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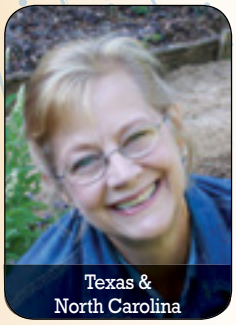

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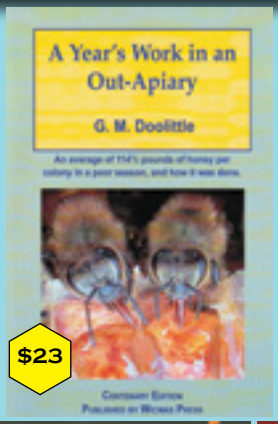

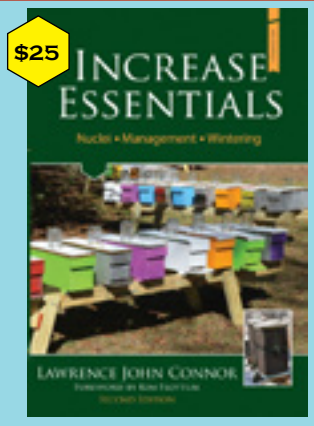

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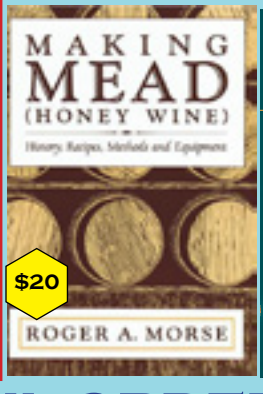

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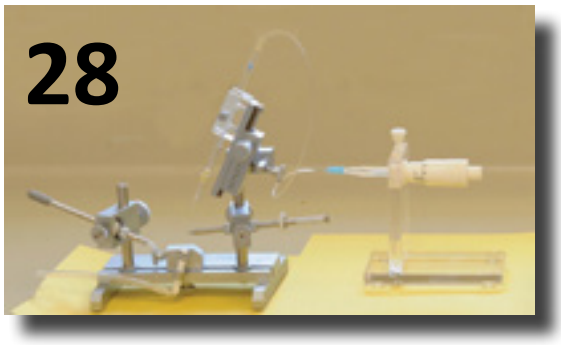

Early Valentine's Day present – Maple buds on February 9.
photo by Kathy Summers

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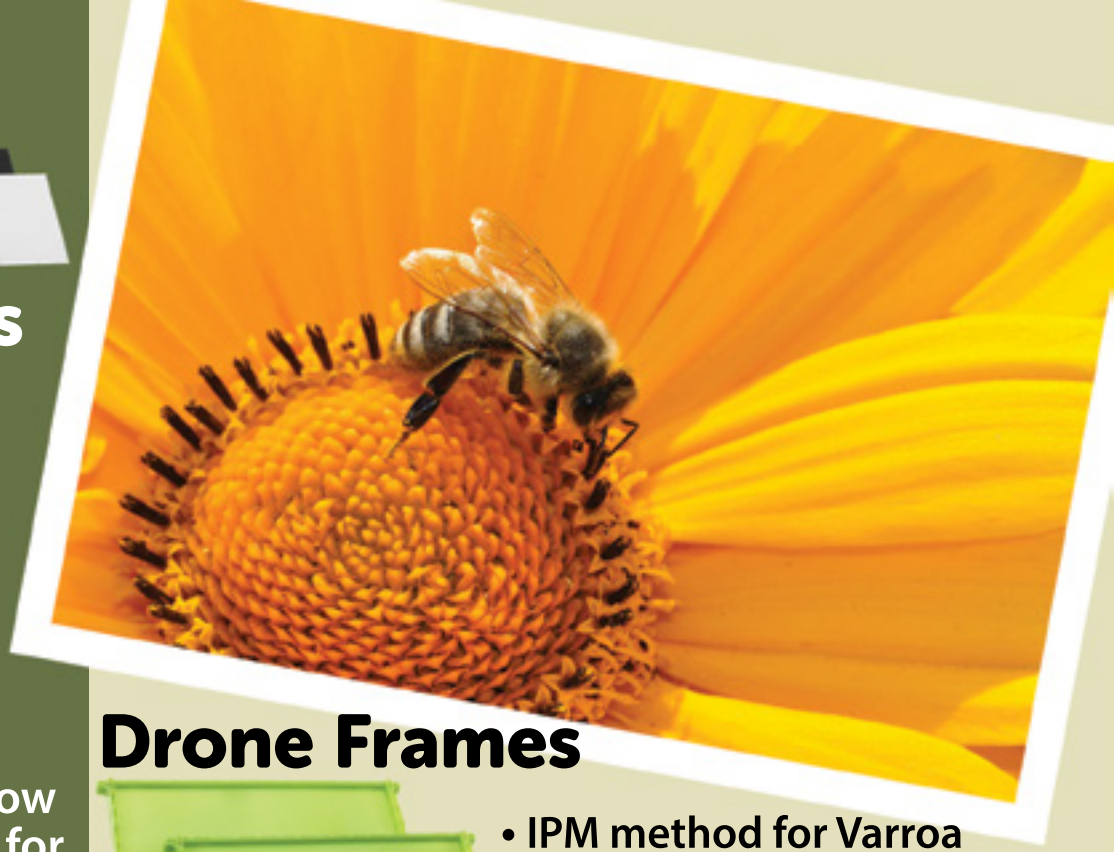

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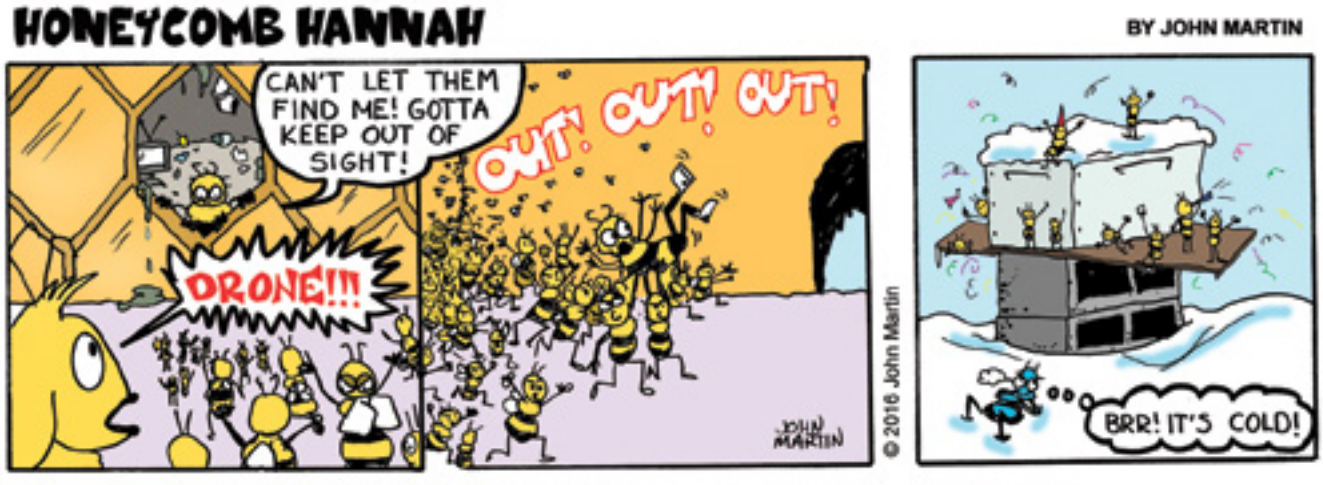

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Invasive Plant Advocacy

It is my understanding that *Bee Culture* has recently published articles advocating the planting of knotweeds and teasel for the benefit of bees. As a natural resource professional and bee lover, I feel compelled to ask you to stop this advocacy of non-native and highly invasive plants. These species are responsible for the loss of native plant species and biodiversity in general wherever they colonize. They form monotypic stands that are incredibly difficult to eradicate. Why promote non-native, invasive plants, when there are so many native species that are just as valuable to honey bees and other pollinators. As a respected publication you wield great influence in the bee keeping community. Please wield for good and stop this myopic advocacy of plants, that although attractive to bees, are disastrous to the general health of our ecosystems.

Doug Sheeley
Natural Resources Supervisor
Polk County Iowa

Editor's Response: *We do not advocate planting and spreading these invasive plants, but the fact remains they exist in our universe and being aware of them is important. Many invasives are also excellent honey plants for the bees that are also in our universe that simply do not have enough good food in many places any more. Further, since they are here, and they do contribute, beekeepers should at least be aware of what they are, that they are invasive, and that unintentional propagation will occur when their bees visit those flowers. Our bees are invasives, many plants are invasive, and that's pretty much the way it is. At least knowing what they are will foster some responsible behaviors on spreading these plants.*

Before Neonics

Mr. Linder seems to be shaking in his shoes at the prospect of things returning to the way they were before neonicotinoids (neonics) came on the scene. He should be more concerned with what neonics will do to our wildlife, bees and human health if neonic use, as it is now, continues. I have been keeping bees for 66 years. When neonics came on the market is when my beekeeping started going to hell. That is also when we lost our pheasants, bobwhite quail and grey partridge. That is also when we lost most of our small farmers.

The ground hogs (multi-thousand acre farmers) have taken over. They have bull dozed farmsteads and wind breaks so they could farm with their big machinery. If Mr. Linder thinks he is in a heavily neonic use area, he needs to come to western Iowa where they have torn up the pastures and hay fields so they could plant corn and soybeans. The seed-chem corporations have not made untreated corn or soybean seed available to farmers in the last two years. I would gladly go back to neonic free days when we were able to get good honey crops.

Here is the way Big Ag farmers do it. First, they spray the ground with pre-emergence herbicide in the Spring. Second, they plant seed treated with neonics. Third, they spray with Roundup herbicide or equivalent to try to kill the weeds, and it is not uncommon for herbicides to be sprayed more than once during the growing season. Last, they come in with their million dollar combines so they can harvest it in a short time. They have driven the price of land sky high and bid land rental way up. Most of the little operators are gone.

I have had bee losses but not what I would call CCD. I believe what is happening is, if the bees aren't killed outright, they bring enough poison back to the hive to knock out the bees immune systems and they succumb to the viruses even if you knock down the *Varroa* mites and the bees die over the Winter. I think the answer to the *Varroa* mite is VSH and other resistant stock, but neonics are the foundation for our troubles.

Something that gives me hope is that a number of respected USDA scientists have found in their research that neonic treated soybean seeds have no practical advantage, yield wise or money wise, over untreated soybean seed in the upper Midwest, which includes Iowa. The neonics don't kill the aphids that attack soybeans

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but they do kill the beneficial insects which eat the aphids.

As for the mayflies on the bridge in Iowa, that was a fluke. Come to western Iowa and you don't have to clean your car windshields very often because there are very few bugs to get on them, which is unlike what it used to be.

If you will check with the U.S. Geological Survey, they will tell you that neonoctinoids were found in all Iowa surface waters and some ground waters. If Mr. Linder is worried about the frogs, he should do more research and find what effect neonics have on frogs and aquatic life.

As for Mr. Linder's assumption that the tonnage of pesticides has dropped significantly, he should consider that Roundup or its equivalent is sprayed on all the soybeans and corn. These chemicals are in our water and we are drinking this stuff!

Mr. Linder is naive and he needs to take the time to check out all the pesticide research that is and has been done.

Ivan Rickers
Westside, IA

Where Is Mt. Hood?

My uncle lived his whole life in and around the Portland-Salem area in the state of Oregon. He didn't have much use for Californians; I'm not sure why. To my knowledge no Californian ever did him any harm.

One of his most memorable notions on the topic of Californians – and one that my brother and

sister still mention every time we get together – was that, "If they thought they could get away with it those dang Californians would come up here and steal Crater Lake!"

Well, it seems that those Californians have pulled off an even bigger heist than my uncle ever could have imagined – apparently they stole Mount Hood! In the January issue of *Bee Culture,* in an article on page 77 about smartweeds and knotweeds, I read concerning Bolander's knotweed, "Native only to California, this species occurs in some areas of the state, including Mt. Hood."

Fortunately, my sister lives outside Portland, OR, and only about 35 miles from where Mount Hood has traditionally been located. I was very relieved when she assured me that it's still there. Let me assure your readers that the Californians haven't yet figured out a way to steal the glorious mountain away from its home in Oregon.

Alan Stout
New Paltz, NY

Author's Response: *There is a Mt. Hood in California, located near Santa Clara. It is also known as Hood Mountain.*

Climate Change?

Ross Conrad must be the nom de plume of Al Gore! When you throw out the English data that is known to have been misrepresented to make their case, the temperature has not risen for about 19 years. Put your recording thermometer on the roof next to the furnace vent and your data is bogus. I suppose the Neanderthal was clever enough to discover that the black rocks lying around would burn and warm up the cave, but they certainly didn't burn enough of it to melt that mile high glacier that reportedly went across my farm here in Ohio. Global warming and cooling has been going on for thousands if not millions of years, long before the coal-fired power plant was thought up. We all want clean water and air, but the earth's forests and the vegetation our bees rely on produce more CO_2 than all the power plants and steel mills, etc. combined. Thankfully, they also produce O, which is more important than the 400ppm of CO_2 Ross reports. I'm all for clean energy, as long as they can make it cost effective, and what will they do if a windmill kills a spotted owl?

Ken Lawler
Ohio

Smokers

The several articles in bee culture on the origin and historical development of smokers as tools for calming honey bees to make it easy for beekeepers to work their hives are well written, interesting, but they do not mention the most primitive smokers of all, the kind that I used as a budding entomologist, of the 1940s – a member of the Mexican agricultural program (MAP) set up by the Rockefeller Foundation in cooperation with the Mexican government to help Mexico feed its own people with their basic foods: corn, beans, and wheat, a program that blossomed into the green revolution.

Mexico had its share of modern beekeepers with Langstroth hives and modern smokers. Charles Mraz, a beekeeper from Vermont, famous in those days for his beliefs regarding bee stings to alleviate arthritis, and of other such health benefits from eating honey and from getting stung. With it all, arthritis ran him out of the beekeeping business before he died. He had a picturesque apiary in the mountains along the road from Mexico City to Cuernavaca, each hive, each super, a different color and all colors of the rainbow represented.

But Mexico had other kinds of beekeepers as well. Dominique, the mayor domo for the agricultural out-station near Cuernavaca had one beehive constructed from orange crate lumber, which hung from a bar under a thatched roof. Long and narrow his hive looked like a prototype of the horizontal hives discussed in research papers today. Breast high it was easy of access. The harvesting system was to break open one of the ends of the hive, and scoop out combs of honey. Some brood might adhere to the honeycombs but brood was good to eat as well. Then he would close that end and let the bees refill it. For the next harvest, he would carve out honeycomb from the other end. The queen and most of the bees were supposed to stay in the middle.

Smokers were all over the station and beyond, dried cow pies they were. When I offered to help, Dominique asked me to pick up the cow pie, light an edge of it and breathe over the smoldering cow pie to waft the smoke into the hive and at the bees to calm, which I did.

Innovative thinking, no es cierto? And think, guys. The smoker was completely organic – the bellows human lung, the container, not tin, but two human fingers and a thumb holding the fuel. And the fuel what could be more organic than a cow pie?

There was a lot of innovative thinking in Mexico in those days as there is today in any country. The then Mexican director of that station arranged to have the road repair crew that came pay him for the rocks, big black igneous ones, they took off the grounds of the experiment station, when for no payment whatever they could pick up all of the rocks they needed from those all around them elsewhere.

John J. Mckelvey, Jr.
Richfield Springs, NY 13439

Killing Rodents

This letter is in response to a 'Catch The Buzz' sent on January 3, 2016 about UK beekeepers needing certification to poison mice and rats. You can view the entire post at ***www.BeeCulture.com****.*

Unfortunately, the way this article is written glosses over the huge damage to the Web of Life that optimally SERVES mankind. The active ingredient in these rodenticides (a blood anti-coagulant) is known to

cause a cascade of effects when the poisoned rodents are eaten or scavenged by other animals – including domestic dogs and cats. That should have been noted because the attachment of "pets" and their owners is viewed as a particularly human-centric concern and their slow poisoning death by bleeding internally (the mode of action not described by this piece) is pretty horrific.

Recently, in the Santa Monica Mountains Conservancy here in Southern California a radio collared mountain lion under scientific study, slowly died of secondary poisoning caused by the egregious and widespread use of anti-coagulant rodent baits. His fur fell out, he became infested with mange and very thin – these declines were documented on the infrared cameras set up to monitor his night movements. It was very sad, yet only the tip of the iceberg in terms of the devastating effects on raptors, scavengers and domestic animals. For the education of those uninformed, here is a link from a reputable institute (the BioIntegral Resource Center) studying these chemical's non-target animal effects.

It is no joke. **www.birc.org/raptors.htm**

Susan Rudnicki

Queen Excluders

Regarding James E. Tew's January 2016 article, which included queen excluder use – I use plastic queen excluders.

Sometimes I take a super from a strong hive to a weak hive (using newspaper) bees and all. I do *not* want the queen along. I am to lazy to look for the queen.

When using a plastic excluder I put a notched one-inch shim on top of the excluder. That gives the bees entrance to top, middle and bottom.

Some say freezing a plugged plastic queen excluder and then snapping it, cleans it. No way! When it gets 60% plugged use it to keep grass down in front of the hive.

I like the way Dr. Tew presents a problem and encourages the reader to look for a solution.

Richard Brewster
Andover, NH

Kudos To Bee Culture!

I wanted to write and thank you for your help in making 2016 Vermont Beekeepers Association Educational Booth a success. Below is one of our volunteer's remarks after working the booth. Thanks again, and VBA will be requesting magazine again for the 2017 booth.

Paul Yanus

WOW yesterday I worked the VBA educational booth from 5PM to 7:30PM I was just blown away by the number of people that are going to be first time Beekeepers this Spring – 26 brand new Beekeepers.

They where from all over the state. A few attended our Winter meeting. Some have signed up for classes. All that had not joined VBA were given hand outs to join,also given information on any local clubs that are in their area.

I now know why so many nuc and package bee suppliers are sold out. Will this year be a record breaking year for new beekeepers across the nation.

Questions and Answers

Honey Bees and LED Lighting

Steve,

You wrote of your brother having honey bees attracted to his lights. I may have an explanation- "Zombie Flys" Don't laugh, we have them here in the Pacific Northwest.

The best way to find out if this is your situation is to capture any bees attracted to lights especially at night. Keep them in a tightly closed jar for several weeks after they die and you will see any zombie fly larva emerge and pupae on the jar bottom. We actually had a bee club member bring in a jar of dead bees and dead flys so we do have the parasite here in the Pacific Northwest.

Here is a link about this parasite; **www.nhm.org/site/activities-programs/citizen-science/zombee-watch/identifying-zombees**.

Ernie Schmidt,
Olympia, Washington

HONEY LABELS

Sometimes a honey label can make or break a sale, especially when sitting on a shelf with bottles from several producers that are all about the same – color, size and price. It's then that a clever, attractive and informative honey label will give you an advantage.

Here are some honey label thoughts if you are going to redesign yours, design a new label for a different sized jar, or haven't made one up yet.

Of course the role of the label is determined by the market it will play in. If you simply give your honey to friends and family is one thing, if you sell it to friends and co-workers, that's another. But if you have a display in a stand, or go to a farm market that's still another, and if you sit on a grocery store shelf with other honeys, that's still another market. Each of these can, and should use a different label, with a different message, but still with similar information for the ultimate consumer.

Let's start with giving it away. Since you're not in the market, you can provide limited information. Maybe the variety if you know it, your contact information if you think that's necessary, and perhaps a date of when produced, so the consumer knows.

However, if you sell honey, the rules change. Once you enter the world of commerce you need to provide substantially more information, and though similar, each state has, or might have different requirements, so check first. But weight, in ounces, pounds and/or grams needs to be there is some form – 1 pound, 454 grams might do it. Or eight ounces, 227 grams or some combination. Contact information is necessary so some regulatory body can find you if they want, and of course, what's in the bottle – HONEY.

The National Honey Board has more information on what should be on a label than you can imagine. Take a look at these links – **www.honey.com/honey-industry/honey-testing-and-regulations/honey-labeling**. They also have these links, as well: **www.honey.com/search/results/3aa4d220c6cb53ba3fb337adcd0bff91/**.


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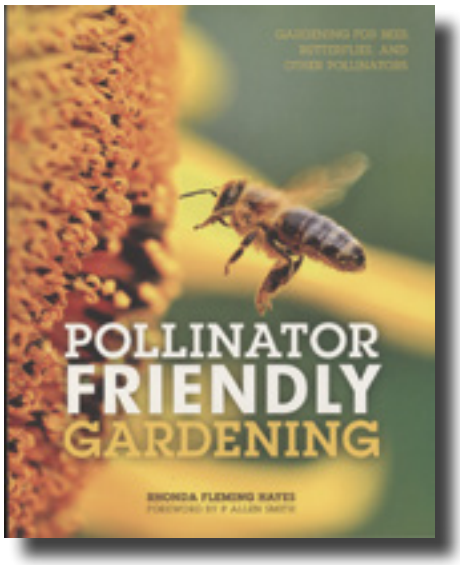
But there are some design guidelines that can help, too. We'll look at some of them this time, and we'll look at more next. In the meantime, we have space and time to get your label here to take a look and maybe learn from. Scan and attach as a jpg and send to me at **Kim@BeeCulture.com** with honey label in the subject line.

So, first be sure it fits the jar you are going to use, and don't use the same label for every size jar you use. There should be ample space above and below the label to adequately see the color of the honey, even if there is a back label, and there should be a back label giving additional information. If your front label says honey (and a name for that honey, such as Spring Blossom), weigh and contact, your back should be telling where it come from, what kind or what season it was harvested and a bit about the honey – is it Raw, Goldenrod, or from the gardens of your home.

What about a top label. Especially if you are in a farm market table market. People can't see the front, or back label, but they can read the top with ease. Tell them something before they even pick up the jar, or tell them enough to make them want to pick up the jar.

Next time, more info. Today, send along your labels and let's take a look. BC

New For You –



Pollinator Friendly Gardening. Gardening For Bees, Butterflies, And Other Pollinators. Rhonda Fleming Hayes. Published by Voyageur Press. 8" x 10", soft cover, color throughout, 176 pages. ISBN 978-0-7603-4913-7. $21.99.

What an outstanding book. The author is a Master Gardener, and for the past 15 years has been applying those skills to enhance and create a whole series of pollinator friendly gardening ideas. She starts with pollinator biology and behavior, discusses natives and invasives (there's a place for everything, but there are alternatives for invasives that she suggests), and the general habitats for most every kind of pollinator. This isn't just flowers, it's a lifestyle. I like that.

I'll tell you what else I like. She isn't the expert on everything here. She brings in other experts that really know about the plants and insects and the rest. What she does is interview these good folks. Marla Spivak is one of these, as is horticulturist George Coombs, C. Colston Burrell, Monarch experts Karen Oberhauser, Chip Taylor and Benjamin Vogt, and humming bird expert Donald Mitchell. She has all the bases covered.

But there's more. Host plants for butterfly larvae, nesting sites for bees, and water. Who provides water for pollinators? She does, several different ways. Even some beekeepers fall down there. Pesticides, too are warned about, along with helping out beneficials in the garden. And plant lists. So many plant lists. And more plant lists. This is the place for gardening for pollinator plant lists.

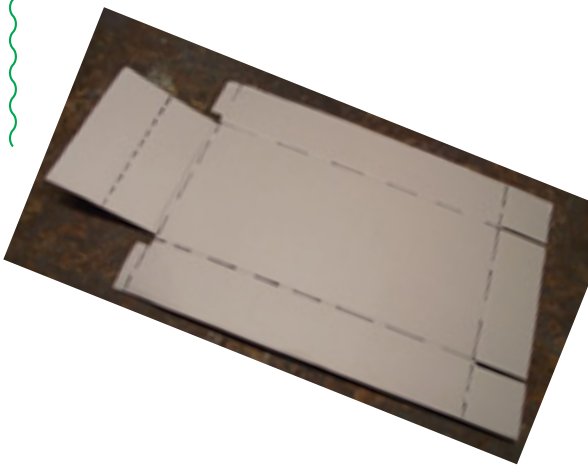
A good gardener, what to plant, a friend of pollinators and a host of experts. This is one good book.

EZ Nuc now has available a conversion kit for use in converting their standard **EZ Nuc** deep nuc to a medium size nuc.

