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Bee Culture

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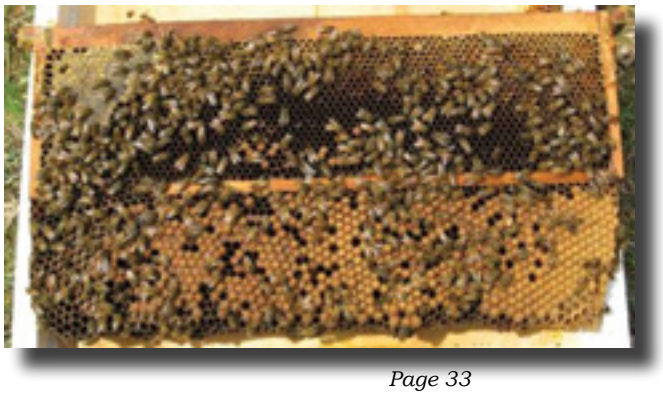

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January in NE Ohio. Flottum photo.

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Bee Culture's Best . . .

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In Every Month –

We Will Miss Randolph

I was sad to hear of the recent passing of Randolph Ferbert. Every time we met him we received a honey stick and a very warm welcome. Beekeeping has lost one of it's biggest champions.

Took this photo of Randolph in Gingerland Nevis, this young beekeeper was showing him her top bar hive and she was just beaming with pride.

Kevin French
N. Dighton, MA

Using Neonics?

(This is in response to a CATCH THE BUZZ dated November 18, 2019)

It seems that using neonics as an across-the-board preventive is like using prophylactic antibiotics. When thought out, the consequences may be as disastrous on two fronts. Constant use in this manner may cause resistance and the side effects are potentially disastrous.

Lynne Cameron

Basic Beekeeping

After reading a letter praising Clarence Collison's research summaries, I feel guilty praising James Tew's appreciation for Basic Beekeeping in your November 2019 issue. But he's right! We can't all be rocket scientists, so to speak, on every subject that interests us. My bees are a great source of pleasure in their own right, not to mention how invigorated and inspired I feel through the activities of our local club and the Oregon Master Beekeeping program. But that doesn't mean that I need to breed queens, forever increase the size of my apiary, or win a Nobel prize for solving the mite problem in order to feel fulfilled.

Like many retired people, I have an extremely busy and fulfilling life, in which beekeeping plays an important role, but in balance with all the rest of it. Tew said it correct when he said *basic* doesn't mean *beginning*. The pursuit of excellence is an admirable goal, but it can exist in the totality of our life, not just a specific subset.

David Donnelly
Boise, ID

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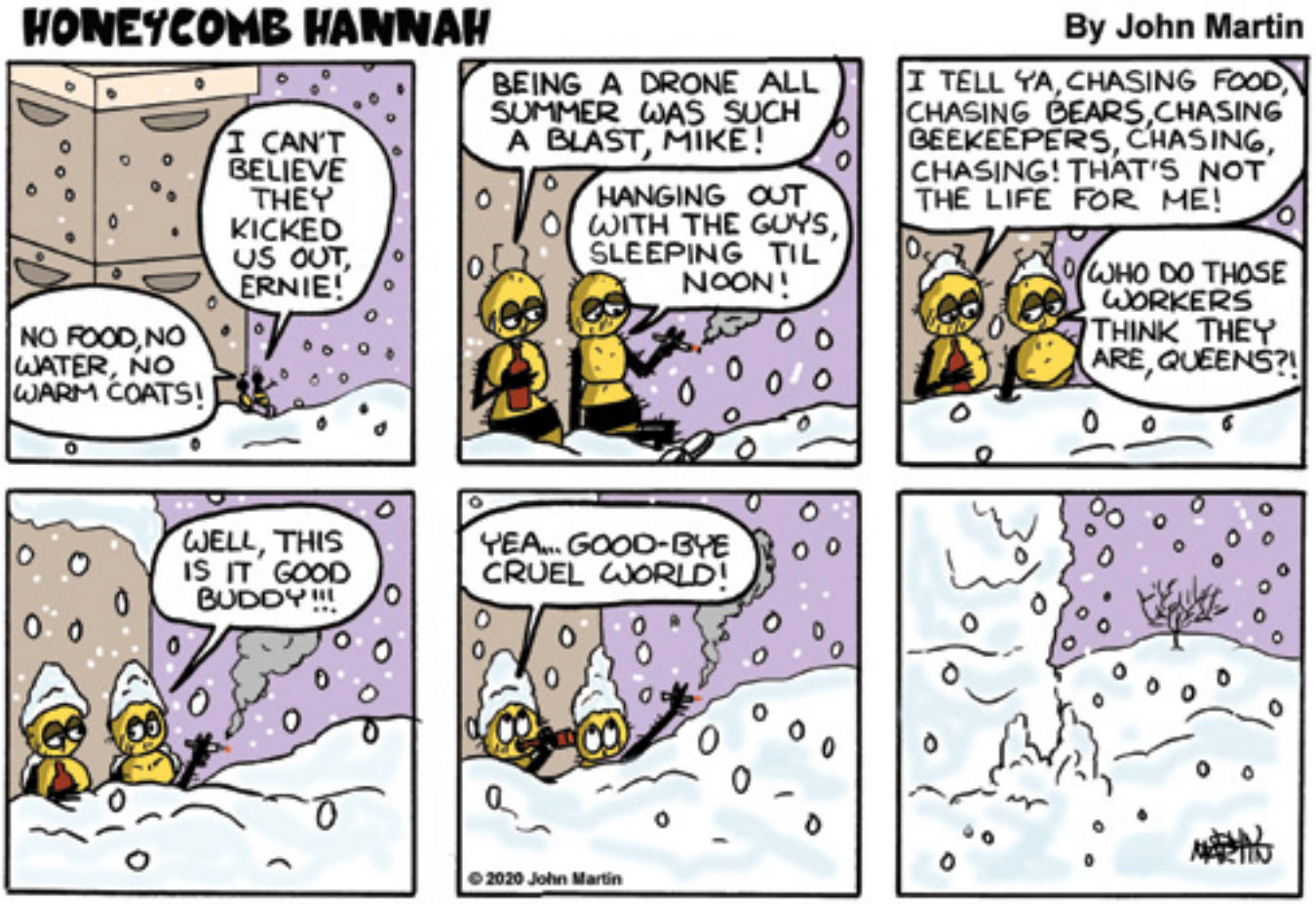

How do you approach the transition from someone with 35 years of experience and has made *Bee Culture* magazine the leading honey bee periodical in the nation to someone else who doesn't have that experience? Then there are the podcasts, webinars, another magazine, I don't know how many books, meetings, events, speaking engagements he was involved with and, and, and, and. You can't do anything but use this person's knowledge, skills and abilities as the pathway to the future. This person is Kim Flottum, Editor of *Bee Culture* magazine. I am truly amazed and overwhelmed at what, how and when Kim has built the *Bee Culture* nation as part of the team with Kathy Summers, Jean, Amanda, and Brenda. Kim is not so much retiring as he is changing his day to day direction with publication of other beekeeping books and enhanced digital connections. He is still around only he is doing things he has wanted to do for years.

My personal goal as Kim hands off this great responsibility to me is not to mess up in bringing truthful information about Honey Bees, managed Beekeeping and their/our environment to you in a compelling way. If it isn't interesting, fun to read and gives you ideas on how to achieve success or avoid failure we aren't going to do it. Simple as that.

The 'Inner Cover' will be a bit shorter as I will let some of our writers cover these events and ideas. What I like is Q & A's from real beekeepers. Having written the 'Classroom' section in the *ABJ* for 30+ years I will continue this, so please take a look at my email address and send Questions to me. I will answer ALL of them. Some will appear in *Bee Culture* and some will be between you and I. We are all in this together, and that is how we will be successful . . . together.

THIRSTY BEES

Hi Mr. Hayes – I was wondering if there has been any studies of bees dying of thirst while overwintering in the hives. Thanks, Charlie Phillips

Honey Bees in Winter have a minor requirement for water above and beyond their own metabolic need. They get it from the honey they have stored which is around 18% moisture. And after they have eaten it and are 'breathing' this respiration of theirs has the moisture in it as well that many times then condenses from the warmer cluster they are in and forms droplets within a colder hive. Picture you blowing your breath on a cold window pane in your home and your warm moist breath condensing on it. The bees can access this water too if needed but generally the honey of sugar syrup the beekeeper is feeding them has enough.

ROBBING

I am seeking your wisdom on preventing robbing during the end of season dearth. Typically, the end of the season is relatively calm and total colony losses from robbing are low. This season has been the opposite. I lost 12 out of 25 six-frame nucs and eight out of 46 single deeps so far. The nucs and single deeps were split between three yards (15, 12, 44). The queens I keep in the yards are VSH/SMR mutts with no real specific breed. As a small scale local queen producer and nuc business that is attempting to expand, these losses come at a high value.

The colonies were verified to be queen right and the nucs/deeps were exceptionally strong with the exception of three colonies. I started feeding around the middle of August when the dearth kicked in and have kept feeding until mid September. A few colonies that were still underweight continued to get fed until the end of September. I use gallon frame feeders for the single deeps and inverted steel gallon paint buckets set on the lid for the six-frame nucs. All of these are filled using a pump to reduce any chance of spilling thymol syrup. Once the hives have reached an acceptable Winter weight, the feeders are removed and a sugar frame is put in its place. Due to the higher than average losses I am considering the following options for the 2020 season:

- Open feeding, to focus attention away from their neighboring hives
- A separate yard for wintering just nucs

I know many people frown upon open feeding and adding an additional yard adds another spot to visit and a loss in travel time. Please let me know if these options have any merit or if you have better suggestions given your experience. I appreciate any feedback or experience you could share.

Trevor Bawden

Honey Bees are survivors across the globe because of active competitiveness. Winter is coming and the Darwinian 'survival of the fittest' gene has kicked it to assure colonies that they have enough food resources to make it until next April. Big strong aggressive colonies are the Bully in the lunchroom.

Moving smaller weaker colonies that are being fed a significant distance from strong colonies who want to 'steal' free food is an option. Stop feeding and remove the motivation for robbing could be an option. Closing down the entrance to the small colonies to a more defendable one big enough for only one or two bees at a time. Open feeding will certainly distract the strong colonies but there can be significant competition and fighting and lives lost at this time of the year as the strong colonies Always Win. And then this is beekeeping which has very few management plans you can take to the Bank 100% of the time. Beekeeping requires minute by minute plan changes and modification sometimes so cross your fingers and smile.

UNCAPPED HONEY

Hi Jerry – After five years every time I open a hive (like pretty much all of us) I have a new "experience" waiting for me, and of course, I'm turning to you for guidance.

I was hoping to squeeze out as much Honey as possible by leaving my supers on as long as I could but alas, cool & wet weather are pressing in on New Hampshire. In the past, I've been lucky enough to have at least 80%+ capped by now, most closer to 95%+ or fully capped frames, and I'd just spin it all out and move on. This year, I've just pulled off my last nine supers and clearly this year has been quite a bit behind the norm. Though it's been another good year overall, several of the frames in the supers are less that 50% capped or not capped at all and partially filled, probably 60% of them which means a lot more uncapped frames. I know capped cells means "ready" as far as the bees (and moisture content) are concerned, but I also thought I read that too much moisture can cause Honey to spoil quicker.

I'm tossing around a few options but for me, I'm clearly just guessing . . .

a) Spin all the Honey together, maybe even run a dehumidifier under a table & tarp, and "dry out" the honey.
b) Spin out the "good" capped Honey in one lot, and the uncapped in another, and feed it back to the bees now, & in the Spring.
c) Spin out the capped Honey. and then "store" the remaining frames to put back in the supers in the Spring. Will they last that long?
d) Any other thoughts you might have?

Finally, can so many uncapped frames really lead to a problem with spoilage, or am I overreacting (again). Gary Ross

Moisture above 18% encourages naturally occurring yeast and bacteria in nectar converted honey to 'grow' and reproduce, called fermentation. It's the same process as making beer, wine, and many other products that require water, sugar and yeast.

Honey bees figured out that if they could lower the water percentage in nectar below 18% that this stored food would last a long time.

There is a device called a refractometer that can measure the moisture content in honey. Maybe you could borrow one from a member in your local association.

If you don't need to sell the honey to pay the mortgage then I would leave it on the colonies as winter feed. No need to extract it. Saves your time and it is normal.

Or you could extract it and as you say in (a) put it in a closed in area with a dehumidifier and lower the moisture level if you can access a refractometer to see what the goal is and if you reached it.

GARY – COMMENT

Ah, I hadn't really thought about just leaving the boxes on. One last question then. I always use a queen excluder; will the Winter cluster move up into the super if stores are needed stranding the queen behind, or do they just go get what they need and bring it back to the brood chamber?

As always, your insight is greatly appreciated! Gary

PS: I do have a refractometer; I was mainly concerned that I'd have too much 18+% Honey that could be adequately kept from spoiling. Thanks again!

JERRY – COMMENT

You need to remove excluders.

WHEN SHOULD I STOP FEEDING POLLEN

Hi Jerry! Thanks for sharing your vast bee wisdom. My wife and I love reading your Q&As.

When should I stop feeding artificial pollen in the Fall? We have eight double brood hives that are full of bees and honey. I fed pollen early Spring and the bees loved it, until natures pollen arrived. Then they wouldn't touch it. In mid-August the bees started going "hog wild" after artificial pollen again and have not stopped. I live in northern Michigan, surrounded by Jack Pine and Black Oak trees. I have zero natural pollen after early August. No goldenrod or asters.

During hive inspections, I see brood and honey, but no stored pollen anywhere. None. What are the bees doing with it and where is it going? Will they stop consuming pollen on their own? Am I doing more harm than good by continuing to feed pollen? My hives are consuming about six gallons of sugar water per week and since August the bees have consumed over 20 lbs. of pollen. I know they use pollen to feed the young, but that much?

I've tried to research this question without any success. Thanks for your time! Jay Kendall

Thank you for the compliment. With you and your wife and me, that means three readers:)

Soooo, pollen is the male element of a plant. It is in a hard protective shell called an Excine and basically contains sperm to fertilize an embryo that if fertilized becomes a seed so the plant can reproduce. Unless stored in a -80F Freezer it doesn't last very long. The sperm starts to breakdown. Bees are attracted to it even if it has lost nutritional value as the outer Exine shell has chemical 'attractants' on it to bring in pollinators that are more long-lasting than the goodies inside. And even the best pollen sub is only about 30% effective. Nurse bees eat pollen converted to beebread and maybe some pollen sub. to give them nutrition and energy to feed their baby larval sisters. But no other caste of bees in the colony eats it. Let's hope the 20lbs was used to rear young healthy bees to make it through a long, hard, cold Michigan winter and not dragged out as trash which is what usually happens. It is looked on as trash rather than food at this time of year because they don't need it to raise more brood.

You certainly want the colonies to store 50-60-70 lbs of honey or sugar syrup for the calories they will need in your winter. That is your goal. Remember at this time of year evaporating the water in the sugar syrup gets more difficult as winter approaches.

If it were easy everybody would be a Beekeeper. Hang in there Jay

CORRECTION AND APOLOGY

Hi Jerry, I've heard it said that crow tastes best when served warm. I'm afraid the crow I'm presently eating is quite cold, but I need to correct the record.

I wrote to you about a year ago and my comment was published in the Feb 2019 edition of ABJ about fanning (robbing) bees. You were skeptical. You should've been.

At the time I was a beekeeper of slightly less than a year. I made two mistakes. The first was believing that I knew more than I did. The second was adding essential oils (including Lemongrass oil) to some sugar syrup and offering it in a Boardman feeder to what at the time was my only colony. I had read that using a Boardman feeder could initiate robbing. It did. The robbing continued on and off for a while, and my solution was to remove the feeder (I switched to an internal feeder) each morning and replace it each evening. I'm in South Florida and this was in November, and just like this November, there is a dearth and it isn't difficult to initiate a situation that leads to robbing. In fact, it's really quite easy. My confusion came when I observed robbing and orientation flights occurring simultaneously. I'm now of the opinion that the fanning bees I observed were not the robbers, they were my own bees. We're back in the November dearth down here again, and having learned from my lesson of last year there is no robbing in my apiary. I still don't see the level of fanning this year that I saw last year, but a year down the road, and a year wiser, I now believe I interpreted my observation incorrectly and, as is usual, you were correct.

I'm now more experienced and realize how little I actually know about these creatures we keep in these white boxes, no matter how many books I've read. I apologize for the misinformation. I feel a little better now although I'm still embarrassed for having spread misinformation, and want you and the readers to know that there still hasn't been an credible report of fanning robbing bees.

Respectfully, and with my most sincere apologies, Sid Lehr

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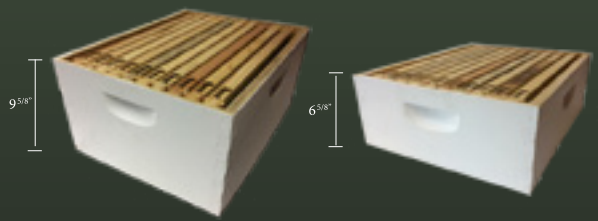

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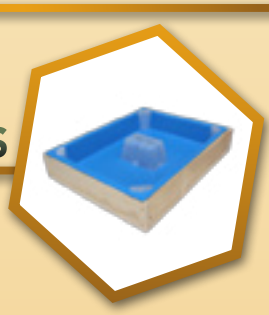

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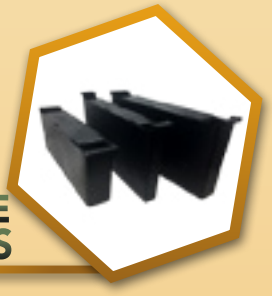

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It's Summers Time –

It's A New Year

Here we are starting another new year with *Bee Culture*. It will be a different kind of year, but we're looking forward to it being a good year.

As I write this it is mid-December and I don't have my Christmas tree up yet, haven't done Christmas cards – way behind this year. The good thing though is we also haven't had much snow or very cold weather. It's been a pretty easy Winter so far. Let's keep a good thought.

This is our first issue with our new editor, Jerry Hayes. We wish him well and welcome him to our little *Bee Culture* team. So far, so good.

We're excited about the coming year. We've got a lot going on as usual. Jean, our advertising coordinator, and I will be at the American Beekeeping Federation meeting the second week of January, in the Chicago area – weather permitting. Chicago is less than an hour flight for us, so it will either be an easy trip or we won't make it at all because it's January and there could be a blizzard on any given day. But hopefully we'll see some of you there. Editor Jerry will be at the Honey Producers meeting in Sacramento the first part of the week and will then join us in Chicago at the ABF meeting.

I'll be joining Kim for some February travel to the DC area and possibly St. Louis. It's been several years since I've been to DC, so I'm looking forward to that trip. There's still so much I haven't seen. Of course, it's February, so again the weather is 'iffy.'

I know you've been hearing this from me for awhile, but I promise you that barring any wild emergencies our 42nd edition of *ABC and XYZ* will finally be finished during the first quarter of 2020. Kim and I have been working hard on it and we are finally approaching the end result. I'll let you know on these pages as soon as it's ready.

We are going into Winter with 18 chickens, seven ducks, two beehives (I think), and one old female cat. We lost another chicken just a week ago and we lost our dear black cat Chloe just after Thanksgiving.

We were very attached to her. It's amazing how comforting and enjoyable our pets can be. She was almost 13. We still have her sister Sophie. They were so different in their personalities. Chloe just wanted to be loved. Sophie kind of treats us like we should feel honored that she lets us live here. But she is still good company for me when Kim is travelling without me.

The ducks and the young chickens are thriving and hopefully everyone will make it through the Winter. We're getting lots of eggs.

There is a flock of some kind of small bird – maybe sparrows – that have moved into the chicken coop for the Winter. There are at least 10 or so every night. It's the first time this has happened in the seven or eight years that we've had the coop. But it's pretty smart on their part – dry, warm, food. They hang out up in the rafters and everyone seems to be happy.

I want to mention a couple of logistical things about your subscriptions to *Bee Culture* and/or *BEEKeeping, Your First Three Years*. We are a very small team – there are five of us total. But Brenda is in Minnesota and Jerry is the editor, so that leaves Amanda, Jean and I to handle phone calls, emails and issues of any kind. We do appreciate the frustration this sometimes causes when you are trying to reach us. This mostly falls on Amanda and Jean, as I'm busy creating each monthly issue of *BC* and in between working on *ABC* and other books and projects. So, a couple of suggestions to make things easier.

If you can email us that is always the most efficient way to communicate with us. Our emails are easy – Jerry, Kathy, Amanda or Jean @beeculture.com. Subscription questions and requests for magazines go to Amanda. Jean handles our advertising. And both Jerry and I are here to help you however we can.

If you're not sure when your magazine expires just take a look at your label and it will tell you. We try to keep current on renewal letters, but again with such a small department it's hard to keep up. That's why we make our label a helpful piece of information.

Also, when renewing online it is always better to go directly to **www.BeeCulture.com** to renew instead of going through a broker or agency. There are several of those out there and although it works, your money and subscription information don't always get to us in a timely manner.

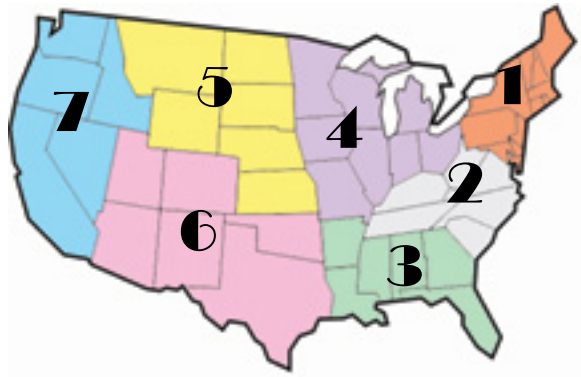
We will continue to do our best to bring you a quality magazine each month.

I wish you all a most Happy New Year. Hope to see you somewhere along the way. Have a good year.

"You really ought to do something about that lisp."

JANUARY – REGIONAL HONEY PRICE REPORT

	% Yes	Regions 1	2	3	4	5	6	7
1.	Do you ever feed any of these?							
	Sugar Syrup	91	87	82	66	71	64	100
	High Fructose corn Syrup	.04	31	45	44	43	36	43
	Fondant	45	31	.09	33	29	18	29
	Feeding Supplement	36	55	27	11	86	18	57
	Pollen Substitute	59	50	45	66	71	73	100
	Pollen	27	12	0	0	43	18	29
2.	Do you do alcohol or powdered sugar sampling before *Varroa testing?*	27	31	36	22	29	18	43
3.	What IPM do you use for *Varroa?*							
	Varroacide Strips	45	55	73	66	57	45	71
	Organic Acids	45	55	36	66	29	36	71
	Essential Oils	18	31	36	0	0	45	57
	Resistant Bees	36	37	0	22	29	45	43
	Drone Comb Removal	22	37	.06	11	29	27	14
4.	Do you test for *Varroa* after treatment?	45	44	27	56	29	27	57
5.	I belong to what Association?							
	Local	68	63	73	78	86	36	71
	Regional	68	50	64	56	0	18	71
	National	40	19	.09	44	43	.09	29
6.	Equipment I use							
	10-Frame	81	88	91	78	86	82	43
	8-Frame	.04	13	27	0	29	.09	71
	5-Frame	22	44	45	33	43	.09	57
	Top Bar	18	31	0	0	0	0	14
	Other	.09	0	0	0	0	0	
7.	Queen Replacement							
	Buy all	18	19	45	44	43	36	57
	Buy some, raise some	50	63	55	56	71	36	14
	Raise All	18	19	0	0	0	0	14
8.	Kinds of queens							
	Russian	45	13	0	0	14	.09	14
	Italian	59	63	73	66	86	45	57
	Carniolan	50	31	36	56	86	36	57
	Local/Survivor	63	37	64	56	57	45	14
	What I can get	18	13	18	22	29	18	14
	Raise my own 'Best Queens'	45	25	18	44	29	36	29
9.	I change old comb							
	Every year	18	19	0	0	0	.09	0
	Every two years	27	13	0	0	43	0	29
	Every three yea	27	37	36	0	0	27	0
	When damaged	86	69	91	89	57	64	86



January 2020. Welcome to a new Decade! OMGosh how did that happen. Well I can angst about the clock ticking forward faster all the time or I can report on the answers to a whole bunch of questions we asked our "Reporters." By the way will you sign up as a Honey Reporter? You get a free subscription to *Bee Culture* if you help out. There is a little ad on the next page with how to do this.

There are 7 Regions in the U.S. that have volunteer Honey Reporters. All levels of beekeeper experience are brought together in their region and the number of Yes answers are recorded and turned into a percentage %. If you take a look there are some great similarities in answers between and among the Regions. And because of geography typical management techniques might parallel or be sooner or later in comparison. Region 1 will be different from Region 3 which will be different than 5 & 7 but all will be familiar to you.

Here is a broad overview of answers to the questions. Take a look at all of the answers by Region as it might help you make decisions.

1) Everybody Feeds 'Sugar Syrup'
2) Really POOR % of those sampling before Varroa treatment
3) Varroa treatment products are 'everything' on the market.
4) Really POOR % of sampling after treatment to see if it worked
5) Association membership is variable
6) 10 Frame equipment is the winner
7) Most Queens are purchased
8) Queen 'models' are kind of like cars, everybody has a favorite
9) Old comb only replaced when damaged

I don't have a judgmental bone in my body but…..for 2020 I am going to do #2 and #4 better.

REPORTING REGIONS SUMMARY

	1	2	3	4	5	6	7	Range	Avg.	$/lb	History Last Month	History Last Year
EXTRACTED HONEY PRICES SOLD BULK TO PACKERS OR PROCESSORS												
55 Gal. Drum, Light	1.98	2.36	2.32	2.16	1.90	1.90	2.70	1.60-3.00	2.19	2.19	2.09	2.19
55 Gal. Drum, Ambr	1.97	2.15	2.20	2.13	1.60	1.70	2.70	1.35 -3.00	2.11	2.11	2.05	2.08
60# Light (retail)	254.29	185.00	201.67	158.35	170.00	180.19	193.75	131.74-325.00	198.21	3.30	200.28	195.51
60# Amber (retail)	243.81	187.47	200.00	165.92	175.00	177.75	200.83	119.74-325.00	201.35	3.36	199.32	194.51
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS												
1/2# 24/case	95.88	75.19	84.00	72.00	61.20	90.92	90.92	57.60-134.40	85.83	7.15	94.62	88.23
1# 24/case	146.63	109.59	130.42	108.82	131.33	119.88	128.40	84.96-211.20	130.11	5.42	133.86	121.69
2# 12/case	134.79	100.13	117.04	96.90	114.42	96.00	114.00	79.20-192.00	119.88	4.99	126.27	107.73
12.oz. Plas. 24/cs	106.46	101.67	102.67	88.97	93.92	99.48	103.20	66.00-172.80	99.56	5.53	99.74	94.64
5# 6/case	161.84	112.11	147.06	105.42	113.16	105.00	147.06	71.50-240.00	138.38	4.61	134.81	116.67
Quarts 12/case	172.49	151.23	139.67	132.29	168.03	152.94	168.00	109.20-222.00	153.61	4.27	159.80	149.01
Pints 12/case	106.94	94.23	80.50	78.96	96.80	94.00	102.00	65.00-140.00	93.58	5.20	93.68	93.39
RETAIL SHELF PRICES												
1/2#	6.09	4.84	4.65	5.06	3.90	1.99	5.36	1.99-9.00	5.23	10.45	5.58	4.87
12 oz. Plastic	7.19	5.75	5.75	5.58	5.05	6.49	6.45	3.79-12.00	6.17	8.23	6.31	5.77
1# Glass/Plastic	9.62	7.28	8.41	7.16	8.09	6.04	9.50	4.79-17.00	8.33	8.33	7.99	7.47
2# Glass/Plastic	15.48	12.23	14.74	12.90	14.63	12.00	16.88	8.39-25.00	14.40	7.20	13.80	12.49
Pint	14.29	10.99	8.75	9.93	11.38	10.40	10.70	6.00-22.00	11.00	7.33	10.21	9.71
Quart	22.55	18.26	16.15	15.73	17.31	17.33	21.88	8.29-40.00	18.72	6.24	17.94	17.51
5# Glass/Plastic	32.58	26.38	45.00	26.16	28.80	21.66	30.00	16.00-50.00	29.68	5.94	29.76	26.14
1# Cream	11.78	8.44	8.00	9.16	11.50	11.94	14.33	6.00-20.00	10.88	10.88	10.18	9.24
1# Cut Comb	14.32	12.87	10.74	12.31	11.50	13.99	14.00	6.00-24.00	12.98	12.98	13.35	11.74
Ross Round	12.31	7.25	11.48	9.00	11.00	11.48	13.75	6.50-17.00	11.21	14.95	11.03	9.79
Wholesale Wax (Lt)	7.30	6.69	4.88	5.33	7.33	3.68	9.70	2.70-16.00	6.66	-	6.73	6.12
Wholesale Wax (Dk)	6.27	4.46	4.28	5.14	7.50	2.60	10.50	2.00-15.00	5.79	-	5.80	4.91
Pollination Fee/Col.	104.33	74.00	80.00	90.00	180.00	190.00	48.25	45.00-190.00	91.56	-	89.88	79.95

NEXT MONTH

Welcome to NEXT MONTH, where our Honey Reporters share a line or two about what they will be doing NEXT month with their bees. Advice is given for each region so you can see what others are doing where you are, and, of course in all the rest of the regions. Check these out. These reporters are successful in business.

