tone that we in the beekeeping industry at any level are not alone. There were more presentations, the Tradeshow was excellent, Silent Auction, Auxiliary Lunch and Meeting, Socials in the evening, Foundation Luncheon, American Honey Show, Commercial Beekeepers Breakfast and Meeting, Workshops and the Annual ABF Banquet. What a Fun, Educational, Social way to spend a few days with our Love of Honey Bees. I would encourage each of you to make time in your life for the 2023 ABF Conf and Tradeshow.

A collection of photos from the 2022 ABF Conference.

Abdullah Asad **Iqbal**

Bees – They Make More than Honey and it Can Help Us

Cellules royales

We all know honey is good for us but what about royal jelly which truly is the food of royalty as it's what makes a queen bee a queen, but could it have benefits for us? That isn't the end of the story for bees as they make 14 compounds apart from honey, royal jelly being one of them. Each has a long list of health benefits and more are being discovered.

As this article would be too long if we went through all of them, we will just focus on the three bee products that have the largest clinical backing: royal jelly, bee propolis and bee venom.

Royal jelly is fed to all bees and given to queen bees in copious amounts. It has long been used in alternative medicine called apitherapy which is the use of bee products for health benefits, but scientists have now noticed that its effects could be harnessed for therapeutic use. In clinical trials, it has been shown to improve wound healing, mental health and blood sugar control.

Then you have bee propolis which is bee glue essentially. It's a mix of beeswax, bee saliva and various compounds bees collect from plants. It's used to hold the hive together and has long been used for treating infections. 'Think pro for protect.' says Dr. Stefan Stangaciu an expert in apitherapy, who regularly uses bee products in his practice and publishes books on the uses of bee products. Finally, you have bee venom, which is the thing behind the sting, but sometimes a bad thing can be good.

Why should you care about bee products? Pharmaceutical trials for diseases are so expensive and the hunt for compounds that can help treat the diseases is always on and bee products can provide options for diseases such as Parkinson's Disease, mouth infections, mental health disorders and diabetes. Then everyone would be happy.

Mental health is a rising problem with one in four Americans suffering from a mental health problem in a year and current drugs have a high chance of leading to symptoms such as weight gain and vomiting. The cost is usually high and requires trained individuals who are in rare supply.

Scientists and companies are looking everywhere for an answer and royal jelly might provide it. A 2012 study has shown that ingesting three grams of royal jelly per day for six months led to great improvements in mental health, blood glucose and red blood cell levels. This study shows that royal jelly could target cardiovascular disease which causes one in three deaths in America and improve our overall health as a common comment made by GPs these days is, 'what helps our heart helps our brain.'

'Natural products are made of a variety of bioactive compounds that have beneficial effects' says Dr. Kleronomos who regularly uses bee products in his treating, Bee venom being particularly effective for pain.' Bioactive means the molecules that have an effect on living things such as us humans. The abundance of bioactive compounds found within it for royal jelly is made of a host of compounds from lipids to vitamins. Key among them is a family of proteins called major royal jelly proteins (MRJPs) which have been shown to have anti-inflammatory, anti-viral and memory-improving effects among others.

Bee propolis is a large host of molecules. 'There are over 70 molecules that have been shown to have beneficial effects in trials.' That means it could be effective for a range of conditions. 'Beehives rarely get infected with bacteria and bee propolis is the reason.' says Dr. Stangaciu. Various studies have shown that bee propolis is effective against infections as it has antiviral, antifungal and antibacterial properties. It does this by disrupting the ability of pathogens to invade a host, produce the enzymes that lead to the problems and so propolis has been shown to be effective in fighting dental infections such as with gingivitis and periodontitis. which is inflammation of the gums. It has also commonly mixed in a cream and Dr Stangaciu showed me a case whereby an individual was treated of

Pure white dried bee venom. Photo by: Shahraoui Mohamed, Morocco

his foot fungus after only a month of applying a mixture of propolis and honey. The effects of bee propolis are attributed to its profile of phenolic acids and flavonoids – these are molecules that are in all safe compounds. There are over 8,000 flavonoids so further research is needed to find the exact flavonoid that causes the beneficial effect. Brazilian green propolis extract when given to hospitalised COVID patients leads to a halving in their stay from 12 days in the control group to six to seven days in the treated group. In other trials, bee propolis has been shown to reduce sore throat and swelling and redness of the throat. 83% of the patients of the propolis-arm recorded remission of the symptoms after three days of treatment, whereas the placebo-arm patients had at least one symptom after three days. An unrelated trial also showed that bee propolis is effective in improving memory in elderly Japanese. It led to a doubling in the verbal memory score of the propolis takers and a large increase in scores for other areas of memory.