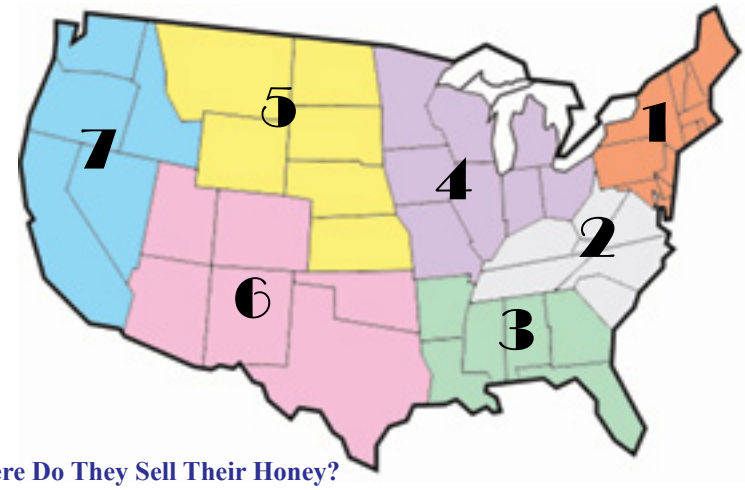
Beekeepers who use all medium sized hive bodies now have a way to produce nucs for the medium size hive bodies. The tendency in the last couple of years for more mature beekeepers and the entry of women into beekeeping to use medium hive bodies resulted in EZ Nuc adding this conversion kit to their product.

The E-Z Nuc medium Frame Conversion unit. It is made of the same type of material that the E-Z nuc is made of and will raise the bottom of the deep nuc to match a medium depth.

It is avail immediately from Jester Bee at **www.jesterbee.com** or from Dadant at **www.dadant.com**.



MARCH – REGIONAL HONEY PRICE REPORT



Again this year we polled our reporters to find out where on earth they are selling their honey. We've been doing this for several years and the trends, though predictable, continue to evolve.

Expanding sales means selling more products to the same people, or finding new people to sell your products to. And, they need to be different people.

Interesting this year is the drop in the number of people selling honey from home. With more urban beekeepers this isn't surprising. It's hard to sell when you live on the fifth floor in a big city. Too, the issues with insurance and food safety are growing so selling from the back porch, if you have a back porch are getting trickier.

The amount that people sell at farm markets continues to increase, even though the number utilizing this resource remains fairly steady. That's encouraging but if you have a market nearby and aren't using it, maybe check it out.

Local mom and pop store sales are decreasing too, as are local mom and pop stores. It's hard to compete with a national brand, and it's beginning to show.

No matter where you sell, check out the articles on labeling this month. A good label will always help.

Where Do They Sell Their Honey?

% of Reporters Selling at these locations							% of Their Honey Sales at these locations							Locations Honey Sold at
2010	2011	2012	2013	2014	2015	2016	2010	2011	2012	2013	2014	2015	2016	
81	71	77	77	72	83	61	43	51	36	73	31	39	46	Home (inside or roadside stand)
13	17	16	19	14	24	14	14	26	19	34	43	32	42	Local community - sponsored farm market (i.e. Sat. & Sun. sales)
23	19	29	28	26	22	24	27	31	40	31	29	20	44	Local Farm Market business that's seasonal (Fall only, for instance)
32	26	29	26	25	28	27	38	34	33	35	26	30	37	Local Farm Market business that's year-round
9	8	4	5	6	6	3	34	24	33	19	10	15	25	Flea Market
37	35	39	35	83	22	22	19	18	24	20	22	19	27	Health Food/Organic store
8	12	10	7	11	13	3	37	9	8	6	10	14	25	Gift Store
19	13	16	17	13	11	2	22	20	21	17	12	19	80	Bakeries/Food Establishments
13	17	14	5	10	9	10	13	13	28	5	16	34	38	Local High-End Retail Outlets (gourmet stores)
37	30	31	27	32	35	15	19	22	16	27	25	20	37	Local, Small 'Mom & Pop' Retail Outlets (grocery & gas)
13	14	17	4	7	11	7	26	32	35	13	28	45	44	Local Small Packer or Producer/Packer
0	5	2	3	3	4	2	0	42	100	67	78	83	45	Huge Packer, they pick up
9	13	11	9	8	11	9	30	38	41	51	37	45	45	Wholesale only to larger stores, you deliver to warehouse
11	14	11	5	13	7	2	3	4	9	5	5	9	30	Breweries/Beer or Mead makers
4	6	10	6	8	6	3	8	6	10	5	8	4	10	Internet, direct retail, mail order
17	29	41	41	33	19	27	11	20	21	18	13	12	34	Work, direct retail
8	8	6	16	10	7	2	25	8	6	16	13	7	27	Local/State Fair, with club

*Total percentage of sales does not come out to 100% because of multiple outlets.

REPORTING REGIONS								SUMMARY			History	
	1	2	3	4	5	6	7	Range	Avg.	$/lb	Last Month	Last Year
EXTRACTED HONEY PRICES SOLD BULK TO PACKERS OR PROCESSORS												
55 Gal. Drum, Light	2.00	2.01	2.16	2.95	2.28	2.17	2.35	1.70-3.00	2.22	2.22	2.20	2.28
55 Gal. Drum, Ambr	1.80	1.96	1.98	2.83	2.22	2.00	2.43	1.60-3.00	2.14	2.14	2.08	2.14
60# Light (retail)	225.00	175.20	194.17	217.68	204.84	174.00	235.00	132.00-280.00	203.68	3.39	204.84	199.68
60# Amber (retail)	230.00	176.83	198.00	231.94	201.70	181.75	230.00	126.00-270.00	205.40	3.42	204.35	193.25
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS												
1/2# 24/case	90.70	75.20	82.00	58.48	84.08	86.40	90.00	48.00-126.00	81.16	6.76	83.82	78.76
1# 24/case	126.49	103.43	116.60	95.77	148.00	108.60	128.13	84.00-180.00	115.81	4.83	119.04	118.00
2# 12/case	112.56	91.92	102.59	88.70	109.03	108.00	118.00	72.00-156.00	104.07	4.34	106.11	107.53
12.oz. Plas. 24/cs	107.45	85.80	97.87	78.67	106.32	108.00	106.60	64.80-168.00	96.23	5.35	97.15	87.88
5# 6/case	134.82	103.25	100.93	102.01	131.30	120.00	135.00	84.00-204.00	118.60	3.95	119.11	120.02
Quarts 12/case	187.89	126.48	131.13	119.52	166.00	144.00	136.00	105.00-275.00	140.00	3.89	138.22	141.19
Pints 12/case	111.99	89.64	81.57	81.22	111.00	73.94	102.67	60.00-144.00	90.37	5.02	91.32	87.17
RETAIL SHELF PRICES												
1/2#	5.22	4.19	3.94	3.20	4.00	4.16	6.00	2.00-7.75	4.42	8.84	4.49	4.15
12 oz. Plastic	6.29	4.82	5.27	4.19	3.93	6.51	7.05	3.00-8.99	5.48	7.31	5.43	5.06
1# Glass/Plastic	7.60	6.52	6.63	5.79	5.78	6.12	10.65	3.00-14.59	6.94	6.94	6.98	6.65
2# Glass/Plastic	13.13	10.36	11.41	10.99	10.09	9.72	16.00	5.40-19.00	11.73	5.86	12.16	11.83
Pint	13.69	9.00	11.06	10.80	9.00	9.90	12.07	4.50-26.00	10.73	7.15	9.65	8.65
Quart	18.24	15.47	14.24	14.57	16.00	16.64	19.07	8.50-28.00	16.00	5.33	15.92	15.56
5# Glass/Plastic	28.63	23.83	11.98	24.10	24.44	25.43	30.00	4.00-40.00	25.07	5.01	26.45	26.19
1# Cream	8.90	7.74	6.99	7.08	11.61	6.89	9.00	5.00-16.00	8.28	8.28	8.56	8.63
1# Cut Comb	12.55	8.33	8.00	8.70	11.60	11.60	15.33	5.00-20.00	10.70	10.70	10.79	10.44
Ross Round	8.33	6.58	8.14	7.93	8.14	8.25	8.40	5.00-12.00	7.77	10.36	9.92	8.45
Wholesale Wax (Lt)	7.05	4.75	4.59	6.73	6.53	4.38	5.13	2.00-12.45	5.84	-	6.04	5.93
Wholesale Wax (Dk)	6.92	4.42	3.34	6.90	5.61	2.00	5.50	1.50-10.00	5.47	-	5.23	4.91
Pollination Fee/Col.	95.63	70.00	47.50	72.50	80.00	175.00	180.00	30.00-180.00	86.43	-	81.57	82.10

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Bee Natural Canvas Pants

100 % Natural Cotton Canvas Pants. Features include 2 large pockets with brass zipper closure, 2 hive tool pockets, brass zipper closure at ankles, and elastic waist and ankles. Size small (30-34 waist), medium (34-38 waist)and large (40-44 waist) $21.95

INNER COVER

About 32 years ago I was working on a farm in Connecticut and got invited to a Connecticut State Beekeepers meeting because they were involved in litigation with the Pennwalt Chemical Company. They were trying to get PennCap-M removed from the Connecticut agriculture scene. Apple growers were spraying orchards with blooming plants on the orchard floor, and corn growers were spraying tasseling corn – both while bees were visiting. I had just left my job working at the USDA Honey Bee Lab in Madison, Wisconsin before moving there, and one of our projects was PennCap-M, honey bees and tasseling sweet corn.

It took some time, energy and money, but we were eventually successful in curtailing the use of that chemical in Connecticut. During the time this was going on I got to know a lot of Connecticut's beekeepers, beekeeping businesses and Extension agents. Those folks were all instrumental in our case against Pennwalt, as was Dr. Tom Seeley who at the time was at Yale and was having some bee kill issues too. His testimony added a layer of credibility to our case we couldn't have bought with any amount of money. And one beekeeper was especially helpful. His was the only commercial outfit in the state, and had been losing bees every summer. In talking we came up with the comparison of losing a beehive being similar to losing a pregnant cow. You lost the cow, the calf, future calves and the milk and meat from all of them. With a beehive you lost the hive, the splits you would get from it and from them, and the honey, bees and wax from all of those hives. Essentially you were losing generations of bee hives and bees – and income. His name was Norm Farmer, and he was particularly good at describing this, and also particularly emotional about finding a killed hive, and the very urban judge in the case had never heard anything like this before. He was dumbfounded, astonished and alarmed. Pennwalt never had a chance.

Over the course of all this I became associated with the State Beekeepers Association, began working on the group's newsletter, sat on the board of a start-up beekeeping museum and attended a lot of county beekeeper meetings. Shortly I became the President of the State Beekeeper's group, and, with that, the state's Director on the Board Of Directors of EAS.

During that time I got to know the very influential guy that ran the biggest beekeeping equipment outfit in the smallish town of Wilton. You could get anything you wanted at his place – Wilbank's packages and queens and any piece of equipment made. He had a lot of customers and all of the wax and wood he sold was made by the A. I. Root Company. He was their biggest dealer at the time.

So right about then John Root is looking for an Editor for this magazine. He was the CEO and was running a candle company, a beekeeping equipment manufacturing company, and this magazine, too, so his hands were full. He'd been Editor earlier so knew this side of the business, like his grandfather Ernest and his great grandfather Amos. Ernest's son, and John's father, Alan, took over the business after Ernest retired, and John moved to the corner office when Alan retired. And now John really needed somebody to run that magazine.

He'd interviewed a lot of people, but they either knew magazines and not beekeeping or vice versa, or they didn't know anything about the science of bees or that was all they knew. He broadened his search and asked his many dealers around the country if they knew somebody who could do this. My friend and Root dealer Ed Weiss called him back and said he thought he might have a candidate. And in fact, John probably knew him because both were on the Board of EAS.

John Root was on the EAS Board because he had his own plane and liked to fly, a lot, and was in a good position to visit future sites for EAS Conferences and did, a lot. He had been Ohio's Director, then was elected the first Chairman of the Board when EAS grew to need one. When his term was over he stayed on to search for new places to meet.

So John contacted me, mentioned that his biggest dealer had recommended me for this Editor's job he had and we should have lunch after the next EAS Board meeting and see what happens. I'd met him previously of course, but geeze, John Root, one of the Gods of the Beekeeping industry, and the former Chairman. Talk about pressure.

Long story short, we met, had lunch, he invited me to Medina and offered me the job. All because this guy in Connecticut, Ed Weiss, had mentioned me as a possible, (and I think John was running out of options).

But one other thing Ed did about then was to start a beekeeping group close to his home in Wilton, where there's a lot of people who keep bees that happen to have good incomes (do you know how much it costs to live in southern Connecticut?). They have incredible speakers, a monthly beginner's class before the regular meeting, field days every month and do a lot of public service work.

Ed Weiss.
Beware
Mosquitos.
Cover Crops.

Today they have more people on their Board Of Directors than most clubs have members. They're called the Back Yard Beekeepers (hence the hat) and they are something to behold. When I was associated with the Ohio State Beekeepers we adopted some of their habits, and even our Medina group uses some of what I've learned from them. And my co-author Marina, who lives not too far from there was a recent President of the group.

Marina and I attended their summer banquet a couple of years ago, and Ed, then about 90 and retired came and we had the visit that old, long time, too long apart friends have, all evening long. It was wonderful. Better than wonderful.

Ed left us back in January this year. Over 90 he was, still thinking about bees and waiting on customers, giving them heck because they didn't do what he said and their bees suffered, and they should be using this new stuff he had just got in and make sure they go to the next meeting. That's what he did best. Thanks Ed.

•

OK, so the Packers didn't make it to the Super Bowl. I'm from Wisconsin and I remember the first Super Bowl. I'm not so much a Packer fan anymore, more a casual observer I guess. But after all, it was the 50th anniversary and they did win the first one, so isn't there supposed to be some sort of pact in the NFL that says they should have not only have made it to the finals but they should have won the whole banana, right? Right? Do you suppose maybe I jinxed them with that hat? Nah, it doesn't work that way. They just got outplayed I guess. Maybe next year.

•

I may be blowing this out of proportion but have you looked at all at where that newly discovered in the new world Zika virus is? It isn't a pandemic, yet, and may never become one, but it is, today, everywhere in the Americas south of Florida and Texas, and in New York in 2013 and February in Texas. First found in Uganda decades ago it is considered mild compared to its relatives yellow fever, dengue, and West Nile viruses. That nobody has died from it in all these years has given it recognition, but not notoriety. Human assisted, it has spread across the Pacific slowly, landing in Brazil about a year and a half ago, probably during the World Cup, pretty much unnoticed. Until last summer when scores of children were, and still are, born with microcephaly, a condition of normal facial features but essentially no cranium. Hundreds have been born that way in Brazil since. That, and another sometimes fatal disease, Guilian-Barré Syndrome was suddenly found to appear along with it.

This all starts – the microcephaly and Guilian-Barré - after a person has been infected with the Zika virus itself, which, interestingly, manifests itself as only having a pinkish rash, low grade fever, joint pain and a headache for about 10 days. And research has determined the mothers had symptoms of Zika early in their pregnancy so it's later these secondary symptoms appear. And, it can be transmitted from unprotected men to women, who may, or may not show signs of the virus.

Ok, why this in a beekeeping magazine? Because it is spread by mosquitoes, and it will be available year round in the southern two thirds of Florida, and the southern-most parts of Texas. But health officials predict it will be seasonal from northern Nebraska south to the Texas/Mexico border, and east to the coast, missing the northern-most parts of the country. It's also predicted to be permanent in the central valley of California up to San Francisco. Then throw in West Nile, another mosquito borne disease. People are dying.

You know that public health officials will be rightly ramping up mosquito control this Summer. Which means more people will be spraying more times in more places earlier and later in the season. Some of these people will be new and it will be a mixed bag of sprays because you don't want mosquitoes to become resistant to any single spray. Public safety trumps everything. That makes sense. Your bees, if in harm's way, will come in second. Find out now what your city will be doing. Be prepared.

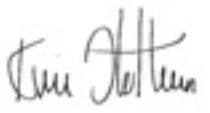
•

Can you believe? In a Sunday edition of the New York Times there was an article on the value to farmers in Iowa and Illinois of cover crops. Really! And not your run of the mill, diversified, organic operation, but a huge corn and soybean operation. One of the owners noticed corn wilting when it got hot – because the soil wasn't holding moisture, so for a lark he tried a small experiment – 1200 acres small – and planted it with a cover crop of grasses. Next year – will wonders never cease – the soil looked, felt and grew better: 20 – 25 bushels/acre better. But they aren't the only ones. USDA, several universities, the Buffet and Noble foundations and even Monsanto and the National Corn Growers are having their AHA! moments when they see the improvements in soil compaction, water holding capacity and nutrient replacement in fields that have cover crops grown in the off season. Indiana has over a million acres this year with these crops. One farm spent about $100,000 on seed, or about $26/acre, but saved $57,000 on fertilizer and made more than $100,000 more on yield. You don't need to be a genius to see the benefits. The main problem – absentee land owners. The second problem – the cover crops themselves. Bee friendly cover crops aren't as cheap as some of the grasses being used. But then, many of the bee crops are valued added crops, harvestable as a crop themselves. There needs to be a market for them, and the farmers need the right equipment to plant and harvest them, but it's doable.

Here's a moment. If you have a farmer, an Extension agent, or a landowner who can take advantage of this information, start pushing to get them to do this. It will only help everybody.

•

It's March. You should be running pretty fast right about now. So keep your smoker lit, your veil tight and your hive tool handy. Here we go.



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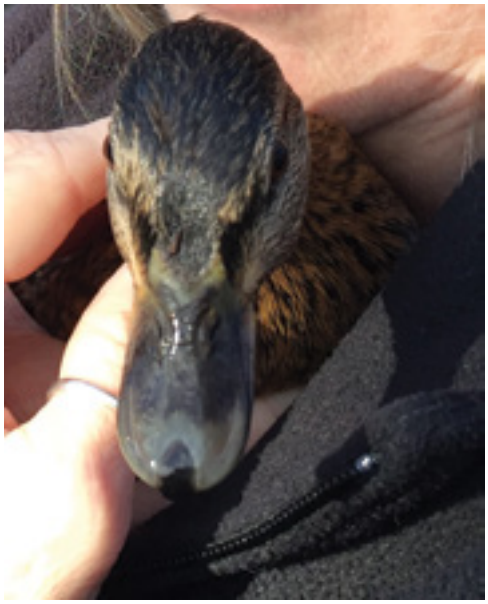

Winter, Botanical Gardens and Ducks

I say this as quietly as possible, but we have still not really had Winter here in our part of Northeast Ohio. Some north of us have a good deal of snow. We've a couple of cold snaps, but essentially no snow to speak of. This is really OK with me, but there are some who seem troubled by this event. There are those who seem to be craving a good snowfall – record breaking, even!

You can see by the cover photo this time that we have maple trees blooming – in early February. Remarkable. And we've seen lots of dandelions all around town. Not the norm at all. About an hour and a half northeast of us a friend has had 75 inches of snow so far this year. So that's northeast Ohio for you – extremes when it comes to weather.

Kim and I spent a sunny, warm Saturday in January at the Cleveland Botanical Gardens at the annual Sustainability Symposium. Kim gave a talk on Enough Good Food – talking to mostly non-beekeepers about how they can help provide for not just honey bees, but all pollinators. It was such a beautiful day that we probably could have gotten into our bees to check them, had we been at home.

There were six or eight talks during the day – one on composting which is a favorite topic of mine. I haven't quite mastered it, but we're working on it. Another guy talked about Rhododendrons, another about water and a couple of talks on soil and turf. Not our typical bee meeting, but an interesting day, as all of these things affect us as beekeepers.

The Botanical Gardens have an event each year that goes for about six weeks called "Orchid Mania." The building is filled with all kinds of orchids – the fragrance was amazing. The colors were amazing. If you're anywhere close to Cleveland it goes until March 6.

Well we lost our little female duck. She kept getting out of the pin, even after we clipped her wings she would find a way out. On a warm sunny, Sunday morning as I was getting ready for church I heard a hawk noisly circling outside. I told Kim – "we need to keep a close eye on everybody today!" When I got home she was out, so I caught her, put her back in and went inside. A little while later Kim went outside to check and said we're missing a duck. I grabbed my shoes and went to look. Normally when she got out she stayed right outside the fence to the pen, but she was nowhere in sight. I went further back in the yard and flushed out the hawk from some brush and he had her in his clutches. I chased him off, but it was too late – she was already gone. She was so cute and funny, but obviously very stubborn.

Now we have one male duck, who was very sad for a few days, and 17 chickens. He seems kind of OK now. He gets great pleasure or at least it looks that way from chasing several of the chickens around. There is one black one in particular that he loves to agitate. So we're in the process of deciding what to do. Do we just see how it goes with him and 17 chickens? Do we get more ducklings and hope that we have better luck keeping this bunch alive – we've now lost five of the six ducks we started with? Or do we try and find him a new home that has other adult ducks? Any advice or suggestions are appreciated.

Spring is the busiest time of the year for us in the Publications Department. And we are a small, but mighty group. This Winter, although not bad weather wise has kicked our butts with flu and viruses. At one point I think all five of us were sick at the same time. There was about a two-week period when we didn't have one day with our whole department present. But we are still accomplishing great things. Our new quarterly magazine *BEEkeeping* is doing remarkably well, to the point that we are now offering it on our website for purchase. Go to www.Beeculture.com. We have several books that will be ready in the next few months and *Bee Culture* continues to grow. We hope you like what we do.

Happy Spring, Happy Easter from us here at *Bee Culture*.

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A Closer Look

SOUND GENERATION AND HEARING

Clarence **Collison**

Bees hear, and make sounds for other bees.

Vibrations and sounds, collectively called vibroacoustics, play significant roles in intracolony communication in honey bees (Hunt and Richard 2013). For many years it was thought that bees were totally deaf to airborne vibrations (sound) (Goodman 2003). However, it has been shown that honey bees can detect the air-particle movements associated with airborne sounds (Towne and Kirchner 1989), and they do so using Johnston's organ, a chorodontal organ in the antennal pedicel (Dreller and Kirchner 1993a). Chordotonal organs are a category of mechanoreceptor sensilla that respond to stimuli ranging from gross motor movements to sound and convert these to neural impulses (Field and Matheson 1998). Three major types of chordotonal organs include: the tympanal organ, Johnston's organ and subgenual organ. Tympanal organs are absent in Hymenoptera (bees, wasps and ants).

Bees generate sound not only through movement of their wings but also with their thoracic muscles. Although they use these muscles to move their wings, they can uncouple their wings to produce heat and generate acoustic signals. Travelling sound waves have both pressure and particle movement components. Sound waves are measured by their frequency in Hertz (Hz), or cycles per second. The frequency of sound waves is heard as pitch; a higher wave frequency creates a higher pitch. Honey bees produce many frequencies of vibration and sound – from less than 10 to more than 1000 Hz. So far it has been shown that they can detect sound frequencies up to about 500 Hz (McNeil 2015).

The belief that bees were completely deaf was refuted by a series of experiments following the discovery that sound signals are emitted by dancing bees. Towne and Kirchner (1989) trained bees to associate a sound with a weak electric shock. Bees learned to avoid the shock by leaving a feeder when a sound signal was given. It was thus concluded that they could hear airborne sound. More recently another training paradigm, in which the bees were trained to turn right or left as they entered a feeder, the correct way being toward the sound source, was used to determine the frequency range and amplitude thresholds of hearing in bees (Kirchner et al. 1991). It turned out that bees hear airborne sounds of low frequencies up to 500 Hz with sufficient sensitivity to pick up the sounds of a dancing nestmate (Kirchner 1993). The same training technique was used to find out which sensory structures are used to pick up the sound signals produced by dancing bees (Dreller and Kirchner 1993a). Sensory structures suitable for perceiving near field sound signals are hair sensilla or the antennae. Bees which had learned to respond to sound were then manipulated by removing one or both antennae, or fixing a certain joint in the antenna or removing sensory hairs on the head (Kirchner 1993). These behavioral experiments revealed that the sounds are picked up by the Johnston's organ located within the antennae.

"Substrate borne vibrational signals are also associated with worker communication"

The Johnston's organs found within the honey bees antennae (Figure 1A) are a collection of sensory cells that are sensitive to vibration. They are found in the second segment (pedicel) of the antennae, and each detects minute motion of the end segment (flagellum). The antennal flagella can detect movement to 20 nm and are sensitive to low intensity stimuli of 265-350 Hz. The Johnston organ consists of over 300 nerve cells (scolopidia), arrayed in a bowl shape. They convert mechanical vibrations into nerve impulses relayed to the brain (McNeil 2015).