Region One
- Is Hive Alive
- Check Hive Weight
- Feed
- Repair Equipment
- Check Hive Wrap
- Replace Sugar Patties if needed
- Any Mice?
- Check Bear Fence
- Assemble new frames/foundation
- Sample for Mites if warm enough
- Treat for Mites if Sample confirms
- Go on Vacation
- Order Package Bees

Region Two
- Check Food Stores
- Check Mouse Guards
- Start Feeding if Needed
- Repair Equip./ Build New Equip.
- Inspect on warm day(s)
- Combine weak hives with Nucs
- Check for Dead Hives
- Feed Winter Patties

Region Three
- Feed, Feed, Feed
- Start Checking for Queen Cells
- Equalize colonies
- Check for AFB/EFB
- Add Protein Patties
- Sample and Treat for Mites
- Swap out old dark comb for new foundation

Region Four
- Check Hive weight
- Feed if needed
- Be sure there is upper ventilation
- Order Queens for April Splits
- On warm days look for Queen presence
- Add candy boards
- Plan to be a better Beekeeper

Region Five
- Prepare Equip. for Splits
- Continue Winter feeding
- Keep Hives Wrapped
- Clean dead bees off bottom board
- Leaving for Almonds

Region Six
- Feed if needed
- Sample and Treat for Varroa
- Going to Almonds
- Check for Dead Hives
- Get Equipment Ready for Spring
- Bees will be in California
- Check Hive Insulation
- Split with cells
- Check colonies on warm days

Region Seven
- Sample for Mites
- Feed
- Check Ventilation
- Collect Deadouts
- Feed Sugar Syrup
- Equalize colonies
- Repair Equipment
- If good weather inspect colonies/ treat for varroa

More Honey Reporters Wanted

We are always expanding our Honey Reporter population and need new reporters in EVERY region. We ask that you fill in most of the wholesale or retail or both sections, most months, and our short survey on the back. We give you a FREE subscription for your service. So if you are interested send an email to **Amanda@BeeCulture.com** and put REPORTER in the subject line. Include name, email, phone number and mailing address and we'll get you the next Honey Report form. Sign up today and be a part of the BEST Monthly Honey Price and Beekeeping Management Report in the industry.

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BEE TALK

Send us your questions, we'll find the answers. Our regulars and our guests will share what they know. Send your questions to Jerry@BeeCulture.com, with BEETALK in the subject line.

Question 1

If a colony is in two deeps what should the estimated weight of the colony be for honey food stores using the 'tilt' up method now in the states listed and why?

1) Alabama; 2) Pennsylvania; 3) Wisconsin; 4) Colorado

First preference is to use combs of capped honey for feed. If no honey in the comb is available, I'll feed 2:1 cane sugar syrup often fortified with natural sea salt and sometimes with chamomile tea to add back minnerals, enzymes, vitamins and other micronutrients to the pure carbohydrate that is processed sugar. *Ross Conrad, VT*

For the Northeastern states, a good rule is that you should not be able to lift the back of the hive if you have average strength. Most estimate that a colony in Ohio, PA, IN and Michigan should weigh about 80 lbs. This can be deceiving as sometimes the bottom box is empty and all the bees are in the second box, or some people try to overwinter their colonies in a stack of four or more boxes. The idea is that honey, pollen and bees should be condensed into two deeps and a medium or three mediums, or a similar combination so they don't have to move the cluster to find food. Nucleus boxes may need to be stacked higher, however they seem to do well if two nucs are pushed together to share a warm wall. *Barbara Bloetscher, OH*

Eastern PA and DC are similar, so I would feel only semi-confident prescribing for the whole state, but this is what we say in this city: I want to see the equivalent of 75 lbs of honey on each colony – the usual guidance was 60 lbs, but Winters have been warm and very uneven lately, followed by cold March weather. I'm even happier with 100 lbs. For a newbie, I translate that into frames. I would want the entire top deep to be stores, eight to 10 full frames, with a little munched out bit perhaps in the middle (for them to cluster on). If that colony were in three mediums, I would want to see 15ish frames full of stores. *Toni Burnham, DC*

I always used the grunt test, if I grunt when hefting the hive, all was good. Except maybe my back! *Phil Craft, KY*

Alabama 40 lbs per side; Pennsylvania 60 lbs per side; Wisconsin 60 lbs per side; Colorado 60 lbs per side. *Jay Evans, DC*

Question 2

When should you start feeding a colony and with what?

I always like to see signs of cleansing flights when the weather breaks and enough honey left in the hive to see the colony through the dearth. If honey stores are low, I feed (see #1). *Ross Conrad, VT*

Bees should be checked in August, especially if a dearth is occurring. You want fat bees going into the Fall because fat healthy nurse bees will nourish fat, healthy Winter bees. If *Varroa* mite populations are above the threshold of 3/100 bees, the bees will need to be fed to compensate for the loss of vigor because the mites feed on the bee fat bodies. Sugar syrup at 1:1 ratio in the Summer is usually the preferred medium. Switch to 1:2 water:sugar in September and October for them to store it. Use top hive feeders NOT feeders that attach to the outside of the hive.

Once nighttime temperatures drop, bees may not go up to get the syrup and it may freeze, so use fondant. Check the colonies in the fall for protein. If the brood frames have little or no pollen stores, feed them pollen in one of many acceptable formats. Reduce entrances if robbing begins. *Barbara Bloetscher, OH*

1:1 sugar syrup midsummer after pulling honey, dry sugar or fondant as a catchup for light colonies in September. *Jay Evans, DC*

In 2018, I gave a June club talk that said WINTER IS COMING and mentioned that only 109 days remained between our club meeting and October 1. In this area, winter prep needs to be done by then. We also have a brutal late Summer dearth, so about 40 of those days don't matter.

So when do you start feeding? Well, how much honey was stored during our one-and-only flow in April-early June? How much did you take? What is the difference between all the honey that is there and the 15 medium frames that I believe to be the minimum here? What if you subtract what a peak population colony of bees can eat for five to six weeks with almost nothing coming in? (In my experience, that can easily be 10 medium frames).

So over 109 days, It is quite possible that our beekeepers will need to feed an easy 50-75 pounds of syrup, dry sugar, or fondant. Our communal wisdom is that it should be 1:1 through September 1, 2:1 into October, and you need to plan on emergency, non-liquid feeding if you are really not there by November. If I have a gallon pail feeder on a colony, that might be just shy of a medium frame of honey, once cured down. Folks with a Fall flow can feed less. I think our beekeepers need to plan

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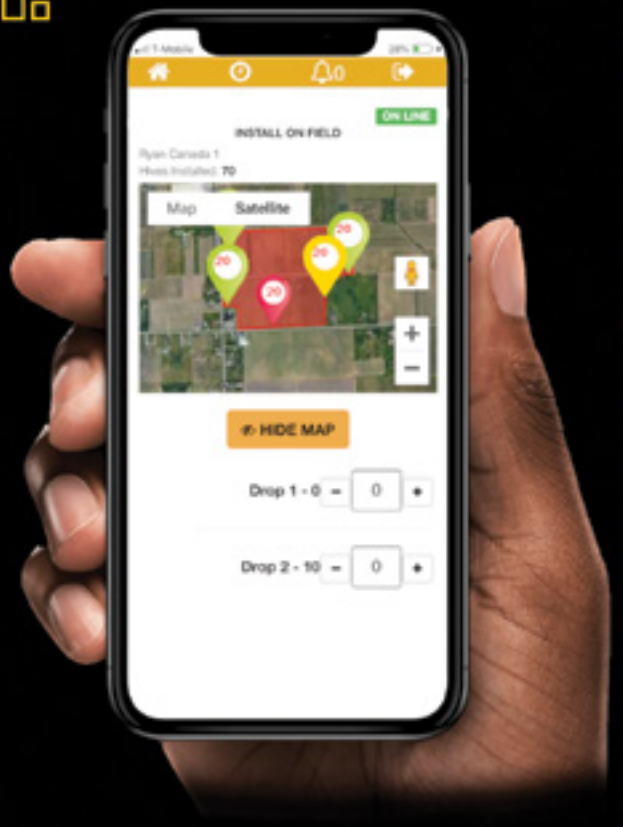

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on at least eight trips to the feeder, and hope to need less. *Toni Burnham, DC*

Tom Webster always said we needed about 50-60 pounds of stored honey/syrup here in Kentucky. My rule of thumb is that I want to see that top deep almost full, and I can see that pretty well by just looking between the frames. And almost full is much more than 50 pounds. If during the Winter, maybe January, and I get concerned about winter stores, I put Dadant winter patties on the top frames. I never feed syrup in the winter. Patties are easier for me, and likely better for the bees. And I can buy in Frankfort! *Phil Craft, KY*

Question 3

When the weather breaks temporarily and the thermometer goes above 50°F on a beautiful sunny microclimate day what should you be looking for from your colonies?

Manipulate frames so that frames of honey and pollen are next to the cluster. Feed if necessary. Check for mice that may have moved into the bottom box. *Barbara Bloetscher, OH*

My favorite answer to this question is "poop." I want to see cleansing flights, heck I just like watching bees fly. I want to see if those cleansing flights are normal, though. Are there orange streaks around the entrance to the colony? Could there be some dysentery? Mostly I hope to see a lot of bees still alive. Maybe some undertaker action. *Toni Burnham, DC*

On warm days, I am mostly just looking for bees flying. Dead bees do not fly! And I may also just take the top off & look for the cluster between the frames. I can estimate the size of the cluster. Never do before February, what difference does it make then? They are alive or not. *Phil Craft, KY*

Likely still cool for loosely clustered bees so not much disruption, just a close peek to confirm honey stores are close to center and bees are in decent numbers for the rest of Winter. *Jay Evans, DC*

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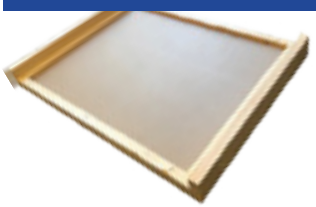

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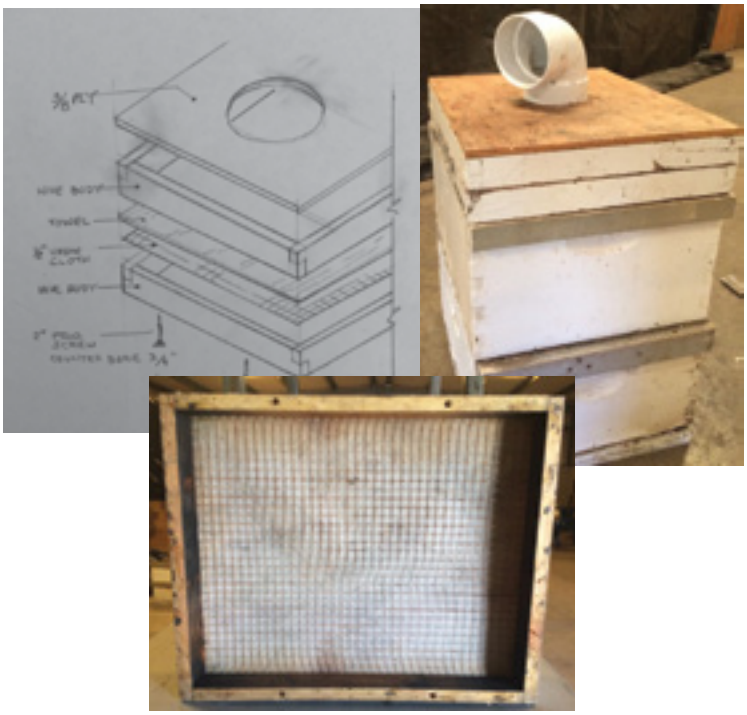
Number 1 Tip of the Month – Fume Pads

I can not take credit for this great idea but I have built these fume pads and tested them in 64 degree cloudy weather. The 4 in. elbow is available at Home Depo for $2.45. Make the hole for the elbow so it can be turned toward the breeze and get ready to remove the supers. It removes the bees extremely fast with no physical harm. I used discarded hive bodies to make the frame and old bath towels to receive the bee go. *Mark and Barbara Hvass, CA*



It is so much easier to keep bees calm if you work a hive from the bottom up. I remove all the boxes and start in the bottom box. By time I've looked at those frames the bees are getting "antsy" (tsk..tsk..). By immediately putting the next hive box on top of that, the bees in the bottom box are back to their own work. I do the same with each of the boxes. It seems to work so well . . .

Claire Moody

You know that feeling of cracking apart two hive boxes with your hive tool, only to have the boxes stick together right back together again before you can lift the top one off? Well my solution to that is to slip a chopstick in between the boxes after prying them apart. Another benefit to this is that curious bees don't get smashed between the boxes. Once I lift off the box, the chopstick goes right back into my pant's pocket. Below is a photo that illustrate the chop stick trick.

This year, in an attempt to keep the wax moths away, I rigged up a system to hang my frames in the bee shed. With space and light between each frame, I feel pretty sure the wax moths will steer clear for the winter.

Thank you to all the beekeepers who share their tricks of the trade, Deborah Davidovits, **www.beacon-beebiz.com**

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FOUND IN TRANSLATION

No Country For Old Bees

Jay **Evans**, USDA Beltsville Bee Lab

Last month I reviewed fundamental studies that have used hand-tagged bees to determine with actuarial precision the typical worker bee lifespan and productivity. These studies rely on Radio-frequency identification (RFID), a tagging system that beats other methods by using extremely liteweight paper tags. RFID tags, unique to each bee, respond to an antenna signal every time tagged bees pass a hive recorder. An author of one of these RFID studies, Andrew Barron from Australia's Macquarie University (**http://andrewbarron.org/**), pointed me to a brand-new study from their group. This study combined the power of RFID with careful colony-level field experiments to determine the subtler effects of chemical stress on the endurance of foraging workers. Already oddly obsessed with the forces that lead to worker burnout, I was hooked. It turns out that this is one of many studies that have used RFID to spy on both overachieving workers and those that don't bring home the pollen. These studies are pushing the limits for our understanding of the subtler causes of honey bee colony failure.

Student Théotime Colin led the Macquarie group with guidance from Barron along with USDA (William Meikle) and Jiangxi University (Xiaobo Wu) collaborators. Their paper "Traces of a Neonicotinoid Induce Precocious Foraging and Reduce Foraging Performance in Honey Bees" (*Environmental Science and Technology*, 2019; **https://pubs.acs.org/doi/full/10.1021/acs.est.9b02452**) details the impacts of a typical chemical stress on lifetime food collection by worker bees. The punchline is that the effects are subtle but cumulative for colony health. What is truly fascinating, though, is the detail with which each worker's life is mapped out. As in Barron's earlier worker, 'elite' foragers carried out hundreds of trips, even in the colonies facing a chemical challenge. The proportion of these elites in the forager pool was lower when colonies were given five parts-per-billion imidacloprid in their food. Consequently, the net number of foraging trips (money in the form of honey, and pollen) was significantly reduced. Exposed bees returned from 46 foraging trips on average, versus 64 trips for controls. Since they also foraged for shorter timespans, exposed bees spent nearly six hours less time on foraging trips over their lifespans than did controls (910 minutes versus 1437 minutes). The main reason for this was that exposed bees died in the midst of foraging, with a median foraging career of 8 days versus 10 for controls.

Shortened lives are also found in worker bees infected with disease. Lori Lach and colleagues showed that relatively low-level infections with the gut parasite *Nosema* (in their case 400 spores of *Nosema apis*) led to higher mortality and smaller returns to the colony. They present their work in the *Journal of Invertebrate Pathology* ("Parasitized honey bees are less likely to forage and carry less pollen" 2015; **https://doi.org/10.1016/j.jip.2015.06.003**). Again, the effects were significant but subtle. The odds of taking even one foraging trip were lower in bees given the parasite, and challenged bees had significantly fewer trips across their lifetimes. They also much preferred nectar to pollen on foraging trips, while control bees showed an equal preference for pollen and nectar. This might be a rare case where foragers put their own needs ahead of the colony, since *Nosema* presents an energetic drain to foragers that can be countered by sugar consumption.

Virus infections, even those with ominous names like Deformed wing virus and Acute bee paralysis virus (or 'Slow' bee paralysis virus, for that matter), are generally not visible to beekeepers. Nevertheless, like *Nosema* and chemical stress, viral infections can have strong impacts on individual bees and colonies. A recent paper by Kristof Benaets and colleagues in Belgium and England tackles the long-term impacts of Deformed wing virus on worker bees ("Covert deformed wing virus infections have long-term deleterious effects on honeybee foraging and survival', *Proceedings of the Royal Society*, 2017, **https://doi.org/10.1098/rspb.2016.2149**). Perhaps not surprisingly by now, infected bees showed both a tendency to die young and poor foraging returns when they survived. Tagged bees that had been injected with a sublethal virus dose were twice as likely to die before they reached the age of foraging, despite starting to forage at a younger age. As foragers they fared even worse, flying three fewer days than healthy bees. In total, infected bees lived nearly five days less than controls, and that lost time was especially noticeable in their abilities to bring home food.

As alarming as a shortened lifespan might be, nutrition, stress, and disease can also change the abilities of bees to perform critical benchmark roles as they develop. These changes might throw the whole colony out of balance. Barron, again, described this adeptly in an essay titled "Death of the Bee Hive" in *Current Opinion in Insect Science* (2015; 10.1016/j.cois.2015.04.004). Normally, an active forager cohort in bee hives acts as a break for younger bees, arresting their development so that they remain as nurses and hive bees for up to two weeks. When foragers die young, the breaks are released and workers begin to forage early. They are not so good in their new role and that fact, combined with a tendency to burn out early as foragers, can cause colonies to spiral downward. BC

A Closer Look

FLOWER CONSTANCY

Clarence **Collison**

Honey bee workers show a strong tendency to visit flowers of only one type during a foraging trip.

"As first described by Aristotle, honey bee workers show a strong tendency to visit flowers of only one type during a foraging trip. It is known that workers rapidly learn a flower color when rewarded with artificial nectar (sucrose solution). However, some previous studies report that the degree of constancy after training is unaffected by reward quantity and quality when bees are tested in an array of artificial flowers of two easily distinguished colors, such as blue and yellow. One possible reason for this surprising result is that large reward volumes were compared. This is likely to mask the abilities of foragers to make adaptive decisions under more realistic conditions. To test this possibility, Grüter et al. (2011) offered untrained honey bee workers ecologically relevant rewards (0.5, 1 or 2 µl of 0.5 or 1 mol l^{-1} sucrose solution) on one or two consecutive yellow or blue artificial flowers and then recorded which flowers the bees subsequently landed on in an array of 40 empty flowers. The results showed that an increase in all three factors (volume, concentration and number of rewards) significantly increased constancy (proportion of visits to flowers of the trained color) and persistence (number of flowers visited) during the foraging bout. Constancy for the least rewarding situation was 75.9% compared with 98.6% for the most rewarding situation. These results clearly show that honey bee workers do become more constant to blue or yellow with increasing nectar rewards, provided that the rewards used are ecologically realistic. As the most rewarding conditions led to nearly 100% constancy, further reward increases during training would not have been able to further increase constancy. This explains why previous studies comparing large rewards found no effect of reward on constancy."

"Gegear and Laverty (2004) assessed the flower constancy of Italian honey bees by presenting individual foragers with a mixed array of equally rewarding yellow and blue flowers after they were trained to visit each color in succession. All honey bees showed a high degree of flower constancy to one color and rarely visited the alternate color."

"The flower constancy of honey bees on successive days was studied by removing and identifying pollen collected by marked pollen-gatherers. Removing pollen from the bees decreased their tendency to collect it later; chilling the bees before marking did not influence their foraging behavior; neither treatment affected their constancy to the kind of pollen collected. No sequence of nectar or pollen collection with age of bee was found. In each experiment most of the bees collected only a few of the pollens available to them. Bees collecting the most common pollens tended to be the most constant. In general, the proportion of bees collecting their original pollen decreased as the number of foraging days increased, and only about half were doing so after one week; the rate of decrease differed in different experiments. No bee regularly collected different pollens at different times of the day. When the pollen they were accustomed to collect was unavailable for a day, most foraged for nectar only or remained at home. Most bees that changed to another pollen probably did so when the pollen they had previously collected was scarce or unattractive for longer periods. About 6% of the loads each contained more than one species of pollen. Bees that collected mixed loads were more inclined to do so later; probably they were dissatisfied with the crops they were working and were sampling others. When a colony was moved to another site with similar flora, the bees tended to visit the same species as before, but when one species predominated, bees that had not visited it before tended to do so (Free 1963)."

"Pernal and Currie (2002) evaluated the influence of pollen-based cues on the foraging decisions made by honey bees using a series of two-choice bioassays, performed within a highly controlled indoor environment. They examined behaviors related to the choice and collection of pollen by foragers among six floral species and three artificial substrates (pollen analogues). First, they evaluated the responses of honey bees to the odors produced by different pollens (or pollen analogues) and pollen lipid extracts. Honey bees displayed similar levels

Three distinct predictive models of foraging ecology have been developed.

of preference to the odors produced by all pollen species over those of pollen analogues, with a similar pattern of response shown to their extracts. They then evaluated behaviors of foragers in response to variation in particle size, using soybean meal that was ground and sifted to create a hierarchy of particle size classes. Bees preferred particle sizes below 150 µm, but the greatest response was shown for those particle sizes below 45 µm. They also assayed the effect of varying protein content on the foraging decisions made by bees by mixing soy flour with different proportions of cellulose powder. Foragers, however, were incapable of discriminating protein content. They determined changes in the response of foragers to different levels of handling time using different sized screens through which bees were forced to crawl to reach an attractive pollen odor source. In these tests, pollen-seeking behaviors were seen to decrease with increases in handling time. When odor was presented simultaneously with other stimuli, it was the primary and overriding cue used by bees to select pollen. These results suggest that individual honey bee foragers do not discriminate among pollen sources based on intrinsic differences in quality, but instead evaluate cues that may increase their efficiency of collection and recruitment to such a food resource."

"Three distinct predictive models of foraging ecology have been developed. Optimal diet theory predicts the behavior which should maximize joules gained per joule expended in searching for food. A joule is a unit of work or energy equal to the work done by a force of one newton acting through a distance of one meter. This entails obtaining the greatest reward while traveling the shorter distance. Minimal uncertainty theory describes the foraging pattern which maximizes the probability of obtaining a reward, but the average reward may not be maximized. Individual constancy theory indicates that foragers restrict visits largely to a single floral type (Wells and Wells 1983)."

"Experiments using honey bees and artificial flower patches were designed to test three alternative foraging ecology models: optimal diet, minimal uncertainty, and individual constancy. Honey bee responses to a mixed color flower patch and to flower morph associated differences in reward quantity, quality and frequency were measured (Wells and Wells 1983). Each honey bee visiting a patch of randomly distributed blue and yellow flowers was constant to one color, even though that behavior was suboptimal. When reward quantity was unequal between the two flower morphs each bee was constant to one color even though that behavior often resulted in suboptimal reward. When reward frequency was higher in one flower morph than in the other each bee was constant to one color, even though that behavior often failed to maximize reward or minimize uncertainty. Although each of their experiments had the potential to refute the individual constancy model of honey bee foraging ecology, none did. Optimal diet and minimal uncertainty theories failed to predict honey bee foraging behavior and, under the conditions defined by their experiments, are refuted."

"Honey bees, visiting artificial flower patches, were used as a model system to study the effects of sugar type (sucrose, glucose, fructose, and mixed monosaccharide), caloric reward, and floral color on nectarivore foraging behavior. Observed behavior was compared to the predictions of various (sometimes contradictory) foraging models. Bees drank indiscriminately from flowers in patches with a blue-white flower dimorphism when caloric values of rewards were equal (e.g. 1 M sucrose in both colors; 1 M sucrose versus 2 M monosaccharide of either type), but when nectar caloric rewards were unequal, they switched to the flower color with the calorically greater reward. In yellow-blue dimorphic flower patches, on the other hand, bees did not maximize caloric reward. Rather, bees were individually constant, some to blue, others to yellow, regardless of the sugar types or energy content of the rewards provided in the two flower morphs. These results suggest that optimal foraging theory (maximization of net caloric gain per unit time) is a robust predictor of behavior with regard to the sugar types common to nectars; such optimal foraging is, however, limited by a superstructure of individual constancy (Wells et al. 1992)."

"Honey bees were trained to artificial floral arrays to investigate their discrimination of, and constancy to, UV (ultraviolet) as a floral color. The floral arrays enabled color to be varied while other floral characteristics (odor, height, etc.) remained constant. Bees were trained to an array that had only one color morph, and then were tested on arrays to which had been added increasing frequencies of an opposing floral color-morph. Colors tested were yellow, UV and 'bee purple' (yellow plus UV). Bees trained to UV or bee purple remained constant to those colors when opposing color morphs were inserted; bees trained to yellow were variable in their constancy. It was concluded that honey bees cannot only discriminate between and remain constant to flowers when the sole floral cue difference is the presence or absence of UV reflectance, but also show a greater constancy to flowers having at least some UV reflectance (Jones et al. 1986)."

"Honey bee forager use of flower pigment patterns (patterns) was examined in the context of a repetitive decision process of flower choice made within-visits that occurred over several trips to the flower patch

(among-visits). Petrikin and Wells (1995) examined whether foragers can utilize pattern information alone as the basis for a complex foraging strategy, and if they can, which strategy is (e.g., energy maximization, risk aversion, individual constancy)? Three experiments were performed: 1) Blue-White Radial- pattern versus Blue-White Bilateral-pattern, 2) Blue-White Radial-patterns with reversed color placement, and 3) Blue versus White flowers (control). When rewards were identical in flower morphs bees foraged randomly. When rewards differed between flower morphs, bees utilized flower pattern to restrict flower visitation to the morph offering the greater caloric reward. Forager behavior thus conformed only to expectations of the energy maximization model. Forager error rate (choice of the flower morph offering the lower caloric reward) within pattern dimorphic flower patches, however, was 32 percent - over three times that observed when only a color dimorphism existed. Bees changed flower morph preference usually on their first visit to the flower patch after rewards were altered, often after visiting just one flower with the lower caloric reward. Increasing accuracy in choosing the more rewarding flower morph on return trips was not generally observed, as might be expected, with gradual learning or a prolonged conditioning response."

"Honey bee forager use of flower pigment patterns was examined in the context of a repetitive decision process of flower choice made within-visits that occurred over several trips to the flower patch. Lamb and Wells (1995) examined whether foragers can utilize shape (three-dimensional form) information alone as the basis for a complex foraging strategy, and if they can, which strategy is used (e.g., energy maximization, risk aversion, individual constancy)? Horizontal two-dimensional, Vertical two dimensional, and L-Shape three-dimensional flowers were used in dimorphic artificial flower patches. When rewards were identical in flower morphs, bees showed no uniform preference. Some bees foraged randomly, while other bees had flower morph preferences, but not all to the same flower type. When rewards differed between flower morphs, bees utilized flower form to restrict flower visitation to the morph offering the greater caloric reward. Forager behavior thus conformed only to expectations of the energy maximization model. Forager "error" rate (choice of the flower morph offering the lower caloric reward) within flower-form dimorphic patches, however, was approximately three times that observed when only a color dimorphism existed."

"Honey bees are adept at regulating pollen stores in the colonies based on the needs of the colony. Mechanisms for regulation of pollen foraging are complex and remain controversial. Sagili and Pankiw (2007) used a novel approach to test the two competing hypotheses of pollen foraging regulation. They manipulated nurse bee biosynthesis of brood food using a protease inhibitor that interferes with midgut protein digestion, significantly decreasing the amount of protein extractable from hypopharyngeal glands. Experimental colonies were given equal amounts of protease inhibitor-treated and untreated pollen. Colonies receiving protease inhibitor treatment had significantly lower hypopharyngeal gland protein content than controls. There was no significant difference in the ratio of pollen to nonpollen foragers between the treatments. Their results supported the pollen foraging effort predictions generated from the direct independent effects of pollen on the regulation of pollen foraging and did not support the prediction that nurse bees regulate pollen foraging through amount of hypopharyngeal gland protein biosynthesis."

Honey bee forager use of flower pigment patterns was examined.

"Fewell and Winston (1992) examined interactions between individual foraging behavior and pollen storage levels in the hive. Colonies responded to low pollen storage conditions by increasing pollen intake rates 54% relative to high pollen storage conditions, demonstrating a direct relationship between pollen storage levels and foraging effort. Approximately 80% of the difference in pollen intake rates was accounted for by variation in individual foraging effort, via changes in foraging activity and individual pollen load size. An additional 20% resulted from changes in the proportion of the foraging population collecting pollen. Under both high and low pollen storage treatments, colonies returned to pollen storage levels to pre-experimental levels within 16 days suggesting that honey bees regulate pollen storage levels around a homeostatic set point. They also found a direct relationship between pollen storage levels and colony brood production, demonstrating the potential for cumulative changes in individual foraging decisions to affect colony fitness."