Lastly, we have bee venom which we all know bees use to protect themselves, but it could also protect us from a host of illnesses. 'It's most effective in increasing flow, so cardiovascular flow (the flow of blood), lymphatic flow (the clearance system of the body) and also reduces pain and inflammation.' Like the other bee products, it consists of many bioactive compounds that target multiple pathways. To find the exact pathway that is beneficial will require much work but we do know that 50% of its weight is made up of melittin which has been shown to be anti-inflammatory.

Red propolis from Dalbergia

Bee venom has anti-arthritic effects of bee venom acupuncture (which is where the bee venom is applied on acupuncture points where the bee stings replace the use of needles commonly used for acupuncture), which with those of the anti-arthritis drugs methotrexate and celecoxib. The study used a relatively large sample of 120 people. Over the course of eight weeks, one group received the drug treatment, and the other received five to 15 bee stings every other day. Both groups showed a reduction in their arthritis symptoms, with no significant difference between the groups. Bee venom has also been used for the treatment of knee arthritis as it led to improvement in pain and physical function scores as seen by the WOMAC index which is commonly used to measure these outcomes. Bee venom is also regularly combined with acupuncture in a technique called Bee venom acupuncture which has been shown to be extremely effective in production. Bee venom is also commonly used for pain and treatment usually involves, 'four to 10 bee stings every day for a few days at the site of pain.' says Dr. Kleronomos. These are extremely important uses as current medication only deals with the symptoms and has a large list of side effects.

This is the case with all drugs which as they, 'have a few inclinations and large-side effects, while for bee products it is the other way round, a large list of inclinations and a small amount of side effects.' says Dr. Stefan Stangaciu, 'the main side effect is allergy and some bee products are acidic such as bee venom that can cause pain'. Dr. Kleronomos agrees with him stating, 'the main side effects are allergies and cases of localised pain.'

So, bee products have been shown to have a long list of uses from treating neurodegenerative diseases to foot funguses and I hope I persuaded you that they should be used in a wide variety of cases. But as always use an expert. More work needs to be done to find the exact mechanisms as bee products differ in their contents depending on where they come from in the world as the local environment for that bee will contain different plants with different nutrients.

Furthermore, a way to mass-produce bee products is necessary as many hives do not produce compounds like royal jelly or bee venom in high quantities. For example, each bee only has 0.1mg of venom and the common doses given in experiments range from 2mg – 5mg which would be 20 to 50 stings. If you took that for three to four months which is how long it can take to get the beneficial effects, it could be 6,000 stings. That is one whole hive worth of bees. However, if we could find the exact compounds that cause these positive effects, we could easily produce the exact compounds.

However, that is if the effects are based on one or two compounds. 'Natural products are made of a variety of compounds that have beneficial effects' says Dr. Kleronomos which are mixtures of many compounds.' If 20 or 30 compounds are needed for bee venoms effects on mental health then it would be impractical to try and produce these synthetically. Only more research will tell what the outcome will be. I only mentioned uses for royal, jelly, bee venom and bee propolis that have been tested in human, clinical trials and have shown benefits. Bee products have been shown to be unsuccessful in some cases, I wanted to mention this so you do not get the opinion that bee products can cure everything. Some bee products have been used for over 3,000 years. So, keep your eyes and ears open for more on the benefits of bee products, as there are trials running to look into the benefits of bee propolis, royal jelly and bee venom and who knows what other compounds. I surely will. BC

Stinger with BV droplet. Photo by: Antonio Couto

Jerry Hayes

Jerry Hayes started out in life as a High School teacher. He hated it. He went into another business where he worked with a beekeeper. Back many years ago Jerry knew about Honey Bees but nobody actually knew a 'Beekeeper', did they? Jerry asked him questions, picked his brain, became more interested and fascinated and started reading everything he could get his hands on about Honey Bees. He turned into the consummate backyard beekeeper. He did all the fun and crazy things backyard beekeepers do and built and experimented with. He wondered if he could get into the Beekeeping world and support a young family. So, with the support of his family he went back to school under the tutelage of Dr. Jim Tew, at Ohio State University. "Top 10 Best thing I ever did", Jerry said.

Years later he looks back on his opportunities as a Research Technician at the USDA/ARS Baton Rouge Bee Lab, Dadant and Sons Regional Mgr., Dadant And Sons New Product Dev., and AR Mgr., Chief of the Apiary Section for the Florida Dept. of Agriculture and Consumer Services, Monsanto Honey Bee Lead, VP. of Vita Bee health North America and now Editor of *Bee Culture* magazine with awe and amazement.