Air-particle oscillations (sound) cause the long, thin antennal flagellum to vibrate, and the Johnston's organ registers these movements (Towne 1994). This sensory system, which is sensitive to air vibrations up to about 500 Hz, is well suited to detect the 200-300 Hz sounds produced by dancing bees (Kirchner et al. 1991; Kirchner 1994), and this is the only natural context, other than its possible use in the control of flight (Heran 1959 in Towne 1994), in which the sensory system is known to be used (Dreller and Kirchner 1993b).

The acoustic near field close to honey bees performing the wagging dance was investigated with pairs of small, matched microphones placed in various positions around the dancing bees (Michelsen et al. 1987). The dance 'sounds' are produced by the wings, which act

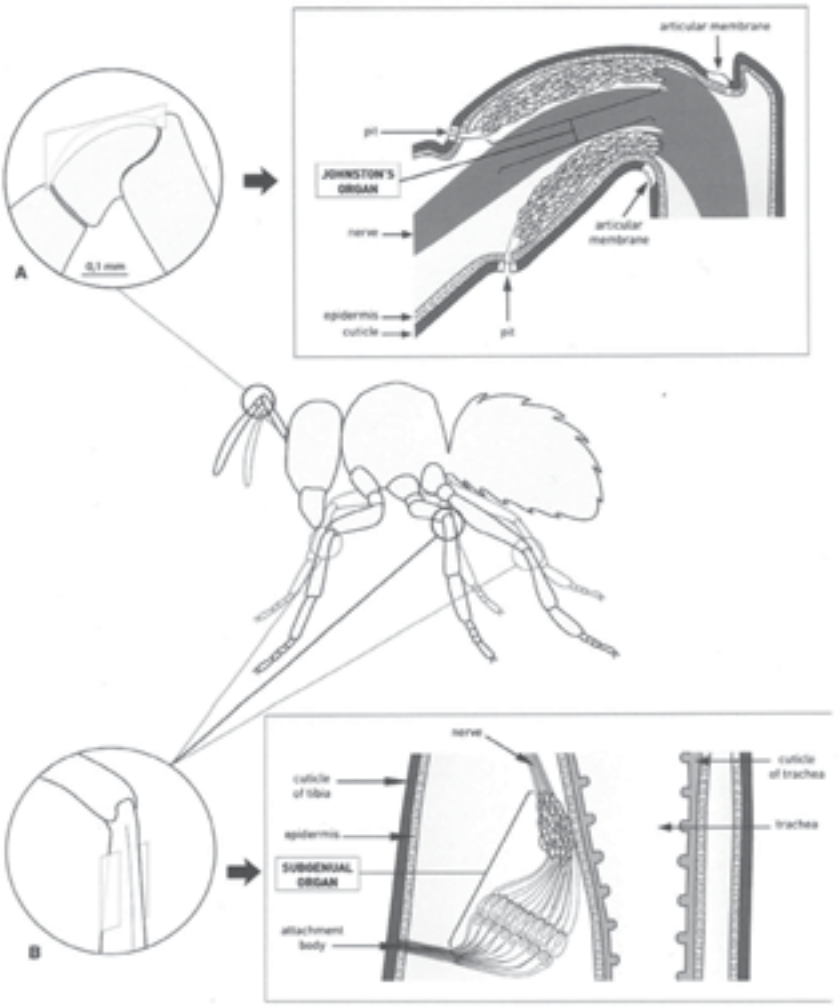

Figure 1 *– The Johnston's organ (A) and subgenual organ (B) are the primary receptors for vibroacoustic signals (sound). Hunt and Richard (2013)*

as an asymmetrical dipole emitter. Close to the abdomen, the 'sound' pressures in the air spaces above and below the plane of the wings are totally out of phase. A zone of very intense acoustical short-circuiting exists close to the edges of the wings, where pressure gradients of about 1 Pa/mm are observed in the dorso-ventral direction (perpendicular to the plane of the wings). The pressure gradients drive air movements with velocity amplitudes up to about 1 m/s. The pressure gradients are much smaller in directions radially away from the bee and decrease rapidly with increasing distance from the wings. The 'sound' pressure detected by a stationary probe at one side of the bee is strongly modulated at 12-13 Hz as a result of the bee's side-to-side wagging. Surprisingly little 'sound' is found near the dancer's head. The positions of the follower bees reflect the properties of the acoustic field: the follower bees place their antennae in the zone of maximum acoustical short-circuiting where the air particle movements are most intense. These observations suggest 1) how follower bees can avoid mixing up the messages carried by the dance 'sounds' when two or more bees are dancing only a few cm apart and 2) how the followers might extract information about a dancer's spatial orientation from the acoustic near field she produces.

Honey bee foragers use a "waggle dance" to inform nestmates about directions and distance to locations of attractive food. The sound and air flows generated by the dancer's wing and abdominal vibrations have been implicated as important cues, but the decoding mechanisms for these dance messages are poorly understood. To understand the neural mechanisms of honey bee dance communication, Tsujiuchi et al. (2007) analyzed the anatomy of antenna and Johnston's organ (JO) in the antenna, as well as the mechanical and neural response characteristics of antenna and JO to acoustic stimuli, respectively. The honey bee Johnston's organ consists of about 300-320 scolopidia connected with about 48 cuticular "knobs" around the circumference of the pedicel. Each scolopidium contains bipolar sensory neurons with both type I and II cilia. The mechanical sensitivities of the antennal flagellum are specifically high in response to low but not high intensity stimuli of 265-350 Hz frequencies.

During the waggle phase, the dancer moves her body in 15 Hz waggling motions while vibrating her wings in short pulses (20 ms duration at frequencies ranging from 200 to 300 Hz (Michelsen et al. 1987; Spangler 1991). These wing vibrations generate weak near-field sounds that dance followers may be able to detect when they are close to the waggle dancer (Michelsen 1993).

In addition to airborne sound signals, substrate-borne vibrational signals are also associated with worker communication. These substrate vibrations are perceived by subgenual organs in the legs (Figure 1B). Subgenual organs are chordotonal organs located in the tibia of each leg, just distal to the femur-tibia joint. Each subgenual organ is suspended in a hemolymph channel. Substrate vibrations (sound) received via the legs are sensed by the subgenual organs where they are translated into nerve impulses that are transmitted to the central nervous system (Hunt and Richard 2013).

During honey bee forager recruitment dances, a dancing bee waggles her abdomen and vibrates her wings and in doing so simultaneously generates substrate-borne vibrations, near field sounds, and jets of air (Michelsen et al. 1986a; Dreller and Kirchner 1993a; Michelsen 2003), all of which can transmit information from the dancer to follower bees. Waggles enhance the transmission of thoracic vibrations to the substrate (Tautz et al. 1996), with maximum signal transfer when the thorax is fully laterally displaced during a waggle (Hunt and Richard 2013). Varied postures of bee's legs perceive both horizontal and vertical components of the substrate vibrations (Sandeman et al. 1996; Rohrseitz and Kilpinen

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1 - Yves LE CONTE and Didier CRAUSER - UMR 406 INRA/UAPV Invertebrate Ecology, Laboratory of Biology and protection of the bee, INRA Avignon, France - 2006.

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1997), and substrate vibrations are translated into neural impulses via the subgenual organ (Kilpinen and Storm 1997). Waggle dances occur more frequently on open cells in honeycomb than on capped cells, and dances on open cells more strongly attract inactive potential foragers, indicating that substrate properties are a component of signal transmission (Tautz 1996). Even though substrate vibrations during waggle dancing transmit information from the dancing bee to bees attending the dance, the substrate vibrations may not provide specific information about the velocity and direction of the dancer during the waggle run (Nieh and Tautz 2000).

Intraspecific communication involves several types of vibration signals transmitted through the comb. The best known signals are the tooting and quacking signals of the honey bee queen and the stop signal of the worker bees (Nieh 1993). These signals all have fundamental frequencies in the range 200-500 Hz, but different temporal structure (Michelsen et al. 1986ab). BC

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INSTRUMENTAL INSEMINATION

Sue **Cobey**

Common Questions

Introduction

Selective breeding and stock improvement are recognized as the long term solution to challenges facing the beekeeping industry. The continuing high loss of colonies and the movement of Africanized honey bees adds to this urgency. Queen producers realize the need for more rigorous programs to select, improve and maintain their breeding stocks. Interest in programs to select locally adapted and survival stocks is increasing.

Controlled mating is essential to achieve the goals of any breeding program. Honey bees present a unique challenge, because queens mate in flight with an average of 15 to 20 drones and therefore mating is difficult to control. Instrumental insemination (I.I.) provides a valuable tool to control the random mating process and is essential for bee breeding and research requiring specific crosses.

Varroa is the major challenge to keeping our European honey bees, *Apis mellifera*, healthy and productive. This parasite feeds on the hemolymph of developing bees and is a major vector of pathogens. *Varroa* is a species complex with many specialized variants. The shift of V*arroa jacobsoni* from its natural host, the Asian honey bee *Apis cerana,* to the Western honey bee, *Apis mellifera,* happened when European bees were introduced there. The mite jumped hosts, adapted and evolved to infest *Apis mellifera* requiring the re-naming of this parasite. The name given to this variant, V*arroa. destructor,* reflects its devastating impact on beekeeping.

Varroa, introduced in the U.S. about 30 years ago, has traditionally been controlled chemically. The reduced efficacy of our arsenal of in-hive miticide treatments have turned attention to alternative controls and selective breeding. The interest in selection of honey bee stocks that can manage, tolerate and/or show resistance to *Varroa* mite infestations has greatly increased. Of concern are the multiple pesticide residues in colonies resulting from exposure to miticides, and their compounding synergistic impact in combination with agricultural chemical residues.

The spread of Africanized honey bees (AHB) is also a motivating factor to establish bee breeding programs. In the southern U.S., the AHB is increasingly interbreeding with our domestic European honey bees. The dominating traits of the AHB, their defensive and migratory behaviors, are problematic. This is especially critical in providing pollination services. The AHB also poses a public health risk. The need to control and maintain breeding stocks that are not dominated by the "Africanization" of our domestic European stocks is well recognized.

This article is intended to help evaluate the need and provide insight into what is involved in mastering the technique of instrumental insemination. It is also meant to give direction to further inquiry, as I.I. is a very specialized skill. As a user and teacher of instrumental insemination, this article is in response to the increasing interest. There are many requirements and prerequisites to prepare the groundwork to master and successfully utilize this. Note that I.I. is simply a tool to control honey bee mating.

Stock improvement, in addition to controlled mating, requires a program of systematic and scientific

breeding methodology. To gain the benefits of I.I. also requires advanced beekeeping skills, the resources to run a selection and breeding program, and a long-term commitment. This is demanding, labor intensive and expensive.

Of critical importance to consider and research is the supporting information and material on bee breeding methods. For example, in the selection process, to maintain low *Varroa* mite levels and also maintain productive colonies involves selection for a complex of behaviors and characteristics. To ensure colony fitness, selection for a variety of traits such as productivity, temperament, overwintering ability, etc. must also be considered. The selection criteria must be weighted and balanced in terms of colony productivity and the "colony cost" of selection for "mite tolerance/resistance".

Honey bees are unique, in that selective breeding is based upon behavioral traits of a super organism with a complex social structure, in a constant state of change. *Varroa* and its associated pathogens are also undergoing constant change. For these reasons, honey bee breeding can be challenging. Yet, with the current focus on bee breeding and advances of research and new scientific technologies, applying this knowledge in the field will hopefully offer real solutions. To gain the benefits of I.I., beekeepers must first build a solid foundation in establishing a breeding program or research project.

Instrumental insemination is simply a tool in this process. To help evaluate if you are ready to take this next step and give some insight into what is involved, here are my answers to frequently asked questions.`

"Instrumental "Or "Artificial" Insemination, Is there a difference?

Interchangeably called artificial insemination and instrumental insemination, is there a difference? The term "instrumental insemination" was coined by Dr. Lloyd Watson, the first to successfully demonstrate a technique of instrumental insemination in 1926. He disliked the term artificial. The term artificial insemination is more commonly used and recognized by other industries such as; cattle, poultry, sheep, swine, equine etc. The term instrumental insemination seems to apply specifically to honey bees.

Why Use Instrumental Insemination?

As a tool to control breeding, I.I. also provides a means to create novel crosses for research purposes. Honey bee mating behavior is highly random and difficult to control. Queens mate in flight with numerous drones, averaging 15 to 20. Virgin queens fly to drone congregating areas, consisting of 10,000 to 30,000 drones from diverse genetic sources. The queen, who only mates during the first week or two of her adult life, stores the sperm collected in her spermatheca for use over her lifetime. The queen stores only a small percentage of sperm from each drone she mated and this is mixed in her spermatheca. All the drones the queen mated with are represented in the many subfamilies of her colony, although the ratio of these may change over time.

Who Needs It?

I.I. is simply a tool for the bee breeder and researcher requiring specific crosses. It provides a method to control honey bee mating. This technique enables the control of who the queen mates with, the number of drones she mates with and the semen dosage given and stored in her spermatheca.

Just because a queen is instrumentally inseminated does not mean she will be superior. The goal of producing Top Tier and "Rock star" breeder queens is dependent upon the selection of stock and the breeding program employed. In this process, many queens must be culled.

Is it Difficult to Learn?

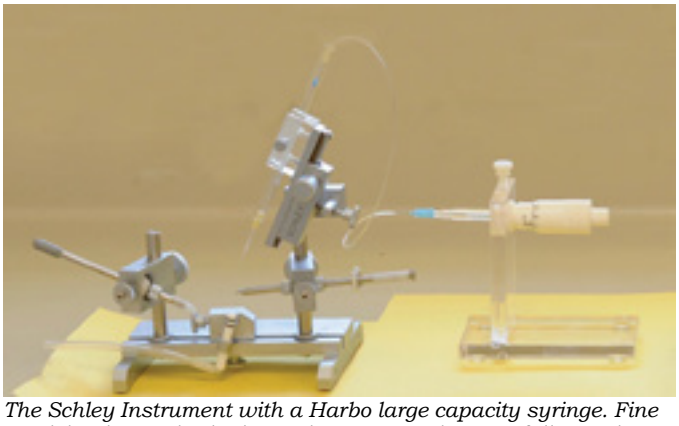
Learning the technique requires; good instruction, precision equipment, practice, fine motor skills, good hygiene, patience and a commitment. The process can initially be awkward and frustrating to learn, as meticulousness precision is essential. The beekeeping knowledge and skills to rear a plentiful supply of mature drones and virgin queens is also required. To gain proficiency practice, manual dexterity, and attention to detail are necessary. The pre and post care of queens also plays a critical role in the success of I.I.

To gain confidence in the technique I suggest, inseminating 30 queens in the initial practice. Keep good notes as to the success of each insemination. Bank the queens in a nursery colony for two days to allow for sperm migration. Check for vigor and mortality. Lethargic or dead queens indicate problems with injury or infection. Dissect the spermathecas of these queens to determine the rate of success. The color of the spermatheca will indicate how well inseminated the queen is, as described in the reference listed: Dissection of the Spermatheca. Inseminate a second batch of queens and introduce these into nucleus colonies to establish them as laying queens.

What Equipment Is Needed?

The insemination instruments are specialized and vary widely in quality and price. The technique requires precision and accuracy in fine adjustments and this will determine the ease and repeatability of the procedure. There is no standardization in equipment and some parts are not interchangeable between instruments. Therefore, research the options.

The basic instrument consists if a stand, a set of hooks or forceps, queen holder assembly, syringe and syringe tips. A microscope with a magnification of 10X to 20X, cold light and compatible stand with sufficient depth of field and instrument clearance are required. A cold



The Schley Instrument with a Harbo large capacity syringe. Fine precision is required, choose instrumentation carefully as there is no standardization and quality varies in equipment.

light prevents heating and drying of tissues, a gooseneck L.E.D. light works well. A source of carbon dioxide, with a flow regulator and flexible tubing to the instrument, is used to anesthetize the queen during the procedure.

Modern instruments offer micro-manipulators that provide fine precision in movements. Large capacity syringes provide efficiency in semen collection, storage and shipment of semen. Various designs of sting manipulation tools offer personal choice in techniques. The Schley Instrument is currently the most widely used instrument, valued for its fine precision and wide range of flexibility in adjustments. The Harbo large-capacity syringe, designed for ease of semen handling and storage, is also popular and compatible with most instruments.

What Are The Most Common Problems?

Good sanitation and proper techniques are critical to success. Injury and infection are the most common problems for beginners. Drones tend to defecate during the eversion process for semen collection, and can be very messy. Care must be given to maintain highly sanitary conditions and avoid feces contamination during the procedure.

The insemination procedure is very delicate and injury to the queen will produce poor results. Manipulations include opening and positioning the queen, bypassing the valvefold and insertion of the semen must be precise and brief. Queens vary physically, especially between the subspecies, and these nuances of differences must be learned and recognized.

Care of queens, their pre and post insemination treatment and introduction method, require careful attention. The queen signals her many changes of reproductive status to the workers, from virgin to mated and laying. These changes vary more among IIQs and therefore introductions need attentive treatment. These factors are discussed in the reference listed: Comparison of instrumental inseminated and naturally mated honey bee queens and factors affecting their performance, (Cobey 2007).

What Is The Most Overlooked Aspect?

Rearing a plentiful supply of select drones to maturity can be a major limiting factor. Queen production methods have been perfected and are routine. Most beekeepers are not accustomed to giving the same detailed attention to drone production. Drones appear plentiful during peak season, yet are seasonally produced and the most vulnerable to stressors such as parasites and pathogens, malnutrition, miticide and pesticide residues, poor weather conditions, etc. The colony will regulate the seasonal drone population based on many factors.

Strong healthy, well fed colonies are required for drone production. A colony can rear about 2000 drones during peak season, of which about half will be immature. Drones are mature at two weeks post emergence and peak at three weeks. Stressed colonies will eliminate mature drones and often continue to rear a new batch of young drones for the future. Colonies headed by older queens tend to rear and care for more drones. In extreme cases when seasonal conditions are unfavorable, queenless colonies will hold and care for drones, although this method requires intensive management.

How Long Does The Procedure Take?

The timing required for the insemination procedure is dependent upon the skill of the inseminator, the quality of the equipment used and the quality and quantity of the live material produced. It is always best to overproduce queens and drones to ensure an adequate supply and allow for culling. In mastering this skill, it takes time to perfect techniques and gain proficiency. The beginner must learn proper procedures. Beekeeping skills essential to rear and care for virgin queens and drones are also essential.

The actual insemination procedure is very quick. Once the semen has been collected, it is a matter of seconds to insert the semen and inseminate the queen. The semen collection process is more time consuming and tedious. Timing is generally determined by the quality and

Select, mature drones are placed in a flight box for easy access for semen collection.

A three year old inseminated queen and her court. Queen longevity is largely dependent upon the amount of semen stored by the queen and the care given in rearing and establishing IIQs.

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maturity of drones. In general, about half the drones will yield usable semen. Many semen loads must be discarded due to contamination during the explosive force of the eversion. Some drones may not be mature and some simply will not yield semen.

A skilled inseminator can collect semen and inseminate about 10 queens an hour. The standard semen dosage per queen is 8 to 10 microliters. The procedure of semen collection and insemination can be separated. Collection of a 100 microliter tube of semen takes about 40 minutes. Each drone yields about one microliter of semen. Once the semen is collected, 40 - 50 queens can be inseminated in one hour. It is helpful to have a "runner" assist in supplying virgins to the table and caring for the inseminated queens after the procedure, including record keeping and marking queens.

What Is The Success Rate?

Success depends upon two major factors; the skill of the inseminator and the beekeeping skills to provide proper care of queens and drones. Assuming this expertise has been mastered, instrumentally Inseminated queens (IIQs) have the capability to preform as well or better than naturally mated queens, (NMQs). Better performance of IIQs is based upon the ability to do selection and control the semen dosage given. The longevity and performance of the queen is largely based upon the genetic diversity of drones she mates with and how much semen she stores in her spermatheca.

The pre and post-insemination care given to IIQs affects sperm migration and queen performance. The claim that IIQs do not preform as well as NMQs is unfounded. Tiring of this perception, I wrote a review of supporting studies. This discussion, listed in the references, (Cobey, 2007) clearly demonstrates how the differences in quality of care affect queen performance, over the actual procedure of insemination.

How Long Can Honey Bee Semen Be Held?

Honey bee semen can be held at room temperature for about two weeks and maintain good viability. The short term storage of semen offers a huge advantage for the transport of semen and insemination scheduling. The type of diluent used and the temperature of storage (do not refrigerate) are important factors affecting viability, see (Cobey, S., Tarpy, D., Woyke, J. , 2013). New techniques are being developed for the long term storage of bee semen at above freezing temperatures.

Advances in cryopreservation techniques for the long term storage of honey bee semen now enable the conservation and reconstitution of select stocks and threatened subspecies, (Hopkins, B., Herr, C. Sheppard, W. 2012).

The genetic diversity of honey bees, threatened by the introduction of pests and pathogens and the introgression of imported non-native subspecies, can be preserved. This ability also offers unique breeding and research tools, as the ability to do selection across time and space improves.

Cryopreserved semen can be held indefinitely. Although, using current techniques there is some damage to the sperm. The laying patterns of queens inseminated with previously frozen semen are not sufficient to head productive colonies, although adequate to recover stock. Research is continuing in this area, with the worldwide interest in establishing honey bee germplasm repositories.

Can I Mix Semen From Many Drones?

Genetic diversity increases colony fitness. Semen, from the numerous drones the queen mated, is naturally mixed and stored in the spermatheca. The ability to pool semen from a diversity of drone sources has advantages for breeding purposes and stock maintenance programs, although the techniques have not been perfected to date.

The natural mixing and migration of sperm from the queen's oviducts into the spermatheca is a complex process, requiring about 40 hours. This involves contraction of queen's muscles, mediated by the Bresslau's pump (the muscular system of the spermatheca duct) and specialized composition of fluids in the semen and the oviducts, as well as active movement of the queen.

Perfecting a technique to homogenizing bee semen is difficult because the sperm tails are very long and fragile, and the semen is highly viscous, very dense and tightly coiled. Mixing techniques require dilution, mechanical movement and reconstitution of the semen, in which some critical components are removed. For routine inseminations, live active drones from different sources can be mixed in a flight box for semen collection.

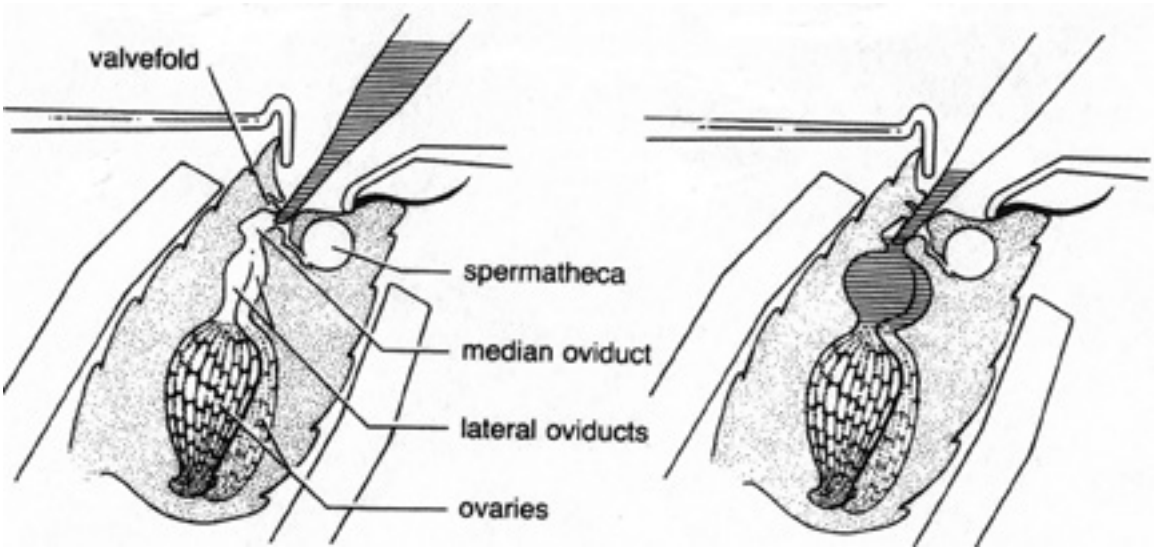

Diagram of the queen's abdomen, showing the valvefold which must be bypassed to deliver semen into the median oviduct for proper insemination. Credit J. Harbo USDA

What Can I.I. Do Beyond Natural Mating?