"Honey bee foraging patterns were studied on artificial flower patches to determine if given individuals could change behaviors under differing conditions. Two types of flower patches were used; those simulating a population of flowers, dimorphic for color and grids simulating a single color-dimorphic inflorescence. In the simulated population of flowers, bees were individually constant to color over a range of reward volumes and flower patch sizes. Each bee remained individually constant to a flower morph when visiting a population-type grid but changed to random visitation on the simulated inflorescence. On the simulated inflorescence, with morphs providing unequal qualities of reward, most bees foraged on the higher molarity morph. Most, but not all bees, failed to minimize uncertainty on the simulated inflorescence. On the simulated inflorescence, bees failed to optimize when one morph provided a greater reward volume than did the other. In the population of flowers bees flew from flower to flower, whereas, they walked on the simulated inflorescence (Wells and Wells 1984)."

"When presented with an artificial flower patch of blue and yellow pedicellate flowers, individual honey bees became constant to one of the two flower colors, rarely even sampling the alternative color. Some bees visited only blue flowers while others visited only yellow flowers. Hill et al. (1997) described the onset of constancy for bees that had had no experience with the experimental apparatus. In 3,020 visits, bees failed to land on or drink from the flower color on which they landed only 17 times. This behavior was not modified by quality or quantity of reward, training to the experimental site, group effects or presence of odor during trials. However, when they trained bees to a target painted with two colors and then forced them to sample monomorphic flower patches in sequence,

Honey bees are adept at regulating pollen stores in the colonies based on the needs of the colony.

all bees visited the only color present: yellow or blue. When they subsequently offered these same bees yellow and blue flowers simultaneously (rewarded choices), they became constant. Eleven of 23 bees showed constancy to the less rewarding flower morph without even sampling the alternative. Those bees failed to sample even though they had previously been forced to visit the alternative flower morph, which offered a reward with twice the calories/volume. Constancy is thus spontaneous in honey bees, but it can be hidden by some experimental protocols designed to study learning." BC

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DRONES

Dewey **Caron**

Understanding Both Kinds

Do you fly a drone? No I don't mean the live drones that fly out of your colony to mate or whether you use tethered drones as a display to "fly" at your honey sales both or an outdoor bee display but instead I am wondering if you fly a robotic drone?

Remember Barry B. Benson? The Jerry Seinfeld Bee movie that was all about a bee which following graduation from college considered the one adult job to make honey a boring life. He sure sounded like and looked like a drone – but in fact must have been a female. If Barry had been a male he would have had an entirely different adult life before him, one not without pitfalls, especially if he was successful.

If you use your search engine and enter the word drone, you get plenty of hits for the artificial drones of technology, not the drones we know in our colonies. Wikipedia, the on-line encyclopedia, has five subheadings of drones; one includes bee and ant drones but the other subheads, Science, Technology and Arts, Entertainment and Media each have many more sub-listings.

Agriculture is one of the leading drivers of drone technology innovation. It goes without saying, since we all like to eat and as the human population of our planet grows every day, we need to increase agricultural productivity. Better production requires good crop health. As beekeepers we are well aware of the importance of good bee health if we want to increase (or even obtain) a bee product harvest or use our bees in pollination – sick bees do not do as well as when they are healthy.

Drones are being used to evaluate crop plant water use, used to detect sickly plants and an increasing array of uses to help farmers maintain healthy plants. Excepting apiculture, **ResearchAndMarkets.com** has a great 136 page overview on present and future prospects of drone use in agriculture."

How might (artificial) drone technology help beekeepers? A drone can quickly search the 8038 acre, two mile radius your bees are currently visiting so you might better ID floral resources. Or maybe you might enlist a drone to assist in finding an alternative apiary site. Since you made so many splits (for mite and swarm control) you now need at least one more apiary site?

Drones as flower pollinators might be just around the corner. Kim Flottum, in his June 2019 *Bee Culture* editorial discussed drones as pollinators. He said: Dropcopter – [reports] "way more fruit using a drone than when using honey bees" – a 25-60% pollination set on cherries and almonds and significantly increasing the pollination of king blooms on applies" (King bloom provides the best apple of a blossom cluster).

It is projected that drones might help protect our foraging workers from pesticide kills. Dropcopter has become the first drone technology company authorized for pesticide applications.

May Berenbaum Buzzwords columnist in American *Entomologist* had an unique take on Bot-Flying. She says Walmart (yes that Walmart) has received a patent on Pollinator "drones" entitled "Methods for pollinating crops via unmanned vehicles**.** **"**If you want to look it up the patent is US218/0065749A1. According to Berenbaum, Walmart wishes "control over its future food supply chain in the post-bee-apocalypse hellscape," And yes we, and they, know our "real" drones do not pollinate flowers.

Berenbaum also offers commentary on a DARPA (Department of Defense Advanced Research Projects Agency) "multi-million dollar grant" to Harvard's Wyss Institute for "RoboBees. "The current version weight less than two grams, beats its wings 120 times per second and can perch, fly and swim but still can't navigate around other flying objects". Look out bee foragers, here come RoboBee, clear out of the way so it can do its job to replace you! I wonder what type of hive houses RoboBees?

Drone watching

Drones, the real ones in your colony, are not a third caste in the bee society. They are the male bees. Only females exhibit differing morphology and worker and queen females are the caste individuals (ants may have several castes of soldier workers as well as worker and queen). And as part of unraveling the mystery of bee biology, we come to understand that drones have a grandfather, but no father**.** This occurs because drones develop from an unfertilized egg, only receiving genes (alleles actually) from their mother the queen. Yet, because the queen is female, the egg she developed from was fertilized so she had a father – her son's grandfather, likely one of a couple dozen grandfathers of her sons.

Drones do not exhibit typical worker bee behaviors such as nectar and pollen gathering, nursing, honey ripening or hive construction. Drones are unable to sting. However have you ever observed a drone rapidly move its body from side to side if you blow

Adding (green) drone foundation frame as mite trap.

Impaling drones with cappings scratcher to examine mite infestation.

on them or touch them with your hive tool? Or have you witnessed a drone fly out when the colony is disturbed and buzz around your veil, in the company to workers? We interpret these behaviors as defense, responses to help protect their home from intruders.

Have you seen zombie drones?" It happens from time to time that healthy drone bees can be seen with the mutation of white eyes. Only drones show the white-eyed mutation, not the workers bees. It turns out drone bees are more apt to express mutations from recessive genes than other bees because drone bees develop from an unfertilized egg. As a result, a drone bee has only a single set, of 16 chromosomes and with only one set of chromosomes, recessive genes can be expressed more readily without being overridden by a corresponding dominant gene. While the white-eyed drones appear otherwise perfectly normal due to the lack of eye pigmentation, they are blind, more or less stuck inside the hive.

Like workers drones pass through complete metamorphosis. Monitoring drone brood is easy to do because the cell diameters are larger. Developing drones, once they reach the capping stage, possess large eyes totally covering the top of the head capsule. Capped drone pupal cells are bullet shaped, distinctly dome shaped, sticking above the comb surface. And they remain as capped cells three days longer than the capped worker cells.

Drones can be found in most colonies only during Spring and Summer but can remain in weak or queenless colonies during Autumn into Winter. Colonies with larger number of workers start drone production earlier and, although there is variation, colonies need at least 4,000 workers to produce drone cells. Initiation of drone rearing occurs about three weeks before swarm preparation begin. The maximum number of drones occurs during swarming season but drone production is not a trigger to timing of swarming.

In feral colonies or those where comb building is not subject to foundation, over 20,000 drones may be produced in a hive (the exact estimate from one study by Rob Page was 22,560). In managed colonies, drones may number from a few hundred to a few thousand. Small colonies under poor environmental conditions may not rear any drones during a season.

Drone brood can serve as colony health indicators. Seeing drones in the spring is a sign of a healthy expanding colony. Seeing developing drone brood in worker cells is a no-no. If you see them there it is symptom that your colony is not "normal" i.e. workers with developing ovaries (a laying worker condition) or the queen is a drone-layer, not the normal queen condition required.

One other (small) side benefit of adult drone presence happens if the hive's temperature deviates from proper limits. Drones will join workers to generate heat by shivering, or exhaust heat (and higher CO_2 air) by moving air with their wings. Not major work activity, but maybe it helps a little bit? Mostly they remain relatively inactive until we open the hive and the light "disturbs" their resting.

PUTTING DRONES TO WORK

As a beekeeper, can we use drones and drone brood to help us be better beekeepers? Drones hang out at the edge of brood so if we pull a frame with many bee bread filled cells and lots of drones it tells us we are "close" to the brood frames. In Spring inspections, a key biological indicator of colony development is when bees start to rear drones. If you start seeing drones in the early spring it is important to take note, because swarm season might follow.

We can use drone brood to provide an estimation of mite numbers in colonies. When drone brood is exposed during a colony examination, we should be looking to see if the developing drone brood harbors mites. If your colonies have little drone brood between the boxes, then use a cappings scratcher to impale capped drone. Look below the tynes for mites among the bodies. The mites will clearly show up against the white pupal bodies. If sampled drone cells were recently capped, the mites might not be seen.

We might also consider raising drones as a non-chemical technique to slow the development of *Varroa* mites in our colonies. Mites prefer to feed on drones because they take longer to hatch and mites are able to rear more offspring in drone brood cells. Use a "natural comb, a foundationless frame inserted between two normal drawn combs, or one of the specialty drone foundation plastic frames (they are green colored). Place near edge of brood rearing sphere during Spring to allow the workers to draw drone-sized cells. Wait until the majority are capped and prior to drone emergence "harvest" them. By killing the capped drone brood, mites within the drone cells will also be eliminated.

An alternative is to use a medium super frame within a standard hive body. The open space beneath the bottom bar and the top bars of the lower box (this works best in boxes that are not immediately above the hive bottom) will be filled in with new comb, usually with drone sized cells. You can easily harvest the capped drones by simply removing this "extra" comb from the bottom of the medium frame and killing the drone brood.

Note for this drone trapping technique to properly work brood nest combs should have little drone-

sized cells. With other drone-sized comb, the bees may be reluctant to build drone cells in new comb.

The drone's "job" is mating

While drones are part of the 'whole' package that makes up the social structure of bees, biologically drones can be said to have a single purpose – to find a queen and mate with her. There is now a broad consensus that queen health and fecundity is extremely important for the health and productivity of the colony. And a Queen's reproductive quality is defined not just by her potential fecundity (largely a function of body size), but on her mating success as well.

Drones, upon emergence need time to mature. The number of viable spermatozoa is zero at emergence. Sperm number reaches average maximum (slightly over seven million) around 20 days of life. Sperm counts decline in older drones (after day 30) though viability remains constant. (Metz and Tarpy Insects. 2019 **doi: 10.3390/insects10010011**). Once mature, drones leave their home each afternoon, weather permitting, seeking to perform their critical reproductive role i.e. mating with a virgin queen.

Queens rely on multiple drones to inseminate them with high-quality sperm. This is done during mating flights. Mating success is critical in order for a drone's traits to be passed to the next generation. Smaller bodied drones produce less semen overall, are underrepresented in and have less success in DCAs. Drones stressed by disease or several common agrichemicals, including miticides used to control varroa, produce less sperm. [reviewed in Koeniger G. et al. Mating Biology of Honey Bees. Wicwas Press].

Studies have demonstrated queens mating only with a single or a small number of drones produce colonies that are less reproductively fit than those headed by queens mating with a larger number of drones. Beekeepers often cite "poor queens" as a leading reason for colony failure. Poor queens might likely result from "poor drones" or less successful mating.

Mating does not occur within the hive. Queens fly into Drone Congregation Areas (DCAs) where 10s to 1000s of males fly about in comets that constantly dissolve and reassemble. During this critical mating activity, one or more comets with their multiple males compete to mate with a queen. The drones of the comets don't fight. They simply seek to fly closest to the queen to successfully mate. Anywhere from five to 20, on average, actually will reach the queen and mate.

RoboBee (Harvard University photo)

Drone congregation areas are typically 10-40 m above ground, and can have a diameter of 30-200 m across, often resembling an inverted cone (wider at the top). The boundaries of a congregation area are distinct; queens flying even a small distance outside the boundaries or close to the ground are ignored by the drones. Congregation areas are typically used year after year, with some spots showing little change over 12 years. Since drones don't overwinter, drones must find these congregation areas anew each season. This suggests environmental cues define a congregation area, although the actual cues are unknown.

A single drone visits multiple congregation areas during his lifetime, often taking multiple trips per afternoon. He visits a congregation area closer to home than does a virgin queen. Drone's fly on averages 20-25 minutes before he must return to the colony to refuel with honey. While at the site, the drones fly around passively; when the virgin queen arrives to the congregation area, the drones locate her by visual and olfactory cues. At this point, it is a race to mate with the virgin queen.

Drones greatly outnumber the quantity of virgin queens produced per season, so even with multiple mating by the queen, very few drones successively mate. The "prize" is of course to be genetically represented in the newly founded colony. Mating between a single drone and the queen lasts less than five seconds, and it is often completed within one to two seconds. Mating occurs mid-flight, 10-40 m above ground.

The drone first contacts the queen from above, his thorax above her abdomen. He grasps her with all six legs, and everts the endophallus into her opened sting chamber (if the queen's sting chamber is not fully opened, mating won't occur). Once the endophallus has been everted, the drone flips backwards (paralyzed) as his sperm is pushed into the queen's ting chamber.

The ejaculation of a drone is so powerful that it ruptures the endophallus, disconnecting the drone from the queen. The bulb of the endophallus is ripped from his abdomen usually inside the sting chamber of the queen mating. The leftover endophallus is referred to as the "mating sign." The endophallus will not prevent the next drone from mating with the same queen, but may prevent semen from flowing out of the vagina.

Drones in a hive do not usually mate with a virgin queen of the same hive because the queen flies further to a drone congregation area than the drones do. If a drone happens to mate with a queen of the same hive, the mated queen may have a spotty brood pattern (numerous empty cells on a brood frame) due to the removal of diploid drone larvae by nurse bees. This results when a fertilized egg is laid with two identical sex genes. Such brood would develop into a drone instead of a worker but before that occurs nurse worker bees remove the inbred brood and

Trapping mites – medium frame with capped drone brood below bottom bar.

consume it to recycle the protein. A successful drone offers something absolutely essential to the future of bees – genetic diversity.

And then . . .

So if most drones don't die mating with a virgin queen nor do work inside the hive, it might sound like they might live long lives. However this is not the case. In the fall, when foraging becomes scarce, drones become just another mouth to feed. At this time worker bees stop tending drones, stop feeding them and then actively kick drones out of the hive, leading to their death.

Fall drone exclusion was the subject of Chapter 7 of a novel written by Nobel Literature Price winning author Maurice Maeterlinck in 1901 *The Life of the Bee*. Highly anthropomorphizing the bee life in Chapter *Massacre of the Males* (Page 94-95) he writes:

IF SKIES REMAIN CLEAR, the air warm, and pollen and nectar abound in the flowers, the workers, through a kind of forgetful indulgence, or over-scrupulous prudence perhaps, will for a short time longer endure the importunate, disastrous presence of the males. These comport themselves in the hive …Indelicate and wasteful, sleek and corpulent, fully content with their idle existence as honorary lovers, they feast and carouse, throng the alleys, obstruct the passages, and hinder the work; jostling and jostled, fatuously pompous, swelled with foolish, good-natured contempt; harboring never a suspicion of the deep and calculating scorn wherewith the workers regard them, of the constantly growing hatred to which they give rise, or of the destiny that awaits them. For their pleasant slumbers they select the snuggest corners of the hive; then, rising carelessly, they flock to the open cells where the honey smells sweetest, and soil with their excrements the combs they frequent. The patient workers, their eyes steadily fixed on the future, will silently set things right.

But the patience of the bees is not equal to that of men. One morning the long-expected word of command goes through the hive; and the peaceful workers turn into judges and executioners. Whence this word issues, we know not; it would seem to emanate suddenly from the cold, deliberate indignation of the workers; and no sooner has it been uttered than every heart throbs with it, inspired with the genius of the unanimous republic. ….The great idle drones, asleep in unconscious groups on the melliferous walls, are rudely torn from their slumbers by an army of wrathful virgins….. Before the bewildered parasites are able to realize that the happy laws of the city have crumbled, dragging down in most inconceivable fashion their own plentiful destiny, each one is assailed by three or four envoys of justice; and these vigorously proceed to cut off his wings, saw through the petiole that connects the abdomen with the thorax, amputate the feverish antennæ, and seek an opening between the rings of his cuirass through which to pass their sword. No defense is attempted by the enormous, but unarmed, creatures; they try to escape, or oppose their mere bulk to the blows that rain down upon them. ….. Some succumb to their wounds, and are at once borne away to distant cemeteries by two or three of their executioners. Others, whose injuries are less, succeed in sheltering themselves in some corner, where they lie, all huddled together, surrounded by an inexorable guard, until they perish of want. Many will reach the door, and escape into space dragging their adversaries with them; but, toward evening, impelled by hunger and cold, they return in crowds to the entrance of the hive to beg for shelter. But there they encounter another pitiless guard. The next morning, before setting forth on their journey, the workers will clear the threshold, strewn with the corpses of the useless giants; and all recollection of the idle race disappear till the following spring.

And if that is not enough reason to give drones a bit more respect consider the summary comments of Jay Evans in his July 2019 "Found in Translation" review of "A gene for resistance to the *Varroa* mite (Acari) in honey bee (*Apis mellifera*) pupae." soon to be published in Molecular Biology **DOI: 10.1111/mec.15080**. Jay reports that drones were used to screen for a gene that might cause mature *Varroa* mites to be unable to rear new daughter females.

The research effort found a bee colony in Toulouse, France, where ½ the male brood produced an equal mixture of normal mite females and non-reproductive *Varroa* females. The ratio indicates a single gene was responsible. Looking at the DNA of 45 drones (drones have 16 chromosomes compared to the 32 of workers and queens) the authors report finding an allele of a gene that they consider to be the one responsible for the non-reproductive mite females. It will of course take more testing as the gene might also be responsible for other important functions in bees. Exactly how the mutated gene results in non-fertile *Varroa* mites also needs to be determined. Jay speculates on three possible mechanisms but speculates that perhaps this breakthrough might be "enough to declare victory on mites." Wouldn't it be ironic if use of the "lowly" drone provides a mechanism into making mites less reproductively capable?

Whatever our reference to drone, the artificial ones increasingly used in crop production, as a fascinating aspect of honey bee biology, as a mite trapping adaptation or for its role in insuring genetic diversity in bees they are worthy of our attention and respect. And for insuring healthy bees. No longer just the lowly drone, they are critical to the normal functions of the superorganism that is the beehive. BC

Dewey Caron is professor emeritus of the University of DE. He now spends time in OR, DE and Bolivia.

Economic Outlook For 2020 Almond Pollination Season

Brittney **Goodrich**

The following article summarizes my outlook for the 2020 almond pollination season in terms of estimated demand for colonies, pollination fees, and other information I believe beekeepers will find useful before making the trek to California. Where possible, information is based on research and data, however some of the outlook comes from my best educated guess given the information available. In 2020, approximately 1.2 million bearing acres of almonds will require roughly 2.4 million colonies for pollination services.

2019 Almond Pollination Market

According to the 2019 California Almond Objective Measurement Report, there were 1.17 million bearing acres of almonds in 2019. This brought in roughly 1.86 million colonies into California. This was down from shipments in 2018, which were 1.93 million.

Abnormally wet and cold weather in the Central Valley made pollination services challenging in 2019. Nut set per tree was down 18% from 2018, and total yield in pounds per acre is projected at 1,880, down 10% from 2019 (USDA NASS and CDFA, 2019). Not all of this was due to poor pollination, growers experienced less than ideal weather conditions throughout the rest of the growing season. I believe the recent memory of last year's bloom-time weather will be a key factor in almond grower's almond pollination decisions this year.

Almond Returns and Acreage Trends

As of October 15, 2019, almond prices were between $2.63 to $2.98 per pound depending on the variety. Prices have remained fairly steady in this range since 2016 (Champetier, Lee, and Sumner, 2019). Almond returns per acre have also remained fairly steady since 2016, though these returns seem small when compared with the 2013-2015 time period with almond prices well above $3 per pound.

Figure 1 shows trends in planted almond acreage since 2007. Since 2015, Nonpareil, the largest planted variety, and other varieties have seen planted acreage decreasing. This slow in planted acreage corresponds with those decreasing almond prices. Additional concerns about available water going forward has likely contributed to this slowing in planted acreage.

Pollination expenses as a percentage of operating costs have increased from 6.7% in 1998 to 20% in 2016 (Champetier, Lee, and Sumner, 2019). Consequently, there has been a lot of discussion in recent years about self-compatible almond varieties (Independence and Shasta) as a way to alleviate some of the pollination expenses. Figure 1 shows the significant increase in self-compatible planted acreage from 2013-2016, however planted acreage has leveled off and decreased since 2016. This is likely due to a combination of lower almond returns in general, coupled with the Independence variety not receiving expected premiums in comparison to other varieties (Champetier, Lee, and Sumner, 2019).

Figure 2 shows planted acreage in 2018 by county in California. As expected, counties in the San Joaquin Valley have the highest amount of planted acreage. Figure

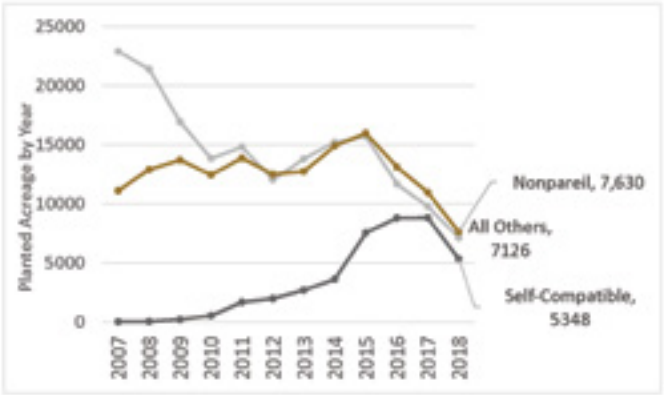

Figure 1. *Planted Almond Acreage by Year, 2007-2018. Source: 2018 Almond Acreage Report, USDA, NASS and CDFA*

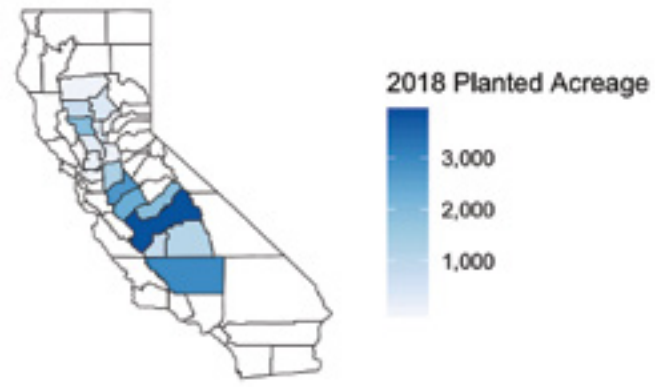

Figure 2. *2018 Planted Almond Acreage Source: 2018 Almond Acreage Report, USDA NASS and CDFA*

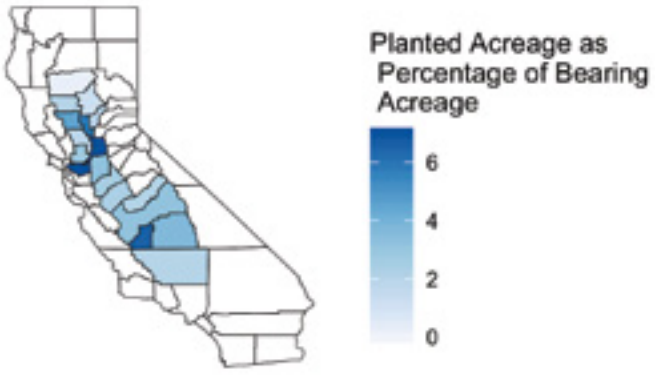

Figure 3. *2018 Planted Almond Acreage as a Percentage of Bearing Acreage. Source: 2018 Almond Acreage Report, USDA NASS and CDFA*

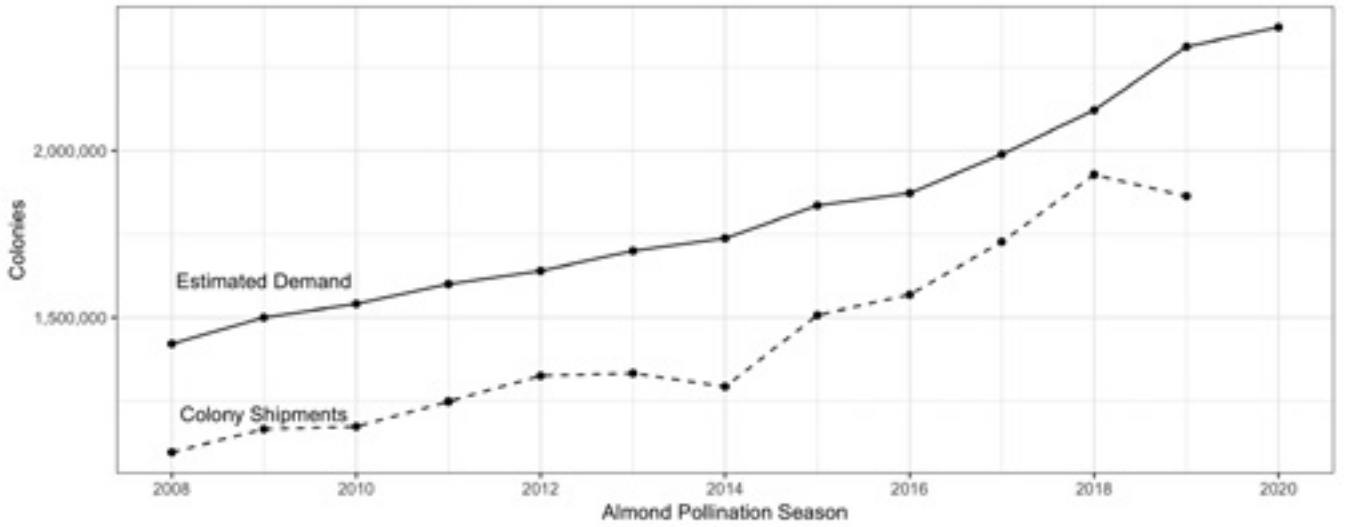

Figure 4. *Estimated Demand for Colonies and Colony shipments into California, Almond Pollination Seasons 2008-2020*
Sources: 2008-2018 Almond Acreage Reports, USDA NASS and CDFA; Apiary Shipments through California Border Protection Stations, CDFA Plant Health and Pest Prevention Services

3 depicts similar information, but reflects 2018 planted acreage as a percentage of the total bearing acreage in each county. When controlling for the total amount of bearing acreage, percentage increases are distributed fairly evenly throughout the state.

With the exception of Contra Costa and Sacramento counties in Northern California, increases as a percentage of bearing acreage by county range from 0.2% to 6.5% of total bearing acreage. Contra Costa and Sacramento counties each saw increases over 40%, but combine for a total planted acreage of 217 acres in 2018.

Colony Demand and Shipments into California

Figure 4 plots the estimated demand for colonies based on bearing almond acreage each year, compared with total colony shipments into California. Estimated demand is calculated using two colonies per acre for traditional varieties and 1 colony per acre for self-compatible varieties. There is consistently a gap between estimated demand and colony shipments, which is filled by colonies that remain in California year-round.

Overall, total colony shipments into California went down by approximately 4% between 2018 and 2019 almond bloom. The Bee Informed Partnership colony loss survey in 2018/2019 found the nation's highest average winter mortality rate (37.7%) recorded since the survey began. This provides some explanation for the decrease in total shipments into California. Total estimated demand for colonies has continued increasing and is up to 2.37 million colonies in 2020, so I do not see this decreasing trend in shipments continuing into 2020.