Add to the above the Classroom Q&A Column of the *American Bee Journal* for almost 40 years, the 'Classroom' Book, Author or Co-Author on 23 research papers and a variety of Honey Bee related articles in a variety of publications. Plus, Past President of Apiary Inspectors of America, Heartland Apiculture Assoc., Colony Collapse Working Group, CAPS Science Advisor, PAm Science Advisor, AHPA Science Advisor and many Professional Presentations internationally and media opportunities. And Now Editor of *Bee Culture* magazine. It has been a Great Journey.

Just recently, Jerry Hayes was honored by Project Apis m during the ABF Conference for his years of Service to PAm, Science Advisory Committee. See photo above.

Contact Jerry at **Jerry@BeeCulture.com**

Emma Wadel

Emma Wadel is a recent graduate of Kent State University with a BFA in Visual Communication and Design and a minor in User Experience Design. All of that is fancy talk for graphic design. She has recently come onboard to help with all elements of design and a bit of customer service. So far, she's taken over the website and all the content updates and is now the graphic designer behind the magazine. Even though her main job is design, with such a small team she's doing a little bit of everything. If you have any questions or concerns about either the magazine or the website, she's the person to contact! Contact Emma at **Emma@BeeCulture.com**

Jen Manis

Jen Manis comes from a well-rounded background in the retail industry, having served many roles from customer service lead, to visual merchandising, to marketing. She earned her BA in psychology from Kent State University, and an AAS in graphic arts and photography from Stark State College. Her diverse background and interests make her well prepared for her many different roles she plays at *Bee Culture Magazine*, including customer service and advertising. When she's not working, you can find her photographing flowers in the garden, reading or spoiling her pet birds.

Contact Jen at **Jen@BeeCulture.com**

What's Happening in

Classified Ads

Somewhat new, somewhat a comeback… Classified ads are back! Starting in our April 2022 issue we will have a section of classified ads. To submit a classified ad, use our Google Form: **https://forms.gle/tLcVkZMv7HbFvFwa6**

Payments must be paid in full before your ad will be included. As a special for April, the price will be $1.00 per word, with a minimum of 10 words.

Questions? Email Jen Manis at **Jen@BeeCulture.com**

New Ad Sizes

We're updating our rate card! With various changes to the magazine (removing ourselves from the newsstand, a new layout and design person, a new advertiser, and various other factors) we have chosen to slim down our available ad sizes. If you are already running ads with us, do not worry, your ad can stay the same. Going forward, any new advertisers and changes to ads will need to be in the new sizes. We are always flexible in terms of size and everything but these set standards will just make our jobs a touch easier. These changes will be starting with the April issue.

If you have any questions or concerns, please contact Jen Manis at **Jen@BeeCulture.com**

New Subscription Offer

As society leans more and more into digital technologies, we've decided to offer a new subscription bundle. We are offering a one-year print and digital bundle for $35! (International pricing is $50.) BUT WAIT… Now through the end of March, we're offering a special offer. You can get this new bundle for $25 (that's the price of a one-year print subscription)! (International pricing is $45). Just use code **PD1B.**

This subscription is great for anyone! If you like the print subscription but don't want to keep loads of magazines around or you ran out of space, now you have access to our past digital editions. We have 150 years of magazines and while none of us have been around for that long, many of us have been around for a good majority of it. Our digital back issues will only go back to 2015, but will only keep growing as time goes on!

New Digital Features

A new feature for the digital edition that came with the February issue of *Bee Culture* is interaction! Before when you opened the digital edition, you weren't able to click the links or emails. But now you can! Any link in **blue** will now work!

Any URL will open in a new tab. Any email will open in your preferred email application.

The ads are interactable as well! If you see a URL or an email, just click! They don't have the special **blue** links but they do work the same way!

All contents pages now also have working page numbers! If you are looking for a specific article, now you can just click the page number or title and it will automatically jump to that page! This change is also in the Display Advertisers section. If you're looking for a specific ad, just go back there and click on the page number or name and it'll jump straight to it!

This new feature will be in all of the upcoming issues of *Bee Culture.* It will also be in the new Back Issues section of the website. (See New Website Feature)

If you ever notice any issues with the interactive portions please use this Google Form to let us know: **https://forms.gle/33Yhcm5evms1aex49** We always try as hard as we can to make things perfect for all of you but every so often something may be missed or something may not work. We'd love to fix it, we just need to know about it!

New Website Feature

With new faces here at *Bee Culture*, we also have new talents. Our graphic designer Emma Wadel has some talents within website design. She will be adding 2015-2019 digital back issues onto the website. While our more recent editions can only be viewed by digital subscribers (a great reason to subscribe to the bundle mentioned before), these back issues will be available for anyone. They will have their own place within the website. This section will feature all issues from 2015-three years prior to the current year. So for 2022, it will feature 2015-2019. This way new subscribers can see how long we've been doing this and can access old issues that may be referenced by our wonderful writers.