I.I. is a powerful tool for breeding as well as research purposes. It provides a means to create specific and novel crosses, beyond what occurs naturally. A single drone can be mated to one or several queens, isolating and amplifying a specific trait. On the other extreme, semen from hundreds of drones can be mixed and inseminated to a batch of queens. Varying degrees of inbreeding can be created to produce different relationships, including "selfing"; the mating of a queen to her own drones. Semen from the spermatheca of one queen can be extracted to inseminate another. These abilities provide a means to study and tease out the complexities of honey bees. The ability to store semen, over the short and long term, also offers many advantages. BC

Additional Information & Resources

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If You Can't Spell It Or Pronouce It, Don't Eat It.

The Best Way To Kill *Varroa* With Oxalic Acid

SUBLIMATION

Frances L.W. **Ratnieks,** Luciano **Scandian,** Hasan Al **Toufailia**

Summary

LASI research shows that of the three application methods used by beekeepers (trickling, spraying, sublimation) to control *Varroa* with oxalic acid, sublimation is the best in all respects. Sublimation is effective at lower doses, causes no harm to the bees, and results in colonies with more brood in Spring. Spraying significantly reduced colony survival. Application of 2.25g oxalic acid via sublimation to broodless hives in Winter killed 97% of the *Varroa*.

Introduction

Pests and diseases are a challenge to all beekeepers. One of the most serious is *Varroa*, the mite *Varroa destructor*, which originates from East Asia and is now found in all continents except Australia. *Varroa* was first detected in the USA in 1987 and is now found throughout North America.

Varroa mites harm colonies directly, through the harm they do to pupal worker bees in sealed cells where the female mites lay their eggs, and where the mother mite and her offspring feed on the blood of the pupa. Worker bees parasitized in this way as pupae have reduced lifespan. However, the greatest harm is caused by *Varroa* spreading virus diseases, such as deformed wing virus. Colonies with relatively low numbers of *Varroa* can die if virus is also present, especially in Winter.

For many years beekeepers could easily control *Varroa* with Apistan strips, which slowly release a synthetic chemical (fluvalinate) that is highly toxic to *Varroa*. However, resistance has evolved. In a recent test we did at LASI, we found that Apistan treatment killed only about half the *Varroa* in a colony. When Apistan was first introduced, and *Varroa* were non-resistant, the kill was nearly 100%.

For some diseases, particularly American foulbrood, beekeepers try to keep the level in their hives at zero. It is practical to do this by regular inspections and elimination of infected hives and equipment. However, it is not practical for beekeepers to eliminate all the *Varroa* in their beekeeping operation. What is needed is a way of keeping the *Varroa* populations in colonies under control, so that there are insufficient *Varroa* to cause harm. Many control methods have been tried against *Varroa*. Our research at LASI has focused on hygienic behaviour, oxalic acid, and trapping in drone brood. Our results indicate that the first two methods are effective, but that trapping is not very effective. In this article we describe a two-year research project on the effectiveness of oxalic acid and which was recently published (Al Toufailia et al. 2015) in the *Journal of Apicultural Research*. The article is open access. Anyone who wants to read the original can download it free of charge from **http://dx.doi.org/10.1080/00218839.2015.1106777**

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Why Study Oxalic Acid?

LASI research on *Varroa* control falls within our wider project, the *Sussex Plan for Honey Bee Health and Well Being*. The *Sussex Plan* focuses on two of the major challenges faced by honey bees and beekeepers: 1) Controlling pests and diseases; 2) Improving the bee food supply. In the *Sussex Plan* we have been trying to carry out research with clear practical benefits. Before starting we talked to beekeepers. It was clear that they considered *Varroa* to be a major problem, and this matched our understanding and experience as scientists.

Oxalic acid has been used to control *Varroa* for several decades and is known to be effective. So why was further research needed? The reason is that the previous research was incomplete. In particular, different application methods and doses had not been compared side by side to determine how effective they were at killing *Varroa*, and the effects they had on the bees. In addition, previous research had usually determined the numbers of mites killed rather than the proportion killed.

What LASI Did

We treated 100 hives with oxalic acid on 12 January 2013. A further 10 were untreated controls, making 110 hives in total. The hives were in 10 apiaries in Sussex, southern England, 11 per apiary. The hives were all in a single Commercial box (11 frames, volume 56 litres, about the size of two medium-depth Langstroth boxes), with a wooden bottom board with mesh floor, inner cover and telescopic outer cover, and were similar to the hives being overwintered by beekeepers in terms of management and numbers of bees. Hives had approximately five to 10 thousand workers.

The hives did not have any capped brood when treated. This is important. *Varroa* can occur in two locations in a hive: 1) in brood cells, where the adult female mites lay their eggs and the young mites develop by feeding on the blood of the pupa; 2) phoretic, clinging to the body of an adult bee. Oxalic acid only kills the phoretic mites. In December and early January, when we did our study, 90% of the hives were naturally broodless. All the hives had been checked a few weeks before applying oxalic acid, and any brood was scraped out with a honey uncapping fork. Care was taken to minimise any disturbance to the bees, and without breaking the cluster by shaking bees off the frames as is usually done during a hive inspection in warm weather. The hives were also checked one day before each of the two samples of bees were collected to confirm that there was no capped brood. As a result, we could be sure that all *Varroa* were phoretic.

Our application of oxalic acid (technically, oxalic

Oxalic Acid Treatment Methods. *Top left and right – Trickling/dribbling and spraying methods, which use oxalic acid dissolved in a solution made using equal weights of sugar and water (e.g., 1 kg sugar to 1 liter water). Bottom left and right – Sublimation method, which uses a heated tool to vaporize oxalic acid crystals; photo to right shows application in progress, with hive entrance temporarily sealed using foam; photo to left shows oxalic acid fumes for illustration purposes only, as when correctly applied the fumes are contained within the hive.*

acid dihydrate) followed methods already being used by beekeepers. This was because our aim was not to develop new methods, but to compare existing methods. In the trickling/dribbling and spraying methods, we applied 50 ml of sugar solution (1 kg sugar dissolved in 1 litre of water) with oxalic acid, made 12-18 hours previously, to each colony. In the dribbling method, the lid of the hive is removed and the solution is poured onto the top bars and gaps between the top bars where the bees were clustered, although there was never a tight cluster. In the spraying method, the frames are briefly removed from the hive and the bees sprayed with the solution.

The sublimation/vaporisation method uses oxalic acid crystals. These were placed into the small cup at the end of the electrically-heated applicator, which was inserted into the centre of the hive below the frames. The heat causes the crystals to sublimate. That is, to turn directly from solid to gas. We used a Varrox® M3080 sublimator powered by a 12 volt lead acid battery. The doses followed existing methods. In all three methods we used doses of 0.56, 1.125, and 2.25 grams per hive. For sublimation we also used a dose of 4.45 grams. In total, there were 10 treatment groups and one control group.

To eliminate any bias due to possible apiary effects, there was one hive per group in each of the 10 apiaries. The Winter weather was quite cold for England, maximum 5°C, on the day of oxalic acid application with an average maximum of 3°C over the following 10 days. It is recommended to apply oxalic acid at temperatures of 4-16°C.

To determine *Varroa* mortality we took two samples of worker bees (mean = 267 bees per sample) from each colony. The first was taken just before oxalic acid treatment and the second 10 days later, when the mortality caused by the oxalic acid was over but before any capped brood was present. The samples were frozen and analysed later. The dead bees were placed into a double-mesh honey strainer. A jet of warm water from a hose nozzle was used to wash the *Varroa* off the bees. The *Varroa* passed through the first mesh and were trapped in the second, finer, mesh. We had previously checked this method, examining washed bees under a microscope, and had found that it extracted all the *Varroa*. We then counted the *Varroa* and bees from each sample. If, for example, the first sample had 10 mites per 100 bees and the second had 0.5 mites per 100 bees, then the mortality was (10 - 0.5)/10 = 0.95 = 95%.

We also monitored the Fall of honey bees and mites for

eight days before and 10 days after oxalic acid application, the survival and strength of colonies in Spring (four months after application), and if they had a queen.

Results

Initial Varroa levels

In the samples of bees collected immediately before the first oxalic acid treatment, the average level of *Varroa* was 9.8 per 100 bees, range two to 29, across the 110 hives. This is quite a high level and meant that we had plenty of *Varroa* to study, and to ensure adequate data for statistical analyses.

Varroa mortality

Figure 1 show that all methods gave high *Varroa* mortality at one or more of the higher doses. However, sublimation was more effective at lower doses. Sublimation was effective at all 4 doses used (0.56, 1.125, 2.25, 4.5g), trickling only at 2.25g, and spraying at 1.125 and 2.25g.

Bee mortality at the time of application

The number of bees falling onto the bottom board and into the dead bee trap did not increase after application for sublimation, but did increase for trickling and spraying (Figure 2). In particular, spraying with the highest dose, 2.25g per hive, resulted in a 10-fold increase in the number of dead bees per day. However, as the hives contained five to 10 thousand bees, even this method killed only 1-2% of the bees at or soon after application.

Colony mortality after four months

Figure 3 shows the number of hives out of 10 that survived until 3 May 2013, and if they were queenright. Of the 10 untreated control hives, eight (80%) had survived. Of the hives treated with oxalic acid, survival was: sublimation, 38/40 = 95%; trickling, 25/30 = 83%; spraying, 19/30, 63%. Sublimation gave the highest survival, and was significantly better than spraying. Of the 10 hives treated with the highest dose of oxalic acid by spraying, 2.25g, only 4/10 survived.

Colony strength after four months

The surviving control colonies had an average of 4.1 frames with brood (counting 0.5 per side with brood present) (Figure 4). This was slightly higher than in hives treated with oxalic acid via trickling (3.6-3.9) or spraying

How LASI Counts Phoretic* Varroa *On Worker Bees. *Top left – Worker bees are shaken into a gardening tub, and a sample is taken with a home-made scoop that will hold 250-300 when full. The bees in the scoop are then put into a zip-loc bag and frozen. Great care is taken not to take the queen. Samples are taken from queenless hives, in December or early January, so that all* Varroa *are phoretic. We always take bees from the center frames. Top right –* Varroa *are washed off the bees using a jet of water a double-mesh honey strainer. Lower left –* Varroa *pass through the first mesh but are trapped by the second, finer, mesh, where they are counted. Bottom right – After* Varroa *extraction, the bees in the sample are counted to determine the number.*

(3.3-3.7). However, the hives treated via sublimation had significantly more brood (4.4-5.0 frames), and was an average of 21% more than the control hives for the three highest doses (1.125, 2.25, 4.5 g).

Checking the Results

Based on the results above from year one, we concluded that we could advise beekeepers that the best method was to treat hives with 2.25g of oxalic acid via sublimation. Although 1.125g via sublimation also gave high *Varroa* mortality, the highest dose, 4.45g, did not cause any harm to the bees or colonies. Therefore, it seemed reasonable to recommend the middle dose to allow a margin for error, for example in case a colony had more or less bees than average and so received a larger or smaller dose per bee.

However, we first wanted to double check our results. Therefore, in mid-December 2013 we treated 89 broodless hives with 2.25g of oxalic acid via sublimation, using the same methods as before. The average varroa level per hive was 14.5 per 100 bees. Most hives, 87 (98%), survived until spring. *Varroa* mortality was 97.6%. This convinced us that we could recommend 2.25g via sublimation, and be confident that this dose would kill most of the *Varroa* without harming the colony.

Conclusions

Our conclusions are simple. The sublimation method is the best in all respects. It results in *Varroa* mortality that is as high as the trickling and spraying methods, but at lower oxalic acid doses. It gives the highest colony survival four months later, in Spring, and results in colonies with significantly more brood than untreated control colonies or colonies treated by trickling or spraying.

Based on these results we recommend that beekeepers do not use the trickling or spraying methods. In particular, the spraying method harms colonies and results in significantly lower colony survival over the next four months compared to sublimation. A bonus of the sublimation method is that the hive does not need to be opened for application, and it is generally the quickest method, taking about three minutes per hive. Most of the time is taken waiting for all the oxalic acid to sublimate, which takes a few minutes for 2.25g.

Our results showed that colonies treated via sublimation had more brood in Spring than control colonies or colonies treated via trickling or spraying. We do not know why. However, a likely reason is that sublimation-treated colonies were healthier than control colonies, as most of the *Varroa* had been killed, and so built up faster. There was quite a high level of *Varroa*

Sublimation Equipment. *Top left – Varrox sublimator, 12 volts and 150 watts. Lower left – Close up of the heated cup at the end of the sublimator into which the oxalic acid crystals are placed. Top right – Lead-acid battery, 115 amp hours, capable of powering the sublimator for approximately nine hours. Lower right – Half teaspoon measures are cheap to buy and are a convenient way of dispensing oxalic acid crystals for sublimation as half a teaspoon, 2.5ml, of oxalic acid crystals is almost exactly 2.25g.*

before treatment, 9.8 per 100 bees on average, and these would not have been killed in the control hives. Although trickling and spraying also kill *Varroa*, the harm they do could have cancelled out the benefit of killing the *Varroa*.

Oxalic acid treatment via sublimation requires the beekeeper to buy or borrow an applicator. Most are heated electrically and need a 12 volt supply. We used a 12 volt 115 amp hour lead-acid "leisure" battery, of the type used in a caravan and effectively the same as a normal car or truck battery. The Varrox® M3080 sublimator we used was rated at 150 watts, meaning that it draws a current of 150/12 = 12.5 amps. A fully charged 115 amp hour battery would be able to power the applicator for 115/12.5 = 9.2 hours. At three minutes per hive this would be enough to treat up to (60/3) x 9.2 = 184 hives. In other words, a large battery would be enough for a full day's work treating hives. Although we did not try it, a petrol generator could also be used. However, it would seem to be less convenient than a battery and the noise and vibration might annoy the bees.

Oxalic acid is a natural chemical, and is found in honey and in many vegetables. Carrots contain 0.5g oxalic acid per 100g (information from Wikipedia). Therefore, a 1lb (= 0.45kg) bag of carrots would contain 2.25g oxalic acid, or enough to treat one hive. The lethal dose for humans is 0.6g per kg (information from Wikipedia) meaning that a beekeeper weighing 165 pounds (75kg) would need to swallow 45g (enough to treat 20 hives) to have a 50% chance of dying.

Oxalic acid is harmful to the eyes and mucous membranes. It is important not to breathe in oxalic acid, both the powder and the fumes. We found that it took only a few seconds to place the oxalic acid crystals into the applicator cup and to insert the applicator into the hive. As a result, we found that even if the applicator was already under power and hot it could be inserted into the hive before oxalic acid fumes were produced, so that all the fumes were confined to the hive. We temporarily sealed the hive entrance using pieces of foam so that the vapour was confined within the hive. It is recommended to keep the entrance sealed for up to 10-15 minutes after the applicator is removed. As we applied oxalic acid in Winter on cool days, there was no foraging activity to disrupt by temporarily closing the entrance.

The administrative position of using oxalic acid to treat hives to control *Varroa* varies from country to country. In Britain, a registered oxalic acid product, Api-bioxal, was approved in 2015 by the Veterinary Medicines Directorate. Api-bioxal consists of oxalic acid dihydrate (88.6% by weight), plus small amounts of silica gel and glucose. The latter materials would seem not to be toxic to varroa. The official UK recommendation, for sublimation, is to use 2.3g to treat one hive. This corresponds to 2.3 x 0.886 = 2.04 g of active ingredient. Our research used almost exactly this amount.

The British VMD approval document states that a protective mask conforming to European Standard EN149 (type FFP2) must be used when handling oxalic acid. In the USA, the EPA (Environmental Protection Agency) approved the use of oxalic acid to control varroa in March 2015. The EPA state that "In addition to the standard beekeeping suit (veil, long-sleeved shirt, long pants and gloves) as personal protective equipment, a respirator and goggles are required."

Oxalic Acid is a Natural Chemical. *One pound of carrots, the amount shown, contains approximately 2.25g oxalic acid. This is enough to treat one hive.*

It is possible to obtain a wide variety of masks with different levels of face protection and a range of filters. Some filters that conform to the required European standard, which applies specifically to dust inhalation, also provide protection against organic chemicals and acids. If using the sublimation method, it would seem sensible to use such a dual-purpose filter in order to provide full protection during both the handling of the oxalic crystals and the sublimation. US beekeepers might test some of the masks available in the USA that conform to these standards and report back on how they compare.

Because oxalic acid only kills phoretic mites, for maximum effectiveness it is necessary to treat broodless hives. By means of hive inspections in late autumn and Winter, beekeepers can determine when the natural minimum brood period occurs in their area. However, brood rearing may vary year by year. In the Winter of 2015/6 we found that brood rearing in Sussex continued longer into December than usual, and resulted in our delaying oxalic acid treatment until January and having a lower proportion of broodless hives. This was probably due to the very mild Autumn, with weather warm enough for foraging throughout December, plus prolonged flowering of ivy, the main autumn flower source, into early December.

What we do is to check hives immediately or a few days before before oxalic acid application and scrape out any small patches of capped brood. Although it is extra work, it is worth doing as even small areas of capped brood will allow many adult female *Varroa* to escape the oxalic acid. Our results showing 97% varroa mortality apply to broodless hives.

The USA is a large country with many different climates, and beekeepers in different regions may need to work out the best method and time of applying oxalic acid to broodless hives. In areas with warm winters there may be no full natural Winter break in brood rearing, and in northern and mountain areas it may be too cold in Winter to open hives. Package bees provide a very good opportunity for applying oxalic acid, as the colony will not have capped brood for approximately eight days after

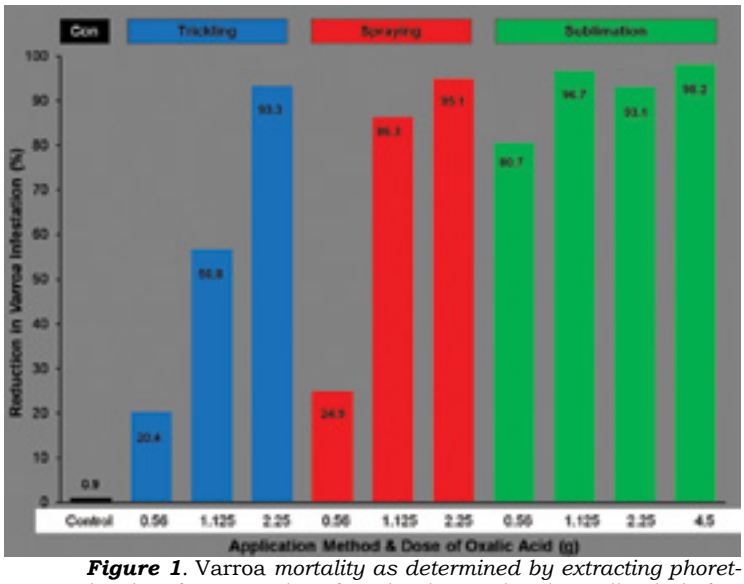

Figure 1. Varroa *mortality as determined by extracting phoretic mites from samples of worker bees taken immediately before and 10 days after oxalic acid treatment. Figures 1-4 are based on those from Toufailia et al. 2015. Journal of Apicultural Research. Vol 54(2), are copyright of the International Bee Research Association, and are reproduced by permission of the editors of the Journal of Apicultural Research. The original article is available open access at* ***http://dx.doi.org/10.1080/00218839.2015.1106777****.*

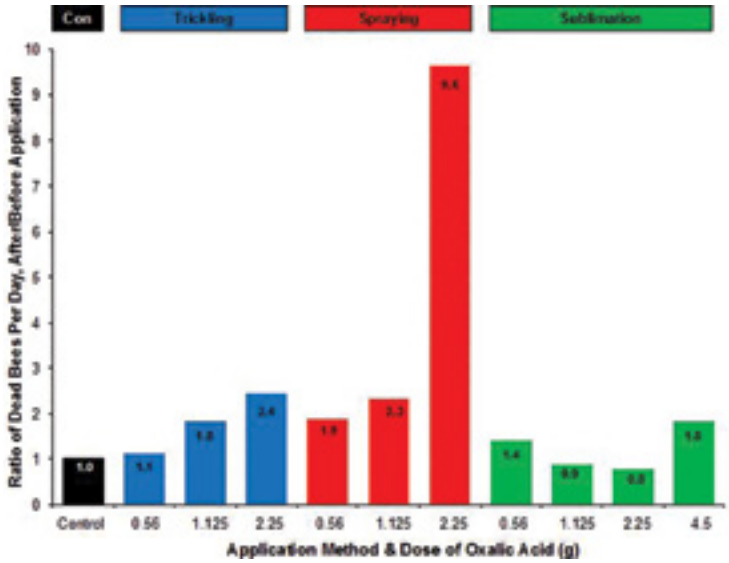

Figure 2. *Ratio of the average numbers of dead bees in each treatment group in the dead bee trap and bottom board combined, for the 10 days after treatment divided by the eight days before treatment. Bees were counted every two days.*

hiving. Beekeepers are practical people and can figure out suitable methods.

The EPA document states that "The solution method and the vaporized applications are made in the late Fall to early Spring, when little brood is present." But even a little brood can protect a lot of *Varroa* from the oxalic acid, as many *Varroa* will be breeding in capped cells. At LASI, we determined the amounts of capped brood in hives in different months and the proportion of *Varroa* in brood cells. This varies from c. 70% to 10% in brood cells, in total, with the minimum occurring in December.

How useful is killing say 50% or 75% of the *Varroa*, versus the 97% kill that can be achieved using oxalic acid in a broodless colony. It may seem that these kills are half or three-quarters as good as 97%. However, when we look at the surviving proportions of *Varroa*, 50% and 75% versus 3%, it is clear that a 97% kill in broodless hives is much more effective than a 75-80% kill in hives with small patches of capped brood. After a 97% kill, the *Varroa* population would have to double slightly more than five times (3 to 6, 6 to 12, 12 to 24, 24 to 48, 48 to 96) to get back to where it was. For a 75% kill it only has to double twice, and for a 50% kill just once. (The populations of all living organisms have the ability to grow in this "geometric" manner, 2-4-8-16-32 etc., when not overcrowded.)

At LASI, we carried out a study in which we determined *Varroa* populations in 42 hives at an interval of one year (Al Toufailia et al. 2014). In that year, the

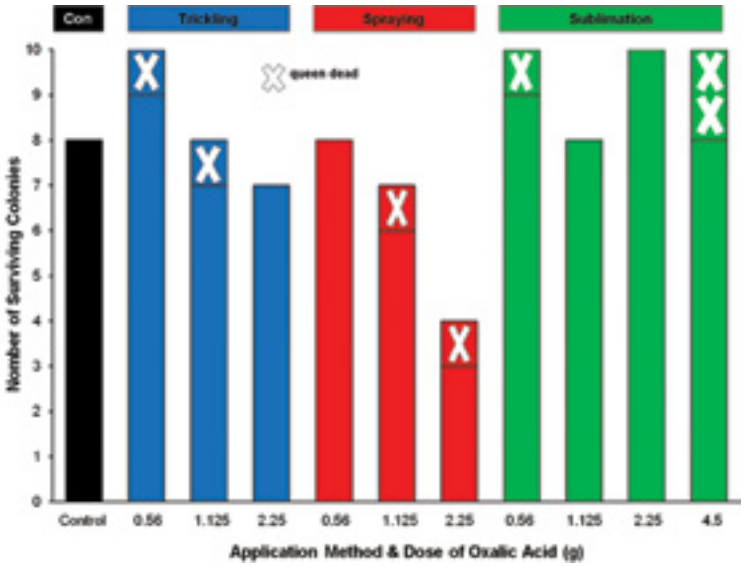

Figure 3. *Colony survival 111 days after oxalic acid treatment, on May 3, 2013. Colonies marked X were alive but queenless. There were 10 queenright colonies in each group at the time of treatment.*

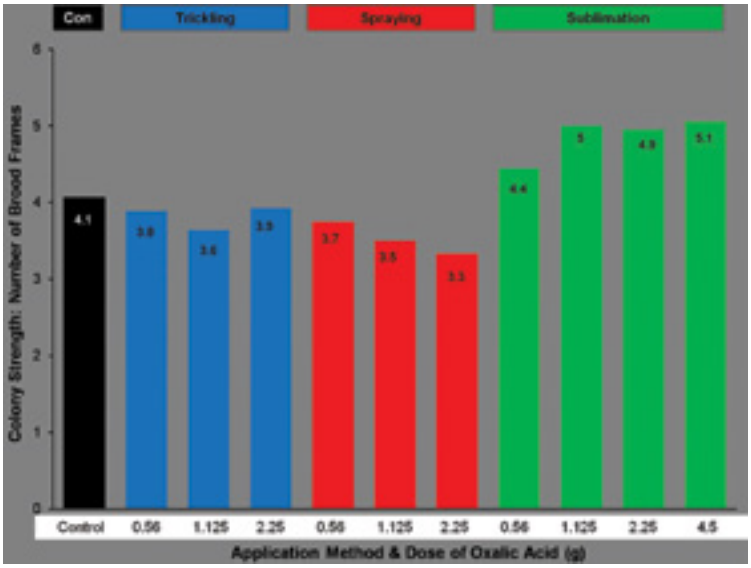

Figure 4. *Colony strength 111 days after oxalic acid treatment, on May 3, 2013, quantified as the average number of frames (0.5 per side) with either sealed oropen brood in the surviving queenright colonies.*

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Varroa populations increased on average by 40 times per hive, equivalent to slightly more than five doublings. This means that killing 75% of the *Varroa* in a colony slows the population by the equivalent of approximately two fifths of a year and killing 50% by just one fifth of a year. By contrast, killing 97% was the equivalent to the control of a year's *Varroa* population growth.