Idaho, North Dakota and Florida remained the top three states shipping colonies into California (Figure 5). As discussed by Hitaj, Smith and Hunt (2018), many honey bee colonies are transferred from the Northern Great Plains to the Pacific Northwest after honey production is finished to be stored until almonds bloom in California. So, even though Idaho looks like the top shipping state

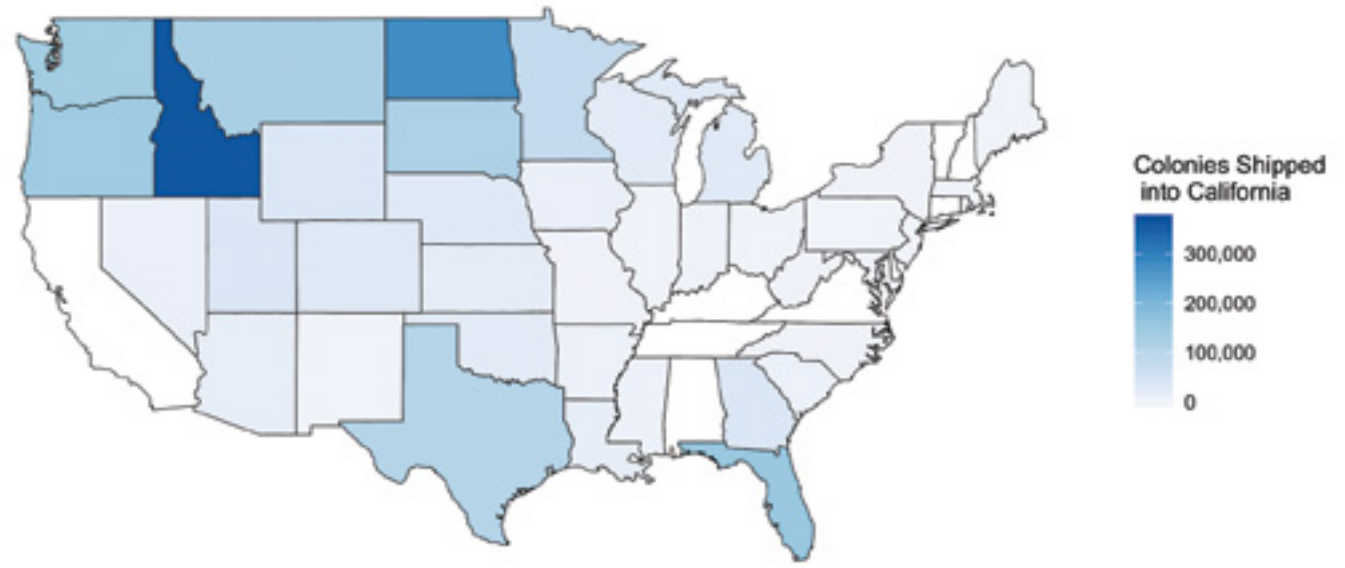

Figure 5. *Colonies shipped into California by State for 2019 Almond Pollination*
Source: Apiary Shipments through California Border Protection Stations, CDFA Plant Health and Pest Prevention Services.

according to the California Department of Food and Agriculture (CDFA) border shipment data, many of those colonies in reality are coming from elsewhere.

Table 1 displays the numbers of honey bee colony shipments from the top 10 states shipping colonies into California for the 2019 bloom, and the percentage change from 2018 shipments. Florida and Texas saw large decreases in the number of colonies shipped for almond bloom. This was fairly surprising, given that prior to 2019 almond bloom, Florida and Texas had seen some of the largest increases in colony shipments to almonds (Goodrich, Williams, and Goodhue, 2019). Texas beekeepers experienced losses of 46%, suggesting at least part of the decrease in colonies shipped from Texas can be attributed to high Winter losses. Florida beekeepers saw losses below the national average (17.6%) suggesting decreases were from something other than colony losses alone. Perhaps Florida (and possibly some Texas) beekeepers who participated in 2017 and/or 2018 almond pollination may have decided the costs participating in almond pollination were not worth the returns.

State	Colonies Shipped for 2019 Almond Bloom	Percent Change from 2018
Idaho	360,127	6%
North Dakota	277,961	4%
Florida	156,432	-27%
Oregon	145,483	-3%
Washington	141,234	1%
Montana	127,373	3%
South Dakota	118,809	9%
Texas	105,497	-22%
Minnesota	77,527	2%
Utah	38,737	14%
Net change for top 10 states		**-2%**

Table 1: Colonies shipped into California by State for 2019 Almond Pollination
Source: Apiary Shipments through California Border Protection Stations, CDFA Plant Health and Pest Prevention Services

Almond Set Vs. Final Yield

Joe **Traynor**

The sole purpose of plant and animal species is to pass on their genes to the next generation and to future generations. For almonds, it is the seed or kernel that transmits these genes. Before modern farming, isolated almond trees produced maybe 100 almonds per tree. Today, with ample compatible pollinizer varieties for cross pollination and with good populations of pollinating insects (mainly honey bees) an almond tree can produce 14,000 almonds (aka kernels or meats) per tree, which translates to roughly 3,000#/acre.

Almond flower production can vary from 40,000 to 90,000 blossoms per tree so all it takes in most years is a 25% set to get a 3000#/acre crop. Individual almond flowers produce 40,000+ pollen grains per flower. Since all it takes is one pollen grain to set an almond, accomplishing a 25% set is not an unreasonable task for bees. Barring catastrophic weather, many more almonds will be set from pollinated flowers than the trees can hold. Drop of pollinated nuts starts after petal fall in March and continues through June. The tiny nutlets from flowers that were not pollinated start dropping within a few weeks after petal fall and can be distinguished from pollinated nutlets by pushing them with your thumb – pollinated nuts will remain on the branch or spur, those that weren't pollinated won't. A significant drop of pollinated nutlets occurs every year. This drop can be discouraging but is Nature's way of balancing crop load with overall tree health.

An almond tree not only has to bring it's kernels to the finish line (to harvest), but must also must drag the hulls and shells along with them. Because green almonds are 52% hull (vs. 14% kernel and 32% shell) bringing hulls to harvest represents a significant drain on a tree's resources. The hull burden on almond trees is analogous to requiring a runner to carry 50# weights during a one mile race – the runner can discard the weights before reaching the finish line, the almond tree cannot. The almond tree compensates by shedding green almonds – hulls, shells and kernels.

Almond trees and peach trees are closely related. Peaches command a high price (around $500/ton) because of their tasty flesh (called "endocarp") that surrounds the seed-containing pit. The endocarps (hulls) of almonds are, like peaches, high in sugar and nutrients making them an excellent and tasty feed for dairy cattle. With current problems in the dairy industry plus more hulls from increased almond acreage, hull prices have dropped from $120 to $60/ton in recent years. Income from almond hull sales is a nice source of extra income for almond growers; it used to be enough to cover hulling costs, but not anymore. The almond industry is working on and is optimistic about developing new markets for their nutritious almond hulls

Like almond trees, peach trees also drop pollinated fruit after petal fall, but not enough for the

Almond Pollination Fees

Table 2 shows minimum and maximum reported almond pollination fees, and average almond pollination fees for the California State Beekeeper's Association (CSBA) pollination fee survey for years 2017-2019. (Note: the 2019 results should be viewed as preliminary.) According to the CSBA survey, average almond pollination fees have gone up around $5 per colony per year since 2017. The range in fees seems to have grown over time, in 2019 there is more than a $60 difference per colony between the lowest and highest fee reported. From talking with others in the industry, the average fee of $195 in 2019 may be on the lower side. Fees for a majority of colonies likely ranged from $200 to $220 per colony in 2019.

The range in fees reported is likely due to differences in colony strength requirements. In a 2015 survey of almond growers, I found a 5.7% premium paid for colonies contracted above the industry standard (Goodrich and Goodhue, 2016). If we assume the 2019 CSBA average corresponds to an average fee for an 8-frame colony, that means a higher than industry standard colony would have rented for on average $206 in 2019.

CSBA asks their beekeepers about projected fees for the upcoming pollination season. Many beekeepers will have already made some of their contractual arrangements in advance by the time they respond to the survey, so these projections are fairly reliable. The average projected fee per colony for the 2020 pollination season is $204. Again, if we factor in the 5.7% premium, that means a projected average of $216 per colony for those contracted above the industry standard of 8 frames.

Supply Issues for 2020 Almond Bloom

Given that most of the colonies in the U.S. already participate in almond pollination, it is important to think about where additional colonies will come from for the 2020 pollination season. In a research article, co-authors and I thoroughly explore this issue, in short, we expect Florida, Texas, Georgia and Louisiana to supply a large

Year	Mininum Reported	Average	Maximum Reported
2017	$ 165	$ 184	$ 200
2018	$ 165	$ 190	$ 210
2019*	$ 170	$ 195	$ 234

*Responses as of November 1, 2019

Table 2: California State Beekeeper's Pollination Fee Survey-Almond Pollination Fee Results, Almond Pollination Seasons 2017-2019

remaining peaches to reach optimum marketable sizes. As a result, peach growers spend up to $1400/acre to thin peaches, a major expense not incurred by almond growers. Unlike almond growers, peach growers get little or nothing for their peach pits or for the seeds within the pits.

During almond bloom in 2013, USDA workers counted the number of pollinated almonds set on limbs in a Kern County almond orchard stocked at three bee colonies/acre and compared them with those from an orchard stocked at 1.5 colonies/acre. The almond set was determined after petal fall and was significantly higher (around 80%) at the higher stocking rate. This higher initial set did not translate into higher yields because of the higher drop of green almonds – the higher the initial set, the greater the later drop. Final yields on both plots were about the same. The take-home message: *higher bee stocking rates will increase the number of almonds that are set, but will have no effect on final almond yields.*

Current bee recommendations for almonds are to use two colonies of bees per acre, with the colonies to average eight frames of bees per colony. Some crop insurance companies accept 16 frames of bees per acre, which can be supplied by 1.5 colonies of 12-frame strength. Two colonies/acre has been and currently is, the accepted bee stocking rate for almonds, in spite of the fact that there is no solid data to back up this recommendation. Because the flight range of bees is 2+ miles, an adequate test for bee stocking rates would require comparing yields on an isolated orchard stocked at two colonies per acre with one or more orchards at least two miles away stocked at one colony per acre or less – both orchards would need to have identical cultural practices. Such isolated orchards have never been found, which is why there never has been, and probably never will be, an acceptable study on bee stocking rates.

The original bee-stocking rate was published by UC in 1947 in Circular 103 on almond culture: "*In general, 1 hive per acre is ample, even in adverse seasons.*" One could quibble about the use of the term "hive" (rather than colony or frames of bees), but this recommendation should still hold today. A number of growers use only one strong bee colony per acre and are happy with their excellent yields.

The cool, rainy 2019 almond bloom certainly qualifies as an "adverse season" for almond pollination, yet final almond yields were far better than many expected or predicted in March – a good indication that bee stocking rates were more than ample. Most almond growers could trim their operating budgets significantly by using half as many bee colonies as they currently use. They may have to show their crop insurance agent that they are renting strong bee colonies and spend time convincing these agents that they are supplying their orchards with ample numbers of bees, even at a stocking rate of one colony/acre. Crop insurance requirements are the biggest impediment to growers that would like to cut back on their bee numbers. Almond growers should enlist the support of UC and the Almond Board to convince crop insurance people that current bee requirements are excessive. BC

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amount of increased almond pollination going forward (Goodrich, Williams and Goodhue, 2019). Clearly, as seen in Table 1, Florida and Texas saw decreases in their supplies of colonies between 2018 and 2019. This suggests fees may have to increase even further to get sustained participation from beekeepers in these areas.

One issue that I foresee as a potential problem this year is the drought that has been occurring in parts of the south this fall. From September through the week of November 5, 2019, Georgia and Texas have been experiencing at least a moderate drought over 58% and 48% of each state, respectively (National Drought Mitigation Center, 2019). Florida and Louisiana have seen smaller, but still significant averages of 18% and 13% of the total area in each state experiencing at least moderate drought. These are states that beekeepers often place colonies in after honey flow in the Northern Great Plains (Hitaj, Smith and Hunt, 2018). The southern climate usually facilitates at least some pollen and nectar flow during the fall months. This year, southern beekeepers likely had to provide more food supplements than usual. This has the potential to impact the overall health of colonies coming out of these southern states.

BeeWhere Registration

As a reminder, beekeepers entering California for almond pollination are required by law to register colonies in the BeeWhere program. The registration cost is $10 per beekeeper, no matter how many colonies. The goal of this program is to help minimize pesticide exposure for honey bee colonies by alerting beekeepers when pesticide applicators plan to apply chemicals nearby. Additionally, this will provide better information on the true causes of bee kills when pesticide exposure does occur.

I have not heard if fines will be applied this year for noncompliance, however it is a possibility. Beekeepers may register colonies online at the following link: **https://beewhere.calagpermits.org/**

Conclusions

I believe the memory of last year's cold and wet almond bloom period will be weighing heavily on grower's minds going into this season, as will lower per-acre yields in 2019. To me this means almond growers will want many strong colonies to ensure adequate pollination, but smaller returns will have them wanting these colonies at a cheap price. For the business savvy beekeeper, this can provide opportunities. Are there any benefits you can request to provide your grower with a discount per colony? One thing that comes to my mind is asking for a portion of the payment up front in exchange for a lower per-colony fee. This can provide some working capital to use to pay transportation, treatment, or feeding costs required before almond bloom, in addition to providing additional security in your pollination agreement.

Best of luck with your almond pollination agreements, and wishing you a happy, healthy and prosperous year in 2020! BC

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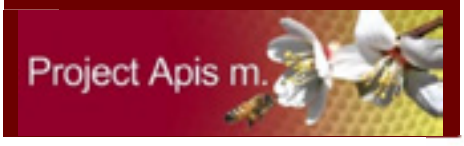

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Honey Bee Colony HVAC

Frank **Linton**

Hive Changes Needed

If you pay the bills for heating and cooling your home, you are aware of the high cost of maintaining a comfortable interior environment. But the price our bees pay to maintain a suitable environment in their hives is invisible to us. Still, it seems reasonable to assume that if we can greatly reduce our costs for heating, cooling, and ventilation (HVAC) simply by adding insulation and optimizing ventilation to our homes, it might also be possible, and rewarding, in terms of health and productivity, to also reduce the resources our bees devote to HVAC chores in their hives by the same methods (Linton, 2018; Mitchell, 2019; Sammataro & Avitabile, 2011).

Our current beehives are designed to be convenient and economical for beekeepers; they are not designed for the bees. The conditions the bees prefer, however, are not a mystery, nor is it a secret how the bees go about achieving those conditions.

To begin with, in temperate climates bees have evolved to live in tree cavities, which are characterized by small size, thick walls, and small entrances. However, the ideal in-hive environment also depends on the bees' in-hive activities. Specifically, whether the bees are raising brood, processing nectar into honey, or overwintering (see sidebar). It seems to me that the tree cavity dwelling is ideal for two of those activities, brood rearing and overwintering, because the thick walls provide good insulation from exterior temperature extremes, and the small entrance provides sufficient, but not excessive, ventilation (and is more-easily defended).

Tree cavities, however, are not good environments for producing honey. Fortunately for the bees this doesn't matter much because, when they live in a well-insulated tree cavity, they do not need a lot of honey (Seeley, 2019). Here is the problem: Nectar contains a lot of water that must be removed to turn the nectar into honey. For example, if a nectar is 60% water, then the bees must remove water that amounts to about 50% of the nectar, or about 5/6 of the water. Removing the water is a two-step process. First, the bees must remove the water from the nectar, then they must remove the water from the air in the hive.

There are two ways bees can remove water from nectar. First, they can heat the nectar, as warmer water evaporates faster. This can take a lot of energy; recall, for example, the energy it takes to boil away a quart of water. Second, the bees can replace the moisture-laden air near the nectar with less humid air by fanning. Bees use both these methods. The most-efficient combination of them probably depends on both internal and external temperatures and humidities. For making honey, though, warmer nectar is better than cooler nectar, and drier air is better than moister air, and the bees need to maximize these conditions to remove water from nectar efficiently.

The second step is to remove the warm, moisture-laden air from the hive. Again, there are two ways to do this. First, if the walls of the cavity are significantly cooler at the bottom, is to let water condense out of the air, like dew condensing on a lawn in the evening. This condition would not seem to be common. The second method is ventilation, exchanging in-hive air with fresh air from outside. The tree bee nest, with its small aperture near the bottom of the cavity, would appear to make this task very difficult for the bees. Still, if bees in trees need little honey, and the nest is optimal for brood rearing and overwintering, it is understandable that bees choose this place to live.

On the other hand, beekeepers are traditionally interested in honey production ("Honey is money"). And as it happens, current beehives, with their thin walls and large entrances, appear to be designed for honey production. The thin walls of the hive enable the interior of the hive to heat up quickly when sunshine or warm outside air impinge on the exterior surfaces of the hive. More importantly, the large entrance enables bees to exhaust moist air from the hive while simultaneously drawing in relatively dry air (Mangum, November 2017, *American Bee Journal*. Figure 1, page 1189).

These same features that make conventional beehives good for honey production make it difficult for bees to carry out their other two main activities, raising brood and overwintering. As readers know, bees keep brood at a constant temperature and humidity. When exterior conditions vary widely, both over the course of a day, and

Reported R Values

• Soft pine hive (2 cm thick):	R1
• Lyson polystyrene hive (2.2 cm thick):	R6
• Superior polystyrene hive (5 cm thick):	R8
• Tree (wall 25 cm thick):	R14

Factors Affecting Ventilation

- Colony's ventilation activities
  - Fanning at entrances
  - Propolizing entrances
  - Internal fanning
  - Bearding
- Colony's in-hive activities
  - Nectar processing
  - Brood rearing
  - Overwintering
- Hive structure
  - Natural internal temperature
  - R-value of insulation
  - Number, size, and location of apertures, including entrance and screened bottom board
- External situation
  - Temperature
  - Solar radiation
  - Wind direction and velocity

from day to day, conditions in a poorly insulated hive with a large entrance will also vary widely if uncontrolled, and the bees must work very hard to overcome these variations and maintain the stable environment that brood requires.

Just how much energy and effort bees would be saved if beehives were optimized for brood rearing is currently unknown, but common sense and current research (Mitchell, 2019) indicate it may be significant. If so, then replacing thin wooden hive boxes with thick foam ones would be a step in the right direction, as would varying the size of the hive entrance to optimize ventilation rates.

Bees have evolved to overwinter well in tree cavities with their thick walls and small entrances. Again, our conventional beehives provide a radically different design, thin walls, and large apertures. And, as we know, bees in these hives consume a lot of honey to stay warm, they often die because they cannot break cluster to reach the needed honey, or die from moisture condensing overhead and dripping down onto them. In contrast, bees in tree cavities or well-insulated hives consume relatively little honey, they can move about to obtain it, and the moisture resulting from honey consumption condenses at the bottom of the hive's interior.

So, it appears that a well-insulated hive is an energy-saving device that is useful all year round, as insulation enables the bees to maintain the interior conditions they consider optimal with a minimal energy expenditure to compensate for fluctuating external temperatures. And thick foam hives are readily available from several vendors.

In contrast, the size of the hive entrance should be adjusted according to the colony's needs; i.e., smaller when exterior conditions are less desirable than interior ones, and larger when exterior conditions are more desirable than interior ones.

While it may be possible for a beekeeper to manually adjust the size of the hive entrance, an automated entrance size controller would be labor-saving and more responsive to the continuously varying conditions within and outside the hive. The sensor for an automated entrance size controller could be a microphone tuned to the sounds of bees fanning. When bees were not fanning, the entrance could be minimized. As bees begin to fan at the entrance, its size could gradually be increased until fanning noise is again minimized. Several other sensors could be utilized to make more subtle adjustments. For example, the temperature, humidity, and airflow rates on the incoming and outgoing air streams would also be informative.

Optimal in-hive conditions are reported to be:

- For brood rearing (Linton, 2018)
  Temperature: 35°C
  Humidity: 55% relative humidity (RH)
- For nectar processing: low vapor pressure (Mitchell, 2019)
  Temperature: >35°C, Higher is better
  Humidity: <60%, Lower is better
- For winter clustering (Sammataro & Avitabile, 2011)
  Temperature: 7°C (7°C to 14°C)
  Humidity: 50% RH.

Any automated entrance size controller will have to be designed to deal with propolis on the moving parts of the size-changing mechanism. Also needed will be a microprocessor to interpret sensor data and to activate the entrance size controller, plus some memory for recording the controller's actions over time, and a power supply. A quick internet search reveals that currently there are no automated entrance controllers on the market. For engineering majors, this would be a good senior or master's-level project.

Modern engineering schools strive to engage student groups in small, practical, socially relevant engineering projects that have commercial potential. I have worked with several universities and student groups on this sort of project relating to honey bees and beekeeping. The students are strongly motivated, they find the projects particularly rewarding, and some go on to create startups based on their work.

So, where does this leave you, the beekeeper? First, you can try switching half your hives to well-insulated ones. If the colonies in these hives turn out to be healthier and more produce than those in your conventional hives, other things being equal, you have learned something useful. Second, you can review your connections to find

Excess/Insufficient Ventilation Effects		
Ventilation Effect on	**Insufficient Ventilation**	**Excess Ventilation**
Brood	Overheats brood	Cools & desiccates brood (may overheat brood in summer)
Pheromone communication	Reduces pheromone circulation	Reduces pheromone communications
Nectar Processing efficiency	Reduces nectar processing efficiency	Reduces nectar processing efficiency (may increase efficiency)
Winter cluster	Suffocates colony	Cools & desiccates Winter cluster

engineering students and universities. Students' projects are often well-publicized. Contact the professors involved and let them know that you, and I, are willing to work with them to help design and test their entrance size controllers. Your bees, and everyone else's, may benefit, and the long-term benefit may be substantial. Finally, keep in mind that these projects are also, and perhaps primarily, learning experiences for the students and you will have a great time.

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Visit beesfordevelopment.org
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Self Sufficient Through Beekeeping

Richard **Harrington**

Keeping bees can be an expensive business or hobby. Even for those of us who maintain our hives well and re-use materials wherever possible, profits tend to be minimal. Beekeeping equipment, made professionally, is expensive. How can anyone in desperate need of money possibly begin a beekeeping career?

The truth is, beekeeping can be done skilfully and successfully with very little money. Hives can be made from all sorts of materials, such as bark or grass, hollowed logs or items usually considered trash. Even the bees can come free, and they do not need to be fed: they find their own food and water. At the same time, the benefits of keeping bees for their pollination effort provides a win for the environment, for impoverished farmers, and for people in difficult circumstances.

And circumstances can be dire for many people. In the Amhara region of Ethiopia, resources are scarce, and jobs hard to find. Most young people here own no land and face a stark future. There is no social security to fall back on; men and women must find poorly paid casual labour, toiling land for crops and burning trees for charcoal. Rural landless households face food shortage for about four consecutive months in every year.

We found Alemnesh Niguru in this situation in 2017; she had been taken from primary school and married to an older man. She was unhappy and ran home to her family where she felt she was a burden, and her prospects were poor. She had no education, could not be married again and was an extra mouth for her parents to feed. What could she do?

Her life changed when she was selected for a **Bees for Development** course. With some intensive training, and some inexpensive equipment, she has a new earning potential. Now that she is selling her honey, she has money for the first time and can make decisions about her own future.

The wonderful nature of bees makes beekeeping such a great way to help life people out of poverty.

While beekeeping does not need to be expensive, it does require knowledge and skills, and investing in learning is what **Bees for Development** majors in. In many places, people with skills and knowledge can be found locally. These individuals often readily share their knowledge, and can pass on many years' worth of skills and experience in how to use local resources to best effect.

Beekeeping can't be expected to solve the poverty problem for a whole region or country. It can help individuals provide for their families, keep children in school, and open opportunities they would otherwise miss. Mulu Abeje, a father of two, also in Ethiopia, didn't have an education, and with no land of his own, had no means to support himself other than through irregular, low-paid labouring work. Mulu was trained and supported by **Bees for Development,** and now uses beekeeping to help his children get the education he never had.

A log hive and a woven hive made in a training workshop, Ghana. A network of Master Beekeepers in Ghana share their experience and skills with new beekeepers. These include several cashew growers, who have seen an increase in their yields here, as well as providing them with new income from honey.

Alemnesh Niguru with honey for sale in Amhara.

Mulu Abeje is able to give his children the opportunity to stay at school thanks to the benefits of beekeeping.

In some places, beekeepers are active in protecting forests where their bees live. Without their interest and protection, the trees would be felled, and ancient forest lost to the spread of cultivation. The trade in honey is protecting forest in North West Zambia; here, beekeepers harvest honey deep in the forest where the best nectar trees are found. Zambian Beekeeper Pathias Ngolofwana can carry eight 25Kg buckets of honey across the Lunga river in his canoe. He then carries these two at a time on his bicycle for a further 10km through forest tracks. *Pathias* believes anyone can become a beekeeper because, he says, "it is an easy job"!

The honey that comes from these tropical forests is of a superb, untarnished quality. As well as being uniquely flavorsome, there is no way that chemical treatments of the type used on farms and gardens throughout much of the world will be present in the product, as their bees live in forests far from any chemical sprays. This honey should be valued more highly than it is at present, helping people like Pathias and giving more reason to protect natural forests.

Some people argue, especially in places where money is very tight, that yields need to be maximised by any means; the temptation to start the endless cycle of investment in frames, boxes, tools, chemical treatments and more is great. Loan sharks are ready and willing to offer expensive credit. The last thing a person in financial difficulty needs is equipment provided on credit that puts them immediately into more debt.

It follows, then, that providing the types of hives used in western world beekeeping - to people who are desperate to find a way of making a living - is not always an appropriate way of giving help. And yet, too often we see agencies persist in bringing what are sometimes termed "modern" hives to people in need. And often we hear of agencies disappointed by the lack of success and uptake of the donated equipment, too. Hives must be appropriate for their situation. Beekeeping needs to be a genuinely sustainable option for people, and this tends to coincide with what is sustainable for the bees themselves, and for the environment in which these bees and people are situated together.

Bees for Development was born from the real need to bring sustainable beekeeping to those in deep hardship, focussing on training and other aspects such as helping beekeepers find markets and adding value to their products. BC

Beeswax candles, Uganda. As well as honey, products such as beeswax, pollen and propolis can be harvested, and used to make valuable secondary products. This opens markets and adds value for the beekeeper, and income generating possibilities for more people in processing, crafting and selling these goods.

Bees for Development is a UK non-profit that works internationally to help some of the world's poorest people to become self-sufficient through Beekeeping. Every donation to ***Bees for Development*** helps us to fight chronic poverty, empower those with whom we work, and contribute to biodiversity maintenance. Donate at ***www.beesfordevelopment.org***

The organization has several high-profile patrons, including Prof. Tom Seeley. Bees for Development North America is a 501c3 organisation, run by Megan Denver of Hudson Valley Bee Supply.

Are You Listening?

NOTES FROM THE BOARD

Apis M. **Mellifera**

Our Greatest Value: Cross Pollination

We have been listening of late to the whys and wherefores of our importance. Of course, most are aware of our honey-, beeswax-, and royal jelly-making activities, not to mention the collection of pollen and propolis, which are important to both bee and human communities. But our major importance, according to those touting our primary strength, is propagating plants so important to the human food supply via pollination.

No less than 90 agricultural crops are often listed as benefited by us as we search for nectar and pollen among their blossoms. This pollinating activity has been estimated to be anywhere from 10 to 20 times the value of our most important products–honey and beeswax. All told, we are said to be responsible for approximately one-third of the United States food supply. We are no little puffed up with importance over this.

Like so many good things, however, our abilities risk being exaggerated out of proportion. In the long run, this can have adverse consequences on the credibility of the above statements. To say, or even hint, as some are wont to do, that without honey bees there would be some sort of basic food shortage either in the United States or the world is simply not telling it like it really is. And we can say pretty conclusively that the quote often repeated and reputed to come from Einstein concerning the fate of humanity's food supply should honey bees not be present, is pure fabrication.

Unfortunately, the fact is that the majority of most of the world human food crops is not insect-pollinated to any degree and thus not benefited by us hardly a wit. The twelve foodstuffs on which the human world survives are either grains like wheat, rye, barley, millet, sorghum, rice and corn, or stems and roots such as potatoes, sweet potatoes and cassava. Bananas and coconuts round the list to an even dozen.

Quantity aside, we take considerable pride in providing diversity and quality. Consider, for example, our most valuable and dependent crop on pollination in the United States, almonds. Life could go on without these nuts in the human world we suppose, but for some it would certainly be less enjoyable without scrumptious, plump bits of almond in salads, or the desserts these often so exquisitely compliment.

Without our considerable efforts, fruits like apples, cherries, peaches, plums, and black or blueberries would be fewer and inferior in quality. Furthermore, the cucurbits like squash, pumpkin, and cucumbers would be in shorter supply each year as the wild pollinator habitat continues to be systematically destroyed by pesticide application and other activities associated with large-

scale human agriculture. And what about sunflowers, soybeans, rape and peanuts? Our labors also have just begun to be realized as important in hybridizing certain crops like cotton and onions.

Finally, meat production could well suffer for lack of top-grade nutrition provided by forage crops like alfalfa which we pollinate. Nitrogen fixation may also be reduced because those unique legumes like alfalfa, clover and vetch, which attract us bees in droves, provide such good nectar and need pollination for propagation.

Perhaps our greatest value has yet to be realized perpetuating diversity in plant species by cross pollination, a hedge against humanity's age-old agricultural practice of simplifying agriculture by narrowing the genetic base of the food supply. In summary, our advice is to praise the quality inherent in our pollination efforts, as well as their in diversification and hybridization potential. Concentrating soley on quantity may leave us with insufficient evidence in the future to guarantee our survival.

A spate of debate has brought out of seclusion an age-old, time-worn topic that concerns the board of directors. Whether honey is better than sugar. The arguments on both sides are legion. One school believes honey is a complete (some say "perfect") food that contains not only carbohydrates, but minerals, vitamins, and amino acids, the building blocks of proteins. Sugar on the other hand is so-called "empty" calories." This results in the idea that honey is basically all sugar, and sugar is sugar, so their should be no conflict?

Digging deeper, we see that honey is not just sugar, but a mixture of simple sugars broken down from complex carbohydrates like sucrose and ready to go to work in the human body in numerous ways. They point to famous athletes and others engaged in strenuous physical activity who get a real charge out of eating honey, which contains fructose and glucose. Maybe so, responds the other side, but sugar (sucrose) too can be broken down by the human body into the simple sugars found in honey. In addition, there's evidence that the human body may preferentially absorb the simple sugars that it itself has broken down, rather than those directly ingested from outside sources. And so on. And so on.