Please be patient with these new pages being uploaded. All of the past editions will be interactive as well; however, it will only be the **blue** links that work and the page numbers. The ads won't be interactive in these back issues. All of that requires some manpower behind it since they weren't previously interactive! We promise they're coming, it's just going to take some time. We want to make sure all of the new issues are the best they can be so that is always our first focus here!

Catch the Buzz also has a new logo, designed by Emma Wadel

Bee Culture

A Case for Embracing Smaller PART 3 Population Beehives

I'm Listening to What You Tell Me

You are older today than you were yesterday

Yes, you are one day older today than you were just yesterday; and yes, aging happens to all of us. Not a single one of us is excluded. During November 2021, at seventy-three and one-half years old, I arbitrarily decided that the techniques that I had used to keep my bees for nearly fifty years, were no longer appropriate for me. If your time has not come – it will. Good news! I have not found aging to be horrible, but I have realized that aging requires that I do some things differently – especially in my beekeeping.

As an aside *(and other comments in my editorial defense)*

I admit that I get bee things on my mind that are reflected in what I write in this monthly column. Many previous obsessive subjects have come and gone. It is, no doubt, obvious to you – if at this moment, you are still reading – that presently I have this smaller colony subject on my mind. I started naively enough. My colonies were consistently growing too large for both my physical stamina and my neighborhood apiary. Plus, these large colonies are really difficult to manage when applying mite treatments. Having no interest in ***not*** *keeping bees, I opted to explore keeping bees with smaller populations.*

I wrote about my findings. Then in subsequent articles, I wrote even more. Then readers began to write me about their single deep experiences. Some of you, I have discovered, have consistently been using single deeps as your primary hive for quite some time. Additionally, while looking at old bee books and old supply catalogs, I realized that small colony hives were abundant years ago. In many ways, this small colony topic is an old concept. It's just recent to me.

Smaller, lighter bee husbandry

Henceforth, I want to keep my bees (mostly) in single deeps and only deal with smaller populations of bees. Increasing age is not my only reason. My neighborhood is changing resulting in my bees being more scrutinized by people who do not have my interest in beekeeping. Nearly as important in my bee management decision as my ever-increasing age is efficient *Varroa* mite control techniques. At times, I have had dismal success when trying to control this predaceous mite in large, beautiful, populous colonies. That's just me. Others of you have done better, but consistently, I have not been able to reduce *Varroa* populations dependably and efficiently in large colonies with honey supers in place. Hold that thought for just a paragraph or so.

Did you know *Bee Culture* offers this free feature?

In the recent December (2021) and January (2022) issues of *Bee Culture*, I've written about my personal, late-life beekeeping epiphany. For those readers who really just need something more to do, and you don't have ready access to my earlier musings, you can find full-text facsimiles at: **www.beeculture.com**.

Once you are on the home page,

1. Go to the upmost back ribbon that is at the top of the page and select, *Latest Issues* from the various pull-down menus.
2. The next screen will open showing the covers of the most recent monthly *Bee Culture* publications.
3. If you are searching for my past articles in December 2021 and January 2022, move your curser to those publication covers. Click on them.

Figure 1
The "Back Issues" page will look like this.

4. Tedious and Important point here – just beneath the date shown in the page center, click on *"Click here to access the web edition"*
5. The stored publication will open. Use the directional arrows to find the *Table of Contents*, then relocate to that page.
6. Read as much as you wish. It's all free.

Okay, back to smaller, lighter bee husbandry continued

I fear that I will finally annoy some of you readers with my thread here. This will not be the first time that I have pushed this smaller colony concept. Many of you are at a place on your beekeeping journey where the largest colony possible suits your program. As I have noted in earlier articles, I do not disagree with your concept of a perfect hive. But for me, those huge populations are not working well for me anymore. Now, I sense that my biggest problem is that I am writing about this concept as I have thoughts on the subject. My article here, as if were, is still warm. But consider the following points.

Beekeeping has been here before

In our beekeeping history, we have certainly been at this single brood nest concept before. This idea is not something new. It only takes reviewing any of the myriad old texts to find photos of single-story concepts in nearly every pictured bee yard.