It is good to have results worth sharing with beekeepers, especially as the *Sussex Plan for Honey Bee Health & Well Being* is aimed at providing practical information. When we started our research on *Varroa* control we never imagined that we would be able to make such a clear and simple recommendation. That is, to have solid evidence that one application method was the best in all respects: killing *Varroa*, not harming the bees, resulting in stronger colonies, and in being quick and easy to apply. That method is sublimation. It is fortuitous that we are publishing our results soon after oxalic acid has been approved for use to control *Varroa* in both the UK and USA. Although the EPA has approved the use of oxalic acid via trickling, spraying, and sublimation, sublimation is the best. BC

Acknowledgements

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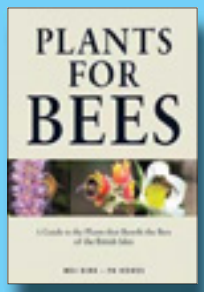

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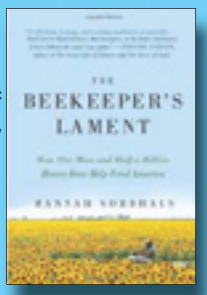

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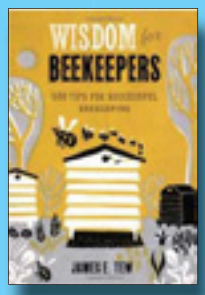

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HOW TO START A NONPROFIT BEE CLUB – PART 2

Being A Nonprofit Means Being A Business.

Michele **Colopy**

Nonprofits are businesses. The difference between a for-profit and nonprofit business is with for-profits net funds are distributed to the owners and stock holders. In nonprofits any remaining funds are retained *within* the organization to support the organization.

Nonprofits *can* make a profit, but no individual volunteer or staff person within the nonprofit receives the funds. The general definition of a nonprofit organization is for *"the purpose of serving a public or mutual benefit other than the pursuit or accumulation of profits for owners or investors."*[1]

The focus of a nonprofit is the mission. Personal agendas will destroy a nonprofit faster than a *Varroa* mite crawling out of cell in a hive. The mission statement guides the objectives, program ideas and goals, and the strategic plan of every nonprofit. The mission statement is the "elevator speech" for nonprofits. The mission of the nonprofit is why individuals become Board members, volunteers, staff, and donors. The mission is the guiding principle of a nonprofit. The mission can be amended based on current events, updated to current social and cultural ideals, and even amended so it can merge with another/similar organization. The mission of a nonprofit is the *raison d'etre* of the organization. Board members, volunteers, and staff must direct their work and efforts at promoting the mission, fulfilling the mission, and protecting the mission. Personal agendas in conflict with a mission are just a *Varroa* mite in need of squashing, fumigating, and having a leg chewed off. Across more than twenty years of work within nonprofits, personal agendas, especially of Board members are the ruin of nonprofits.

I am not an attorney, nor am I a tax accountant. Licensed attorneys can assist anyone with starting a nonprofit, but you *do not need* to have an attorney to apply for nonprofit status with the IRS, and to register in your State. Not all attorneys understand nonprofit law. If you work with an attorney: ask questions, know what service they are providing, and what they are not providing. If you have to tell the attorney what nonprofit applications to file to secure nonprofit status, if they provide a canned set of By Laws which do not meet your mission, if they do not discuss liability concerns with you: get another attorney. Better yet, seek the advice of your State Council of Nonprofits.

Board development is key to securing dedicated, caring individuals who will promote the mission, fulfill it, and protect it, and therefore protect the nonprofit. Board and staff reputations can impact, and reflect the nonprofit. Board members must understand their obligations, duties, and role in guiding and protecting the nonprofit today to ensure the nonprofit has a tomorrow. Most states have a "council of nonprofits" which can provide guidance in board development and training. If prospective or current Board members are asked to attend a Board training workshop they should jump at the opportunity. Those Board members who decline, should be released from the Board. Far too often individuals in "business" think they know how to be a Board member. Experience has shown, those individuals often make the worst Board members. The myths surrounding nonprofit management are broad and deep . . . and myths. No one is ever too old to learn. Debunk some of those myths for yourself at **www.councilofnonprofits.org/myths-about-nonprofits.**

By Law development. There are standard topics that should be included in any By Laws and/or Articles of Incorporation for a nonprofit, such as a conflict of

interest statement, nondiscrimination statement, dissolution of the nonprofit, removal of officers, insurance and liability, amendments, and items pertinent to the specific nonprofit (i.e. if a membership nonprofit). The conflict of interest statement is important for transparency, and acknowledgment that all Board members are serving for free, and will not financially benefit from their tenure as a Board member. This means that Board members cannot receive grant funds from the nonprofit while serving as a Board member; cannot receive payment to a Board member's company for services to the nonprofit. A Board may allow exceptions, but for transparency it should be stated in the meeting minutes any Board connections to a contract or grant; and, the Board member must recuse themselves from any discussion surrounding the proposed "benefit" to them. However, that Board member has now placed all of the other Board members in an uncomfortable position of voting for or against "them." Conflict of interest guidelines are there to protect the nonprofit and all of the

Nonprofit Association of the Midlands
Serving Nebraska & Western Iowa

Guidelines & Principles
for Nonprofit Excellence
Legal Compliance and Best Practices

Board members. It is easier to follow them, than try to get around them.

Nonprofit Standards of Excellence[2] have been developed by State Councils of Nonprofits, and national nonprofits with affiliates. The Standards help the nonprofit adhere to best management practices for nonprofits and their volunteer Boards. These Standards are a bench mark for any nonprofit, and a guiding document to promoting, fulfilling, and protecting a nonprofit.

Insurance and liability concerns of nonprofit board members. Recently, I began reviewing raffle laws. The State of Kansas legalized raffles by nonprofits in Nov. 2014. In Ohio, raffles can be held by for-profits, but only if half of the raffle proceeds are donated to a charity. If your bee club in Ohio is holding a raffle, and the bee club is *not* a non-profit, nor did the club donate half the proceeds to a nonprofit, the bee club has committed a first degree misdemeanor.[3] Board members must understand their responsibilities, as well as liabilities when serving as a Board member of a nonprofit, and a bee club that is *not* a nonprofit. For in-depth information, review "What Every Nonprofit Board Member Should Know," presented by attorneys Adler & Colvin.[4]

Being a nonprofit does not exempt the organization from fees and taxes. Being a nonprofit allows donors to receive a tax deduction for their charitable donation. However, a local or state "sales license" may be needed to sell honey, or non-food (but honey/bee related) items at, for example, the Fair booth. If a bee club sponsors speakers; those speakers paid more than $600 should complete a W-9 for the nonprofit. The bee club then must complete a 1099 at the end of the year to those speakers. The income tax becomes the speaker's responsibility. If your bee club is not a nonprofit, and you are able to pay speakers more than $600, you should become a nonprofit. Otherwise, you will begin to have difficulty securing a Treasurer for your club due to tax concerns of a club that is *not* incorporated, and *not* a nonprofit. Licenses and fees vary in each state so check with your State Council of Nonprofits for information. As to tax concerns for clubs *not* incorporated and *not* a nonprofit: contact a local tax accountant.

Starting a nonprofit, transitioning your bee club into a nonprofit is not just about paperwork. Board members, and the club membership must understand, and accept the responsibilities of managing this entity called a beekeeping association. In serving a public or mutual benefit nonprofits can do great work, led by great people who have come together to promote, fulfill, and protect the nonprofit beekeeping association for future beekeepers. BC

If you have questions about becoming a nonprofit call the Pollinator Stewardship Council at 832-727-9492 or email **info@pollinatorstewardship.org** or contact your State Council of Nonprofits.

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[1]Kate Luckert Graduate Student, Case Western Reserve University, **http://learningtogive.org/papers/paper41.html**

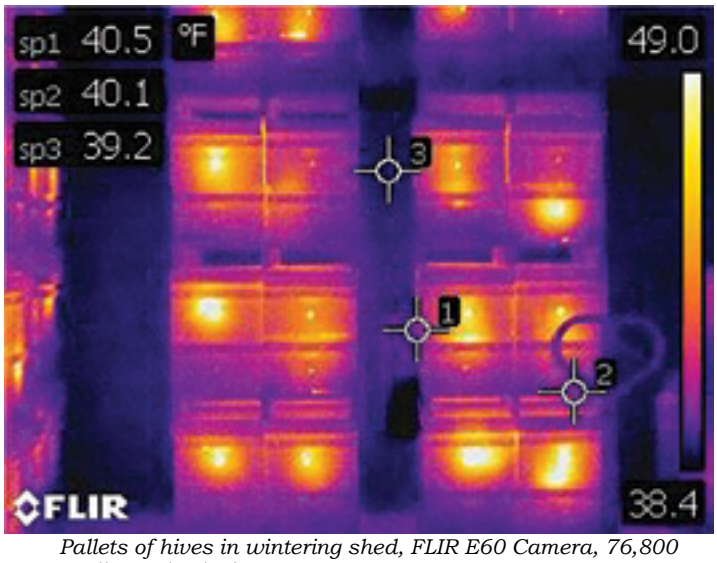
[2]National Council of Nonprofits, **www.councilofnonprofits.org/tools-resources/principles-and-practices**

[3]Ohio Revised Code, Title XXIX Crimes, Procedure, Chapter 2915: Gambling, section (A)(2)(C)

[4]What Every Nonprofit Board Member Should Know, Robert A. Wexler and Sheila Warren, September 20, 2007, **www.adlercolvin.com/pdf/nonprofit_governance/AC_Web_Resource-What%20Every_Board_Member_Should_Know_%2800160422%29.PDF**

Pictures from National Council of Nonprofits at **www.councilofnonprofits.org**

Michele Colopy is the Program Director for the Pollinator Stewardship Council. She holds a Master's degree in Arts Administration/ Nonprofit Management from The Univ. of Akron, and has created, revitalized and held leadership roles in nonprofit organizations for more than 20 years.



Pallets of hives in wintering shed, FLIR E60 Camera, 76,800 Radiometric Pixels.

Should An Infrared camera be in your toolkit?

Winter Uses For Thermal Cameras

Jerry **Bromenshenk**

It's Winter in Montana, 17°F outside, and snowing. Obviously, it's not a good time to open hives for inspection. Our hives are wrapped for Winter, sitting outside in snow drifts. Thirty miles north of Missoula, several thousand colonies are securely packed inside a new wintering building built by Bill Fluke of Arlee Apiaries.

Indoor wintering buildings have been used for some time in Canada (see *Beekeeping in Western Canada*, 1998) and are becoming more common in northern states. In Canada, hives are moved into Winter storage in October or early November and kept inside until Spring. In the U.S., migratory beekeepers are using sheds as safe, accessible places to keep hives from Fall through early Winter. Just before almond pollination, these hives will be loaded onto trucks and shipped to California.

It may seem extravagant to store hives indoors for only two to three months, it provides a place to keep the hives before almond bloom, protection from Winter cold and theft, and the convenience of hives close to home.

In Montana, we often have a thaw in January, before it gets cold again. This presents an opportunity to check colonies. If the bees have been rapidly consuming their honey stores, it's time to feed them. In the sheds, beekeepers will be selecting hives to ship – it doesn't make sense to pay freight on dead-outs and weak hives.

Time to get out the IR camera to check bee colonies. For outdoor hives, we image at night or on overcast days. It's best to examine hives in early morning hours, since hive boxes retain heat from afternoon sun; and reflected sunshine masks emitted heat from clustered bees. Inside a wintering shed, time of day isn't an issue. Hives are kept in dark; red lights allow the beekeeper to work within the storage unit with little disturbance of the bees.

Paint color can greatly affect IR accuracy. Reflective paint, especially silver, makes it hard, if not impossible, to image bee populations. Matt color paints and unpainted hives will vary somewhat, but you should be able to discern cluster shape, position, and size. Hives wrapped in quilts can't be imaged; there's too much insulation space between the surface of the hive and the outside of the wrap. Hives tightly wrapped in black plastic can be imaged, but any gap between the plastic and the surface of the hive will degrade the image – I pull the wrapping tight and staple to box surfaces.

The most accurate thermal image is taken from a vantage point centered-on and perpendicular to the face of each hive. In wintering sheds, hives are usually stacked on pallets. When hives are stacked as high as the ceiling in rows only two to three feet (~ 1 meter) apart, the problems are: (1) ability of the camera lens to focus on and image the full width of the hive due to insufficient stand-off distance, (2) seeing the image on the view-screen of the camera, and (3) getting the camera high enough to image upper tiers of hives.

Regardless, our outdoor hives and those in Bill's storage shed offered opportunities for illustrating winter uses of IR cameras. Given that everyone wants a bargain, I'll spotlight entry level, under $1000 camera options – namely the **THERMAL COMPACT** and a **SEEK REVEAL**, and the **FLIR ONE,** and **FLIR C2** cameras.

As described in my preceding article, all of these cameras use newly developed sensor arrays, smaller than a postage stamp. The Thermal Compact and FLIR ONE cameras mount on mobile devices including Smart phones and tablets. Unfortunately, the same camera can't be used on both iOs (Apple) and Android devices, since Apple uses a Lightning charging/data port and Android uses a microUSB. Some Android devices need an adapter cable, since the microUSB port is reversed. On these units, a camera without an adapter is only useful for taking IR selfies.

SEEK THERMAL COMPACT and second generation **FLIR ONE** cameras are small devices sold as a dongle that plugs into the phone or tablet data port. That's an inherently fragile (breakable) system. The cameras are so small that misplacement and loss are to be expected. Battery life is relatively short. Piggy-backing the software of a Smart phone or tablet keeps prices affordable, providing surprisingly versatile cameras that are also great fun. However, total cost includes the price of the Smart phone or Tablet. These cameras provide an affordable introduction to thermal imaging and also serve as a commercial for higher-end, professional thermal cameras.

Don't have a Smart Phone to spare or want something more rugged and simpler to use? Consider a stand-alone, point-and-shoot thermal camera such as the **FLIR C2** or **SEEK THERMAL REVEAL**. Housed in rugged cases, they are intended to be entry level cameras for professional use by electricians, plumbers, builders, and – beekeepers?

The **FLIR C2** fits in a shirt pocket, with a lanyard for around the neck, reducing chance of a camera falling out when leaning over a beehive. The chunkier **SEEK REVEAL** is designed to be carried in a toolbox or a jacket pocket. The **SEEK REVEAL** has a built-in flashlight and

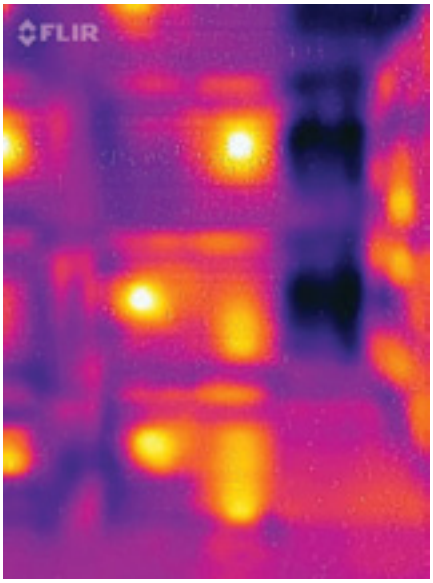
the IR lens is perpendicular to the view screen, which has advantages in tight, dark spaces.

Let's look at some specifications, pros, and cons for these entry level cameras. The first generation **FLIR ONE** is a clamshell style IR camera that only fits an i5/5s phone. The second generation **FLIR ONE** camera has a four-fold improvement in resolution compared to the first generation **FLIR ONE**, and **FLIR** has gone to a dongle, like that used by both first and second generation **SEEK THERMAL** compact cameras.

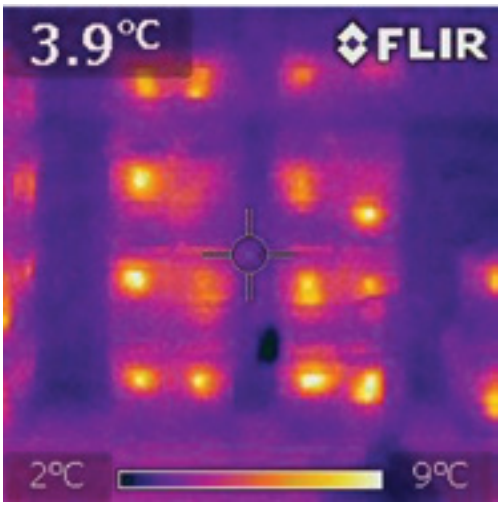
The bargain at the moment is the first generation, low resolution **FLIR ONE**, since it won't fit the i6 phone. If you have an i5/5s phone, with a bit of searching, the first generation **FLIR ONE** can be purchased for $90-$150, while supplies last. The improved resolution, second generation **FLIR ONE** is listed at about $250 for either the iOs or Android format, but be prepared for a long waiting list (weeks to months) for delivery.

Let's start with a description of the first generation **FLIR ONE**. The camera is a clamshell case that slides onto an i5/5s phone, with an adapter plug to extend the audio output. The clamshell contains two cameras; a **VGA** visible camera and a **FLIR Lepton™ IR** camera. The dual cameras allow MSX blending. MSX is a term FLIR uses to describe blending or overlaying of a visible spectrum image with an IR image to enhance detail. The resolution of the IR camera is a relatively low 60 x 80 or 4800 radiometric pixels. The camera has an IR temperature range of 32°F to 212°F (0°C to 100°C), but I've pushed it lower, and it can detect temperature differences as small as 0.18°F (0.1°C). The clamshell weighs 3.9 ounce (110 grams) and only adds 3/8 inch to the thickness of the i5/5s camera. The good part is that with the **FLIR ONE APP**, many of the phone or tablet functions are enabled, such as a choice of up to seven color pallets, sharing to Twitter, Facebook, e-mail, SMS; image storage on the camera roll, and video.

There are some downsides to this camera. Temperature calibration has to be done manually by pulling down on a button on the camera before taking a picture. Battery life is claimed to be approximately four hours. I've not gotten more than one hour. The iOs Lightning plug does not charge the camera battery, so two different cables are needed to charge the phone and the camera separately. Also, the dual camera setup can't enhance image quality at night or in a wintering shed since the light level is insufficient to register on the visible light camera. An upside is that the camera doesn't drain the iPhone battery.



Pallets of hives in wintering shed, FLIR ONE, 1st Generation Camera.



Pallets of hives in wintering shed, FLIRi7 Thermal Camera, 19,600 Radiometric Pixels.

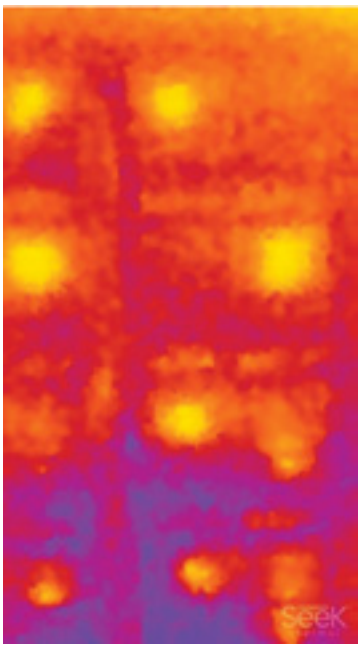
The second generation **FLIR ONE** changes to a dongle format, gains an automatic shutter, a higher resolution 60 x 120 sensor for 19,200 radiometric pixels, and extended temperature range -4°F to 248°F (-20° to 120°C). The companion app adds panorama, time lapse, and close-up options, improved spot measurement detects, and nine color palettes. However, actual functions may vary with the brand and model of Phone or Tablet. *It's also unclear whether the dongle has its own battery.*

SEEK THERMAL'S Compact cameras draw power from the phone or tablet, so expect frequent recharging of your phone. Seek Thermal cameras are available with either a 20° or 36° fixed lens. The second generation **SEEK THERMAL XR** adds adjustable focus for close up to long range imaging. The thermal temperature range is listed as -40 to 626°F (-40 to 330°C), allowing it to provide subzero readings.

The IR sensor uses a 206 x 156 array for a posted resolution of over 32,136 pixels. As with the **FLIR ONE**, the picture or video, color palettes, image storage, and other functions use many of the iOs or Android (4.03 or higher) mobile device's native camera capabilities. However, the Thermal does not have its own, standalone visible light digital camera. It's strictly a thermal camera.

The **SEEK** app can access the camera in the phone or tablet to provide a split image, one half showing a visible image, the other the thermal image. However, depending on where the lens of the visible camera is positioned relative to the lens of the IR camera dongle, parallax problems may make it difficult or impossible to line up the visible and IR image. My iPod has its camera lens at the opposite end from the data port. Parallax issues can also occur in close ups with the **FLIR ONE** cameras, even though the visible and IR lenses are close to each other.

Both the **FLIR ONE** and **SEEK COMPACT** cameras have sensors with a smaller pixel pitch than in larger thermal cameras, crowding more pixels onto a small chip. With the larger, professional grade cameras, I've generally found that increasing numbers of radiometric pixels is predictably correlated with improving resolution and image clarity. That's not necessarily the case with the inexpensive mobile device mounted cameras.



Pallets of hives in wintering shed, SEEK THERMAL COMPACT, 32,136 Radiometric Pixels

When used in a wintering shed, my professional grade **FLIR i7** thermal camera with 19,200 pixels provided a more detailed image than either the first generation of the **FLIR ONE** or the **SEEK THERMAL COMPACT**. The first generation **FLIR ONE**, with only 4,800 radiometric pixels, did produce a clearer image than the Seek Compact with 32,136 pixels. My ~$7,000 **FLIR E60** camera with 76,800 pixels provided the clearest images, but at 23-28 times the cost of a second generation **FLIR ONE** or **SEEK THERMAL COMPACT**.

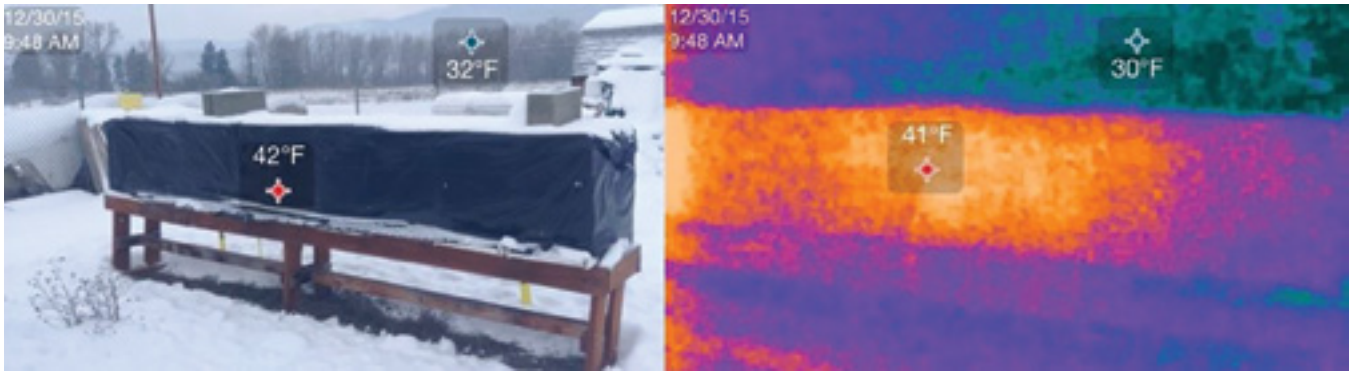
Inside the Wintering Shed, I discovered that light levels were too low to register a visible image, negating any advantage of the **FLIR MSX** technology. Although the **FLIR IR** thermal camera can image an object in the dark, the **FLIR's** visible light camera was useless in the dark or under red lights. Essentially, inside the wintering building, all of these cameras only functioned in thermal mode.