We bees would like to insert our two cents worth into the discussion and help beekeepers and others look at the controversy differently – from a human economic as opposed to a nutritional perspective. We know honey costs more money than sugar in the store, but is it really more expensive? Money is a human invention; we bees refuse to use the stuff. Instead we prefer another universal measure of value, energy expenditure.

It takes energy to do things in this world. All energy comes from the sun, and is incorporated initially into plant materials through photosynthesis, which is then exploited by bees, humans and all other life on this planet. Plants expend energy to grow; we bees need energy to fly, collect nectar and pollen and process hard-won gain. Perhaps our most expensive energy cost is evaporation of water from nectar (70 or 80 percent moisture) to the final product, honey (19 percent water).

The energy expense to the beekeeper is labor in managing and harvesting the crop, and mechanical or fossil fuel input via heating, filtering, bottling and transporting the sweet for eventual sale. The energy costs in honey production are indeed significant, but can pale in comparison to those for processing sugar from beets or cane. The ground must be prepared, the plant grown and harvested, and resultant sugar refined into a processable commodity. All this takes a great deal of energy, before a further expense comes into play later, however, evaporating the water off before being sold. Add to this the fact that raw product is often transported long distances to centralized refineries at significantly more energy cost.

So why does sugar still cost less at the store? Because so many of its production expenses are "externalized"; they don't find their way into the accounting books or balance sheets as monetary costs for humanity. Instead these become "environmental costs" that are looked at as "free," but can result in air pollution, solid waste disposal, or social costs, and resultant unemployment due to centralized, technological or machine processing.

Finally, land-use policy favoring large-scale producers can often force small producers off the land and into the unemployment lines with large social costs that are shouldered by society as a whole, and not listed on any balance sheet. In summary, this "tragedy of the commons" is unfortunately the result of a great deal of human activity around the globe measured in human economics terms.

One study has stated that sweets and drinks may contribute up to a third of total energy credits for human food consumption. It suggests it might be interesting to look for energy-efficient and non-consumption alternatives to the current human "sweet tooth," concluding: "If eating sweets means comfort, perhaps an energy efficient back-rub could do the trick?" Those humans who can't kick the carbohydrate habit, however, at least now have the knowledge that we honey bees take the top prize in producing the most environmentally friendly sweet.

In the final analysis, we conclude that honey production is far less expensive in capital expense and energy than sugar. It employs more people (labor intensive) and is environmentally less costly with a minimal carbon footprint. Now which is better, honey or sugar? BC

BEE LIVES

They Will Know Summer

A Board Game Played by Beekeepers Who Recommend It – If You Heed Their Experience

M.E.A. **McNeil**

The beekeepers arrived at my door. "Do we take off our clothes or put down cash?" was the first question, playfully ready for a board game about bees. We had closed up our all-too-real hives for the season with enough anxiety for what we'd find when we'd open them again that we all had a cheery kind of hope for this evening -- a time to just have some fun with bees, even if they were toys.

They came to play the new board game called Bee Lives: We Will Only Know Summer. This happened because the venerable peer-reviewed academic magazine Science reviewed the game, only the fourth time in its 140-year history that it had considered such a diversion, and we were all intrigued. A game that's *really* about bees?

The eight beekeepers assembled had, all told, about a hundred years of beekeeping experience among them, as well as a passel of advanced degrees – a good group for a lively evening of bee play as well as the universal sport of beekeepers: opinion sharing.

The game was created by Philadelphia beekeeper and librarian Matt Shoemaker. He is not a traditional librarian: He works at Temple University at the Digital Scholarship Center with various innovations such as 3-D modeling and virtual reality. His work is part of a tech revolution in play-based education that coincides with a renaissance in board game play.

For those of us who have not been up on the evolution of board games, it's good to know that we humans were playing in the early Bronze age, a game comprised of rows of nodes carved into rock, found at multiple sites in the Fertile Crescent. The game Senet has been retrieved from Egyptian tombs. Go was played in ancient China, and backgammon was played in Mesopotamia nearly as long ago. Chess originated in sixth century India. Many pre-Colombian Mesoamerican cultures played patolli, a war and gambling game that depended on strategy and luck.

American settlers had little time for such games until the 19th century shift from agrarian to urban living and the accompanying increase in leisure time – for some at least. The 1880s to 1920s are known as a golden age of board gaming in this country. Children were encouraged to play games heavy with moral instruction, sending players along paths of virtues and vices, promoting the doctrine that the principled life would lead to success. Those themes were replaced mid-19th century with Algeresque rags-to-riches games, with the goal of accumulation of wealth. Monopoly was among several competitive capitalistic games in the 1930s, and it has become the most commercially successful board game to date.

A New Era

We all, it seems, shelved our board games or left them to the children for the last half century. Then, around 2000, a wave of inventive games reawakened a world-wide audience in what is called a new golden age of board games. It's huge: There are board game cafés and even a dedicated field of research into gaming known as game studies or ludology. The classic games, like Sorry, require players to follow a path to a goal and rely mostly on luck. Traditional abstract strategy games, like chess and checkers, involve a battle to outthink an opponent. What is different about the new games, and Bee Lives is one of them, is that their mechanics and artistic design have become more deeply thematic, with players having agency to manage resources. The game often cited as starting the movement is Catan, where such commodities as sheep and lumber are traded to build settlements.

The younger beekeepers gathered around our table are players of such games. (The rest of us are referred by board gamers to as "muggles," the non-magical people in Harry Potter.) Like Catan, Bee Lives is categorized as a Euro-style game, differentiated by strong themes and degree of interaction. Indeed, many of these games were created in Germany, but the Internet – which, ironically, has influenced this backlash of pleasure in face-to-face gaming – has made it possible for game inventors like Shoemaker to communicate worldwide with producers, testers and players. In addition, he has funded his game with Kickstarter, and he is not the only game designer to do so. "Most board game designers like me," he said, "Would just like to make their investment back."

What interests our gathered

board game players is that most such new games have themes but they are often no more than motifs, like Catan, which only nominally teaches about trade or settlement building. In contrast, Bee Lives purports to take place in more of a real world – the world of bees.

Meet the Beeples

"Cool," agreed the beekeepers as they sat down to the game table, surveying the beautiful artwork by Alina Josan and fingering the bee-shaped wooden playing tokens called "beeples" (a play on the word for pieces shaped like little humans known in the board-game world as "meeples", my people). At each of four game boards they discovered a little red wooden mite with evil eyes, good for a laugh -- for a change. In order to tag team to a bountiful buffet table and beers with creative names or wines, the players sorted themselves into teams: Susan Kegley, an environmental chemist who prefers to be introduced as a farmer, partnered with Master Gardener Sherrie Vigneron; professional Napa beekeeper Rob Keller joined with organizer of local bee breeding Cynthia Perry; Santa Cruz bee professional Emily Bonder with Rob Rowlands, an audio engineer who has worked with bee sounds; my husband Jerry Draper, our son Jerome and me, keepers of a small apiary at our organic farm.

As we began, it was Jerome who had been shanghaied into decoding the complex rules to guide the group. He was ready with an overview. What he did not anticipate is that these were beekeepers playing a bee game.

"Is it the treaters versus the nontreaters?" asked Perry, tongue in cheek.

No, he explained, the game comprises a year in the life of a hive. To begin, each player needs to choose a queen from different behavioral types: an aggressive queen, suggesting *A.m. scutellata;* a swarmy queen, suggesting Russian strains; a prolific brood-layer, suggesting an Italian strain, or a hygienic queen suggesting VSH. And it's possible to change queens as the game progresses.

Already there ensued a discussion of advantages and disadvantages of real life breeds. Poor Matt Shoemaker: He'd vetted his Bee Lives at enormous game shows, GenCon in Indianapolis and Spiel in Germany, where board gamers picked it up deftly in demo games. He concluded that a game would last about 30 minutes per player. We beekeepers, not so fast; there was much to be considered. The game had not yet started.

Jerome urged it on, passing a beautifully embroidered cloth bag around for players to draw out random hexagonal pieces representing vegetation, used to build out the game board. He explained that as the queen of a small hive, starting in March, each team must determine how best to use their few worker bees to expand and care for their hive, and that priorities are dictated by season. Most of the game play takes place during the productive months from March to November.

The Mighty Mites

Still there were questions. "What about AFB?" Each player had a separate card to track disease, and the little red mite token stands in for all of it. The mite moves negatively whenever a player forages or raids another hive. That trade-off passed the group's analysis; bees do pick up pests or disease from foraging or robbing. In the game, it's also possible to sacrifice a bee to clean up the disease, which elicited some shrugs. If only it were so.

"Pesticides?" The game designer has dodged that controversy, ignoring that danger. "Really?" said Kegley, president of the Pesticide Research Institute.

The first round began with the choice of an action – foraging pollen and honey, represented by little orange and yellow blocks; scouting to lay down a new environmental

tile or building wax by moving a cell-number marker as each colony began to build. That all made bee sense, and was fun enough until the first of the season cards was turned over. The cards determine monthly events, and the first one revealed an early reduction of forage. That passed the realness test with knowing sighs.

Each round encompasses a month, during which players made choices and after which Jerome directed a reset of the game pieces. Ah, the players welcomed a respite from the real world of beekeeping to find that lost workers return to their stash to be born again.

As workers multiplied, the hives risked swarming, true to life. The Keller-Perry team had chosen a swarmy queen "just for fun," and she created the first "wild" hive in the game when she left with half her workers. The players were quick to point out that "feral" is the correct word here, since none of the *Apis mellifera* subspecies is native.

"The multiplying villainies of Nature do swarm" *MacBeth*

The fun of the swarm queen was not shared by all; she was the first to upset the harmony of colony building. Her split-off hive created danger on the board, and things got serious. But that swarm was only the first. Players gathered pollen and honey to feed their bees and were crestfallen to see them become crowded and leave in a swarm. They were even more disheartened to realize that they'd spawned swarm colonies that would come back to rob their hives.

Although each player is a beekeeper managing a hive, the feral colonies go on to act autonomously. Such colonies operate like extra players, taking turns by following a list of actions to claim foraging locations and raid players' hives for honey. Apart from the game-world affront that the "wild" hive represented, the beekeepers agreed that element of the game was the least true to real bee behavior. Apart from *A.m. scutellata*, early season swarm hives tend not to "raid" other colonies, since their focus is on foraging and building.

Nonetheless, these bee wars became the main source of game-derived conflict. True, swarming early and often earns precious victory points, but it also creates more opportunities for future confrontation for everyone from the "wild" hives that are created. Summer swarms still get points, although fewer, even though our table noted that "a swarm in July is not worth a fly." A player can even still pick up a point for a swarm in November. Tisk, tisk was the collective opinion of the beekeepers whose real drones were done by then.

As the seasons pass, the vegetation represented on the tiles dwindles in foraging value – just as it does in nature. Shoemaker subtitled his game They Will Only Know Summer because he keeps bees in West Philadelphia, where there is a strong dearth.

In the end of our game, and a very long game it was, the players gave up on November. The evening had tilted toward more frustrating than invigorating, a lot like keeping bees – too much like keeping bees. Try as they could – changing queen types, creating more brood, expanding the number of board tiles (symbolic of scouting new forage), gathering pollen, nectar and even water (against overheating) – the players could not keep up with the attacks of the spawned "wild" hives created by intended or unintended swarming. Their hives were besieged by the rogue hives growing in nightmarish strength and invading as more colonies were going feral and the honey robbed.

The frequency of these raids diminished resources to the point where there was often too little for players to work with, and they gathered too many demoralizing tombstone-shaped starvation tokens. Five hours into it (compared to the predicted two), we all gave up. It was a dreary reminder of how we've often felt in our real apiaries for ever so long.

Winter game play offered a quick reckoning, concluding with brief months of rebalancing bees and honey to tally a final score, realistically determined also by the progress of the little red mite token along the disease counter.

Other Bee-Themed Board Games

Over a hundred bee-named board games can be found, most for children and a few more or less, mostly less, accurately related to bee behavior or beekeeping. Our gang did not play the following games, but among the hundred they were among those worth noting:

Like a Bee is an open source game with beautiful graphics, designed by Alayna Citrin. This educational game addresses the plight of the bees by asking players to engage with the cause by helping farmers pollinate crops as well as planting forage for wild bees. The board, tokens and cards illustrated with excellent photos of produce are downloadable to color print. It ends with a nice touch, directions for making seed balls to distribute. **http://alaynacitrin.com/likeabee**

The Beekeeper's Year is a game designed by Andrew Markey about managing bees through the seasons with the goal of harvesting the best honey crop. Event cards signal swarming, weather conditions, pests and disease, and legal issues. Collected honey crystals can be turned into cash, with honey prices fluctuating from round to round. **https://www.thegamecrafter.com/games/the-beekeeper-s-year**

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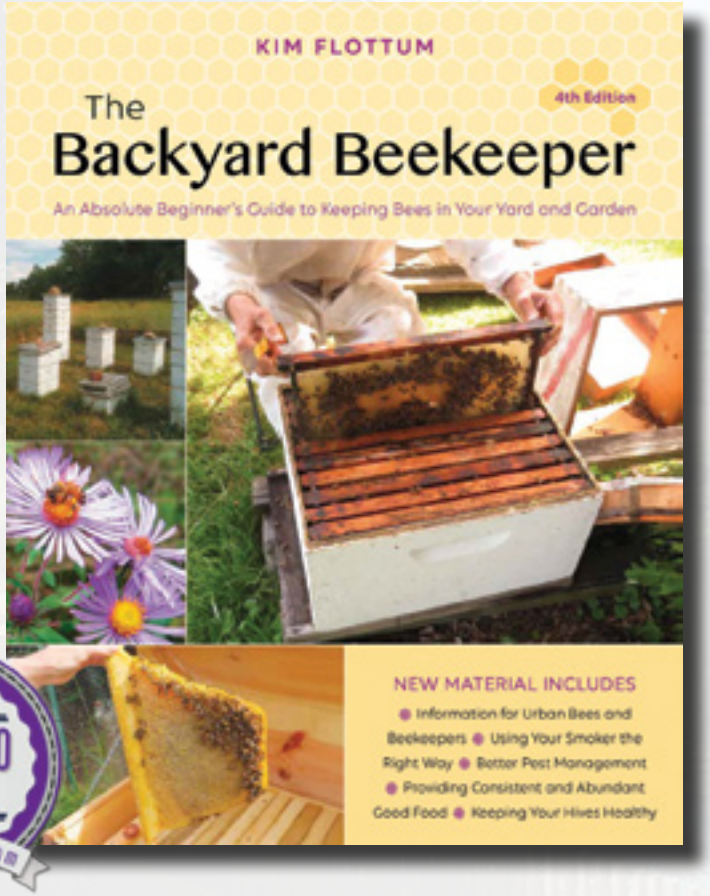

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Hope as a Renewable Option

Spent as we were, everyone in the group agreed that Bee Lives is unique and worth playing, with too much potential to give up on. As it is, the rules seem labyrinthine, especially those governing hive raiding. We were forewarned: Shoemaker says up front that his game is "designed to be difficult and at times unpredictable," and a look at the rules reveals its complexity. After all it is ranked – and yes, board games are evaluated for difficulty by a group called Board Game Geek – Bee Lives was ranked 3.60/5.0 for complexity. Although some board gamers, a ubiquitous 21st century breed, had little trouble playing this game, even our young beekeeper gamers found it daunting. One muggle called it "an event more challenging than the Master Beekeeper exam. Half the board games in the world are harder than this?? Yikes." Perhaps what we experienced was analysis paralysis.

We all had lots to say: If they are going to have feral hives, they should have migratory hives. There should be an American foulbrood card and everything gets burned. How about a card with skull and cross bones, pesticides that kill your hive. We need drones and the culling of the drones. How about rolling the dice to get a laying worker, a drone laying queen, yellow jackets, small hive beetles?

With the tenacity of, well, beekeepers, we analyzed ways to make the game work more smoothly. What we didn't know is that we could have begun with a simplified version. We were unaware that Shoemaker had come up with easier ways for new players to become acquainted with the game. They are much like what the Kegley-Vigneron team suggested.

For those who would like to play Bee Lives in a version that is more, as Shoemaker explains, "an experience in bee behavior and less as a game," he recommends eliminating all of the raiding, and therefore the necessity to defend against raids. (It turns out that in his original design only the "wild" hives raided one another, but it was the Euro-gamers that promoted carte blanche raiding.) Although without raiding, he says, "the game loses something for more serious board gamers, but it is perfectly fun this way and lets you still see how disease, comb management, and competition for foraging can be difficulties for bees." His second option is to eliminate "wild" hives altogether.

Shoemaker has other suggestions to simplify play, which he will gladly share if you contact him through his website **hitemwithashoe.com**, where you can also buy the game.

Cynthia Perry summed it up: "This is a bee-themed game but not a challenge or a test of beekeeping skills. Most notably I do not think of beekeeping as a zero sum game. I think if it as a collaboration where we all help each other to keep 'our bees' thriving."

One game designer, Eivind Mork, said of the challenge to base a game on real bees "it is very difficult (if not impossible) to create a game that is very realistic." His game is called Bee Wars, which is an indication of the design of most of the bee-themed games.

"I do think that our jokes and comments as beekeepers," said Perry, "Added to the game in ways I doubt would happen with the real gamers. We spent the evening cracking ourselves up which made it really fun. It could be interesting to pit four non-beekeepers and four beekeepers against each other and see who picks it up first. I bet the beekeepers would spend all their time trying to find the beekeeping sense and biology and carping about the errors and the other people would win. P.S. Next time we start at noon."

Emily Bonder saying that she'd like another game night. Yes, we thought, let's do it. The game is both ingenious and beautifully designed. New players can learn from our experience and start out with a less complex version. We could see it being played at a beekeepers' event with ample opportunity for kibitzing by onlookers. In the meantime, *Bee Lives* can be played as a solo game. BC

M.E.A. McNeil is a journalist and Master Beekeeper. She is most grateful to the game players named above who played beyond the call and to Matt Shoemaker who provided the game and took our jibes good naturedly (we think). She can be reached at ***mea@meamcneil.com****.*

The Plains Rich In Cultivated And Native Plants

Connie **Krochmal**

The Plains region is a major honey producing area. Honey bees find a rich array of cultivated and native bee plants in the area. Some of those flowering during the Summer months include the following.

Alfalfa (*Medicago sativa)* is of unknown origin, although it was likely native to Asia. Introduced by European colonists to America, it tolerates dry climates. The plant prefers a fertile, well drained, lime-rich soil.

Hardy to zone five, this erect, much branched perennial is around 1-2½ feet tall. The purplish-violet blossoms form dense, cylindrical clusters from June through September.

Alfalfa is a major honey plant, especially in the West and Northeast. Hot and dry weather brings excellent nectar flows. Beekeepers can harvest 200 pounds of honey per colony.

The honey can be water white to extra light amber with the shade differing along with the flavor. The premium quality, thick, heavy table honey can granulate to form smooth grains.

The honey has a delicate, mild to slightly peppery flavor. Alfalfa is also a source of pollen, and a major source of honeydew.

Several types of clover are important bee plants in the Plains. **Red clover** (*Trifolium pratense)* is adapted to a pH of five to six. Suitable for poor soils, the short lived, fast growing perennial or biennial is spreading to erect.

Three feet tall, it bears dense, globe-like flower heads, over an inch long. The red, purple, or white blossoms appear from May until frost. However, most of the flowering occurs during the Summer.

The fast and heavy nectar flow brings 100 pounds of honey per colony. The superior quality, thick, heavy honey is water white or light amber, sometimes with pink or red tinges. With a pleasant, mild, very sweet flavor, red clover honey granulates to a coarse or mealy texture. Bees also collect pollen and honeydew from this plant.

White clover (*Trifolium repens)* is a creeping or spreading perennial, up to a foot tall. The pink or white, dense, globe-like flower heads are over an inch long. Like red clover blossoms, these emerge from May through October. Introduced from Europe, white clover has naturalized in many regions. It tolerates acid and gravelly soils.

This is the most important clover species for honey production. Warm temperatures and high humidity bring lots of nectar.

White clover typically yields 200 pounds of excellent quality honey per colony with the body and color depending upon growing conditions. The color ranges from white or extra light amber to bright yellow. It becomes darker when stored or if the nectar flow is sporadic.

Coarse grains develop when this granulates. White clover honey has a delicate, mild, sweet flavor and a sweet aroma. This plant also yields pollen.

Cantaloupes (*Cucumis melo)* are excellent bee plants. Proper pollination results in adequate fruit set and classically shaped fruits. The Agricultural Research Service specifies that "at least one bee for every 100 flowers" is needed in commercial plantings.

Bees obtain nectar and slightly sticky, heavy pollen from cantaloupes. With large plantings, the honey surplus can average over 30 pounds per colony. This mild flavored honey varies from pure white to light amber.

Cucumbers (*Cucumis sativus)* generally require pollination, which is provided by honeybees. Inadequate pollination leads to underdeveloped and malformed fruits.

The bees collect both nectar and pollen from cucumber blossoms. A surplus of honey can result. With a good body, this has a cucumber-like flavor, which mellows with time.

The honey varies from extra light amber to light yellow. Often, colonies that are pollinating cucumbers experience decline due to a food scarcity because there are too many bees competing for too little food.

Sunflowers (*Helianthus spp.)* are also widely grown in the Plains. In addition to the cultivated types, at least five native species of sunflowers can be found in this area. Sunflowers require pollination for seed production.

As major honey plants in the Southeast, the Plains,

and the Southwest, sunflowers yield much pollen and nectar from Summer to Fall. The average honey crop is about 65 pounds per colony. Great for creamed honey, this ranges from very light amber to yellow. The flavor can be tangy.

Purple loosestrife (*Lythrum salicaria)* is an invasive species found in many areas of the country. In the Plains, this perennial occurs in sandbars, wet meadows, wet ditches, marshes, and shorelines. It thrives in all climates in partial shade and full sun. Throughout the daylight hours in all manner of weather, bees work this excellent bee plant for nectar and pollen.

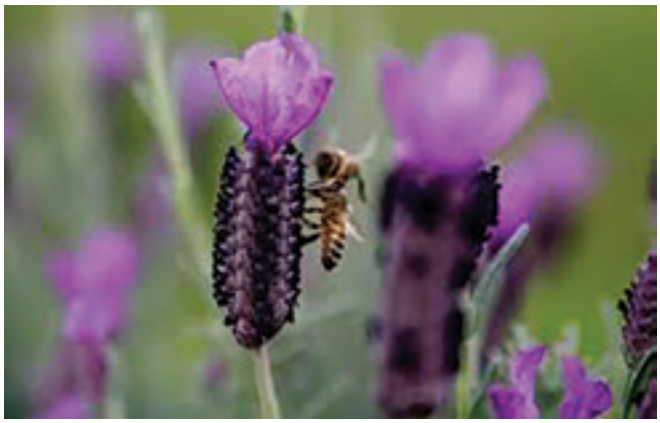
This naturalized plant can yield a good crop of honey. With yellow combs, this honey comes in a range of colors from light to dark. Sometimes, this will have a greenish tinge. Intensifying as it ages, the flavor varies from mild and pleasing to strong.

Two species of the **black eyed susans** (*Rudbeckia spp.)* are found in this region. These are sources of nectar and pollen. Cut leaf coneflower (*Rudbeckia laciniata)* is a reliable, long lived, branched, coarse looking, clump forming, wiry stemmed perennial. This is 1½ to ten feet tall and half as wide. The foliage is quite hairy. Often lobed, the lower leaves are up to four inches long.

From mid-June onward, the light yellow, bristly blooms, 3½ to six inches wide, feature drooping petals and greenish or greenish-yellow disks.

Cut leaf coneflower is found over much of the eastern half of the country westward into Montana and Arizona in moist woods and rich, low spots.

Gloriosa daisy (*Rudbeckia hirta)* is also known as brown eyed Susan. In the Plains, this can be found in meadows and prairies and along roadsides. The plant occurs in much of the eastern half of the country as well.



The short lived perennial is widely grown as an annual. It tolerates drier conditions than most others. The erect, hairy, branching, thick-stemmed species can be three feet tall and equally wide. The basal leaves are four inches long, while stem leaves are smaller.

Opening on tall stems from June until frost, the yellow to orange-yellow blooms are three to five inches wide. They feature dark cones.

Canada thistle (*Cirsium arvense)* grows in meadows and pastures and disturbed sites in addition to occurring along roadsides, field margins, and woodlands adjacent to rivers and streams. It can be found in all mainland states except Texas, Oklahoma, Louisiana, Mississippi, Georgia, South Carolina, and Florida.

This extremely aggressive, invasive herbaceous perennial can reach one to four feet in height. The erect, branched, ridged stems are often hairy. Often clasping the stem, the alternate, spiny-edged leaves assume various shapes. Basal foliage can be eight inches long.

The small, numerous flower heads form on branched stems in round, domed clusters. The male and female blossoms emerge on different plants. Female plants bear small, scented blooms.

A mature plant can produce 30 flower stalks with 40 or more flower heads per stalk. Blossoms are usually lavender or purplish-white, sometimes pink or white. These begin appearing in June and continue into August.

Canada thistle is an important nectar and pollen plant in the West. Copious quantities of nectar are easily accessible to bees.

This plant brings a generous honey surplus. The excellent quality, light colored honey ranges from white or water white to transparent. Comparing favorably to basswood and clover in quality and taste, the mild, very pleasant tasting honey is the finest of all thistle honeys – a class by themselves. A favorite among bees, the sticky pollen often ends up in the honey.

Several other crops that are widely grown in this area are good bee plants. These include corn and cotton.

Some other excellent Summer blooming bee plants in the Plains are the asters, goldenrods, sneezeweed, basswood, buttonwood, chicory, milkweeds, sumacs, smartweeds, Spanish needles, and the various sages.

While the species above have appeared in previous articles, those below have not.

Narrow leaved coneflower (*Echinacea angustifolia)*

This species is found in moist and dry prairies in the Plains. It occurs from Montana to New Mexico, and from North Dakota southward to Texas, Louisiana, Missouri, Iowa, and Minnesota as well as New York.

Suitable for zones four through nine, the plant is also known as purple daisy. This species was among the plants collected by the Lewis and Clark Expedition in 1805. The dwarf, hairy plant is typically one to two feet in height with an equal spread. The multi-stemmed native is mostly unbranched.

Borne on long petioles, the deep green, much veined, hairy leaves are mostly basal. They're sparse, lance-like, and only 1½ inch across.

Narrow leaved coneflower blossoms emerge during late June and July in the Plains. The flowers largely resemble those of the common purple coneflower except

they're smaller. The blooms appear on nearly leafless stalks.

The flower heads are up to 2½ inches wide. The spiny, dome-like cones can be purplish-brown, orange, or brown.

There are 12 to 20, quite narrow rays that reach a foot in length. Initially, these point upwards, but later become drooping. They're mostly pastel pink to dark violet-red, purple, or rose-purple, but are occasionally white.

The flower stalk is bare at the top. The bracts are long lasting. Bees and most other pollinators visit the flowers of all these species. The purple coneflowers are rich sources of pollen.

These blooms also provide nectar. When enough of the plants are available, a small crop of honey can result. Tips on growing the purple coneflowers appeared in the article on Summer blooming bee plants in the Midwest.

Plains coreopsis (*Coreopsis tinctoria)*

Sometimes called golden coreopsis, this is the most widely grown and best known species of coreopsis. Native to the Plains, it has naturalized pretty much throughout the country.

Forming patches, this species prefers low-lying moist soils, often sand or sandy loams. Its habitats include wetlands, roadsides, meadows, shorelines, ditches, and moist woodlands.

The slender, erect, branching plant is two to four feet in height with a 1¼ to two feet spread. The glossy, green, opposite leaves, four inches long, are mostly entire. But, they can be divided or pinnate with very finely cut segments.

Flowering during July and August in the Plains, the long stalked, 1½ to two inches wide flower heads are very abundant. These arise mostly on the upper part of the stems. Their disks are usually brownish-red.

There are usually eight rays, which are lobed or notched. They're yellow with a red spot towards the base. The fresh blossoms have served as a dye, which accounts for the Latin species name.

All coreopsis are sources of nectar and pollen, and are considered good honey plants. The best nectar flow is generally among the later blooming ones, especially in sites with wet or moist soils.

Limited information is available on the honey. According to some reports, one particular unnamed coreopsis species can yield a bitter tasting honey.

Growing Coreopsis

About a dozen species of coreopsis are in cultivation. Generally, bees prefer the native species to the cultivated varieties with some exceptions. Hardiness can vary slightly according to the species. These readily self sow.

The annual types are quite popular and among the easiest to grow. They're especially easy to grow from seed, and are very suitable for novice bee gardeners.

When selecting coreopsis for bee gardens, the single flowered types work best. Requiring minimal care, these fast growing plants prefer a slightly moist, light, well drained, somewhat acid soil. However, most will grow in average garden soils, including dry ones. The native species are moderately drought and heat tolerant.

Full sun is typically best although one species is known to tolerate more shade than the others.

Prepare the soil and add a general purpose fertilizer. Space the plants about 1½ feet apart, depending on the mature size. Plant seeds of the annual types in Fall or Spring.

The perennial coreopsis can be grown from seeds, divisions, and cuttings taken from non-flowering stems. Perennials can be divided in Spring or Fall.

Nearly all species can be grown in almost all zones as annuals for most of the perennials will generally bloom the first year. BC

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

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Fired Up For Bee Hunting!