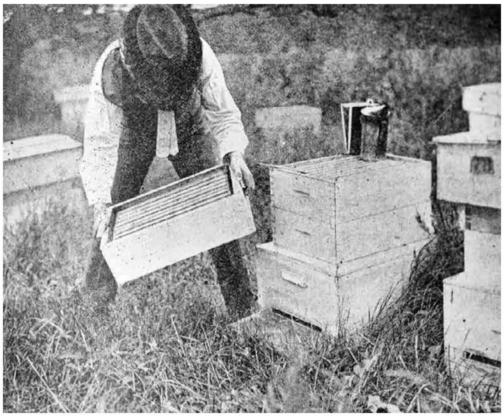
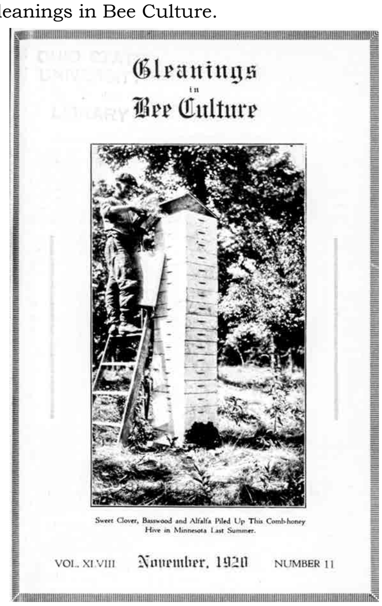


Figure 2
Single story brood nest on bee hives in 1918.

The characteristics that are different in the current beekeeping world are: (1) Today's modern queens are truly reproductive marvels. This has not always been the case. (2) Our nectar and pollen sources are only a pittance of what they have been in our beekeeping past. (3) Our environment is replete with pesticides and toxins that seem to restrict our bees' development. (4) Modern beekeepers must restrict introduced predaceous mite populations and other recently introduced pests that drag our bees down.

Figure 3
The cover of the November 1920 issue of Gleanings in Bee Culture.



I must guess that primarily due to two to four above, modern beekeepers cannot hope to have the opportunity to snap photographs of those huge honey crops that were possible in the past. In the photo, I present the cover from the November 1920, *Gleanings in Bee Culture.* Atop a single deep brood nest are fifteen comb honey supers. Other than telling me that the crop was from Minnesota during the summer of 1920, and was from sweet clover, basswood, and alfalfa plants, I know nothing about the colony.

While this photo probably does not reflect the experience of most beekeepers of the day, it seems to have been possible for such crops to occur. I would guess that the photo shows the total number of supers that was produced by that colony within that Spring and Summer of 1920. There simply cannot be enough bees in a single deep to cover that many combs in all those comb honey supers. Plus, the bottom comb honey supers would have been badly travel-stained by all the upward forager traffic. A competent comb honey producer would never have allowed that management error. Even so, producing that much comb honey in one season on one single brood nest colony would be a *"breath-taker"* today. *(Who knows? I suppose there is the unworldly possibility that the nectar flow was so intense that the bees made an unworldly amount of honey in a inconceivability short time. As you know, I was not there.)*

Charlie P. from Tennessee, alerted me to this

Charlie and I have talked bees and life on many occasions. He has told me of his Tennessee operation where he has had good luck keeping his colonies in single deep brood bodies. He said, as I have come to understand, that controlling *varroa* is paramount to productive beekeeping. He can control *varroa* more efficiently within a single brood box.

On a second note, thank you, Charlie P., for alerting me to an article in an older back issue of *Gleanings in Bee Culture.* I have no idea how you knew this piece was in the beekeeping literature. My compliments to you.

In the June 1982, issue of this beekeeping magazine, Gary Friedman contributed a piece titled, *Single or Double Brood Chambers - A Two-Part Look at A Controversial Subject.* Mr. Friedman seemingly made his observations on his colonies when they were in an apiary in Houston, Texas. He consistently wrote that his comments may not be applicable for northern beekeepers. I'm in the upper Midwest, so, there is that fact. Mr. Friedman wrote, *"Having large brood nests is a smart idea. But at the same time, using a double brood chamber when the queen is only laying in one of the supers means that we beekeepers are often losing about 80 pounds of good Spring honey. Correct management of the brood chambers is perhaps the most important tool for producing large crops of honey."*

My takeaway from Mr. Friedman's writings was that, indeed, I have not been actually managing the bees' brood nest. I just kept giving them abundant hive space to forestall swarming behavior and to build large populations that would ostensibly mean large honey crops. But my management process would inadvertently build large *varroa* populations if I did not perform multiple mite control programs. As I have written to the point of misery, controlling mites in large colonies in not easy or efficient.

Amy M. from New England alerted me to this

Amy said, I have been keeping bees for 18 years in Betterbee Beemax™ hives. The past three years, I have moved to keeping them in single deeps. (I'm getting older and a full deep of honey in August is just unmanageable for me).