To fully test these cameras, I imaged outdoor hives just after dawn, on an overcast morning. Air temperature varied from 24-27° F, relative humidity was about 91%, with a very light dusting of falling snow. The hives in our fenced wintering yard are wrapped in black plastic and placed on saw-horse style stands to both keep hive entrances out of snow banks and to make hives less accessible to mice, voles, and skunks.

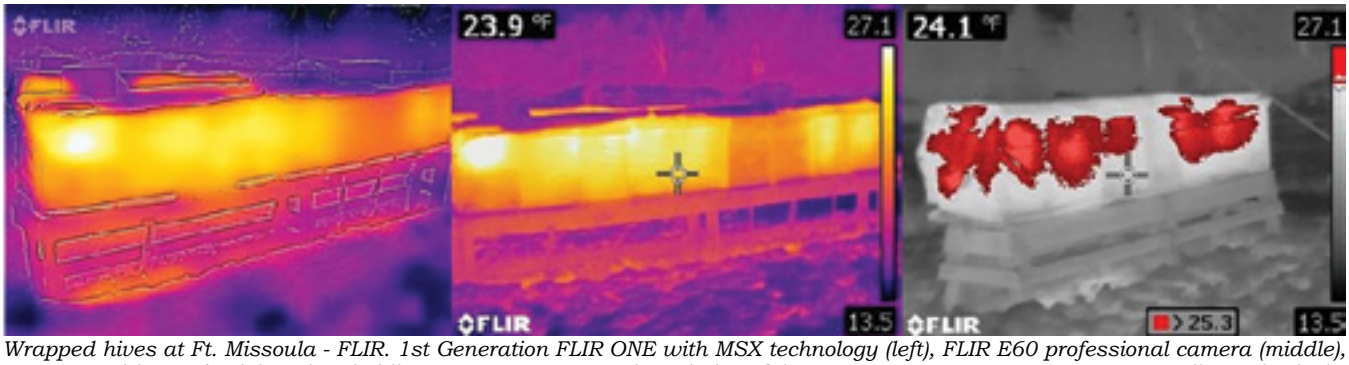
The iPod's visible light camera produced a clear, visible image of the front of the hives on a Table. However, it's obvious that the temperature recorded by the attached **SEEK THERMAL COMPACT** dongle was inaccurate, since air temperatures were in the mid-20s, not 30-32°F. For comparison, I imaged the same Table of hives with my clamshell **FLIR ONE** and with my **FLIR E60**.

From previous testing, I know that the **FLIR C2** provides images similar to those of a 1st generation **FLIR ONE**. I haven't been able yet to access either the second generation **FLIR ONE** or a **SEEK THERMAL REVEAL**, so I can't address their performance. I'm working on getting them to test. The **FLIR E60** is my go-to professional camera. Not only is its native resolution sufficient for imaging of hives, but it has many more functions and capabilities, within the camera itself and the available Apps, including **FLIR TOOLS** and also **FLIR's** research grade software for thermographic analysis. I'll address the E Series cameras in my next article.

In my next article, I'll focus on the next step up, **FLIR'S E-SERIES** cameras. These are professional grade instruments, ranging from just below $1000 to almost $7,000. I'll also discuss why, at least some beekeepers should consider having one or more of these cameras in their tool kit. Entry level cameras have their place, but have limitations. Beekeepers, who buy the wrong camera for their needs or who do not know how to use their camera, are likely to conclude that the technology doesn't work. If in doubt, borrow or rent a camera before purchasing one. I'll explain why in following articles. BC



Wrapped hives at Ft. Missoula - SEEK THERMAL. Ipod digital camera image (left), SEEK THERMAL COMPACT IR image (right). Stated resolution of the Termal Compact is 32,136 radiometric pixels.



Wrapped hives at Ft. Missoula - FLIR. 1st Generation FLIR ONE with MSX technology (left), FLIR E60 professional camera (middle), FLIR E60 with grey/red (hot) thresholding set at 25.3°F. Stated resolution of the FLIR ONE 4,800; FLIR E60 72,800 radiometric pixels.

WHAT'S HOT

Thermal Top Bar Hive Beekeeping

Wyatt **Mangum**

Top-bar hive beekeeping is a popular and pleasant way to keep bees. There are no heavy honey supers to move, and the hives are at a comfortable working height. Both of those features make the bee work easier on the back. In my apiaries, all my top-bar hives, even my extra long five-foot hives, are mobile, which I routinely move working alone. I rent the hives for $60 per colony for pollination, and recently I published a web page showing Summer honey production data of around 60 pounds per hive (see the links at my webpage at the end of this article).

Top-bar hives are inexpensive to build and require no fancy woodworking tools, except for a table saw to cut the top bars. Usually another beekeeper has one and will cut the top bars for a hive or two, which is easy for those so skilled.

With the availability of thermal cameras in the consumer market, beekeepers have a new tool to assess some colony conditions. Since I come from a physics and mathematics training, for years I have wanted a thermal camera for apiary use. Currently, I am using two Flir thermal cameras. One takes an iphone 5 (32GB), the other an iphone 6 plus (128GB). My iphones are essentially dedicated to their thermal cameras, that is, they do not have active phone numbers, but they can download the needed apps over web connections. The iphones store the thermal images and videos. So I got the maximum memory (32&128 GB), even though the file sizes of thermal images and videos are much smaller than comparable files using visible light.

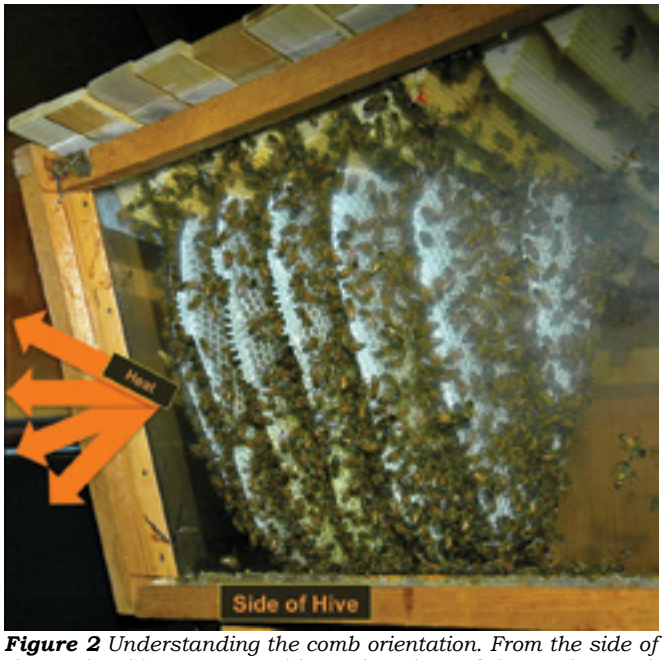


Figure 2 *Understanding the comb orientation. From the side of the top-bar hives, you would see the edges of the combs, analogous to looking at a loaf of bread from the side. Like the larger hives in the apiaries, this top-bar observation hive has its combs perpendicular to the glass side of the hive. The heat radiates from the side coming between the combs as shown by the arrows. By "seeing" the heat from the side of the hive, we obtain a view of the colony, so far, mostly from the brood nest, but extending into the honeycombs too.*

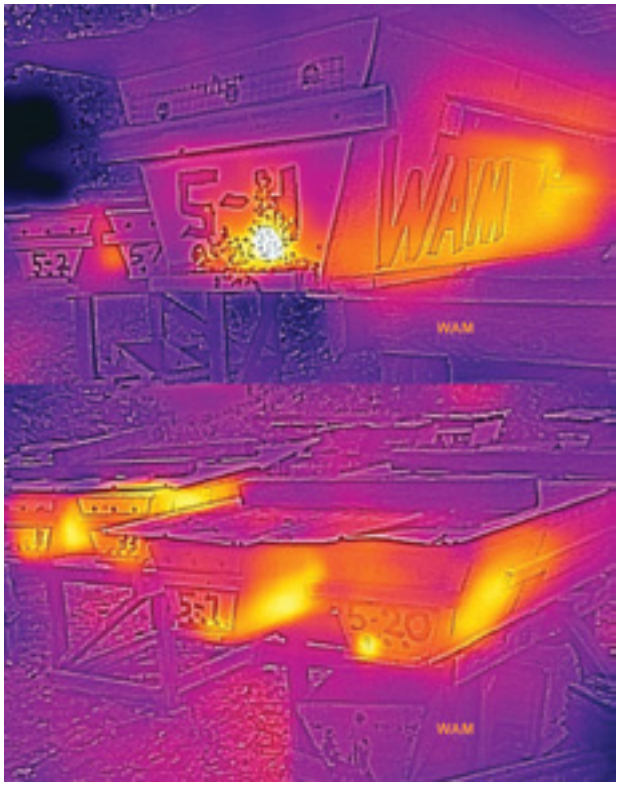


Figure 3 *One of my top-bar apiaries shown with an artistic thermal heat scale. The upper picture is a hive close up while the lower one shows an apiary. The glow indicates heat from the hives with brighter meaning hotter. The hot brood nests, located near the entrances, glow the brightest. My entire top-bar operation is mobile. If I lose an apiary location, I move everything quickly. No need for help. That happened last Summer when the loggers came – Poof! That apiary was gone like a ghost!*

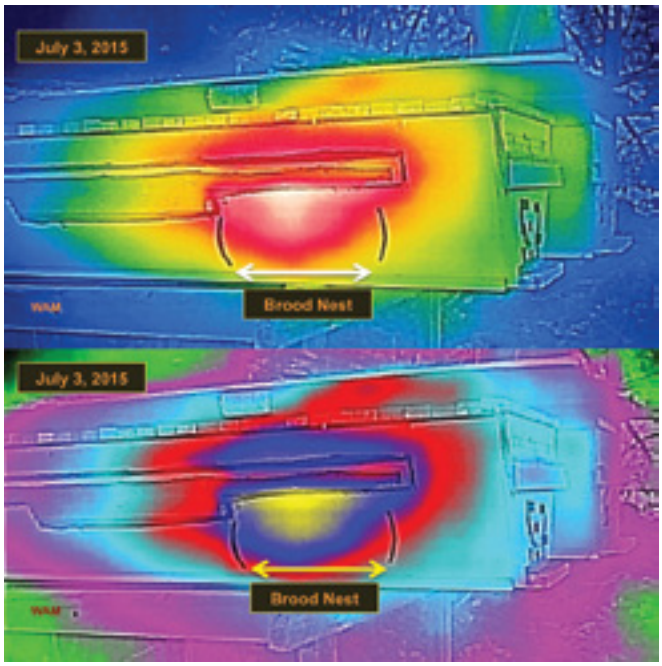


Figure 4 *A side view of the same top-bar hive in two heat scales. The hottest color is white (upper) and yellow (lower), and then the colors become cooler the further from the marked brood nest. The thermal heat image of the brood nest matched the physical placement of the observed brood nest between the vertical boundary marks, which did not happen in one case (see below).*

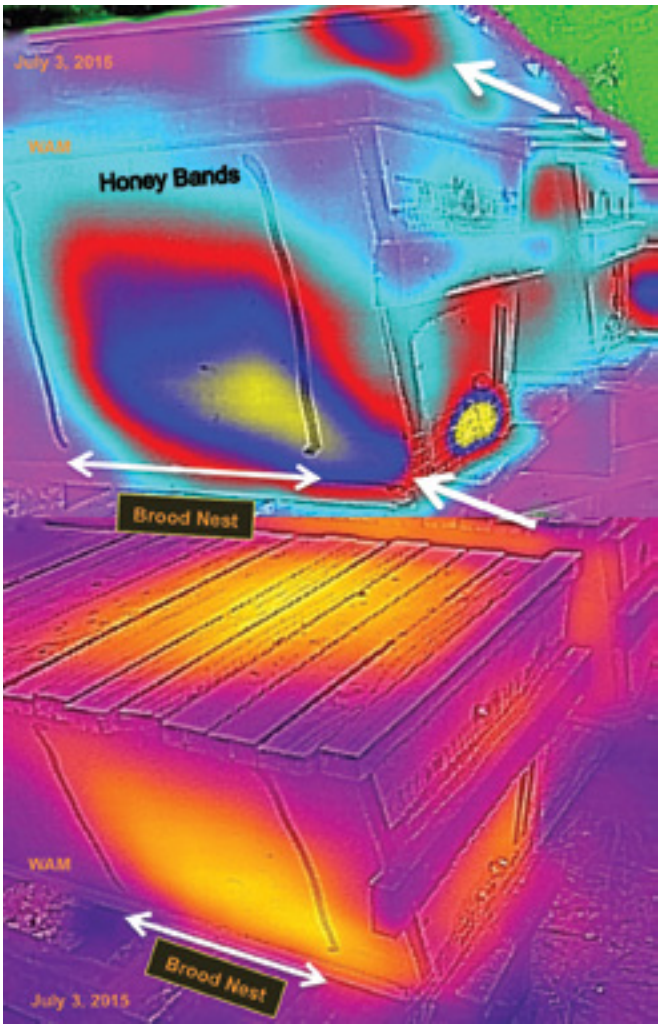


Figure 5 *Matching the brood nest to its heat pattern with additional details. The left side of the brood nest abruptly matched the boundary mark because a solid comb of honey stopped the back of the brood nest. On the right side, bee traffic to the entrances formed a warm path, distorting (blue) out of the boundary marker (and to the lower white arrow). The upper white arrow points to heat reflected off the cover. That heat came out of the top of the hive, shown by the glowing top bars in the lower*

I have been studying top-bar hive colonies with thermal cameras, in ways analogous to what others may have done with frame hives. For this application, the thermal camera records heat from the colony radiating through the wooden side of the hive (see Figure 2). Unless in the heat of the Summer, the brood nest is usually warmer than the surroundings. Internally, the brood nest is approximately 95˚F (35˚C), but less so on the surface of the side, what the thermal camera sees. It is best not to have sunlight on the side, which would be camera-recorded warmth *not* produced by the bees and can confuse how to diagnose, or "read" the image. The thermal camera color-codes the different temperatures in one of several color scales chosen by the photographer. Some scale choices are more artistic (see Figure 3) while other scales reveal details about the heat variation radiating from the hive, called the heat signature.

To obtain baseline heat signatures corresponding to known internal colony conditions, I matched the heat signatures from the side of the top-bar hives to the observed colony conditions within. Figure 4 shows an example where the vertical lines marked on the hive indicated the boundary of the observed brood nest. Internally, the brood nest would be held at a higher temperature. Externally, the warmer part of the heat signature fits within the boundary marks. That was a typical Summer pattern observed in the cool mornings. (In a top-bar hive with the entrances at one end of the hive, the bees locate the brood nest close to that end of the hive. That makes access to the brood nest very efficient, especially in the Spring. In the Summer with limited forage, the brood nest typically became smaller and contracted away from the entrances.)

Figure 5 shows Hive 11, a new colony, in two heat scales. The top image shows the brood nest close to the entrances within the brood nest boundary marks on the hive. Notice the blue heat path leading to the lower entrances (indicated by the lower white arrow at the front of the hive). I took these pictures on a cool Summer morning. From the bee activity they made a warm path to the entrances. At the lower entrances, they appeared hotter (yellow) to the camera because of the direct heat transmission (not through wood as with the brood nest). The upper white arrow, pointing to the metal hive cover, showed a blue hot spot. That is *reflected* heat from the metal cover, heat coming from the top of the hive. The lower picture shows the heat coming out of the top of the hive, indicated by the glowing top bars, heat originating from the brood nest below.

Figure 6 shows a case where the brood nest and the warmest part of the side do not completely match the brood nest boundary marks. The brood nest had contracted far back into the hive in the Summer dearth. The warmest part of the heat signature seemed too far to the right, centered near the camera's aiming sights, the surface temperature being approximately 73˚F (22.8˚C).

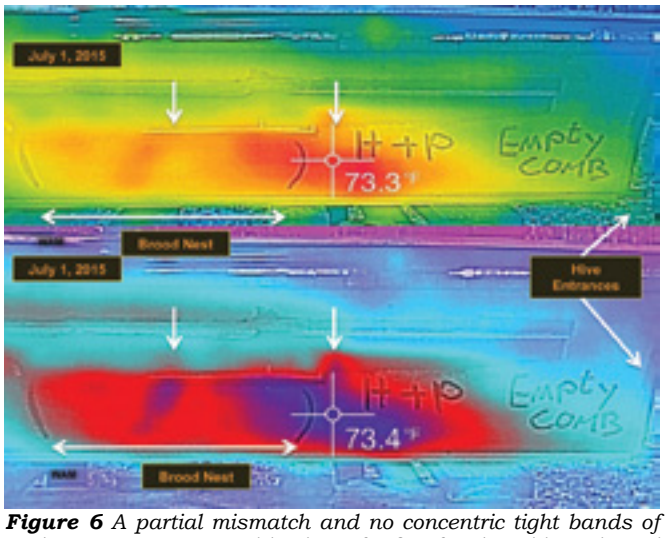


Figure 6 *A partial mismatch and no concentric tight bands of cooler temperatures. A side view of a five-foot long hive oriented like Figure 3 with the brood nest marked the same along with the two heat color scales, except above red was the warmest (no white), and below, blue was the warmest (no yellow), perhaps because conditions were not hot enough in the hive. The warmest areas red (above) and blue (below) had shifted into combs marked honey and pollen (H&P). The brood nest pattern appeared normal. The small vertical downward pointing white arrows indicated subtle features in the two heat signatures, best seen in the lower heat scale.*

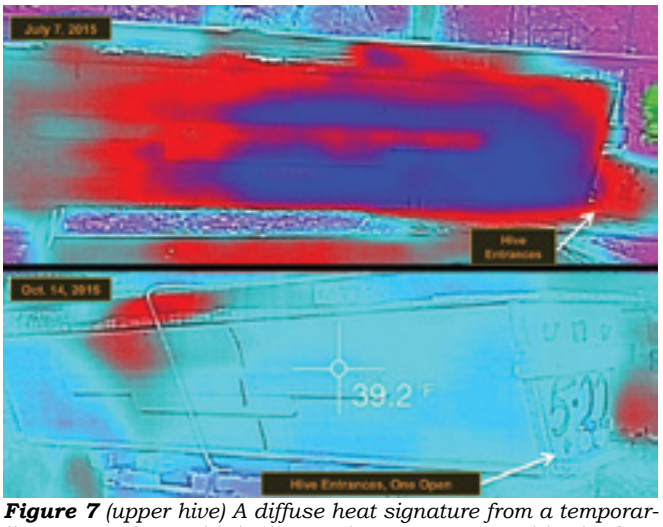


Figure 7 *(upper hive) A diffuse heat signature from a temporarily strong colony with laying worker eggs scattered in the front half of the hive. Soon in the Summer heat, small hive beetles will conquer the colony, sending its combs to slime and ruin. (lower hive) The heat signature of a small colony in the Fall. I knew the colony was nonviable because I had seen its laying workers. I am expecting to see this kind of heat signature of nonviable colonies in late Winter and early Spring. Hopefully, not too many.*

Inside, the brood nest pattern appeared normal. But the heat shift to the right was curious. With the entrances on one end on the hive, typically more bee activity occurs in that direction. On the entrance side near the brood nest, combs typically become empty from brood nest contraction, but still retain honey and pollen bands above, so I marked them H&P on the hive. Further from the brood nest, the empty combs were near the entrances. This organization is normal for queen stock with proper local season sense in a Summer dearth.

However, it seemed like the colony was not heating its observed brood nest consistently, the area between the boundary marks. Some heat scales reveal slight variations in the heat signatures, which might have a bearing on the thermal biology within the hive. In the lower scale of Figure 6, a warmer blue bubble appeared in the middle of the (possibly) under-heated brood nest. Strangely in the upper scale, the warmer red bubble barely appeared. Colony cases like this one need more study. Nevertheless as of January 2016, the colony had a heat signature with the cluster just within the right boundary marker with a cluster size consistent with other "normal" Winter colonies.

In the Summer, if a colony had a greatly diffuse heat signature, then I *suspected* some difficulty was occurring in the hive. I have only used this thermal camera for one Summer with limited observations so I do not yet know how reliable this procedure is. With that in mind, here is a case in the upper picture of Figure 7. The diffuse warm blue pattern extended all the way to the entrances. I knew this colony had failed to requeen itself following Spring swarming from all the recently vacated swarm queen cells. I let it remain queenless until its brood combs showed eggs of numerous laying workers (many eggs per cell). The colony population was still surprisingly strong with plenty of guard bees and crowded forager traffic for July. From the outside, it would not have been among the high-priority hives to inspect if working with limited time in colony triage mode. Colonies in this condition are cryptic and time-consuming to find by slow inspection. Hopefully the thermal camera can rapidly and reliably detect them before pest problems occur.

The lower picture of Figure 7 shows a small heat signature, just in cool red area near the back of a five-foot long hive. In the Summer, this marginal colony went queenless. As the colony became weaker, not able to cover its combs with bees, I removed them, saving the combs from small hive beetles and wax moths. I replaced those top bar combs with pieces of plywood towards the front of the hive. I also plugged five of the six entrance holes with scrap sponges (my entrance reducers), protecting the small colony from robbing. I wanted a heat signature of a very weak colony for educational use. In this case, the colony had laying workers, but was still alive on a cold day (39˚F, 3.9˚C) in October 2015.

The thermal cameras need not detect heat from just bee clusters. For example, I increase my colony numbers and find potential survivor stock by catching swarms in numerous bait hives spread out in three counties. Last Spring I caught 17 big swarms, or 30% of bait hive occupancy. That was a typical season and a very economical increase of colonies when package bee prices have shot up over $100. I do not use scent lures, never touch a ladder, and have no complicated rope pulleys to hoist hives way up in a tree. I cannot do any of that when putting out around 50 bait hives. Rather, I use empty comb to get the scouts to build early consensus to accept my bait hives. At the end of swarm season, I need to gather up my empty bait hives, remove their empty combs (two per hive), and fill other top bar hives with them for storage under fumigation for wax moth control. (I also do open air comb storage too, without chemicals, but right now that capacity is limited.)

The upper picture in Figure 8 shows a pile of two-foot long top-bar hives full of empty comb only, no bees,

ready to be transported to a sealed and locked storage container for fumigation. In the Spring, empty combs in the bait hive do not have wax moth problems, too early in the season. After swarm season, in the beginning of Summer, especially with warm nights, wax moths are more active.

I became busy with other projects and left the pile of these hives as you see them, figuring the comb would be safe for about a week. I was almost correct, as shown by the warm hive on top of the pile (see Figure 8, lower). When wax moth larvae consume combs, they produce metabolic heat. If the infestation is large enough, and consequently warmer than the surroundings, the camera can detect a heat difference. The result: a heat signature made by moth larvae. I knew wax moth larvae produce heat. During Fall inspections, I have seen a very weak bee cluster shift next to a ball of wax moth webs–*for warmth*, which I too could feel on a cool day. I thought bees getting warm from worms consuming their colony was just plain depressing–and that was *before* we had varroa and beetles!

With new technology come careful and wise use. First if a colony shows a normal heat pattern (for now that appears like Figure 4), it could still harbor problems that have not disturbed its heat signature. Therefore, the thermal camera is not a substitute for timely colony inspections. For management, the thermal camera is to make beekeeping more efficient, and perhaps to eliminate some colony inspections, lowering stress on the bees, but it is not a tool for lazy beekeeping.

Furthermore, for efficiency I want to find the colonies that need critical attention *first*. Here is an example I would like to see happen. Assuming all the Summer colonies above were in the same out-apiary far from home, the heat signatures would tell me the problem ones to inspect *first*. Then I would detect, for example, the still strong colony with laying workers first (the hive of Figure 7, upper). Now I know what I need to transfer to that colony to salvage it, as I inspect the other colonies, the one with normal heat signatures (Figure 4). If I found the problem colony near the end of the apiary inspection, I would need to reopen hives for what I needed–inefficient. When I have numerous hives in several apiaries to inspect, I do not want to back up. The last hive to inspect for the day, the finish line, is the other way, into the hives not yet opened, the ones also needing attention.