The Sport Of Finding Wild Bees

Thomas **Seeley**

Bee hunting is the sport of finding wild colonies of honey bees. To pursue it, you usually start by capturing a half dozen or so worker bees that are on flowers, doing so with a small contraption called a "bee box" (Fig. 1). Next, you tuck a small square of comb filled with sugar syrup inside the bee box, along with the bees. Once the boxed-up bees have found your comb and have loaded up on your syrup, you release the bees to determine the compass bearing of their "bee line," that is, the direction in which they fly to their home. Finally, you move the syrup-filled comb, along with some bees, step by step down their bee line until you find their home. The hunting of wild colonies of honey bees is a delightful outdoor pastime, and like most forms of hunting, it is a seasonal sport. There is no point in going bee hunting if you cannot find bees to establish a bee line, so usually you go bee hunting only at those times of year when you can find bees on flowers.

I have almost always started my bee hunts by capturing bees on flowers, so I hesitated to say yes when I received an invitation last Spring to give a demonstration of bee hunting in Vermont on Saturday, October 19, 2019. This invitation came from Elise Tillinghast, the Director of the Center for Northern Woodlands Education, who was planning her organization's Annual Conference. I knew that this conference would be held at the Hulbert Outdoor Center in the town of Fairlee, in central Vermont, and this meant that my chances of finding bees on flowers at the time of this conference would be slim. By the middle of October, heavy frosts have usually killed off the flowers in central Vermont. Heck, by the middle of October there can be heavy snowstorms in central Vermont. As Elise and I spoke on the phone, I recalled how, 50 years before, on 24 October 1969, my father and I had driven through snow-covered mountains in Vermont on our way to my interview for admission to Dartmouth College, which is 20 miles south of Fairlee, Vermont.

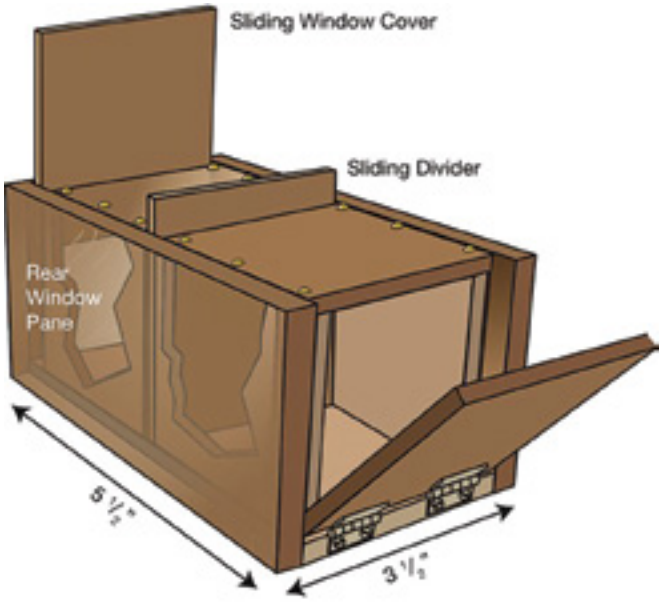

Figure 1. *Diagram of the bee box that I use to introduce worker honey bees to a rich food source when I go bee hunting. It has a rear compartment in which I corral a half dozen foragers caught off flowers, and a front compartment in which I place a small square of beeswax comb loaded with sugar syrup. Once I have a group of foragers confined in the rear chamber, I place the syrup-filled comb in the front chamber, and then I raise the sliding divider so the captured bees can find and fill up on the syrup. After several minutes, I open the door to let the bees fly home and tell their nestmates about the treasure trove they have encountered.*

Despite my misgivings, I said yes to Elise's request. I did so partly because I figured that I could always present an indoor talk about bee hunting if the weather prevented an outdoor demonstration of the craft, but also because I recalled reading in an old book on bee hunting about a method for establishing a bee line when nothing is in bloom. The book is a small, 72-page work called *Bee Hunting*. It was written by John R. Lockard and was published in 1908. In Chapter 7, Lockard describes how he is able to continue bee hunting "when all the flowers, by the laws of nature, cease to bloom" (p. 35). To do so, he would either build a small fire to heat a flat stone, and then put a chunk of honey comb on the hot stone. Or he would put a coal miner's lamp in a pail with a vent cut in the side, and then would place over the burning lamp a pan holding some honey. "The spout of the lamp should come within about two inches of the bottom of the pan. The honey begins to boil immediately and sends its scent out over the mountains . . . [soon] bees may be heard darting through the air or seen hunting slowly through the bushes in search of something to eat."

Knowing how the mistake of leaving a frame of honeycomb outside a hive during a nectar dearth can give rise to a frenzy of robbing, I could see why Lockard's method works: the aroma released by heating honey

Figure 2. *The author with his setup for testing the method of attracting bees to a feeding station by burning combs and heating honey in a small fire. The basket holds his standard bee hunter's gear: bee box, jar of sugar syrup, paint pens, magnetic compass, and notebook.* Photo credit: Tig Tillinghast.

in the open must be a potent attractant of robbers from colonies nearby. So, my plan for the bee hunting workshop at the Northern Woodlands conference was to try out Lockard's method of burning honeycombs to attract foragers (robbers) during a dearth, and if it worked, to then conduct a full-on bee hunt. Of course, this plan depended on Saturday, October 19, 2019 being a sufficiently warm and pleasant day in Fairlee, Vermont, so that colonies near the Conference Center (if any) would be fielding robber bees in search of plunder.

I was lucky that Saturday, for although the air temperature was 30°F at 6:30 AM, the sky was cloudless so the sun shone brightly and by the time I began my show-and-tell on bee hunting at 11:15, the air had warmed to nearly 60°F. Perfect! Step one was to explain the general process to my students, and then to light a little fire and start heating some beeswax comb and honey to cast forth their attractive scents. But instead of using a flat rock (which might explode) set over a fire, or a pan set in a pail containing an oil lamp, I built a little fire on an old, cast-iron griddle that I set atop an inverted trash can (Fig.2). This way, I was able to perform my demonstration without damaging the neat lawn in front of the Conference Center. Once I had my little fire burning briskly, I laid atop it two chunks of dark comb filled with crystallized honey (Fig. 3). Soon, these beeswax combs were melting and the honey they held was bubbling. Alluring aromas of beeswax and honey filled the air.

To my surprise and delight, this technique for attracting bees worked beautifully. Within five minutes of putting the chunks of old comb on the burning wood, a bumble bee flew upwind to my smoky cornucopia. This bee landed without hesitation on the palm-sized square of honey-filled comb that I had positioned on the cool end of the griddle, to give any bees attracted to the site a place that was safe—not too close to the fire – for stealing honey. The bumble bee's rapid arrival showed me that Lockard's advice was not just hot air. This was demonstrated again five minutes later when a honey bee cautiously approached my lure for robber bees. Like the bumble bee, she flew upwind to the fire, evidently attracted by the plume of scents coming from the heated combs, but she was more cautious than the bumble bee, perhaps because she sensed that she might soon be robbing, and she knew instinctively that robbing is dangerous work. Eventually, after about eight minutes of warily circling the tempting comb, she landed, inserted her tongue into an open cell of warm honey, and started to drink her fill.

It was now about 12:30, so I popped inside the Conference Center to grab some lunch, and when I returned to the feeding station some 20 minutes later I was surprised to find a little crowd of 14 worker honey bees standing on the feeder comb, loading up on the warm honey. This told me it was time to start performing the standard operating procedures of a bee hunter: label with paint marks several bees for individual identification, note when the labeled individuals depart from and return to the feeder comb; and record (as well as possible) the compass directions in which the bees fly home. Within an hour, I knew that on average these bees were leaving for home on a bearing about 40° east of north, and that the hardest working bees were taking only about four

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Figure 3. *Close up of the old combs, containing crystallized honey, warming on the fire and starting to release the scents of beeswax and honey that are powerfully attractive to robber bees.* Photo credit: Tig Tillinghast.

minutes to fly home, unload, and return to my comb. Great! I knew from previous studies (discussed in Chapter 5 of my 2016 book *Following the Wild Bees*) that these four-minute "away times" indicated that the home of the bees busily visiting my feeding station was only about 300 meters away.

Knowing that the bees' home was some 300 meters away in the direction 40° east of north, I knew that their bee-tree home was somewhere on the wooded hillside that rises steeply to the north of the cluster of cabins that house visitors to the Hulbert Outdoor Center. Fortunately, the trees on this hillside are mostly large oaks, maples, and white pines. This meant that we might need to inspect only several dozen (not several hundred) trees to find the one housing the colony. Fortunately, too, I had a team of a dozen beginner bee hunters who were, like me, eager to find "our" bees' home. I explained that our procedure now was simple: scan slowly and carefully up and down each side of each tree's trunk, and out along its major limbs, looking for the traffic of bees flying to and from the entrance of their nest. This tree-by-tree search work requires patience, but because the human visual system is extremely good at detecting small objects moving rapidly against a stationary background, it is usually easy to spot the bees when you are inspecting the tree that is their home. This is especially true in autumn, when the broad-leaved trees are shedding their leaves. After about 45 minutes of searching, I heard somebody shout "Found the bee tree!" Great!!! A beekeeper couple from Massachusetts had discovered "our" bees zipping in and out of knothole about 12 meters up on the south side of a handsome white oak.

Discovering this bee tree gave us all the feeling of triumph that comes from conducting a successful bee hunt. Indeed, we had conducted this hunt in an almost record time – barely three hours. What I will remember most vividly from this hunt, though, is seeing the first two bees – a bumble bee and a honey bee – mysteriously appear, without a flower in sight, lured by the irresistible scents of beeswax and honey swirling up from honeycombs warmed by a fire. BC

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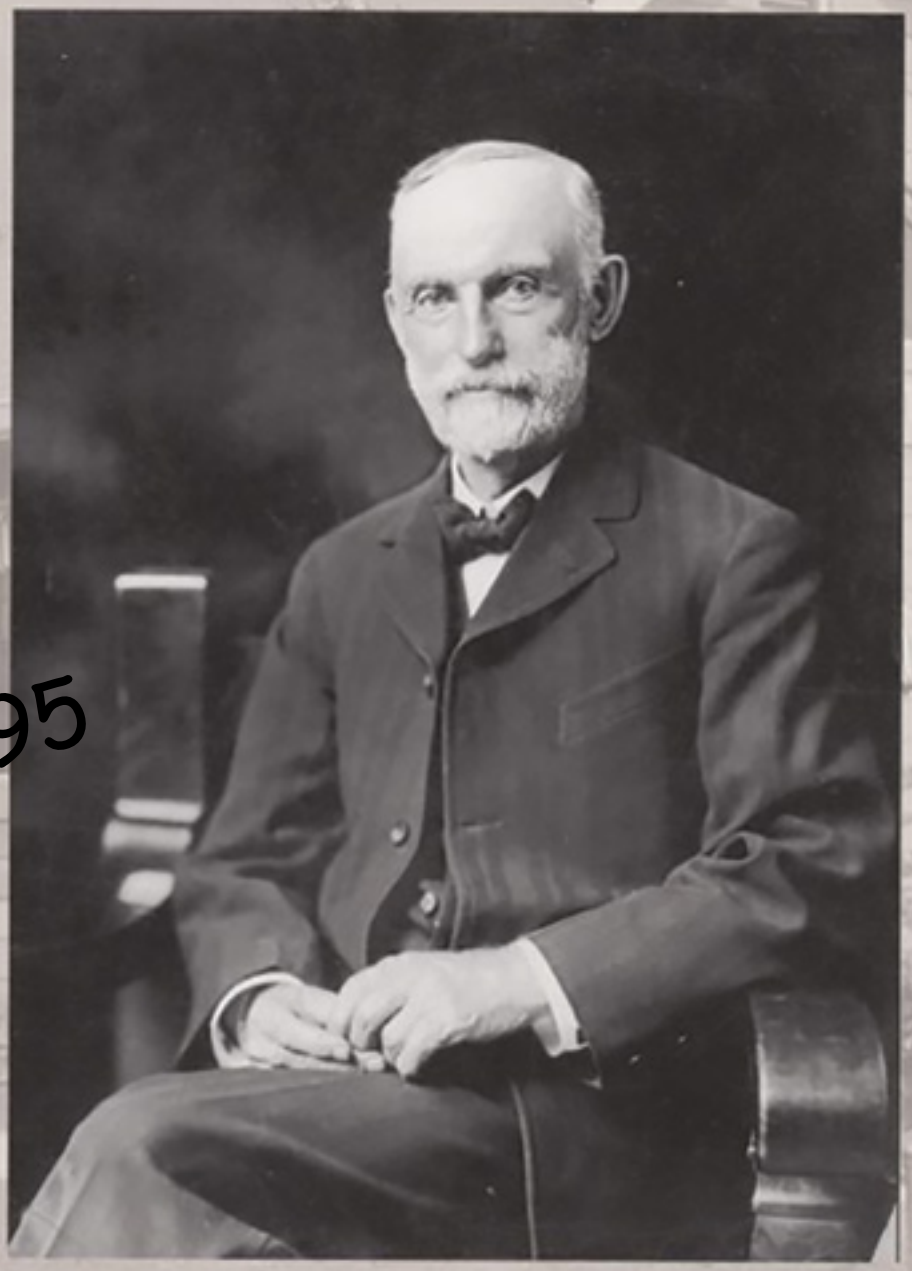

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The Perfect Queen

Patricia **Harness**

It's Not That Easy

This year, I had the perfect queen in my apiary. She was gentle, did not swarm in Spring, and overwintered well. I nicknamed her the "Honeymaker." Why buy perfection when it was already in hand? In fact . . . Why not sell her perfect daughters so others can enjoy the same experience? As the Summer rolled on, I learned the hard way that finding good queen mothers is the easy part of successful queen rearing!

Let's hear it for the boys

Before we talk about the queens, we need to talk about the other half of the equation – the drones. This seems like a 180° turn away from queen rearing, but it bears directly on the question of how to grow good queens, with the personality and performance that I wanted. We beekeepers generally avoid drone comb – it can't be used for producing worker brood for splits, and it produces twice as many *Varroa* mites per cell (Collison, 2015). But without drones, attempts to get a queen mated will be fruitless. Without *enough* drones, I'd end up with poorly mated queens that would be superceded quickly. I knew that the handful of drones that beekeepers typically end up with (from pockets of

wonky comb) would not be enough, but how many would I need to get 25 queens mated through the Summer?

Larry Connor advises planning on four square inches of drone comb per virgin queen to be mated (Connor 2003). That amounts to 76 drones per queen (16 drones per square inch). One frame is about 6" x 16" of actual drone brood, which is 96 square inches – a perfect match for 25 virgin queens! That was my goal this year. In my eight colonies that overwintered, I had at least three hives with three full drone combs, more than enough for my goals. Although I already had the drone comb, it is easy to get bees to draw out more. A drone frame can be purchased, or a deep wooden frame without foundation will generally become drone comb.

A few good drones

Since I wanted quality queens, I knew I needed *quality* drones, not just enough of them. Drones are a luxury product for a hive. Beekeepers don't see drone production in a new split or small hive, and many have observed in a dearth or in fall that drones are unceremoniously chucked out of the hive. While having full-grown drones is a luxury that can be jettisoned, *rearing* drone brood is also an expense that a weak or compromised hive will not attempt. Based on careful documentation from others, I knew that I needed hives that were full-sized (Free and Williams, 1975), that were bringing in copious amounts of pollen (Czekonska et al, 2015), and were bringing in adequate nectar (Seeley and Mikheyev, 2003) to get strong drones that could keep up with pampered virgin queens. Drone performance is compromised by *Varroa* feeding as well, so those colonies needed to be low in *Varroa* (Duay et al, 2002).

I am including these scholarly references so you can share in my surprise at just how much each of those variables – size of colony, amount of incoming pollen and nectar, and *Varroa* pressure – can affect the drone quality. Just having drawn drone comb isn't enough to get good strong boys in flight. We'd all love to have the free time and resources to 1) establish colonies with known amounts of drone comb, and 2) move these to an island with meager forage so we can establish high- and low-nectar flow colonies with in-hive feeding, and then see what happens to drone production and populations – like Dr. Seeley and Dr. Mikheyev were able to do (Seeley and Mikheyev, 2003). But I don't have the time or resources for all that, so I'm going to piggyback off those who do.

Selective Service

Which hives should have drone comb, and have the honor of being the likely fathers of my beautiful future queens? Does it matter for generating good queens, who are gentle, not swarmy, and good honey makers? Well, last year, I accidentally ran a breeding experiment. I had eight sister queens, all emerged in June. Five of those eight sisters either swarmed or tried to take off in early-mid August, back in 2018. (The Honeymaker, and two sisters, were well behaved.) Those five colonies did not make honey in the Summer either, unlike the Honeymaker, despite having similar "birthdays" in the neighborhood of early June. The swarmy daughter queens were not good stock, in my opinion, so I had two queens to work with, the Honeymaker and a sister which did pretty well and did not swarm in the Fall.

In late Summer of 2019, I had reared 25 daughters from four lineages whose mothers did not swarm in Spring (when well managed

for space). I also had two queens whose mothers *had* swarmed in the Spring. Of the 13 full-sized and 12 half-sized hives in my apiary, only one hive swarmed this year – a daughter whose mother had swarmed this Spring. And keep in mind that except for the six full sized hives being run for honey, the rest were being fed sugar syrup like there was no tomorrow – since there would not BE a tomorrow for those hives if they did not get enough comb built out. Despite the ongoing artificial "nectar flow" this Summer in my apiary, the half-sized hives from non-swarmy mothers stayed put. What a difference from last year!

What does it take to get good-lookin' drones for my Queens?

For my apiary, where we have Winter with a capital W (five months no foraging, with a handful of fly days), successful drone production starts the year before I need them. First key drone production factor: *Varroa* control. I manage the hives such that there is low mite pressure year-round, as shown by alcohol wash results which are at two to four mites per 300 bees in August for a full-sized colony. That's a good low number THIS year, ensuring that NEXT year's hives will enter spring with low mite pressure, protecting my drones.

Second key drone production factor: already-existing drone comb. It (almost) goes without saying that there won't be drones in May without drone comb already present in the hive. Since bees in my area do not draw out comb well until temps are pretty mild, meaning late May or early June, no drone comb in late April means no drones until later in the season – too late for early queens. So drone comb production starts the Summer of the year *before* I need it.

I had already mentioned the importance of nutrition for strong and numerous drones. In the late Spring, for the most part, a strong colony is well provided by Mother Nature with pollen and nectar. If there is too long of a stretch (more than three days with no end in sight) without foraging possible after mid May, I will have to step in to save the drones. I didn't have to this year. And luckily this Summer we had a good nectar flow through July, during our typical Summer dearth. By mid August, the rain dried up . . . And some colonies were already evicting the drones. The rest were likely putting the drones on "limited rations" – but by early August, I had all the queens mated that I needed.

Inbreeding: possibly a concern?

Hold on! Don't we have to worry about inbreeding? First thought on that: what does inbreeding look like in bees? It is true that a brother-sister or uncle-niece *honey bee* mating results in bees that are not as capable at recruiting nestmates for a nectar source, nor as effective at maintaining the brood temperature when heat-stressed (Bruckner 1979). That's part of what makes up inbreeding depression in honey bees. Both of those traits are key to having a strong, honey-making colony. But this is so far from an open mating situation – a queen only mating with ONE drone, and a brother or uncle no less – that I decided not to worry about it.

Even if a given beeyard has one queen (and her drone sons), the virgin daughters are going to encounter some drones from away. If there are six colonies per square mile (as there were in Germany, for example, see Mortiz et al, 2007), there are at least 18 other apiaries in a one mile radius (3.14 square miles in a circle with a one mile radius). Each location will have at least one colony (feral or managed), which is likely home to at least a hundred drones. So 18 other sources of drones who might fly to where our virgins (and their brothers) congregate, 100 drones or more apiece . . . That's a minimally 1800 unrelated drones. So, playing the odds, I decided to discount general inbreeding effects on general colony health.

However, there is another aspect of inbreeding with honey bees that did worry me: the sex locus gene and diploid drones. Whether a honey bee larvae becomes male or female is determined by one gene (not a whole chromosome) with multiple alleles (think "versions" of the gene) at the so-called sex locus. If there is only one set of genes (as is the case with a haploid drone honey bee), there is only one version of the sex locus which results in a male. If a fertilized egg has *identical* copies of the gene from each parent, then it will become a diploid drone - and get eaten at day four (Mackensen 1951).

There are likely 70 or more different alleles in the U.S. (Lechner et al, 2014), though there many not be that many in my given breeding population. So a powerful indicator of inbreeding is the percent of empty cells in a comb that was laid full of eggs by the queen. A good capped brood pattern will only be missing up to 7% of cells in a patch (Lee et al, 2019); I look at a 5x5 area for the best section and for the worst section, and average those numbers. So if a poor 5x5 patch was missing three cells, and the best 5x5 section was solid capped brood, that's 6% missing, or 94% solid.

I only have four queens to breed from this year, two of whom are sisters. I took the risk seriously that I would have too many related drones flying around, possibly resulting in spotty brood in a few years. So I went to the trouble to take my virgin queens to a friend's apiary to tap into a different drone population than my own. This apiary is about 15 miles away, definitely out of my virgins' flight path.

I chose this apiary because the

beekeeper has been selecting for bees that are gentle, do not swarm if given more space to store nectar, and survive Winter. Some of those traits are easier to select for than others . . . certainly Winter survival is the easiest to select for. Selecting for low swarming means being disciplined about not using swarm cells or queens from a caught swarm. That's a hard moment in beekeeping, for me at least, to crush beautiful queen cells from a hive that swarmed. But that measure is what it takes to select for queens that will produce drones that carry the genes for low swarming tendencies.

The drones in this mating apiary were a source for a third of my queens this year, and the rules about successful drone production applied in this apiary as well as everywhere else: good nutrition, low mite pressure, and adequate drone comb from the year before. Fortunately, Mother Nature provided great nutrition this year, this beekeeper has a successful mite management strategy, and his hives have plenty of drone comb from years prior.

By having my own queen lineages mate with two different drone pools, I created eight lineages. That should be plenty of drone variety! Even so, I am logging the brood pattern for each queen, mainly by the less formal "good" rather than % missing, at least for this year. My new daughters have adequate solid capped brood – at least 90% solid – so far so good!

Stacking the odds in my favor

But wait! Beekeepers have been told in books and classes that drones and queens fly from their apiary such that the resident drones miss the resident virgin queens, as a measure to prevent inbreeding. If so, there's no point in thinking about producing my own drones! Well . . . a California queen breeder, Randy Oliver, recounts the following: "In a large mating yard in California, the queens and drones start flying at about 1:30 in the afternoon. You can hear the drone congregations moving around overhead. When you hear them, you'll start to observe comets chasing queens, often starting at about head level or even lower. Those queens may finish mating before they reach 30 feet above the ground." (R. Oliver, personal communication). Other work has

shown that drones prefer closer Drone Congregation Areas, less than a mile away (Koehniger et al, 2005).

So the majority of drones that my virgins encounter will likely come from the same apiary. Even so, I want more peace of mind than that. I'm going to ring my mating apiary with three out-apiaries, about 3/4 mile or so away, with drone source colonies. I might just move two production colonies to each of the out-apiaries, or set up a drone production colony in each apiary with a traditional colony to support it (Conner 2006). A drone production colony has a caged virgin queen, lots of drones, and enough workers to take care of the drones.

A few cautions about high drone populations

Be warned: a drone-producing colony may not be an ideal *honey* producing colony. It is possible for drones to drain your honey resources (Seeley, 2002). Dr. Seeley measured honey production in colonies with or without drone comb (colonies with drones had four drone combs in four deeps, so that's a lot of drones). Dr. Seeley found low-drone colonies to have almost double the honey production. Based on this work, I will use a colony to produce extremely high numbers of drones (see Connor, 2006 for how to do this), and not run it for honey at all. For the other colonies, I will use only 5% or so of the *brood* area as the max amount of drone comb per favored colony. That would be at most one deep frame for drones in a double deep, which is half the number of drones that were in Dr. Seeley's high-drone colonies.

The second concern about boosting drone populations is boosting varroa mite populations too. When a foundress mother mite goes into a brood cell to reproduce on the bee pupae, she has at least one fertile daughter emerge with her from a worker cell. But she has at least two daughters emerge from a drone cell, due to the longer time it is capped (Fuchs and Langenbach 1989, Schultz 1984, Collison 2015). So let's compare the scenarios where a hive has 100 foundress mites in 100% worker brood, or in 80% worker brood, and 20% drone brood. In a no-drone hive with 100 mites, 200 mites will exist after the worker brood emerges (100 original foundress mites + 100 new mites). In a hive with 20% drone comb, 220 mites will exist after all the brood emerges (100 foundress mites + 80 mites from worker cells + *40* mites from the drone cells). This will increase the *Varroa* mite population faster, and treatment may be necessary sooner for hives selected for adequate mating drone brood production. For my apiary, I am able to drastically reduce the mite population in the Fall and Winter with multiple OAV treatments. I know it's working because the alcohol wash numbers

are low the following Summer (<1% mites in August), even in hives with lots of drones. Trust, but verify!

I just wanted to share my reasons for taking drones seriously in my apiary, to offer some food for thought. Drone sources do matter for the daughter queen's traits, as I documented a drastic reduction in swarminess in my hives in just one generation of selection. A home apiary is a good place to invest in good drones, since 10 or so hives (each with one drone frame) can allow selected drones to overrun the local drone population. Care is required to ensure that there is drone comb at the right time, and that the hive can take care of the drones to produce quality drones when you need them. And extra care will be needed to manage *Varroa*, but the upside is so attractive that it is worth the extra management to me. BC

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Winter Success

Zachary **Lamas**

Whether there is an extended rainy period arriving or an unexpected artic vortex dipping deep into the south, your hives are probably going to be just fine. Bees have evolved beautifully to tolerate changes in the weather. I say this, but each year Facebook proves me wrong. Almost like clockwork when a deep artic vortex drives cold Canadian air unexpectedly into southern states, social media fills up with posts about whether or not their bees will be fine. Commonly people ask if they should move their colonies into the garage for a few days. Some will run extension cords and lightbulbs to their colonies in the backyard. The topic of emergency feeding comes up, with recipes for sugar blocks and arguments about whether or not syrup can be applied during the Winter can be applied. I have to admit, I am the one that replies with a snarky comment, that is very much not needed at that time. So I'd like to make a not-so-snarky pre-emptive reply before the upcoming Winter arrives: Your bees are fine, and can manage changes in weather perfectly well if they don't have pre-existing conditions going into Winter.

A nucleus colony with a small population. This colony is not ready for the Winter. It most likely would not survive the Winter on its own. In our operation, these colonies are united in the Fall and fed. We will not overwinter them on their own. Keeping colonies like this in the Winter leaves many beekeepers worrying about their colonies through the Winter. We may respond to weather extremes with extreme action, trying to save something that wasn't Winter ready at the start.

In fact, I firmly believe we can experience more joy with our bees if we transfer from emergency-hospital like responses to our bees and the weather to a pre-emptive structured management style. The first step is to step away from this "warm blanket" mentality with our bees. We get cold in the Winter. Every Winter jacket, glove and hat I own exists because I cannot thermoregulate outside on my own. However, our bees are not like that. A healthy, intact population is perfectly capable of staying cozy warm through any artic vortex thrown at them. So, lets enact beekeeping management, that creates healthy, intact populations by the Fall.

I worked for Michael Palmer at French Hill Apiaries in Saint Albans, Vermont for three seasons. Each year, Mike was adamant about requeening questionable, non-honey productive colonies during the Summer. We treated for mites right after honey was taken off the hives, and we fed colonies that were light early in the Fall. If the Fall flow failed, then we replaced the Fall flow with a sucrose feeding. All of this was done between late July and early September. Respectfully, Requeening in July, treating in August and feeding in early September.

After leaving Mike's I realized so many beekeepers would pay attention to how he wrapped and insulated his colonies, but neglect to ask pertinent questions about the requeening, treating or feeding. Mike and I have both left colonies unwrapped and uninsulated on the Canadian border only to have them booming by the spring. Winterizing is an important part of Mike's operation, but it isn't the most important. Anyone can wrap and insulate a dying hive in September. But who cares if your dead hive is insulated in the cold of January? There's more to keeping a colony Winter ready than any insulate we can superficially apply to the colony. Specifically, we need to focus on management starting in the mid-Summer and ending in the early fall that will create a healthy, unbroken population ready for the Winter. I'll briefly talk about the three things as beekeepers we have in our control, that we did at Mike Palmer's, and that I focus on in my operation, RockStar Queens. These are: requeening, mite management, and feeding. By focusing on these three things, we create a healthy population, and we can start to leave this "warm blanket" mentality about our bees.

Did You Do These?