I do not paint the insides, except for the screened bottom boards. I only paint the parts that get exposed to the sun, which is the most important part to maintaining their longevity. I have some boxes that are 16-17 years old. The only ones that I've lost were the result of a bear visit.

What I have found, is that some colonies really do want to swarm in the singles, (mostly ones installed on drawn comb), but some don't. The extra swarmy ones need to be split and managed, or have the queens replaced. I often move those queens and a few frames into a resource nuc. Queens in their second year up here in New England, I will put on a second deep, and once she lays it up, I will take that second deep off and make two splits out of it so I can keep those genetics.

Keeping the single brood chamber in polystyrene is easy. The queen lays out all 10 frames without issue, there is plenty of brood and I am thinking that perhaps they don't feel so crowded since she's not dealing with two outer frames on each side being filled with honey due to wooden hives not keeping the temperature so even. (This is purely anecdotal)

Jim, if you're trying to keep your colony numbers down (which I gather you are from what you have been saying on your podcast Honeybee Obscura), then put on an excluder and just pile up the supers as high as you can (a la University of Guelph) and give an upper entrance. I find I don't really need to worry about the swarming after June if I give them plenty of space up top. I also add my empty supers directly over the brood chamber instead of on top of the filled supers, I don't know if it makes a difference or not in terms of them thinking there is more space.

I have been focused the past two years on sustainable queen rearing. Making my own queens. They are just too expensive now and as you know acceptance is not guaranteed. So, having those resource nucs or making those splits are vital to my operation. If I somehow end up with too many, then I can easily just give them away by sending an email to my local club. Someone always needs a queen, so having those extra nucs doesn't necessarily mean I'm growing my apiary.

Strips for varroa *control are easy in a single to add and remove, especially outside of honey super season. I never have to remove that top deep of cranky bees in the Fall to dig out whatever treatment I've put in.*

For now…

Okay reader, now you're back to Jim. I'm out of space, but I am far from finished. Far. But for now, a closing thought. Do those of you who are deeply established within beekeeping history recall the *Buckeye Hive* design manufactured by the A.I. Root Company during the 1920s and 1930s? During those years and into the war years, beekeepers were very serious about wintering honey bees. To a great extent, we have gotten away from that seasonal management dedication today. Before *Varroa*, it was just too easy to get more replacement bees rather than worrying about wintering losses. I am reconsidering this management drift in my apiary.

The Buckeye Hive was an insulated single-story unit with an oversized outer cover to allow for an insulating quilt to be positioned inside. This old hive design strongly resembled the expanded polystyrene hives of today. I would contend that beekeeping has nearly come full circle. The plastic foam hives of today are essentially the Buckeye Hives of the 1920s.

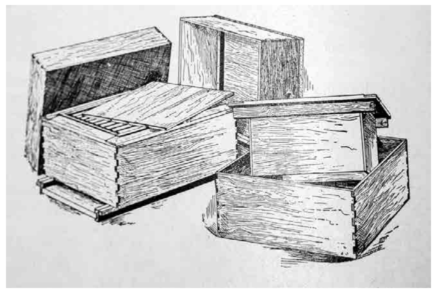


Figure 4
This single story insulated hive from 1919 would be significantly expensive to manufacture today.

***Varroa* has called me out**

Okay, I need to admit – at least to myself – that *varroa* not only has played a significant role in how many colonies I can now manage. I am realizing that – for me – to restrict *Varroa* populations within my colonies, I need to manage the bees' brood nest mechanics more than I have been in decades past. Seemingly *Varroa* has dictated how many colonies I keep, and now, *Varroa* is dictating the size of the brood nest in those colonies.

My beekeeping destiny appears to be fewer colonies with more manageable brood nests and an increased concern about wintering assistance. What others have already accepted for years, I am now fully embracing. That *varroa* predation and wintering success are intimately associated is a clear relationship. It's true. I am managing both honey bees and *Varroa* mites.

Charlie P. and Amy M., thank you for essentially writing this article. I freely acknowledge your input. No doubt the readers will appreciate your experiences.

My video for this article

For most monthly articles, I produce a short video that supports the concepts that I addressed in the article being discussed. This month, more than most, I have used that video medium to review what I have been trying to write in recent three articles on this small brood nest subject. I hope you will have a look. I have enjoyed exploring the concept of single box colony management.

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https://youtu.be/MTRi_LNi6bQ

Breakfast Honey Recipe –

Shana **Archibald**

Stuffed French Toast

INGREDIENTS

French bread or sour dough loaf, cut to fit in a 9x13 pan (a regular loaf of bread works too)
8 ounces cream cheese, room temperature
2 tablespoons vanilla, divided
2 cups powdered sugar
Juice from 1 lemon
2 cups fresh blueberries
1 cup fresh raspberries or blackberries (frozen berries will work too)
6 eggs
2 cups milk
1/3 cup honey
1 teaspoon ground cinnamon

INSTRUCTIONS

Prepare your 9x13 backing dish with cooking spray.