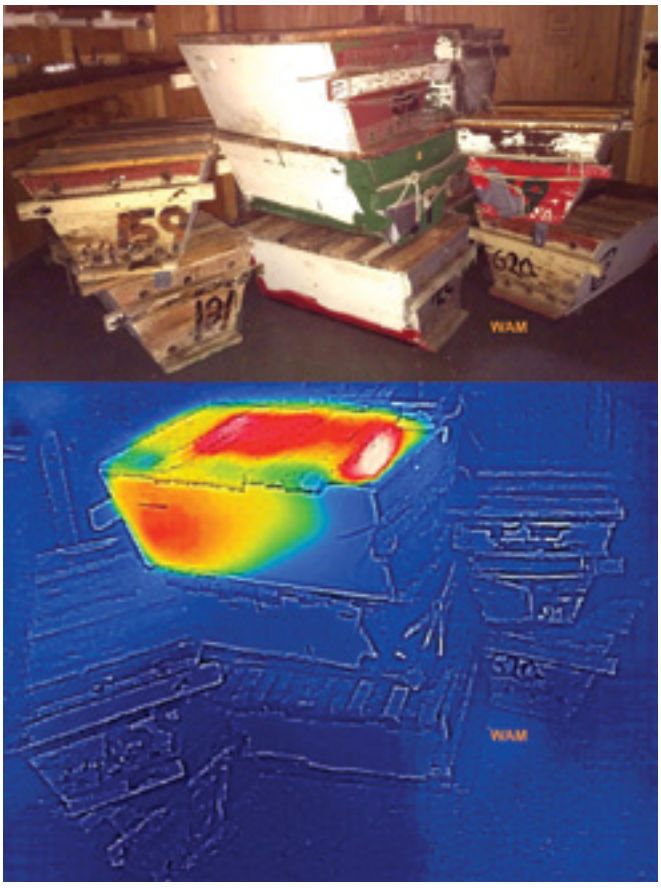


Figure 8 *(upper) Top-bar hives full of empty combs ready to be moved to fumigation storage until next Spring. Temporarily, they are in my bee house that holds 30 top-bar observation hives used for my research. In the beginning of Summer, I left the combs unprotected a little too long. (lower) A thermal image of the same pile of hives. The top hive has a raging case of wax moths infesting the combs and producing heat.*

Hopefully thermal cameras will keep us moving forward towards better beekeeping. BC

Acknowledgments

The author thanks Suzanne Sumner for her comments on the manuscript.

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A beekeeper in Kentucky writes:

Ordered my bees for April 2016. I plan on setting up four hives. I have made all my frames and boxes from scratch and am wondering if I can add 3# package bees into all foundationless frames?

I have added a 1" starter strip of foundation to all of my frames, but, I'm not sure if I should add full sheets of foundation in lieu of the 1" strips or if I should alternate full sheets and 1" strips. I've read that it will create too much "Bee Space" and that I should use full sheet of foundations. I do not have any drawn out frames, as I'm new to this.

I plan on retiring next year and my plan is to raise bees. Any insight will be helpful.

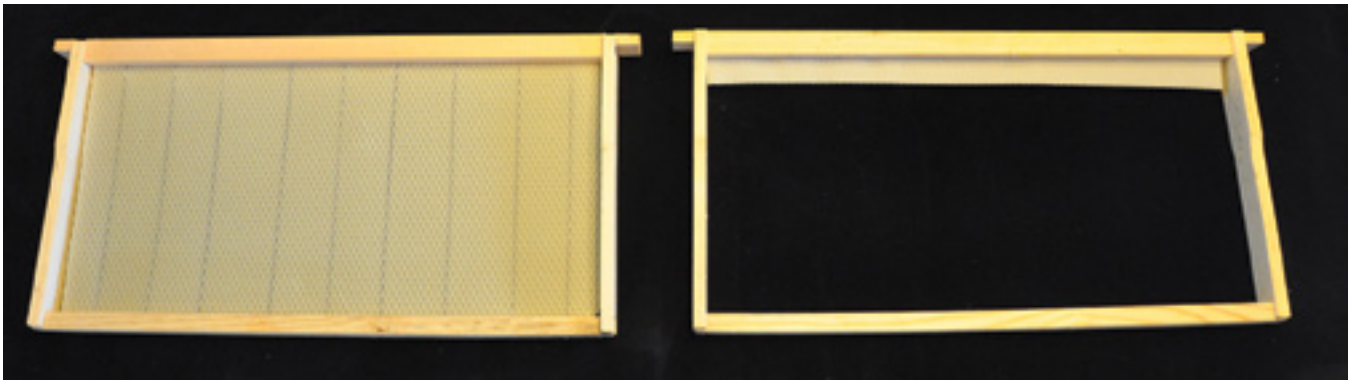
Phil replies:

The development of wax foundation was one of many innovations that came about in the late 19th century during what I refer to as the beekeeping renaissance, ushered in by the widespread use of moveable frames in something resembling our modern bee hive. Other equipment advances included the smoker and the extractor. The advantage of foundation is that it gives bees a template from which to draw out beeswax comb. Without it, they would still form combs of perfect, hexagonal cells, but might attach them to any surface in the box and extend them in any direction. When placed properly, foundation results almost 100% of the time in combs drawn out within frames, allowing easy frame removal for inspections or for honey extraction.

In spite of such desirable results, some beekeepers over the years choose alternative methods. My paternal grandfather kept bees in the first half of the 20th century. He passed away in 1948, before I was born, but according to my uncle who helped tend his hives, Grampa never used full sheets of wax foundation. Instead, his new frames began with starter strips such as you describe. About 15 years ago while visiting with an aged beekeeper in the mountains of my native Eastern Kentucky, I watched him installing strips about an inch wide, cut from whole sheets of wireless foundation, in the tops of his frames. I told him about my grandfather and surmised that this must be an old-time mountain beekeeping tradition. *"No"*, he replied, *"This is poor man's beekeeping. Whole sheets cost too much."*

These days, those who decide not to use wax foundation are more likely to be concerned about contaminants than cost. Beeswax tends to absorb chemicals, and some studies have shown low levels of synthetic miticides in commercial wax foundation. For my part, though I understand the concern, I don't think the amounts detected warrant abandoning such a useful tool. However, others disagree. Ask ten beekeepers the best way to approach a problem and you will get eleven different answers. Wax foundation, no foundation, plastic foundation, starter strips – as my friend Kent says, "The bees don't care", but what works for them may not work best for the beekeeper.

I experienced that first hand a few years ago when I decided to add a couple of supers for cut comb honey on one of my hives. I thought it might be a good opportunity to try starter strips. Typically, any type of comb honey is started on special, extra-thin foundation in order to incorporate as little foundation wax as possible in the finished product. My thinking was that if I used starter strips and then cut the comb honey from the area of the frame below the bottom of the strip, my cut comb honey would consist entirely of pure, foundationless comb. The problem was that the bees did not choose to cooperate.



While they generally built wax between the boundaries of each frame, their execution was far from 100%. Sometimes they decided to connect two adjacent combs; occasionally they ignored my starter strip altogether. I had to perform what I call corrections. Almost daily for a week or so, I pulled up every frame from each box and removed any comb drawn outside the frame. In the end, I did have beautiful frames of comb honey - without foundation, but not without regular, painstaking intervention on my part at the beginning of the process. After cutting the comb honey from the frames and allowing the bees to rob the remaining honey from the strip at the top (as I always do with wet, extracted comb), I stored the frames. The next year I placed them, with the strips of drawn comb, on a strong hive, and was rewarded with two more boxes of beautiful comb honey. That time, less correction was required. For me, with only two supers to manage, this was workable. If I were trying to produce 50 supers of comb honey, I might have to rethink my method.

I am concerned that, as a beginner with four hives, you are creating an additional challenge for yourself. Four hives means four boxes with a total of 40 frames to begin with, and another 40 when you add your second deeps. If you do not check each of them, on an almost daily basis for several weeks, you could easily end up with frames that you cannot remove individually to examine. In just a few days, the bees could create a real mess that you, as a new beekeeper, might not be prepared to handle. We use foundation because it simplifies one part of a complicated process – good for the beekeeper because it's less work, and good for the bees because it allows us to take better care of them. Alternating frames of foundation and frames with starter strips is unlikely to help, and might make things worse. As you say, the large space between the full sheets is an obvious violation of the bee space.

I am often concerned that those of us who encourage and welcome new beekeepers into the craft tend to emphasize its very real rewards and downplay the difficulties. It is not easy. In the beginning there is a steep learning curve. There are so many things to learn that beginners can quickly feel overwhelmed. When my kids started to drive, we let them learn on an automatic, though my wife and I drove (and still drive) cars with standard transmissions. My son even borrowed my brother's automatic to take his driving test. Not having to shift gears gave them one less skill to master in the beginning. After they got their licenses, we taught them to use a clutch. I think it worked out better.

Starting with four hives is ambitious enough without adding complications. My suggestion is to use frames with full sheets of foundation and get through your first year. With a little experience and with the free time you will have after you retire, you may decide to expand. That would be the time to shift gears and experiment with starter strips or any other ideas you may have read about and considered trying. Good luck to you!

A beekeeper in Tennessee writes:

I lost about 30 frames of honey to SHB this past year (2015). I think this occurred because of queen problems. I kept cutting queen cells out. It was my 2nd year as a beekeeper. I hope I learned my lesson. This year I'm going to let the bees work it out.

Phil replies:

In spite of all the books, magazines, classes, and online information available to beekeepers these days, experience is still sometimes the most effective teacher. Congratulations! You just graduated from Beekeeping 205 – how not to attempt swarm prevention.

As I discussed in my column of January 2016, small hive beetle damage virtually always occurs as a secondary issue. The primary cause is an event which reduces the number of healthy bees in a colony, allowing small hive beetles to reproduce in large numbers uncontrolled by the hive's legitimate population. While *Varroa* mites continue to be our greatest challenge, often creating an opening for small hive beetles to exploit, the loss of a queen is also a common precursor to beetle damage. All too often this loss is brought on by a beekeeper attempting swarm control by removing or "cutting out" queen cells.

When a colony prepares to swarm, it produces dozens of queen cells – a wasteful but usually successful strategy for assuring a viable replacement for the old queen after she accompanies the swarm from the hive. It seems logical then, that depriving the colony of the means of making a new queen will prevent it from swarming. Usually, however, it merely delays the process. In fact, bees themselves sometimes destroy queen cells to temporarily interrupt swarming when, for instance, inclement weather prevents their flying at about the time that the cells are ready to be capped. They soon resume swarm cell production, just as they do after queen cells are removed by a beekeeper. As Hamlet told Horatio (confusingly and in a completely different context), "If it be now, 'tis not to come. If it be not to come, it will be now. If it be not now, yet it will come – the readiness is all." In other words, some things are going to happen no matter what we do. Swarm cutting is only effective if done thoroughly and repeated weekly until the conditions driving the swarming urge (such as overcrowding combined with a strong nectar flow) have passed. If the beekeeper misses just one or two cells hidden in a clump of burr comb, the swarm will still depart. As a swarm prevention strategy, cutting out queen cells is time consuming, labor intensive, and has a low rate of success.

However, the real problem occurs when a beekeeper removes all of the queen cells, not realizing that the swarm has already departed! The old queen is gone and so are the cells from one of which her successor should have emerged. The chances of the colony's making a new

queen are drastically reduced since the old one usually quits laying several days before leaving and, consequently, the hive may not contain any larvae young enough to be developed into a queen. Even if a successor is produced, it can only be after a delay of several weeks. That means that the natural loss of aging field bees will not be compensated for by emerging brood. The population of the colony will suffer at time during which it should be at its most productive. How is this possible? It seems as though it should be obvious when a swarm has taken place by the reduction in the number of bees, but that is not always the case. Many a time I've had a beekeeper tell me that he spotted a swarm in his apiary, but since all of the hives still seemed full of bees, he had no idea which one it had come from. I've had the same experience myself. Colonies have an amazing ability to build up rapidly under the right conditions and the number of bees in a hive is difficult to estimate, especially to the eye of an inexperienced beekeeper. Even cutting out swarm cells before they are capped does not guarantee that you are catching them pre-swarm. Though bees usually swarm just after sealing the queen cells, they have been known to take an early departure. Destroying queen cells always entails some risk of creating a queenless hive.

As a speaker, I sometimes give talks on swarm reduction. Note that I say reduction, not prevention. Inhibiting the natural urge to swarm, which is the method by which colonies reproduce, is a difficult task and one on which many beekeepers tend to place too much emphasis. I frequently have occasion to talk with the owners of commercial apiaries, and I never hear any of these highly skilled beekeepers express concerns about swarming, though of course it occurs in their bee yards too. However, commercial beekeepers make a lot of nucs – an effective way to reduce swarming (though that is an incidental benefit to them.) After all, swarming is just the method nature has evolved for making splits, and swarm colonies can be thought of as nature's nucs. Whether natural or engineered by beekeepers, the creation of new colonies reduces congestion in the brood box, increases genetic diversity, and helps the species to grow and thrive. Making nucs is the method of swarm reduction that I recommend to beekeepers and the one I practice myself, along with trying to recapture the swarms which do occur and settle temporarily in the trees in my apiary. If you don't want to manage additional hives, nucs can be sold, used to bank extra queens, or saved to combine with a weak colony later in the season. Or you could just let the swarms go. Healthy colonies are capable of producing a good honey crop even after swarming. As you put it, let the bees work it out.

If you would like to learn more about the swarming process and add to your beekeeping library, I recommend two books: *Biology of the Honey Bee* by Mark L. Winston, and *Honeybee Democracy*, by Thomas D. Seeley. If you want information on reducing swarming, I also suggest *Swarm Essentials*, by Stephen J. Repasky. And don't forget to keep an eye on the trees! BC

Bo Sterk

Bees, Beetles, Fine Art Prints and Teaching Beekeeping In Primitive Conditions

Larry **Connor**

Bo Sterk and I met at the Florida Bee College several years ago. We were selling books and he was selling shirts to help the College program. My business partner, Rob Muir, and I quickly developed a friendship with him. After the January 2016 ABF Convention in Jacksonville, FL, I was able to interview Bo in his St. Augustine home.

Born in Cleveland and raised in Avon, Ohio, Bo was always interested in Nature as a kid. He still has his collection of 1700 butterflies and 600 mounted beetles he started as in his youth and continues to collect to this day. "I have trouble not picking them up and adding new ones to the collection," he explained. Butterflies and beetles are not the only things he collects. Bo and his wife, Jo, both professional artists besides their other passions, have amassed many interesting items, including artwork from friends, ethnographic artifacts from travels around the world, and their own art creations.

Bo went to Kent State University and earned a BFA in printmaking and illustration. "I almost had enough credits for a degree in botany, growing up with all of those greenhouses in Avon and then taking many botany classes in college – the art and science was a reflection of my many interests," he explained. He paid for his education by creating botany illustrations for student research projects and their scientific papers and MS and Ph.D. dissertations. He finished his art degree in 1975.

Bo has worked both as a commercial artist and a creator of fine art. "Commercial art is when someone tells you what to draw and then they pay you. Fine art is when nobody is telling you what to do and you are producing what you want to create. Of course, then you have to pursue ways to sell your artwork if you want to make any money," Sterk laughed.

Bo has done commercial art jobs for Apple Computer, Budweiser and by illustrating three children's books (I found two on Amazon). But his passion was to produce fine art over his career, moving an average of one thousand pieces out of his studio every year. "There are at least 20,000 pieces of my artwork floating around out there." Bo explained. "Someday they will be more valuable for someone's grandchildren."

The key to selling this artwork was to travel to major fine art festivals in large cities around the United States. For over 20 years he traveled to shows in Dallas, Minnesota, Denver, Chicago, Cleveland, Kansas City, Milwaukee, Ann Arbor and many other places. In the larger art festivals here were more potential buyers for fine art, and not just arts and crafts. "It is important that you maintain a quality image," he explained. To assist him with this quality and high volume sales, he employed and trained several art students to help him in production, making and framing his fine art prints. Lately he has not seen this level of quality on the road. He has his prints in many art galleries for sale on consignment.

Sterk moved to St. Augustine, Florida in 1984 after visiting with other artists from the area. Attracted to the oldest city in the United States that shares a Spanish and English tradition, Bo was drawn to the fact that St. Augustine has a large artist colony, with considerable production of fine art. Also, the Florida climate and beaches, as well as many good restaurants were part of the allure for a northern boy. For many years since the move he continued his art production and touring the country to sell work at art shows. As the market changed, Bo turned his attention to renovating several small houses. These rental properties have helped him pay bills and have kept him busy with all the issues that come with being a landlord.

What does Bo Sterk's artwork look like? He describes it as whimsical satire with humorous animal imagery. He has a series on cats with wings – one hangs in his dining room.

It was Bo's fascination of nature, his passion for collecting insects, and an opportunity that took him into the study of bees and beekeeping. Besides being influenced by an uncle who kept bees in Ohio, a local artist in St. Augustine started doing apitherapy for her MS. Since there were not many beekeepers in the neighborhood, Sterk offered to get a hive of bees and manage it so she would have bees for the therapy. "I never did the actual stinging. I let her husband sting her. After two years of therapy her disease got worse and they wanted the bees off the property. I took the hive and thus I was keeping bees for myself."

"Now I have 25 hives of bees; I had 50 at one time and I am more comfortable with 15-20 colonies. With a background in real estate and from doing cutouts, being basically a carpenter this has been a rare challenge," he explained.

"When I began, I kept bees because of the fascination of the bees. Then I started working with my mentor George Waldoch from Jacksonville to learn how to keep bees. George not only knows how to whisper to bees but also knows the commercial parts of beekeeping, he explained. "Do it right, do not get stung. You don't need to wear gloves if you're gentle", says Bo.

Fast forward into helping others

After years working at educational programs and extension programs, Bo began giving back his knowledge to others. "Fifteen years ago I started to do bees in the Caribbean. One of the bee inspectors at the time took me to Barbados and I did the fieldwork for classes of beginning beekeeping for a week. I was immediately hooked and saw the need for education and trainings in the islands. There are big hurdles to overcome though including bureaucratic efforts to control people coming to the islands, stereotypes of what people thing beekeepers are, and the need to educate people on beekeeping. We had to meet with the Ministers of Agriculture on all these islands and convince them that local honey is best because the demand for it so great from the residents. The demand is so high that the beekeepers have not been able to get their honey to the tourists," he explained.

Bo's Objectives of Teaching

Bo gave me the following when I asked him about his objectives in teaching in less developed areas with people not experienced with bees and beekeeping:

- Help people develop a sustainable living, to supplement a beekeeper's income.
- Help people develop a green income.
- To do this he worked primarily with women and youth groups. They are more available and able to care and nurture the bees. Youth groups are always excited about learning the beekeeping. If you get them hooked it is a good thing – they value education in the Islands because education is so far out of their reach, especially in Haiti.

Here is his story about the importance of education to the people he trains:

"The last time I conducted a five-day workshop in the mountains, I had one fellow about 30 years old walk four hours in and four hours home every day just to attend the meetings. He would leave home with only some rice and pigeon peas. I would give everyone coffee. Once you give these workshops a couple times, and you see this level of interest and dedication, you are hooked," Bo explained

Haiti

Bo has gone to Haiti for 10 years. He was strongly impacted the third world aspects of the country. He took his wife, Jo, with him on one trip so she could teach candle making in a small village with no running water or electricity. She was unable to express her disbelief about how very primitive everything was for months after. When Bo travels into the mountains he takes his own food with him, meaning that he carries live chickens bound at their feet, water, and everything else he has planned to consume. The cooking conditions were, at best, very primitive. His photos of the facilities make you wonder if you would feel safe eating food prepared in these "Haitian kitchens".

The first time he visited he did an exploratory trip. He found that the existing beekeepers were all keeping bees in logs. They were basically all bee tenders. They used a machete

A log hive with the banana leaf removed at the end. Sterk encourages rural, mountain, Haitian beekeepers to make more log hives rather than deal with the tremendous expense and transportation issues associated with Langstroth hives. Some beekeepers cut top bar hives out of sheets of plywood that sell for $80 US each.

to ream the comb out and crush it and drain the honey out. "The honey is pretty bad tasting from all the smoke ash – it was pretty awful," he explained.

"The first thing I did was to encourage them to make more log hives. I did not want to make drastic changes, and I encouraged them to work with the logs to increase their production. The first time I visited one beekeeper he had six hives, after working with him he 25 hives on the following trip. When he got to 60 hives he was able to get a moped. This allowed him to go into the city and go to college. In Haiti, a college degree means that you can get a steady job in agro-economics, working with the farms market their products directly. When he about to graduate he had about 75 log hives. We then moved to top bar hives. A sheet of plywood was $80US. I developed a design that allowed each beekeeper to develop four hives per sheet. The top might be the piece of tin or a banana leaves. The top bar seems easier on the bees to harvest. Only about 25% of the country has electricity so beeswax is highly valued."

"Now the same guy has been able to purchase five Langstroth hives. They do not have good extractors,

Haitian apairy on the side of a hill, each log supported with several rocks to keep them rolling down the hill. Bo Sterk is in the red shirt.

so they have to rely on homemade extractors. They sell their honey in old juice containers or zip-lock bags. It sells for about the same as in the U.S. or a bit more," Bo explained.

A lot of honey is bartered for any other produce not produced on their farm.

All small scale beekeeping. Bo continues to push the development of more the log hives in the mountains. Yet the top bar hives have been very successful, making four hives from a sheet of plywood. Until the earthquake in 2010, farm wages were running about $1 per day. After the earthquake wages have gone up to $4 per day.

A Favorite Story

I asked Bo to share his favorite story about helping students in Haiti. He related the experience working two boys, eight and 10 years old when he first met them. "They would bring in school kids the first day – mountain boys. They would stay with their mothers while their fathers traveled some distance for work. The young boys ended up being the farmers with their mothers. The two brothers got two top-bar hives from our program. They build six more hives. They have eight hives now, and knowing how a top-bar hive works, they would convert a kitchen chair with arms into a hive, putting the frames along the arms of the chair. They blocked them with scrap wood and used a banana leaf as a cover."

"Now they are about 16 and18 years old, but it is hard to make contact with them. It takes two hours by four wheels with a driver – then I had to walk in an hour to meet them. Meanwhile, the boys had to walk 2.5 hours to hear me talk," Bo explained.

"Translation is difficult. Because of the diversity of language, my talking involves having two – creole and a pidgin – translators.

He usually teaches in a Catholic church because it is the only place with a civic center or a space for classes. Teaching was done by demonstrations, especially the difficulties and obstacles to make things that are sustainable. All doing natural comb with a starter trough or a wax in string.

The most advance student has about 70 log hives. He puts a swarm in, hold the bees inside for four to five days and then gives the hive woven ends.

This photo shows the two boys Bo has worked with since they were eight and 10. Beekeeping has given them valuable income, selling honey to people within their community.

Florida Bee College

"(Dr.) Jamie Ellis's bee college is fabulous. It is one of the best things that has happened in the southeastern United States, hands down," Bo enthused. "After going down to the Caribbean, I was able to convince Ellis to take the bee college there. I am just finishing up my master craftsman in certification (he is a master beekeeper through the University of Florida Bee College)." His project has been to write and illustrate a 25-page set of simple instructions for use in Island development programs. He is also translating his beekeeping guide into creole.

Save the bees = feed the people

Bo's plans include the March bee college in Florida and the next Caribbean bee college. He, of course, is focused on getting his new manual printed and going back to Haiti. There is will work toward his objective:

Save the bees = feed the people. In Haiti, honey bees are going to prove to the people that small steps by keeping bees will improve some people's life dramatically. BC

Check out Bo's website for Bees Beyond Borders – **http://beesbeyondborders.net**

Follow Dr. Connor and ask him questions about his interviews at upcoming beekeeping meetings. For his latest schedule, and for a list of his books, consult ***www.wicwas.com.***

The Horizontal Two-Queen System

William **Hesbach**

Figure 1 *– Vertical upright two-queen colony with one brood chamber on the bottom board followed by honey supers, a queen excluder, and another queen-right broom chamber on top*

Two Queens One Colony

As beekeepers discovered long ago, a single colony with two queens generally builds a large population of bees and can produce abundant excess honey.[1] The reason two queens in one large system will out produce identical queens in two separate systems, can be explained simply by the fact that a two-queen system will produce more bees, but it's a little more subtle than just that.

The first obstacle a two-queen colony must overcome is the fact that in almost all animal species there's a fitness contest among sexually maturing individuals that determines their reproductive rights. With honey bees it's a fight to the death when circumstances allow rival queens to meet. Therefore, the idea that two queens can exist harmoniously mixing pheromones and laying eggs, runs contrary to the natural one-queen order of a colony, but under certain conditions two-queen systems do occur. Natural two-queen systems can occur during supersedure when a daughter queen will coexisted with her failing mother, also at times when both queens are injured rendering them unable to engage in a reproductive contest.[2] The case we will discuss is an intentional manipulation where two queens contribute to the brood of a single colony but are not allowed access to each other.