Requeening

Not all queens are equal performers. As much as I may like one queen line in my apiary over another, I have to make a decision as to whether she gets to stay in the box or not. I have a few things I am looking for. To keep

A nuc yard outside of Durham, North Carolina. When an artic vortex brought cold Canadian air for a week, many beekeepers worried about their colonies. I opened mine to show that a colony without pre-existing conditions is cozy and sound during weather changes.

this simple and brief: is her colony booming during the Spring, a period of plenty and growth. If not, I will mark the colony for a requeen. I keep it as simple as that in my business because of a practice Kate Blofson, a coworker at Michael Palmer's and I decided upon. It was a habit to write "check queen" on a colony if we were uncertain if we should requeen or not. This was because the colony looked good, but not so good. We noticed a pattern that all the colonies labeled "check queen" were dwindling after the flow stopped. Then we would hustle to requeen these colonies so they could build back up for the Winter. That really looked like a lost opportunity for us as beekeepers. So Kate and I decided either the colony was ok, or requeen. We would no longer pass the buck along. Our requeening became more structured, and timely. The new queens had enough time to rebuild healthy, intact populations for the fall flow. However, if we tried requeening later in the season, there simply isn't enough time for the new queens to rebuild a population. Also the populations tend to dwindle significantly by delaying.

Managing mites

Whether you treat or not, left unmanaged, mites will kill a colony. During the Spring through main flow, healthy colonies will produce surplus drone brood. The *Varroa* mite will preferentially invade drone brood cells over worker cells. This is great during the Spring and early Summer for our worker brood. However, the *Varroa* have reproduced very well, and quickly in drone brood, and will now only be able to invade worker brood during the Summer dearth. Ouch! That is a lot of pressure on our worker bee population. We manage our *Varroa* so that our worker bee population, both the developing brood and adult workers, are not heavily impacted by *Varroa*. We need an intact, unbroken population by the Fall, to rear our Winter bees.

Feeding

Feeding is my third least enjoyable beekeeping task. My second least enjoyable is late Winter emergency feeding. My absolute least favorite is loading starved dead outs on the truck. Simply put, I would love it if the Fall flow would feed our colonies for the Winter. In upstate New York, the golden rod and asters often do. I love it. All that honey ensconcing the brood nest is for the bees. However, a reliable Fall flow is not always the norm, and we will feed back to a colony what it needs to survive the Winter. I am not in Maryland, and in my operation I began feeding in mid-August of this year. We don't have much of a Fall flow here. After two feedings, most colonies were up to their Winter weight. This was great. Any brood reared during this time would not be nutritionally stressed.

Requeened early, managed for mites and ready for the Fall flow – this colony has an intact healthy population ready to rear it's Winter bees.

Putting it all together

Requeening colonies with suspected queen issues mid-Summer is a great way to give a new queen the chance to rebuild a population before the Fall. We manage our mites so the worker bee population, brood and adult bees, are not heavily impacted. We replace the Fall flow with syrup feeding if we have to. Now we have healthy populations, by the Fall, that are not nutritionally stressed or impacted by *Varroa* ready to rear our Winter bees.

These healthy, intact populations will cluster just fine through any artic vortex thrown at them. In fact, when we manage our colonies like this, we can step away from this "warm blanket" mentality. Instead we can look outside our windows from our cozy homes, see a white snow covered ground and know our bees are clustered and just as cozy warm as we are. BC

This article is part of Zac Lamas's bee talk- Winter Prep Begins Mid-Summer.

Show Me The Money

David **MacFawn**

Over the last 15 years, a beekeeping finance spreadsheet has been developed by David MacFawn to analyze if money can be made selling honey, NUCs, or colonies for pollination. The purpose of this spreadsheet is to make your mistakes on paper and not with real-life money. Yes, a bee operation can be profitable with the correct scenario.

Net Present Value is the criteria whether to accept or reject a bee investment and management plan. Your costs need to be known so when your honey is sold you do not lose money. Total expenses need to be known to fund the operation.

When thinking about starting a honey bee operation, several questions come to mind:

- How quickly can and should the operation expand and build?
- What are the costs, potential revenue, and possible profit?
- What is your Initial expense for equipment such as veils, hive tools, bee brushes, gloves?
- How much financing will be required?
- What should you charge for 1-pound jars, pint jars, quart jars, NUCs, etc.?
- What is the potential profit for each jar size?
- Should you purchase honey for resale?
- What will honey purchased for resale do for your profitability and revenue?
- Should you purchase new or used equipment?
- Should you purchase existing colonies or start with packages or nucleus hives?

The bee business has a price, volume, distance relationship. More hives have to be moved a farther distance to pay for the trip. Also, most analysis assumes you can sell all the honey or NUCs and assumes can keep your bees alive at least at the hive mortality (40.7% annual) rate.

The operation needs to keep track of its product mix/inventory, i.e., how many of each jar type is sold. The jar product mix should be based on what you can sell and your marketing plan. Also, the product prices for each jar should be market-based and the spreadsheet will tell you if you are making a profit and what it is based on your selling price and investment. If your woodenware is paid for, you can do quite well after the initial investment. For pollination, woodenware and equipment cost are limiting factors. Here is where purchasing used or commercial-grade equipment will help.

The Net Present Value (NPV) should be used as the decision criteria. The NPV compares the value of a dollar today to the value of that same dollar in the future, taking inflation and money being realized into account. If the NPV of a prospective project is positive, it should be accepted. However, if NPV is negative, the project should probably be rejected because the total cash flow will also be negative. The Net Present Value comparison rate is the interest for investments (6%-7% historical for stock market) rate. For example, if the NPV is negative, you are losing money by investing in the bee operation as currently planned in the spreadsheet; based on the negative NPV you can make more money by investing elsewhere. You need to adjust or change your entries in the spreadsheet to reflect a different bee investment strategy. The NPV is discounting and translating cash flow to the present time based on the interest rate.

The profitability/NPV is very sensitive to the hive yield and hive efficiency (winter losses and non-yielding hives). It is also sensitive to the product price and product mix. Sell retail whenever possible.

Entries in the Spreadsheet

• Packages & NUCs; Queens

Packages will probably delay honey production by one year. NUCs, which typically cost more than a package, may produce some honey production in the first year. This spreadsheet assumes honey production in the first year. The Net Present Value (NPV) will be affected negatively if there is no honey production in the first year.

What will honey purchased for resale do for your profitability and revenue?

• Mileage

Minimize mileage as much as possible. Place bee yards close to your home and within five miles of each other to minimize forage overlap and driving distance.

• Equipment–Woodenware

Purchase used or commercial-grade equipment whenever possible. If used equipment is purchased, burn any old frames and scorch out the inside of the woodenware to prevent possible disease transmission.

• Labor

The spreadsheet is very sensitive to the labor rate.

• Honey Production Value and Jars/Labels

Honey production value is very sensitive to your sales strategy. With specialty jars, if selling in the correct venue, you can increase the honey's price per ounce. Jars are a major expense but can be covered by the type of sale and higher revenue at a lower quantity. This gets back to your marketing strategy: up-scale or sell in a "farmers market."

You should set your honey value at market price and the spreadsheet will back into the resulting sales margins and profit. Your marketing strategy defines the type of jar and label(s). The jar and label(s) will sell your honey so be very careful on what you use based on your marketing strategy, and how and where you will be selling your honey.

Changing the product mix will allow you to see the impact on the Net Present Value (NPV). This will allow you to see if you are making money under those sales assumptions and the other inputs.

• Treatment Costs

If bees are not kept alive, the entire spreadsheet assumptions crumple. The cost of Apivar is included in this spreadsheet for *Varroa*.

• Pollination – Sugar Costs

If you pollinate crops, you may have to feed your bees.

• Honey-Processing Equipment

The Net Present Value (NPV) is very sensitive to the equipment cost. You should delay equipment purchases like woodenware, extracting equipment, honey processing buildings, as long as possible to minimize the amount and value. Shipping costs should be included in the prices.

What are the costs, potential revenue, and possible profit?

• Interest Rate

NPV is very sensitive to the interest rate that you get for loans. If you cannot make at least the interest rate for loans, you can use your money for other non-beekeeping endeavors

• Hive Yield Efficiency

The hive yield efficiency is determined by the number of honey-yielding colonies and survival rate. The NPV is very sensitive to the hive yield efficiency due to honey production quantities.

I typically have a maximum of 20 hives per yard (South Carolina) for bee foraging reasons and also this is the maximum that I want to work at one time. These yards should be approximately five miles apart to minimize travel expense but maximize the areas over which the bees will forage.

Minimize travel means not moving the hives unless you hope to capture another nectar flow. Moving the bees to the Appalachian Mountains for the sourwood flow is not profitable due to the sourwood producing only two to three years out of every five years on average unless you live close to the mountains.

For honey-only production (no pollination), consider leaving enough honey on the colony for the Winter. No sugar cost. The strategy depends on the relationship between sugar and honey prices and your management strategy. Some believe that honey is healthier for the bees than sugar. (Studies have shown sugar increases survival rates.)

The spreadsheet is sensitive to labor.

The spreadsheet is very sensitive to yield per hive number; very sensitive to per ounce revenue; sensitive to the interest rate; very sensitive to hive survival rate.

The spreadsheet does not include price escalation year over year for costs or revenue for simplicity's sake. However, you can include this somewhat by the equipment prices you input. Cost per mile is just one rate for the entire five years the spreadsheet covers.

Should you purchase existing colonies or start with packages or nucleus hives?

The quicker you build up your hive numbers, the more revenue (honey and wax) you will have to cover your equipment cost. This means your Net Present Value (NPV) will go up. The hive yield can be varied and change two to five pounds and you will see the NPV change.

Vary variables like initial investment, labor rate, depreciation period, yield per hive, cost per mile, scrap percent and you will see a business plan developing and some ideas on what you need to do to make money.

Several tenants result from this analysis. Invest in your bees and woodenware first before investing in a lot of extracting equipment or a big building. Purchase commercial-grade or lower equipment, or good used equipment wherever possible. Equipment is expensive and a major expenditure.

A backyard honey operation can be profitable under the correct scenario. A backyard operation does not have the travel expenses and labor expenses a larger operation does. A small operator should consider an agreement with a larger operation with a honey house to extract their honey to minimize their extracting equipment and honey house investment.

Net Present Value is and should be the criteria of whether to accept or reject a bee investment and management plan. Cost of that jar of honey needs to be known to determine what the minimum price you can sell your honey for and not lose money. The revenue needs to be known to determine how much money you will make. Also, total expenses and outlays need to be known to allow you to acquire the money to finance the operation. It should be noted that cash flow in a bee business are calendar dependent; i.e., cash will typically be going out in the Winter or Spring until you can sell some NUCs or honey produced. BC

For more information on David's spreadsheets you can reach him at ***dmacfawn@aol.com****. We will have the spreadsheets available in the near future at* ***www.beeculture.com****.*

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Discussion Points

- Do beekeepers manage mites nearly as much as bees?
- When should mentors explain varroa challenges to new keepers?
- Are we losing too many new beekeepers?
- Oddly, is *Varroa* somewhat of a friend to beekeepers?
- An equipment review.

A New Decade

Mite Managers And New Beekeepers

The year was 1964

I was 16. My grandparents were alive and well and lived on the family farm. Life was good.

On that Alabama warm Autumn day, I walked a fence line separating one of my grandfather's fields and a forestry plot. During the previous years, I had picked up arrow points in this area. The chances were slim that I would find another. Still, I casually glanced around the area – just in case one showed itself. It didn't.

Without warning, I began to have thoughts and questions that were beyond my years. I was two years from high school graduation and knew a life's transition was looming. My life would not always be this way. The 60s were just getting fired up.

Being the oldest son and grandson, no one in my family had college experience. Should I do that? Maybe continue to work at my father's paint supply company. Maybe try to farm the land on which I was walking. Then there was always the military. What should I do about that?

Without warning, I abruptly asked my 16-year-old self when I would leave this dimension. Boom! No warning. The question was just suddenly there. I had just asked myself, as young as I was, what year did I think I would leave this world? Now, that's heavy.

Obviously, I had to put some thought into the matter. For a 16-year-old, this was a serious estimate. In 1964, the year 2020 had a futuristic ring to it. Like Rin Tin Tin, 20-20 just had a sound to it. *(If you know Rinnie, that dates you. For those who don't Rin Tin Tin, look him up. Google knows.)* The advantages to that year were that the numbers melodiously rolled from my tongue, and it was so far in the future as to seem that it would never become the present. Ergo, I felt that year should be my year. It just felt right. Now… Hold the phone. In a stunningly short time, 56 years have passed. It's 2020! My big year is here.

You need to know that my plans have profoundly changed. ***That 2020 thing is off the table!*** Why do I even still have this odd 56-year-old memory? It's crazy that I still recall this youthful philosophical episode so well. What have I done to myself? You must know that I will be a bit skittish all this year. But here I am, ready

About 55 years ago my grandparents parked, on a different day, at the spot where I had my talk with myself. The field was to my back while the tree line is in the background. My two younger brothers and I used that 1952 Dodge ½T pickup to learn to drive. Three gears on the column. Flathead six engine. Floor starter switch. My younger brother restored it and still has it. I was the photographer. I love this snapshot.

for another year of controlling varroa and managing bees. As I have done for so many recent years, I need to get my packages ordered. As I start another decade, I have a few thoughts that I have presented below.

We have evolved to become mite managers who also keep bees

I don't think this is news to most of you. We need to keep our bees healthy in order for us to suppress our *Varroa* populations as the season progresses. In 2020, as before, we start next Spring managing mites. If there is no *Varroa* suppression program – there will be no successful bees. Essentially, we are *Varroa* managers first and foremost (Or we should be), and yes, that is a weird aspect of 2020 beekeeping. It's been about 35 years coming.

Years ago, I accepted the reality of permanent *Varroa* infestations, but in my heart, I have always clung to the notion that – someday, someway – honey bees and we, their keepers, could figure something out to push these pests out of our bee lives and our hives. I suspect I have been resistant to totally accepting the invasive pest because I still remember bees without *Varroa* and tracheal mites. In 1971, Mite-less bees were my introduction to beekeeping.

No, I am not daft. Others may argue that point. I know the mites are here for the long haul, but it's that memory of mite-free bees that I suppress, but one that I cannot kill. It's always there – lurking. Ask any pre-mite beekeeper. They feel it, too. But be aware that, all those years ago, beekeepers had other problems – toxic bee-killing pesticides, low imported honey prices, societal resistance to bees. We had problems, but we did not have mite problems. *We did not have mites.*

New beekeepers and mites

The old days are gone. The new days of 2020 are here. What follows is a slippery slope. The failure of new beekeepers coming to beekeeping and staying in bees has made me accept this factual mite reality without involving old emotions of my heart. I was recently given some valuable numbers from a large beekeeping club concerning their popular "*Introduction to Beekeeping*" class. This intro class always fills, and there is a wait list. Here's the rub. Two years after completing this class, 80% of the new keepers will have left the beekeeping fold. I feel that it is primarily the effects of *Varroa*, but I have not a shred of data – only my conjecture. But I also accept that there are other issues in play that may disenchant a tyro beekeeper.

While I am not the oldest beekeeper around the apiary, I have been in hives for about 46 years. That gives me a lot of experience, but over time, experience ages and becomes obsolete. If beekeepers, like me, do not continue to produce new experiences, we become something akin to a 1964 Chevy, interestingly quaint but really old. From my understandings, I can say that through the passing years, beekeeper numbers have always waxed and waned.

Six decades ago, organophosphate pesticides did not help our bees. A few decades later, Killer Bees – scared beekeepers and the public to the point of bee avoidance. Beekeeper numbers dropped. But, at some point, beekeeper numbers went back up. Thankfully, they always have. Before my time, there was no control for American foulbrood, except burn the infected hive equipment. During my early years, we could freely use antibiotics with abandon, but now Terramycin® has been made essentially unavailable to most beekeepers. *(I must agree with this restriction for smaller scale beekeepers.)* Now, once again, we just burn infected equipment. The same has happened with Nosema control. We once had fumagillin, but now we don't. *(I've heard a rumor that could change in the future. Only a rumor.)*

Beekeeping's golden age. Bah humbug.

It's a good time to say that since U.S. beekeeping started, there has never been a perfect period for which we all yearn to return. Since it was initiated in this country, our craft has always been evolving. We started with gums and box hives until the evolution and development of the beautiful equipment that we now have.

Varroa, beekeeping's unruly friend

Without *Varroa* hypothetically eating our bees and causing such a public outcry, I really doubt that we would have had this current sustained interest in all things beekeeping.[1] In all our apicultural history, we have never had an interest bump like the one we are in now. *Thank you varroa, but could you tone it down just a little?*

Over time, my opinion will change, but for now, I feel that from the get-go, if one is unable or unwilling to control *Varroa*, their bees cannot ultimately succeed from season to season. Controlling mites must be accomplished as both new and established beekeepers manage their bees in other traditional ways. While other tasks must be performed, without some kind of mite control program, all other bee management procedures will be (mostly) folly.[2]

I hate to write this, but I admit that I am challenged when trying to accomplish Sisyphean mite control tasks that are endless. We have to do something to suppress mites every year. Every year. I am reminded of several

Beekeeping's enemy with a peculiar twist.

[1]A hypothetical question is begged, "If a sure solution for varroa control was developed, and the pressure from that pest declined, would societal fear for the healthy survival for the "Angels of Agriculture" also decline? Are beekeeping's other problems enough to keep beekeeping in the bright, positive, light of public interest? I've no idea what the answer should be.

[2]I have personally experienced this oddity. I have taken honey from dead colonies that had built so strong that they produced a honey crop before the *Varroa* bomb went off.

occasions when some aspect of computerization was added to beekeeping or presented at a meeting, an older keeper would say, *"I came here to learn about bees, not about some computer trick."* A variation of this concern could be, *"I came here to learn about bees, not mites!"* And this beekeeping craft thing is fun – right? Oddly, it surely is.

I can't explain this.

I would estimate that at more than 90% of the discussions that I present on the topic of mites and their control, usually someone will offer a comment much like this: *"They have kept bees for some number of long years and their bees have never been treated"*. I listen politely. I believe them. But I do not know how the bees or the beekeeper routinely accomplish this feat. Each encounter is slightly different.

Are these beekeepers and their bees on borrowed time? Is there some environmental thing about their apiary location? Are their bees isolated? I don't know. Everything is in the story's details, but I can say this – there is no way that I can offer a general recommendation to other beekeepers based on this information. Most of us – by far – will be managing dead bees if such compassionate neglect is our control program – well, for sure that would be my bees ignominious end.

Now, enter the new beekeeper. What are they to do? What should we tell these new keepers when they ask what methods to use for mite control? How should we reassure them? When it comes to mite control, I sense that we all could use some mentoring.

Apiary skies will not always be blue

All days in the apiary are not happy days. To truly know a good apiary day, one must have some "ungood" apiary days. The swarms that got away. The new queen that has been disappointing. Not a good nectar flow and the beekeeper will mostly like have to feed the bees.

But to counter these frustrating points, there are some good opposites. You hived the new swarm; the purchased queen was a good one and the flow was strong and long. Then there is *Varroa* – always lurking. Always building up populations. Always scheming to take all the "good opposites" away. It's the 2020 bee manage way.

A good chance for successful wintering.

Truly an "ungood" day for this colony. At least the queen is present.

When should the new beekeeper be introduced to this mite pest certainty? When should they be told that some "ungood" days will coming to their apiary? In many cases, *Varroa* mites will be leading that charge.

Unload on the new beekeeper at the end of the class?

Normally, the bad news of bee diseases is held until near the end of a beekeeping class. I have done this time and time again. It's common. But honestly, it's somewhat of a duck-and-run for instructors to *completely* hold this dark discussion until last.

Wow! To present the total load of *Varroa* complexities to people who are still trying to distinguish shallow supers from inner covers. Coming on that strongly would scorch the hair on these new people. What's to be done? Don't they need to know something bad this way comes? Yes, but it's complicated.

Now, I've asked a question I can't readily answer.

One of my points for this article is that during my 46-year run in beekeeping, the craft and the beekeepers coming into our craft have changed. With the ravages of *Varroa* being practically assured, how should instructors introduce the myriad new beekeepers to this pest? We must not frighten all these new people, but they must know that mite management and bee management are nearly equal.

True, for reasons other than predaceous mites, many new beekeepers try bee husbandry and drop out. That is not unique to our present time. New beekeepers have always come to our craft only to quietly leave a few to many years later. I once was a hot-shot water skier. I'm finished with that hobby and have not a piece of water ski equipment left. No interest. I suspect all of us have dropped something we once enjoyed. Beekeeping is not exempted. Even so, we'll always have the memories. (Modified from the musical classic, *"We'll always have the moon."*)

I try to offer strategic hints in my presentation or

intro class as it moves along. I, also, try to offer practical reassurances that this mite thing is a hurdle that most of us cannot avoid. In all reality, I doubt that any of these new, bee-interested people would even be considering a run with beekeeping had it not been for the media coverage about how beekeeping is under serious stress. In all things bad in beekeeping, be gentle when the news is delivered. Even now, I can't say that I just offered you the correct introduction procedure for this dour topic. What works for you? What works for your audience?

To the uninitiated beekeepers who might be reading.

The main points of beekeeping are still solid. Bees pollinate, produce honey and provide rewarding biological studies. Some seasons are better than others. *Varroa* is a hurdle, but one that the industry and its scientists have developed control protocols for use as combat tools when encountering mite challenges. In our own way and in our own time, we are surviving quite well – even with our present pest challenges. It's what we do. We are modern beekeepers of the 2020s. We manage bees and mites.

I'm going to take a shot at this. It may or may not work.

All – and I mean all – of my woodworking magazines feature equipment review sections. I rarely have done this in my *Bee Culture* pieces unless the reviewed equipment was pertinent to my article's flow. So occasionally, I plan to present simple reviews of selected equipment – sometimes new while at other times, not so new.

I have several suits, but one I have used extensively the past two Summers. It is a suit from Guardian Bee Apparel[3]. I really like the feature of being able to zip the veil open without removing it. I will give a fuller discussion when I review my "seasonal" bee suits next month.

If this equipment review concept doesn't work well, it will go away.

If you're at this point

If you've read to this point, I deeply thank you. I hope you're around next month for another visit. BC

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A video chat
https://youtu.be/7sK2o2iVcQ0

[3]Guardian Bee Apparel
https://guardianbeeapparel.com

New to the party

I'm late to the party,
Sorry for the delay.
Just jumped off the boat
Now I'm makin' headway.

That poseur Destructor
Gets all the good press.
But I'll clean out your hive
And I couldn't care less.

As I crawl comb to comb
In my stylish black coat.
Beekeeper be wise
And take very good note.

For though it's my gift
To make honey ferment
I've got other methods
To rouse your lament.

Like laying my eggs
In the walls of your cells.
Then my babies mature
And emerge to raise hell.

So please spare your bees
From this muculent mess
For there's really just one
Valid form of redress.

On this miracle cure
Opinions may differ
But I firmly believe
In the power of the Swiffer.

Like a white, fluffy prison
Of pure, driven snow.
It snags beetle-legs
And never lets go!

Peter Keilty

BIGGER PICTURE

Jessica **Louque**

This Isn't Suburbia

Squirrels are tree rats. I mean, technically they are rodents, but usually they're a little cuter than your typical rat so it's ignored that it's a rat in a tree. They are not known for doing any substantial damage to a bee yard (that I know of) and have never caused direct problems with a hive. They are known for destroying wiring, insulation, and creating thousands of dollars of damage in wired barns and houses. I extremely dislike squirrels. I don't like when they chatter at me, or run through the trees yelling at each other, or steal my bird seed. I hate Hate HATE when they get in the house and eat the wires or chew through the barn haphazardly until it has to be totally rewired. Other than feeding predatory birds, I have no beneficial opinions on squirrels, and even that use is questionable given my war with predatory birds going after my chickens and guineas and turkeys and ducks.

We are already having some roaming bear issues with our bees, and we always get a couple hives knocked over by deer (and/or they hit our car). Squirrels are just the beginning of a Winter Series of hunting season targets to knock out some pest species that are over populated and causing problems. Only Bobby (my husband) and Charlie (my middle son) hunt in black powder season, so Henry (my oldest son) is the only one hunting squirrels in early season. The doves are mostly gone and not in a high enough quantity to kill for food but they are definitely my favorite of the wild game buffet. Squirrel is not my super favorite but the aggression I have towards their existence does make it taste a little better.

I'm throwing in a caveat for you guys here that although it is obvious I have a list of animals that I don't like, I absolutely do not condone abusing or torturing animals or hunting just to kill something. If you are going to hunt, you need to be able to be incredibly accurate with your weapon of choice, whether it be bow or gun (or close contact when killing from a snare or trap). You need to do some research on the anatomy of the animal you're hunting to know where to aim for preserving meat and not giving yourself lead poisoning or rupturing the spine. Nobody wants a paralyzed non-dead prey. If you can't kill it in one shot, don't go hunting. It is the most sad thing to see a deer running around with three legs because somebody couldn't either follow through or confirm their kill or take responsibility. Sometimes accidents happen but they're not common if you pay attention and are a responsible outdoorsman. I am not a fan of trophy hunting, unless it's "trophy" in the sense that you're hunting down something causing damage on your property and you kill the raccoon that's been terrorizing your flock, so you take it and give it to your birds to eat in retaliation. I'd consider that a trophy, but it's more of a revenge hunt. Even then, it's still hard to shoot something that's looking back at you… unless it's standing in a pile of your recently deceased favorite bird. I suppose if you hunt and you don't feel something akin to sadness or respect for what you hunt, you might have a little bit of psychopath in there somewhere. Respect is not wasting the body or the time you put into your ability to hunt prey. Respect is also knowing that your food had a good life before you ate it, and making sure it's a clean kill. It takes practice with a gun to be accurate, and no scope is accurate out of the box. Sight your scope well in advance of hunting so that you know it's zeroed in and ready to go, but periodically check your scope as well to keep it zeroed in. Carrying your gun around, whether it be sling or hand carry, is still shaking the mounting and can make it loosen. It normally only takes a slight adjustment, but just one click on the adjustments can mean the difference in shooting a nose or an ear and injuring and animal without bringing it down, and leaving it scared enough to run out of sight.

Cooking squirrel in Brussels sprouts and bacon.

In addition to all this, you need to take a hunter safety class. Technically in our state, we don't need a license to hunt on our own property, but it's still a good idea. Either the safety class is a good review of what you already know, or you'll learn something you didn't. I believe last year I posted about learning the Tyrell County laws about shooting frogs in roadways and it was absolutely worth the entire class' worth of time just to learn that law. The most important part of hunter safety is being aware of your surroundings. You have to know where your bullet will go if it goes through the intended target, or if you miss. This can depend on the type of ammunition you use, the gun you're using, and the terrain. Also, the main gun safety is keeping your finger off the trigger. I can't even count the times I've watched or heard of people keep their finger on the trigger in anticipation of shooting prey, and either misfiring or injuring someone with them. Those things are

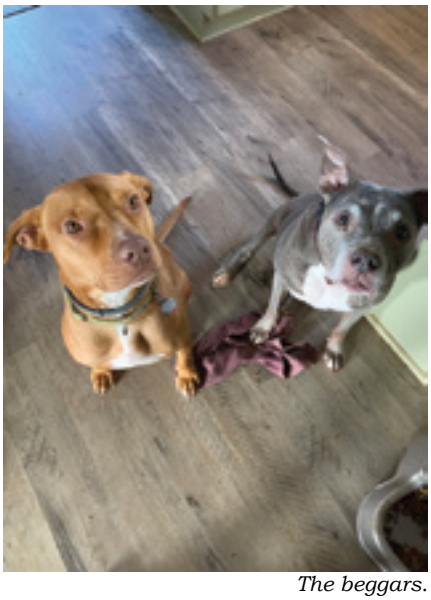
Henry with a big squirrel.

absolutely preventable and shouldn't happen. If you ever swing your gun in my direction because you're not situationally aware (or any reason, really) then it will be the last time we hunt together.

Squirrels can be hard to hunt because they are in the smaller spectrum of prey. If you are lazy or a bad shot, you might use a shotgun of small caliber like a 410. This can cause a lot more damage to the meat and make a nasty mess to clean up and the spread varies depending on the distance to your prey. So many things can affect accuracy, but it is pretty hard to miss with a shotgun. Normal people use a .22 rifle and typically go for the upper chest or head. There's nothing there to eat and it's a quick kill. It's easier to skin an animal with fewer holes because it has less damage and blood loss. Henry typically uses his .22 Savage rifle with a scope on it.

We've had a lot of squirrels running around the area and Henry's been having a fit to hunt them. I'll cook anything we kill that's non-predatory (with the exception of bears, I like bear meat) and usually have to run through a few recipes each year to get the nuances down for taste. Squirrels can be tough because they're mostly muscle and you're only really looking at eating their legs (back legs unless they're particularly large) and maybe some back meat. If you look up some squirrel hunting videos, all these guys will make it look super easy to skin a squirrel but it's actually a little difficult to finish it off, especially if you do it all the way. You can just start at the legs or the back and go about halfway up if you're only using the meat from the back down and save a little time, also assuming you don't want to keep the pelt for anything or any other parts (I have made jewelry out of teeth and such). You're definitely going to want a really sharp knife with a good point, or game shears. After this, you really need to brine or soak the meat in something. I either use water and a lot of salt, or vinegar and maybe onions and let it sit in the fridge for at least a day. If you go longer than that, make sure you change the liquid and rinse the meat but it won't stay fresh much longer than that. Rinse again once you're ready to cook it. You might notice some hairs still attached, which is fairly normal in most animal processing. It will cook off most of the time, but you can pick it off individually if it bothers you that much.

Henry shooting downhill - know your terrain.