If you're using French bread, cut into one inch slices.

Make the filling by mixing the cream cheese and one tablespoon of vanilla, until smooth. Fold in berries.

In a large bowl, mix together the eggs, milk, honey, one teaspoon of cinnamon and one tablespoon of vanilla.

Pour over the bread making sure to get the tops of the slices.

Cover and chill overnight (up to two days).

Preheat oven to 350 degrees.

Remove French toast from refrigerator while oven heats.

Bake, uncovered for 30-40 minutes, or until puffed and golden and a knife inserted in the center comes out clean.

Cover with foil and bake another five to 10 minues if needed for the eggs to set.

CALENDAR

♦INDIANA♦

The Heartland Apicultural Society (HAS) has made plans to host its 2022 conference in June in Evansville, Indiana.

Watch **www.heartlandbees.org** for details.

♦IOWA♦

Central Iowa Beekeepers Association will be holding a winter seminar on Saturday, March 19, 2022 at the Grimes Community Complex.

Speakers include Dr. Tom Seeley, Dr. Carol Fassbinder-Orth, Randall Cass, and Andrew Joseph.

This seminar is a full day, in-person event. Registration is $40. $35 for CIBA members and $20 for students (K-12 and college). This price includes lunch.

Details and registration process can be found at **https://www.centraliowabeekeepersassoc.org/**.

♦MISSOURI♦

Missouri State Beekeepers Association will hold its 2022 Spring Conference on March 11-12 at the Truman State University Student Union building, 901 S Franklin St, Kirksville, MO 63501.

Speakers include Zac Lamas, Marla Spivak, and Carl Korschgen.

Afternoon breakout classes on Friday and Saturday include two segments on Queen Production by Queen Breeder Cory Stevens, EAS Master Beekeeper; Microscopy Discoveries in Beekeeping, and more.

There will be a vendor hall during the entire conference with state and national beekeeping supply vendors.

Keep updated on conference details, registration, and hotel accomodations at **www.mostatebeekeepers.org**.

♦OHIO♦

Lorain County Beekeepers Association is proud to announce the 27th Annual Beginner Beekeeping Class.

The classes will be held on March 4, 11, 18, and 25, 2022 from 7pm-9pm at Life Church (1033 Elm Street, Grafton, Ohio 44044). The cost is $50 and includes a one year LCBA membership and a montly email newletter. Books will be available for an additional $23 fee during classes.

For more information and to download the Class Registration Form go to the LCBA website: **www.loraincountybeekeepers.org.**

♦TEXAS♦

Texas Beekeepers Association will be holding a Summer Clinic on June 25, 2022 at the Lone Star Convention Center.

The keynote speaker is Keith Delaplane. The clinic includes Beginner Tract, Advanced Topics, Sideline to Commercial Tract, Panel discussions and hands-on demonstrations.

To register visit: **https://texasbeekeepers.org/** or for more information contact Dodie Stillman at **vp@texasbeekeepers.org**

Texas Beekeepers Association will be holding their Annual Convention on November 3-5, 2022 at the Mayborn Convention Center.

Their conference includes renowned keynote speakers, interactive classes, industry updates, legislative updates, and annual membership meetings.

Registration opens in August.

To register visit: **https://texasbeekeepers.org/** or for more information contact Dodie Stillman at **vp@texasbeekeepers.org**

♦WEST VIRGINIA♦

West Virginia Beekeepers Association is holding their 2022 Spring Conference March 18-19, 2022.

The keynote speaker is Sam Comfort.

The Conference will be help at WV University Residential Complex (Towers) Blue and Gold Room.

For more information and to register see: **https://www.moncountybeekeepers.org**

The Monongalia County Beekeepers Association is proud to annouce the 2022 Spring Beekeepers Course.

The classes will be held April 2 and 9 from 10am-3pm. Lunch is provided courtesy of Beehive Café. The classes will take place at the Monongalia County Extension Office.

Register at **https://www.moncountybeekeepers.org** and for more information call Debbie Martin at **304-367-9488**.

♦WYOMING♦

The Wyoming Bee College beekeeping pre-conference workshops and conference will be held at Laramie County Community College in Cheyenne, WY, on March 11-13, 2022.

The pre-conference on Friday is offering three different workshops and the main conference offers everything from beginning beekeeping through journeymen and advanced beekeeping.