The beggars.

Some people don't like the gamey taste of wild meat. A lot of this is the diet and age, but it's also a distinct lack of fat on animals that have space and ability to run and roam. If I eat a cow, I want marbled meat. I also think that grass fed cows taste weird. Squirrels are definitely on the stranger end of wild meat tastes, and some people won't eat them because they are basically large rats. If you can get over that, the best intro is cooking them in bacon. Everything is delicious in bacon, and it will keep the meat more moist. I like it with brussels sprouts because they have a slightly bitter taste that compliments the bacon and squirrel. Bacon and Brussels is a pretty common side for us anyway, so we're just adding some extra meat to the skillet. This works best if you layer the squirrel by putting bacon on the bottom. It cooks the bacon into the squirrel and keeps it from getting dried out on the bottom or cooking too long or hot and getting tough. I know it's just an unpalatable meat for some people, but it's worth a try just to be able to contribute to feeding yourself or your family with something that you did yourself. It's at least an accomplishment for the day, and will probably save you some rewiring later on.

Happy Hunting! BC

Jessica Louque and husband, Bobby run Louque Agricultural Enterprises, a contract research business specializing in apicultural studies. And they raise bees, and children at their home in NC.

New Year's Resolutions

(You have to do them all.)

You have your new *Bee Culture* calendar all ready to hang up. Your New Year's Eve celebrations are all arranged. You have not yet decided on your personal New Year's Resolutions yet simply because you are not very good at keeping them much past January anyway. However, you really do want your bees to be healthy throughout the coming year. They need to be able to provide pollination in your vegetable garden, whether it's a big garden or just a few pots on a deck. Plus, you are hoping the weather cooperates to provide you with a bumper honey crop.

Here's a way to feel absolutely smug about keeping those pesky Resolutions. Here are 12 resolutions; you could use one per month. Make a copy, cut it up and stick one on each month of your new calendar. In that way you will set a record! Keeping all your Resolutions.

So now it is time to turn off the television and stash your cell phone in a cupboard so you can now make your list of Better Beekeeping Resolutions for the New Year of 2020 (a very convenient number to type or write). Here are some suggestions, just to get you started.

Resolution 1. I will tackle the stored bee equipment as soon as the Christmas tree and all the outdoor lights, and other holiday decorations are taken down and put away for another year. If you have some honey supers stored in plastic trash bags check them carefully. An enterprising mouse can chew through those and make a mess.

This is also a good time to see if any stored equipment needs repair or painting or if it needs to be replaced. It would be wise to see if the equipment suppliers are having good sales. Since this is a quiet time in beekeeping any orders will be shipped promptly unlike during honey flow time.

Resolution 2. I resolve to read something in every issue of Bee Culture this month, and every month. It can be an article to help understand bees or one about varroa or about a piece of equipment. The excuse of "I don't have time" is OK but only once in a while. There is time if you look for it. If a sports game is more important, keep the magazine handy to read during time-outs and commercials.

You might discover something important if you read only the editorial. A Book Review (they are usually short) could give you an idea for suggesting a birthday present. Look at the advertisements—a new piece of equipment that would really help your honey harvest might appear. It only takes a quick minute to read the list of articles and authors. Choose what you will read first. Being informed about bees and beekeeping leads to being a Better Beekeeper.

Resolution 3. I resolve to read the Christmas present beekeeping book. Well, you asked for it because you thought it would improve your beekeeping skills. It also had the latest information and is well-illustrated. A problem with all beekeeping books is that the information may not exactly fit every climate that exists in this country. Bee work starts earlier in the warm South than in the cold North in Montana. So you will need to adapt the book's information to your locality. If there is a section on requeening, read it in case you wish to introduce some different lines of queens in your colonies.

If the book was about planting for honey bees and other pollinators it would be nice to share the information with your neighbors. Even if they are not beekeepers, helping all pollinators is a good project for everyone.

Resolution 4. I resolve to have a plan for opening up a hive. Bees know what their tasks are and are busy accomplishing them. Bees function quite well when not disturbed. When your smoker is lit, your hive tool in hand, Stop! Ask yourself "Why am I going to inspect the colony?" Take a moment to review. Am I looking for disease? Am I looking for pollen and nectar stores? Queen performance? Or am I "just looking?" If you cannot think of a good reason, then put out your smoker and go do something else.

Remember, if you are in small hive beetle territory, opening the hive and breaking open the "prisons" will increase egg-laying by the beetles.

If you have a good plan in mind, then go ahead and open the hive. Just disturb the bees as little as possible. If a problem does appear you can decide on your next action. Now you have a perfectly good reason for a return visit for observation or correction of the problem.

Resolution 5. I resolve to keep some sort of records. The "brick method" can be useful for short bits of information. A horizontal brick means "all is well." An upright brick can mean "this is queenless." You are the one to create the brick dictionary. Our phones and pads are useful for record keeping but must be protected against fingers sticky with honey, wax and propolis. If your fingers are protected with gloves that are easy to remove and put back on they will help. You need to enter the date and any brief comment to remind you for revisiting a particular hive. Your

computer can be one of your record-keeping tools also.

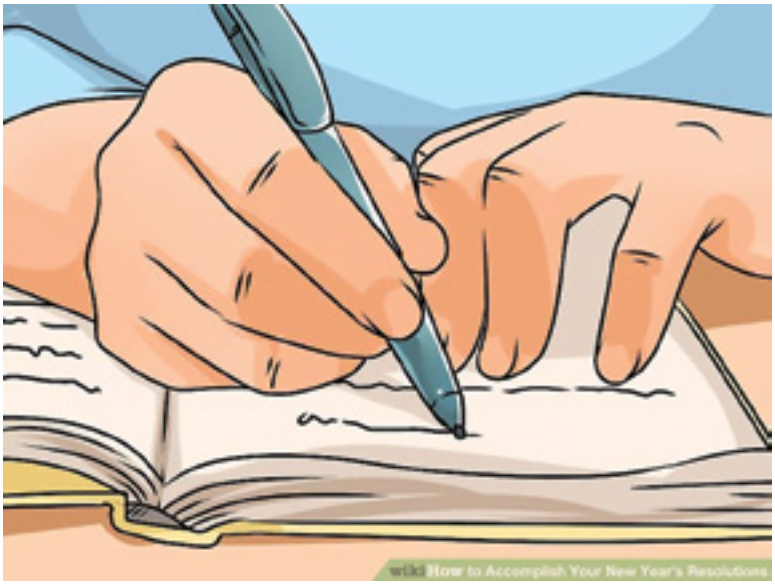
Just remember that keeping records simple and to the point make them useful. If they are too complicated you will not find them useful. You can certainly try the various colony-monitoring programs that are on the market now. Check with some beekeepers using them to find the one most useful to you and your style of beekeeping.

Resolution 6. I resolve to be a Weather Watcher. It's not about if you need a raincoat today. It is about rainfall, drought, too hot at the wrong time, too cold at the wrong time. Bees cope with the weather, as they have for millennia. But today you are stewards of your bees and have the responsibility of good living conditions and their food and water supply. We may notice when our tomato plants are wilting in the middle of summer during a dry spell. It is easier to see when the vegetable garden needs watering. Are your bees lacking nectar? Even if your honey crop is reduced your bees need to stay alive until weather conditions improve. Endless rain can also be a problem. Bees cannot forage; nectar is diluted or even washed out of plants. Yes, bees can suffer from unsuitable weather conditions.

Resolution 7. I resolve to be a Plant Watcher. Your honey crop plants will tell you when to put your honey supers on your hives. The plants are good indicators of weather conditions. However, are you keeping track of bee plants in those 18,000 acres around your beeyard? Farmland use can change from good bee pasture to a field of wheat. Landscaping in city parks can be changed. Go down those roads and streets you never use and find out if the available forage has changed. You may need to change your bee-feeding schedule.

Resolution 8. I resolve to control those pests, varroa and small hive beetle. Review your records (See Resolution 5) to see how your control methods have done. Perhaps the equipment suppliers have something new to offer. If your bees have been healthy and showed no problems, then there may be no need to change. If you decide on a new approach, try it on a few colonies. However, records will be important.

Resolution 9. I resolve to attend local and state association meetings. Speakers from other associations and from research labs will bring new information to help keep beekeepers informed. At large meetings equipment suppliers will be displaying and demonstrating new items. Although beekeepers have differing ideas on bee care, it is worthwhile to share information. Furthermore it is a good idea to help in some way, setting up tables, putting away chairs, or even bringing some refreshments. All associations are better with some participation.



Resolution 10. I resolve to offer to be a mentor to a new beekeeper. You always learn something when you open a hive, either yours or that of another beekeeper. A good mentor does not do the actual work but is there to observe, to guide the newbee, answer questions and point out the colony's and the queen's actions. If the queen has died perhaps you can provide a frame with some eggs and young larvae to save the colony. Your local club needs to maintain a list of members who can be mentors. Put your name on that list!

Resolution 11. I resolve to learn about other pollinators and other stinging insects. The winter is a good time to learn about all the other pollinators. Bumble bees and the small solitary bees are in trouble from declining habitat. These bees are necessary for the pollination of crops also. Blueberries, tomatoes and sweet peppers need the "buzz pollination" that honey bees cannot do. Squash bees are needed for good pollination of squash, pumpkins and melons. Beekeepers frequently get calls about "removing those bees" that turn out to be yellowjackets. Understanding the life cycles of other insects gives a more complete picture of what is needed to prevent their decline.

Resolution 12. I resolve to Bee Prepared. Get organized! Equipment needs attention—repair, paint now, before it's needed. Order supplies before they are needed. Are the honey supers ready for the blossoms?

Do you have a plan for rotating out old comb? If you live in bear or skunk country, is your electric fence working? Do you need to make improvements in the apiary? Bee season will be better with your advance planning.

If you can think of other Resolutions to add, then please do so. After all, your bees are depending on you for their home; their food and water, if needed; and their safety from marauding critters (even though the bees don't realize it).

Guess what! If you fastened a Resolution to each month on that calendar – and actually followed them – you might be the only person in the whole world who kept **all** their Resolutions this year! Congratulations! BC

Ann Harman pushes us to be better beekeepers, from her home in Flint Hill, Virginia.

Teaching Can Be The Best Way To Learn

Don't do these!

Winter is a great time to attend beekeeping classes and presentations. This means it's also a good time to teach a beekeeping class, or offer a bee related presentation. Whether it's a general information presentation, or a more involved workshop or beekeeping class, you don't have to have kept bees for decades in order to inform others about the wonders of honey bees and the ancient craft of beekeeping.

Thankfully, honey bees and beekeeping are such fascinating topics that capturing an audience's interest is not very difficult if you're prepared. As long as your share what you are passionate about and connect with the audience you'll do fine. From my own experience, I have found that offering a successful bee related presentation is more about not making too many mistakes more than doing any specific thing really well. Here are some things I suggest you try to avoid when conducting a beekeeping presentation.

Mistake #1 – Providing inaccurate information or answers to questions

One thing you do have to know is what you are talking about. There is more than enough misinformation about beekeeping out there on the Internet and even in some books. Providing accurate information is critical for establishing and maintaining your credibility and integrity. If you are asked a question that you are not sure about, it is better to say you don't know but will find out and get back to the person, rather than make something up on the spot that may or may not be true. Present material you know and are sure of (personal experience is best followed by scientific research).

Mistake #2 – Not knowing the interests of your audience

Having a clear idea of who your audience is and what their interests and needs are is very important. You will want to tailor your presentation to the knowledge level of your audience. Are you addressing a room full of people who know next to nothing about beekeeping, beginners in their first year or two, or seasoned professional beekeepers? Providing information that is designed to be of value to your audience is a sure way to get and keep their attention.

Mistake #3 – The Cold Opening

Get someone to provide you with an introduction for you before you speak. If the person can warm the audience up a little bit and talk you up a bit before introducing you, it will help to break the ice getting the audiences initial attention and setting them up to anticipate your presentation. If it is not possible to have someone introduce you, then don't start off by going right into your talk or lesson. Welcome everyone, point out where the restrooms are, and fill the audience in on the agenda you have planned before launching into your presentation.

Mistake #4 – Start off babbling

Your opening line can make or break your talk so you want to start strong. Most people will judge their interest in what you have to say within the first minute or two of a presentation. When I give a talk I always try to remember advice I read once about the first words one should say when giving a speech or presentation. The article suggested that as a speaker you should either:

- Start with a question related to your topic that matters to your audience
- Offer a factoid related to your topic that shocks the audience, or
- Start with "Once upon a time..." – a story from your life that connects you to your topic will cause the audience to lean forward and pay attention

Mistake #5 – Forgetting back up materials and reading from your slides

Being prepared means that you have an outline of what you are going to say, or a PowerPoint presentation that you can use to guide the audience through your presentation. Just don't make the mistake of reading from your presentation slides. I often use simple photographs to help illustrate the points I want to make in a talk, often without captions at all, just to keep from falling into the trap of reading to the audience. Don't forget to have a back up copy (or two) of your presentation on stand-by, just in case something unexpected happens to your primary copy. To help break up your presentation a bit, it's also nice to have a prop or two that you can show or pass around to give people some hands-on experience.

Mistake #6 – Monotone delivery

Your voice is the critical tool you use when speaking in front of others so use it effectively. Be sure to vary the pitch and speed of your voice during your presentation. By varying the tone of your voice and timing of your words, you can make even long presentations more interesting. I like to add a short pause after making a remark that is likely to catch the audience by surprise, before explaining what I mean. For example, when I tell people that when their bees die the colony is giving them a gift: the gift of becoming a better beekeeper, I will pause before explaining that by examining the dead hive and determining the cause of death, steps can be taken to

Controlling the lighting so that digital slides show up clearly can be extremely challenging in outdoor venues.

prevent a repeat of a similar situation in the future and that this is the path to improving their beekeeping skills.

Mistake #7 – Displaying nervous body language

It has been estimated that the majority of our face-to-face communication is through body language. Avoid pacing back and forth, keeping your hands in your pockets or fidgeting no matter how nervous you may be. Be sure to smile and make eye contact with the audience including those who are sitting off to the sides of the room. This can help to make you feel less nervous because you are talking to individuals rather than a teaming mass of strangers.

One of the most challenging times to present in front of an audience is right after lunch when some folks may get drowsy and want to nap. I find that moving around a bit during the presentation, especially if you can move toward or near a person who may be starting to doze off, it can help to get their attention and wake them out of their slumber.

Mistake #8 – Having an unfocused message

Have a theme for your presentation. Clearly communicating a big idea you want to share can help to attract and keep an audience's interest. When choosing a theme, try to keep it simple and remember to focus not just on what your core message is, but why you believe it is important. A common theme for presentations in front of a general audience for example is "Help save the bees".

Mistake #9 – Being too serious or telling bad jokes

Sharing stories or making jokes can also help to make a presentation a lively and fun. Just be sure to have your material relate to your chosen theme. If you decide to tell jokes, keep them clean and don't joke at the expense of anyone in the audience, so as not to inadvertently offend anyone. Incorporating humor into a presentation only works well when not done in a cringe worthy way. Psychologists have found that as a speaker, if you can make people laugh, not only will you lower their defenses and make them more likely to listen to the serious thing you have to say, you'll also be viewed as a more confident and competent speaker. Be warned though, a bad joke is worse than no joke at all. Therefore it is a good idea to test out any jokes beforehand to make sure they are actually funny. If you are simply not a funny person, sharing a humorous anecdote can be a more natural way to get the audience laughing (or at least smiling) and helps the audience warm up to you.

Another technique to grab the audience's attention is to tell a story but not finish it. When you say: "I want to share a story with you that is related to my presentation today, but you leave out the conclusion and say: "I'll get back to the end of this story later in my talk", you draw folks in with the story, but keep them engaged by not immediately finishing or providing the punch line.

Mistake #10 – Ending late and not leaving time for questions

Be sure to keep track of the time during your presentation. The audience will have expectations as to how long your talk will go and may get very disappointed if you do not adhere to the agreed upon time frame provided. Staying on time is even more critical if there is another speaker scheduled to follow your talk. If necessary, practice your talk ahead of time and time yourself so you know how long it is liable to take. By keeping track of the time you can be sure to leave time at the end of your presentation for questions and answers. I like to do this even though I typically will also take questions throughout the course of my presentation.

When taking questions, be wary of inquiries that having nothing to do with the main subject of your talk. I have on occasion had to ask folks with off-topic questions to "hold that thought" until all on-topic questions have been answered. This respects the interest of the majority of the audience members who came to hear about the topic that was advertised.

Teaching can be the best way to learn

It is well established that the best way to understand a concept is to explain it to someone else. Researchers have found that students enlisted to tutor others work harder to understand the material, recall it more accurately and apply it more effectively. Student teachers have been found to score higher on tests than pupils who are learning only for their own sake. So if you are passionate about bees and beekeeping, consider sharing your passion with others. Just be sure to avoid these 10 common mistakes. You just might have some fun, help inform others and become a better beekeeper for it. BC

GLEANINGS

JANUARY 2020 • ALL THE NEWS THAT FITS

OBITUARIES

Carl E. Hausknecht, 64, of Athens Township, Pennsylvania, passed away on Sunday, November 24, 2019 at home following an extended illness. Carl was a long-time branch manager for Dadant and Sons Inc., overseeing the Waverly, New York branch.

Carl was born on May 26, 1955 in Waverly NY, the son of the late Ralph and Mary (Griswold) Hausknecht. He attended Athens Area High School, graduating in 1973. He went on to earn a Bachelor of Science Degree with a major in Plant Science from Pennsylvania State University in 1977.

Carl went to work for Dadant and Sons Inc. on November 27, 1978, at the Waverly office. Carl was employed as branch manager for over 40 years until the time of his death. He was well respected and appreciated by beekeepers all along the East Coast, and in the states served by the Waverly branch. Carl was an excellent bee supply salesman and was very passionate about the beekeeping and honey bee Industry. In Carl's free time he enjoyed hunting and the outdoors. He spent many hours watching and enjoying the wildlife from his deck at home. He attended Athens United Methodist Church, serving on several committees, and was a member of The Rotary Club of Waverly.

Carl is survived by his daughter Elizabeth (Jason) Hashman, granddaughter Alexis Hashman and grandson Wyatt Hashman of Harker Heights, Texas; brother Wayne (Evelyn) Hausknecht and nephew Ben (Yolanda) Hausknecht of Harrisonburg, Virginia; and niece Kelly (John) Chripczuk of Boiling Springs, Pennsylvania. He is preceded in death by his father Ralph Hausknecht and mother Mary (Griswold) Hausknecht.

Carl will be greatly missed by his many friends at Dadant and Sons Inc.

BEE EFFICIENCY BOOSTS DIVERSIFIED FARMING

The more diverse a farm's plant population, the more beneficial it is for bee pollinators, and the more efficiently those pollinators work.

Those are the conclusions in a new paper published in the journal Ecology Letters by former Washington State University graduate student Elias Bloom.

Bloom and his co-authors, WSU entomology professors Tobin Northfield and David Crowder, looked at pollinator and plant populations on small farms (under 30 acres) and urban gardens in western Washington.

"Growing a wide variety of plants boosted the number of bee visits," said Bloom, now a post-doctoral research associate in Michigan State University's entomology department. "People want a silver bullet crop that they can plant that will bring in more pollinators, but that idea just wasn't supported by our data. Having a variety, especially if they're rare in a region, is the best way to increase pollinators."

These rare plants, which could be anything that isn't grown by other nearby farms, complement more traditional crops because they may flower at different times of year, or have beneficial traits that help pollinators vary their nutritional intake, he said.

Increasing that diversity also boosts pollinator efficiency by upping the number of visits a bee makes to crops at that farm.

"That means farmers can increase bee visits to their farm without adding more bees," said Bloom, who earned his Ph.D. from WSU in entomology in 2019. "And we showed it works for both honey bees and wild pollinators. If a farmer is thinking about buying more bees, planting more diverse crops could be an alternative."

A third finding of the paper is that giving bees a diversity of resources, like nesting habitat and flowers, in landscapes around a farm can also increase pollinator visits to a farm.

Elias Bloom earned his Ph.D. from WSU in entomology in 2019.

Bloom and his colleagues worked closely with 36 farms and urban gardens to look at the variety of plants each produces, and to measure pollinator visits. Among their partners were Hmong gardeners, originally from Southeast Asia, who now farm in the Seattle area.

"They brought a few plants with them when they immigrated here that you won't find in other gardens," Bloom said. "But they also grow staples found on most farms and gardens nearby, like tomatoes, peppers, or squash. Our research shows that this experimentation to introduce rare plant species may drive plant-pollinator interactions."

That doesn't mean farmers have to seek out rare produce from Asia or Africa, it just means they should consider a wider variety of plants from different plant families.

"You ideally want plants that flower at different times and with different flowers shapes and dimensions," Bloom said. "Some flowers are very small and shallow, which is great for small wild bees. Taking those things into consideration helps boost pollinator visits to your farm or garden."

Bloom's research was part of his Ph.D. dissertation and was funded in part by the National Science Foundation, the USDA, Western Sustainable Agriculture Research and Education, and others.

Media contact: Elias Bloom, WSU Department of Entomology graduate, Michigan State University Department of Entomology, 517-884-2006, bloomel1@msu.edu

CALENDAR

♦FLORIDA♦

Spring Bee College will be held March 6-7 at UF/IFAS Honey Bee Research and Extension Lab, Gainesville.

For more information visit **https://entnemdept.ifas.ufl.edu/honey-bee/extension/bee-college/**.

♦GEORGIA♦

Lake Country Beekeepers Association 8th Annual Short Course will be held January 25 at the Greensboro United Methodist Church..

Speakers include Bob Binnie, Rick Coor, Keith and Rose Anne Fielder.

For information visit **LCBA2020.eventbrite.com** or contact **lakecountrybees@gmail.com**.

Georgia Beekeeper Association will kick off their 100 year anniversary celebration at their Spring Meeting February 21-22 at Augusta University.

Speakers include Kirsten Traynor, Wyatt Mangum and Rachael Bonoan.

For information visit **http://www.gabeekeeping.com**.

♦ILLINOIS♦

University of IL Bees and Beekeeping Short Course will be held April 18 at the Bee Research Facility and the Carl R. Woese Institute for Genomic Biology.

The cost is $100. Must bring your own protective gear. Course is limited to 50 participants.

For more information and to register email **cundiff@illinois.edu** or 217.265.7614.

♦INDIANA♦

2020 IN Bee School XVIII will be held February 29 at Decatur Central High School.

Marla Spivak will be the keynote speaker. Program runs from 8:30 to 5:00

For more information visit h**ttps://indianabeekeeper.com/events/indiana_bee_school_xviii**.

♦IOWA♦

CIBA Winter Seminar will be hel January 18 at Grimes Community Center in Grimes. The cost is $35/members and $40/non-members which includes lunch.

Featured speakers are Larry Connor, Judy Wu-Smart and Sheldon Brummel.

For more information visit **https://centraliowabeekeepersassoc.org**.

♦MISSOURI♦

Eastern Missouri Beekeepers Association 13th Annual Beekeeping Workshop will be held February 7-8 in St. Louis.

Keynote speakers include Jennifer Berry, Kim Flottum, Gary Reuter, Becky Masterman, Bridget mendel Lee and Ana Heck.

The cost is $85/person, $95 after January 19. Banquet costs is $30/person.

For more information visit **www.easternmobeekeepers.com**.

♦OHIO♦

Warren County Beekeepers and OH State Beekeepers Association will hold their annual Beginning Beekeeping class January 25.

For information visit **warrencountybeekeepers.org/**.

♦OKLAHOMA♦

The Big Bee Buzz will be held March 27-28 at Asbury United Methodist Church, 6767 S. Mingo Road, Tulsa.

Keynote speakers include Kim Flottum, Landi Simone, Reed Johnson and more.

The cost is $75/members, $85/non-members and $90 after January 16.

For more information contact Carol Jones, 918.844.5493.

♦TEXAS♦

Austin 9th Annual Beekeeping Seminar will be held January 4, 202 at the Marriott, La Frontera, 2600 La Frontera Blvd., Round Rock.

The cost is $75/person.

Featured speakers include Juliana Rangel, Blake Shook, Mary Reed, mark Hedley and many more.

For information contact Lance Wilson **lance@beekeepinghelp.com**.

♦WEST VIRGINIA♦

The Mid Ohio Valley Beekeepers' Association will hold their Honey Bee Expo January 25 on the campus of WV University, Parkersburg.

The cost is $20/person by January 6, at the door $25. .

Featured speaker is Jim Tew.

For information visit **www.movba.org**.

♦WISCONSIN♦

Green Bay Botanical Gardens and GB Master Gardeners present their annual beekeeping classes at the Gardens – January 21; January 22 and February 11.

For more details and information contact **www.GBBG.org**.

Dunn County Beekeepers will hold an "Introduction To Bees and Beekeeping February 8 at Menomonie Alliance Church.

The cost is $60/person, $95 after January 19. Banquet costs is $30/person.

For more information visit **www.dunncountybeekeepers.org**.

♦WYOMING♦

Wyoming Bee College will be held March 21-22 in Cheyenne, with a Pre-Conference Workshop held March 20.

The cost of the workshop is $125/person. The cost for the conference is $85/person or you can do both for $195.

Featured speakers are Phil Craft, Jamie Ellis, Scott Debnam, Reyah Carlson and more.

For information visit **www.wyomingbeecollege.org**.

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Do You Know How To Look For Mites?

Ed **Colby**

"Pride cometh before a fall," according to a reliable source.

Faithful readers of this column might long ago have surmised that but for bad judgment and regular misadventures, I'd be out of stories. Yet an optimist might say my cup is half-full, because without material, a writer flounders and ultimately despairs. Every time I blow it, my gal Marilyn cheerfully chirps, "I'll bet you can get a column out of this!"

My new beekeeping friend Megan wanted to tag along, and thankfully I said yes. It was October 23, and I wanted to confirm low *Varroa* mite numbers at one of my yards by sugar-shake sampling. I'll bet I've done 500 of these in my long life.

Megan and I dumped 300-bee samples into mason jars with number-eight hardware cloth inserts in place of the lids. We dropped a dollop of powdered sugar onto those little darlings, gave the jar a couple of shakes and let it sit for a few minutes.

Next we turned the jar upside down and vigorously shook it about 30 times over a clear plastic tub. When you invert the jar and shake the bees, sugar-coated mites let go of their honey bee hosts and come tumbling through the hardware cloth jar lid into the tub, where you can count them. I like my mite numbers to be very low going into winter, say, zero or one mite per sample.

All Summer I hadn't been finding mites in the concentrations I have in years past. More than once, I told other beekeepers, "This is dangerous talk, I know, but I'm not finding *Varroa* this year." When I said that to my commercial beekeeper friend Derrick, I do believe he rolled his eyes.

But I knew what I was doing – diligently sampling for mites and using the results to make a treatment determination. Reasonable?

Even in September and October, my mite numbers were so consistently low that I planned to wait until the bees went broodless in November and then hit them with an oxalic acid dribble. Hives that tested zero for mites late in the fall might not get a treatment at all.

So when Megan and I shook our first sample into the tub, I, being the presumed expert, reviewed for her how to count mites. "Look," I said, "There's one wiggling her little legs, and there's another one!" I found two in this particular sample, but then Megan said, "I see another one, and there's one, and there's one, and there's another!" So now we were up to five or six mites, most of which I had missed. I found this disconcerting. Evidently my eyes are worse than I thought.

Well, I thought, I'll try Tina's technique, which I had to this point considered a waste of time. I poured a little water into the tub, and voila! Mites floated to the surface like shiny, reddish, pinhead-sized ticks doing the breaststroke. Except there weren't five or six. I counted 20 and suddenly felt ill.

We repeated this test on another hive, with similar results.

Megan consoled me. "We never stop learning," she counseled. Then she got pragmatic. "Let's treat 'em!" she exhorted.

Fortunately I had some Apivar (amitraz) strips in the truck for just such an emergency. I put on my rubber gloves and we treated 'em all.

The next day at another yard, when I re-tested other hives, I got similar results. I had apparently been undercounting mites by a factor of five or 10. All my careful notes of season-long mite counts went out the window. Now, with Old Man Winter knocking, I stopped counting and started treating.

A few weeks prior, a formerly strong colony lost most of its bees over a short period of time, and when I sampled it for mites, I found nine. So how many did it really have?

On the upside, since I began counting (or undercounting!) mites 10 years ago, I haven't had widespread colony collapse. My bees generally wintered well following a Fall treatment. Maybe bees can tolerate higher mite numbers than I thought possible. But in the past I've been pretty diligent about treating my hives in September, or earlier if I found some hot ones. This year I thought I was in the clear.

My discovery that I was undercounting mites coincided nicely with the onset of queens shutting down for the winter. Most of my colonies had gone broodless, so the panic-driven oxalic acid dribble treatment I gave them should have been extremely effective. I treated 120 hives, some at temperatures in the 30s, because you do what you have to, and I got pinched between organizing the state bee meeting and an arctic blast that brought record low temperatures.

There's always a silver lining. I'd agreed to sell back to Paul a yard I'd bought from him years ago, and just to be on the safe side, I'd earlier treated those bees with Apiguard (thymol).

I got caught with my pants down. No excuses. Did you learn from my mistake? Because if you're looking for mites but not finding them, then maybe, just maybe, you don't know how to look.

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