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

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BOTTOM BOARD

Ed **Colby**

Jury Duty

I heard through the grapevine about a commercial beekeeper who lost an almond contract when someone insinuated that his bees must surely be riddled with *Varroa* mites, simply because he stopped using amitraz to kill mites.

This is wrong on at least three levels. First, it violates the first beekeeper commandment: *Thou shalt not backstab thy fellow beekeeper.*

Second, I have it on good authority that this commercial guy is an excellent beekeeper who lives and breathes mite control.

Third, amitraz is losing its efficacy, due to overuse and failure to alternate its application with other mite control measures. Like Covid-19 variants that mutate to become more contagious to humans and resistant to vaccines, mites are learning to live with amitraz. Some unimaginative beekeepers are keeping *Varroa* at bay with repeated amitaz treatments and nothing else. I've heard tales of treating ten times in a year. How long can this continue, before amitraz goes the way of Apistan and Checkmite, and mites become completely resistant?

In the past, if you treated with amitraz, you could scarcely find a mite afterwards. Now there appear to be reservoirs of resistance. When I do post-treatment sugar-shake mite counts, I find that amitraz kills most mites in most – but not all – colonies.

My jury summons came just before Christmas. It was an honor to serve. I did have to interrupt the trial on three occasions, because my hearing is shot, and sometimes folks don't get close enough to the mic. During the juror interview, when I told the public defender I was a beekeeper, he said his wife wanted to keep bees. After the trial I gave him my beekeeper card. I said his wife could call anytime. One of the other jurors wants to buy my honey.

We were 12 more-or-less random citizens. The judge told us we held a human being's freedom in our hands. He was presumed innocent, until proven guilty. All this made me feel proud to be an American.

The defendant had a rap sheet and was clearly no angel, but that didn't make him guilty as charged. After listening to the testimony, I *suspected* he committed the crime of driving under the influence of drugs but nonetheless harbored reasonable doubt.

When we the jury retired to render a verdict, I anticipated some back-and-forth. What I encountered instead was unanimous agreement that the state had failed to prove its case. We found the accused not guilty in less than five minutes. We ranged in age from 20 to 74. We were working people, retirees, a student. I'm confident we represented a continuum on the political spectrum. Yet we came together for three days, considered the evidence, and decided a man's fate. I'm confident we made the right decision.

This makes me wonder why our elected leaders – hopefully men and women of goodwill – have such a hard time coming to consensus on how to promote the common good.

I did a re-do on my book – "*A Beekeeper's Life: Tales from the Bottom Board.*" One of the stories had what I thought was a snappy ending. But two random sentences from an earlier version of the story got inexplicably pasted on, right after that snappy ending. I can't explain this or how I missed it before. But writing is like beekeeping. You learn as you go. I learned long ago to never let *Varroa* mites have their way with my little darlings. In writing a book, I now understand that you need a trusted editor, because when you get too close to something, you inevitably lose your focus.

There is currently much buzz about top-ventilated versus non-top-ventilated overwintering hives. Do we want upward movement of air entering from a lower entrance, so that moisture escapes via a top entrance? Or is it better to close off the top of a necessarily well insulated hive, so that as moisture condenses it runs down the inside walls of the hive? (Not on top of the bees' cluster!) This gives bees a water source and mimics the natural overwintering of feral colonies nested in tree hollows.

In my experience, non-insulated, top-ventilated hives with low mite counts can Winter pretty well here in west-central Colorado. I could tell you my success rate wintering top-ventilated colonies, since I began giving my bees a November or December oxalic acid dribble. But I don't think I will. Jinxes are real, for me at least, and braggarts live to rue their pride. I believe in sound beekeeping practices but also in luck.

Well insulated, non-top-ventilated hives with low mite counts also might work. I said might.

It's January as I write and snowing like the good old days. In a blizzard the other day, my sidekick Marilyn struck up a conversation with some poor waif at a lonely roadside bus stop. This poor child was trying to get to Oregon, but she had to go to Denver first, because her life was complicated. Her traveling-companion boyfriend abandoned her after he broke the stick shift on her truck. She left the truck at the Safeway parking lot. She was broke, with only a bus ticket and a to-go meal from Catholic Charities to sustain her. The bus was hours late, Vail Pass was closed, and this unfortunate told Marilyn she was afraid to go looking for a bathroom for fear the bus would show up while she was gone.

Good gal Marilyn drove her to the Amtrak station and bought her a train ticket. Later, I commended Marilyn for her spontaneous generosity. "You little darling! Any kindness begets yet more kindnesses that ripple through the universe. Love is all we have, all we ever had, isn't it?"

"That's it!" she said. She flashed her trademark Marilyn smile, and my heart swelled until it nearly burst.