In two-queen systems, certain changes occur in the colony's balance leading to a larger population, the most significant part being the amount of foragers they produce. Beginning is the early 1920s scientists set out to discover the relationship between the population of a colony and the number of foragers. One study used a nondestructive trapping device made of oiled tubes that returning foragers could crawl through but couldn't fly in. The bees then fell into mesh bags and were retrieved and counted. Their research verified earlier findings indicating that large colonies devote as much as 9.5% of their population to foragers, while in smaller in colonies, the population can be as low as 4.3%.[3] The key beneficial effect of producing a larger field force is greater information gathering capacity. This allows the colony to locate nectar sources quickly, and select the most productive sources more effectively giving them an advantage when nectar is both scarce and abundant.[4]

One possible biological mechanism that can explain a colony's response to produce more foragers relates to advancing the natural progression of age-related tasks. As adult bees emerge and age, they perform a number of tasks for the colony in a somewhat orderly progression starting with cell cleaning and advancing to foraging with about 11 identified tasks in between.[5] The progression through an age-related task is determined by a bee's genetics, which elevate juvenile hormone levels with age. Another determining factor is the bee's central nervous system that can also elevate hormone levels based on various colony conditions.[6]

An important colony condition influencing how an individual bee progresses, is her frequency of encounters with the age-related task she is currently performing. In the case of a nurse bee it's the encounters to care for brood. With lots of encounters a nurse bee is likely to follow a somewhat orderly progression to the next age-related task. In a productive two-queen system, that orderly progression can be altered to better serve the colony. Since the colony is producing large amounts brood and also a large population of nurse bees, the slightly older nurse bee cohorts will encounter less brood in need of care. At the colony level, those older nurse bees can be hormonally triggered to bypass all the interim age-related tasks and become foragers, which is more in line with the needs of the colony. Studies have shown that nurse bees can advance to foragers at seven days of age instead of the 21-days typically associated with the age of a forager.[6] These precocious foragers can become a factor in the larger field forces that two-queen systems are known to produce.

Another noted advantage of a two-queen system is that there is more queen pheromone per bee, which may reduce the tendency to swarm. One theory about swarming is that as single queen colonies grow large, the queen's mandibular pheromone (QMP) and footprint odor, both partly responsible for suppressing the swarm urge, have difficulty circulating to bees on the far reaches of

***Figure 2**. A complete horizontal configuration. You'll need two attached bottom boards, deep or medium brood boxes, two half size migratory or telescoping covers (shown), honey supers and a standard cover. Also needed is a set of full size migratory covers (not shown) and a flat queen excluder.*

the colony's various comb edges. Without sufficient QMP and footprint pheromone, worker bees at those locations are less informed about the queen's fecundity and have a tendency to start queen rearing.[7,8] According to the theory, that's one reason why we often see queen cells along the bottom edge of comb. There is science supporting this theory and also credible anecdotal accounts that populous two-queen systems tend to swarm less. Even so, a colony's reproductive events are difficult to suppress, so observing prudent swarm management is still required.

The Horizontal Two-Queen System In Practice

Two-queen systems designed to manage and increase honey production have been used extensively on a small scale, but have not been adopted by large commercial beekeepers.[9] As you can imagine, the hive manipulations can get complicated and there are arguments both for and against the effort required for the increase in production. Early on, two-queen systems were almost always configured vertically but have since been configured in both vertical and horizontal systems. In their simplest form, vertical systems are upright stacks (Figure 1) with one brood chamber on the bottom board followed by honey supers, a queen excluder, and another queen-right broom chamber on top. Vertical systems can grow rapidly into large towers and require lots of heavy work to manage properly. The historical literature commonly references vertical systems with 10 or more boxes and goes on to explain that for ease of manipulation they were, if you can imagine, tilted to the ground so they could be worked on horizontally and then reassembled vertically.[10]

On a practical level, a few years of hefting ladder-high 90-lb deeps can convince any beekeeper to reconsider the vertical stack and look for a more workable two-queen system lower to the ground. Fortunately they exist and that's what I'll explain here starting with the equipment.

The system I'm describing is a horizontal system in that two colonies are placed side by side so they can share a common set of supers (Figure 2). The brood chambers stay physically separate although I prefer to join the bottom boards with screws. This ensures both sets of brood chambers stay at identical heights even if the assembly is placed on a slightly uneven surface.

Initially, supers are placed over a queen excluder. Some beekeepers consider the queen excluder optional. I prefer to use an excluder until harvest, and just for reference, when a queen excluder is used the systems are sometimes referred to as *two-queen* as opposed to being called a *multiple-queen* system when a queen excluder is not used. In multiple-queen systems the queens are kept caged in common brood chambers long enough for both queen's pheromones to thoroughly circulate. At that point either queen would be accepted. But as explained in the 1913 *ABC and XYZ of Bee Culture*: "If both be liberated at the same time, one in one corner of the hive and the other in the opposite corner, both will be tolerated by the bees." The author goes on to explain that this condition is tolerated as long as the honey flow continues but will most likely end in a "royal battle" when the flow stops and especially if the end flow is accompanied by robbing behavior.

Conversely, the use of a queen excluder will allow the beekeeper the option to decide when, or if there will

***Figure 3.** You'll need to make two half size covers for the five frames left exposed when the honey supers are positioned in the middle of the brood chambers. These covers can be simple migratory covers or with a little more work, telescoping covers. The idea is a snug fit against the honey supers to minimize rain penetration. Also visible is the flat queen excluder needed to isolate the queens.*

***Figure 4.** This mock-up illustrates that the key manipulation in a horizontal two-queen system is to allow both brood chambers access to a single set of honey supers while isolating the queens. A flat queen excluder placed between them is all you'll need to get it done. In operation, the frames on each side of the excluder are available for drone trapping, inspections, and manipulating brood. After the flow and harvest, a two-queen system can be dismantled or allowed to continue.*

be a royal battle. The preferred excluder is flat without a raised rim because when you place a flat excluder, so it straddles both brood chambers, it eliminates the bee space on the box edges between the two colonies so the queens can't wander over and try to kill each other. If you use a wood framed excluder, the raised rim will provide a bee space between the brood chambers and to keep the queens separate so you'll need to add a filler strip under the wire portion of the excluder over the adjoining box edges to eliminate that space.

In a horizontal configuration it's not clear that nurse bees will readily share brood tending because of the journey required to travel between the boxes and the fact that each queen's pheromone may be more isolated to their own side. In a vertical system it's easier to visualize how nurse bees can move freely up and down through a queen excluder. Also a vertical system has the added advantage of efficient convective flow aiding heat transfer and pheromone distribution. Although nurse bees may be not be as efficient in a horizontal system, the boxes are more accessible for management and you can intervene to increase brood by adding frames and also equalize the colonies strength by moving brood around.[11]

If you're thinking about trying this configuration, you'll need two small half covers (Figure 3) for the five frames left exposed on each colony when honey supers are stacked in the middle. They can be migratory or half telescoping covers. You'll also need a set of full-size migratory covers for use during the spring build when there are no honey supers. In operation, the half covers should fit snuggly against the side of the supers to keep rain penetration to a minimum. That leads to the issue of the queen excluder's thickness. A flat excluder is usually a little larger than the outside dimensions of a box. Although it's only a fraction of an inch it will prevent a migratory cover from fitting snug against the honey super's side. To eliminate the issue, you can add an appropriate shim or make a half size inner cover.

That's basically the equipment configuration so the next step is to consider startup choices. If you're trying for increased honey production, it's best to start a two-queen system with a strong overwintered colony that you can split early. That way you can use the parent colony for one side and immediately requeen the split for the other. Another way is to start with your own overwintered nucleus colonies, or other strong yard splits. If you chose to start with overwintering stock, it's best to apply a broodless *Varroa* treatment the previous Fall, or during the Winter, so your stock is as clean as possible coming into Spring. You can also start with early packages on drawn comb and feed so they build quickly. However you decide to start, the idea is to begin about eight weeks, or more, before your main flow and manage their build so they're ready in time with a large field force.

Forecasting the Flow

Judging when your main flow may start on any given year is where beekeeping becomes an art based on a considerable amount of seasonal observation over a prolonged period of time. Without this knowledge, consultations with other experienced beekeepers and growers in your area are crucial.

Starting on your own requires that you keep a calendar identifying your particular area's bloom schedule by species and date. It's an ideal method to familiarize yourself with your local bloom scape and you'll discover many interesting secondary floral sources beyond the usual fruit blooms or dandelions. Unfortunately, the main drawback of a bloom calendar is that the bloom times are hardly reliable year to year and are dependent on many variables the most prominent being the average daily low and high temperatures in the current season also known as the growing degree-days.[12] Even with its drawbacks, your bloom calendar will help with an estimate of when to start your advanced preparations in a typical year.

Final Notes

Most two-queen systems are used for increased honey production and if that's the goal, it's important to keep in mind that a two-queen system depends on both productive forage, and accurate timing of the main nectar flow. So if you decide to try one in an area with historically low nectar flows, you may not experience increased production. Even without increased production, since a two-queen system requires more attention to early Spring preparation, the skills you sharpen while preparing the colonies will enhance your beekeeping in the rest of your apiary. In addition to increased honey production, once mastered, your skills can be used to assist weak colonies, help manage swarming, facilitate requeening, and help when making new colonies. On a more personal level, more than any other system a two-queen system can broaden your understanding of your area's floral

sources and bloom schedule. Once you begin to yoke floral sources to observation of how the biology of your colony is effected, you're on the way to a more complete understanding of beekeeping as art. BC

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[11]As an interesting side note, an inventive beekeeper filed a US Patent on a system including a device he named a "beeway-isolator" The beeway–isolator addresses the issue of bee mobility in a horizontal two-queen configuration by allowing bees direct access to all four brood boxes while excluding the queen to a single set. Unfortunately, it never came to market, but the plans are included in the patent.

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Taking Advantage of Winter to Help Reduce Pests

Jennifer **Berry**

While the frost still lingers here in the south (and the snow to our north), it's time to take care of a few items on our beekeeping to do list.

To start, we are going to use these chilly temperatures to our advantage. Now's the time to begin dealing with Small Hive Beetles (SHBs), because – depending on where you live – SHBs can either be a mild irritation or a major pest.

So, what exactly makes a pest *a pest*? Well, it's always fun to search for definitions online. The one I enjoyed reading about the most really doesn't apply to beekeeping, but I found it entertaining:

Pest: the guy at the party or club that tries to pick-up every woman in the place. He is usually drunk, smells, and has bad breath.

Hopefully this type of pest isn't lurking in your apiary. If so, I'd suggest getting a big dog and a can of Raid! Haha.

Okay, seriously now, the actual definition that applies to us:

Pest: a destructive insect or other animal that attacks crops, food, livestock, etc.

In our situation, SHBs are destructive insects that attack bee colonies. By themselves, or even in groups of a few hundred, they aren't such a problem. The problem begins when their populations get out of control. This is the case for most pests really.

Think about your yard, garden, or house: if there are a few spider mites on your azaleas, or few aphids on your tomatoes, or even a few ants in your kitchen, you don't think much about it. A few weeks pass and you're making a salad, so you head to the garden for some fresh produce. As you bend down to pick that beautiful, ripe tomato – **BOOM!** – it all comes into focus and you see thousands of aphids, white flies, hornworms – they're attached to every stalk, leaf and bloom. You think, *Crap!* At this point, the plant doesn't seem to be suffering too much, but you know from past experience that, if you wait another week, it's sayonara for the ole Solanaceae species. Back to the house you go for a pair of gloves, a water hose and some soap. But, as you pass by your kitchen window, something catches your attention. *Wait! What is that moving all over my kitchen?* As you press your face into the window screen, those few ants you saw a while ago are now a few million, and the fruit you just placed in your grandma's ceramic bowl is being consumed in front of your eyes. Oh, and that Azalea, nothing more than a skeleton of twigs and webbing.

In the beeyard, it's even worse. Have you ever seen what SHBs can do to a thriving colony? It's not pretty! The first time I experienced these pests was when I was helping Dr. Jamie Ellis (at that time, he was just "Jamie") on a project in South Carolina. Jamie wanted to see if a) one could trap beetles in the bee yard before they invaded a colony, and b) what type of material(s) you would need to do just that.

In preparation for his study, he spent days drilling holes into one-gallon buckets, gluing small plastic containers onto the bottom of the inside, and gathering up edibles he

assumed beetles would find tasty. Once all the supplies were ready, we drove to the coast of South Carolina to a farmer who had hired a beekeeper to deliver several pallets of bees to pollinate melons. The beekeeper had never returned to collect his hives, and the farmer believed most of the colonies were in poor shape.

It was a typical Summer day when we arrived in South Carolina: cloudless, hot and humid. The field was encircled with tall privet hedges, kudzu and bramble. It provided good nourishment for the bees, but it absorbed any movement of air (causing the 95° to feel more like 125°). It had rained the night before, so we hiked to the hives to avoid getting stuck. As we approached the first pallet of bees, I noticed one of the hives had a purple stain running down the side of the supers (Figure 1). Upon closer inspection, we realized it was fermented honey oozing out of the super and down the side. The smell was *horrible*. A robust, complex mixture of something dead, with a hint of fermented, fruity sweetness, rounded out with some earthy tones and yuck to the third power! I'm sure you can imagine the scent.

The hive with the foaming ooze was dead. All that was left were thousands of beetle larvae wriggling in and out of cells, adult beetles running about, and slimed comb and equipment (Figure 2). The slime is created as the SHBs (adults and immatures) defecate after consuming brood, honey and pollen. This causes the honey to ferment, creating CO_2, bubbles, which then boil out of the cells.

The other three colonies were in horrible shape. One of the hives had all the bees clinging to the outside, because the interior resembled the oozing hive, complete with larvae and slime. It was sad to see all those bees trying to protect their home from the multitude of invaders – after fighting a hard battle, eventually giving up and being either pinned in the corner or hanging outside.

Our job that day was to collect as many adult SHBs as possible. We had our handheld aspirators (Figure 3), which, after using for about 15 minutes or so made you feel like passing out. So, after thousands of beetles were sucked out of the hives, it was time to sex them (determine which beetles were males and which were females). Yep, you can do this. Not something I talk about freely to strangers in the grocery line or anything, but a normal scientific process for the good of mankind (or bee-kind!). As we sexed the beetles, the females received a spot of pink fingernail polish on their backs, and the males would get a spot of blue.

Figure 1 *– Fermented honey foaming out of the colony.*

In the morning, we strung the traps in the trees and released the beetles to see a) which sex would arrive at the traps first, or b) would it just be a random gathering at the feeder bucket? We were just hoping for beetles in the buckets. We released the beetles and waited, waited some more, waited a bit longer, and, after a few hours – nothing. Not a single beetle was found in any of the traps. After spending all day in the heat sucking up beetles, and then all night painting them blue or pink – to say we were disappointed is an understatement. But, that's research for you.

Anyway, the point of telling you all this is just how disgusting those hives had become because a few beetles had turned into a few thousand. Plus, this being my first experience with how devastating these beetles (pests) can be, it is forever ingrained into my memory.

What can we do now to keep SHBs from becoming PESTS?

First, move our colonies – especially the ones that are in the shade. SHB larvae *love* to develop in soil that's not too dry or too hard. Ever compare soil types under a tree versus soil in the field? The soil in the shade is (obviously) protected from direct sun, plus it's also getting that yearly layer of leaves – this all creates the perfect combination of soft, organic matter for SHBs to maneuver through and develop. If your colonies are in the shade more than half the day, it would be a good idea to move them into a sunnier location. I know this may be impossible for some of you whose only available apiary is in your backyard. We'll get back to you in a minute.

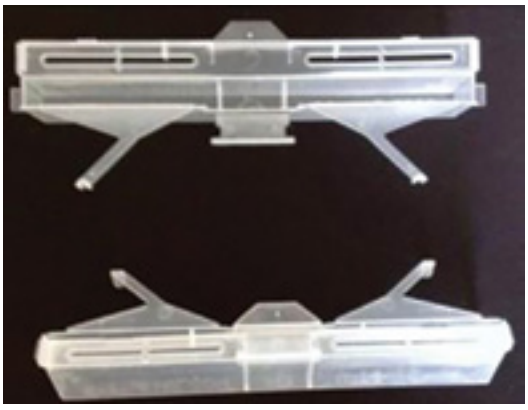
Over time, SHBs not only take over colonies, but they also become permanent residents in our apiaries. It may take years, but it can happen – especially in moist, rich or sandy Southern soils. This past year, we had a colony that was leaning too far to the right. To keep it from tipping over, we moved it a few feet onto more level ground. As I was relocating the blocks that the hive was situated on, I disturbed the soil

Figure 2 *– Slimed wax comb from SHB activity.*

Hand held aspirators work well for sucking up SHBs.

underneath. That's when I noticed hundreds of white SHB larvae and pupae. *WHAT? There shouldn't be any beetle issues here!* We had just gone through the entire colony (actually, all the colonies in that apiary) and saw SHBs here and there, but not to a degree that concerned us. And this particular colony had been fine. No SHB larvae, good brood patterns, a healthy population – but the evidence was lying buried in the ground. The more I scratched, the more immature SHBs I found. This particular colony was even in full sun most of the day, but the surface underneath the colony, in between the two blocks, was moist, dark, and nutrient rich with hive debris constantly dropping down from above. We moved a few more colonies, and, sure enough, MORE BEETLES!

After the work day was over, it was time to phone some seasoned beekeepers (Bob Binnie being one) and tell them what we found. Several responded that, in their experience, after a few years, the SHB populations rose in certain apiaries, no matter if they were in full sun or not. Therefore, these beekeepers would periodically vacate apiaries for a year or two to remove the food source and cut back on SHB populations. Made sense, but we didn't have the luxury of moving out of our apiaries. Instead, we moved each individual colony over a few feet to expose the soil underneath. Next, we took our hive tools and scratched away the debris, exposing the immature SHBs to the sun. It did the trick. Over the next few months, we noticed a considerable drop in the number of adult beetles running around inside the colonies. This may work for those of you who have apiaries in the backyard and are unable to move to another location.



Small Hive Beetle trap.

It's important to remember that the sun is also doing a number on the immature stages. The SHB's cuticle is unable to deal with UV light, so they die from exposure. We learned this one year when we came across frames with SHB larvae wriggling about. We had set them aside till we could finish working the apiary. When we came back to collect the equipment, the ones that were propped facing the sun had no living SHB larvae. Some were dead on the ground, but most were sticking straight out from the frame as if they had been zapped by some invisible alien ray-gun. The ones on the underneath side of the frame, however, were still alive. The difference between the two treatments: sun. Boy, this beats chucking nasty, slimed frames into the freezer (next to your pot roast? Gross!) or into buckets of water.

A word of caution here: even after the frames are exposed to the sun and the larvae are dead, you never want to put too many slimed frames back onto one single colony, especially a weak one. The smell can attract robbers, and the cells could possibly still have eggs tucked into crevices. It would be best to distribute slimed frames to several different strong colonies as opposed to giving them all to just one.

Now for you northern birds, remember this: SHB larvae and pupae can't survive in northern soils during the Winter. The freeze kills them. Hence, no need to move your colonies over a few feet. Any SHB immatures in the ground up there have long since met their demise. This Summer, however, would be a great time to move them – especially if you are seeing beetles scurrying about.

One more thing we do this time of year – after we have moved the colonies - is place beetle traps next to the cluster. SHBs need the warmth of the bees in order to survive during the cold months – they can't do it on their own. Placing these traps won't eliminate all the beetles, but it's all about keeping these critters from becoming *pests*. The traps we use at the lab are the Beetle Jail in-hive traps. There are three compartments – the center compartment is inaccessible to the beetles (also to the bees). We fill the center section with some moistened pollen substitute, which hopefully acts as a bait to draw the beetles close to the trap. The beetles then enter either of the other two chambers (which we fill with oil) to hide from the bees and then die. It's funny though – you'll open one hive to pull out the trap and it is so full of beetles, not another one could possibly squeeze its way in. Then, you open the colony next door and their traps are empty. *Unpredictable little pests are the worst!*

March can be a busy month for the bees and beekeepers – especially here in the south. Luckily, with colder temperatures still lingering about, moving colonies doesn't have to happen in the dark. This is a good thing – no, an ***awesome*** thing, actually! All we need to do is get out in the morning after that cup of coffee (and before the bees start flying), close them up, strap them down, and move away. This will hopefully reduce a few pests and help our bees live healthier lives.

Enjoy the Spring, but keep an eye to the sky, it may soon be filled with thousands of swarming girls. Take care of you and your bees! BC

Jennifer Berry is the Research Leader at the University of GA Bee Lab.

BIGGER PICTURE

Jessica **Louque**

Blue Moon

Blue is my favorite color. Unfortunately, it's not always nature's favorite color. Either that or nature really loves blue and is a hoarder so nobody else can have it. This year we have decided to circumvent nature to the best of our abilities and go blue on our own. Hopefully by the end of 2016 you'll be reading an article about our ridiculous success with blue. Otherwise you'll be reading an article about my ridiculous propensity to buy seeds and epic failure at the color blue.

Only once in a blue moon do you ever see pollen that might could possibly even be considered blue. There's always a vast array of the far end of the rainbow, with cream, yellows of all shades, gold, orange, and even the decent mixing of reds when the henbit is in bloom. There's even a good smattering of greens and grays. Rarely do you see blue or purple pollen coming in with the girls. This year, that's about to change at the Louque house.

We usually go through plant withdrawals in the winter, and spend ridiculous amounts of money buying seeds that we may or may not have enough room to accommodate in the yard. It's usually heavy towards the vegetable side, but I love to have flowers everywhere too. They take less effort and it makes me feel like I'm feeding the bees (that's my excuse anyway). For the 2015 Christmas, Santa brought us a bunch of seeds that should make flowers with blue pollen.

As scientists, we see a lot of false information about a variety of aspects in the bee world. There is a lot of speculation in some areas that are really neat because they aren't important enough to warrant funding. Knowing which plants produce what color pollen is really cool, but is not particularly important in the long run for bee health because you can't specifically identify the origin after its in the hive without your friendly palynologist on standby. To pick the choices, we basically went through all the photos, theories, and probable sources of what might produce blue hued pollen. Some plants that were identified are probably just blue flowers, but some do have the highly sought after blue. For the most part, all of these seeds were available at outsidepride.com. There is a pretty large range of seeds available on their website, and if the quality of these seeds is what I'm expecting, then they will have a repeat customer.

I didn't realize that chicory produces blue pollen, but it seems to be the general consensus. We have a quarter pound bag of chicory that is ready to be planted as soon as the North Carolina weather settles down into a friendly spring-like range. Let's be honest – in North Carolina that nice weather will probably be the last two weeks in May before the scorching drought hits in June. I'll go with optimism on this idea and hope for consistently nice weather in early April.

In the other larger quantities, we purchased borage and cornflower. Even if these somehow don't produce blue pollen, they are definitely bee attractive. I feel like they should both have blue pollen, just based on the flower color, but that's a horrible assumption since that's not a thing that normally happens. Based on our seed packets though, it looks like only bluish flowers produce blue pollen. I think I've seen cornflower pollen before, but I thought it was a light yellow or cream color, but I do have a lot of pictures of bees on the flowers. This experiment could be great for photo ops.

The bees like cornflower even if it doesn't have blue pollen.

The next possibility is hyssop. We will be trying out the *Hyssop officinalis* as well as the giant hyssop, *Agastache mexicana* to see if it makes a difference. They are both a pretty purple color, but I am not familiar with their inner workings on a bee-eye level. These are only in a 1,000 seed packet, nothing major. Another plant in the "possible" section is lupine, *Lupinus perennis*. The lupine, along with Chinese forget-me-not (*Cynoglossum amabile*) and Eryngium "Blue Glitter" (*Eryngium planum*) are really my only three high probabilities for blue pollen that came from Johnny's Seeds. Normally, they are my go-to for seed buying, but they are not on board with the anti-diversity blue campaign.

We are going to try to grow phacelia, since it definitely has blue pollen. The lacy phacelia does not grow well in this area, but we're hoping to plant it with a lot of compost and organic matter in the soil and hope for the best. I have grown desert phacelia before, but it is so delicate that our thunderstorms will rip the flowers off the plants. Unless I am mistaken, I believe the Globe Thistle (*Echinops ritro*) is another guaranteed blue pollen plant. Viper bugloss, *Echium plantagineum*, and Blue Angel bugloss, *Anchusa capensis*, have lots of reported blue pollen sightings, so we'll throw them into the "definitely" category even if it may not be true.

My friend Tom sent me some

pictures outside of his office of bees on a weird blue bush covered in electric blue pollen and asked what it was. I had no idea so I completely ignored his email until I could smugly tell him well of course that's Bluebeard how could you not know? *Caryopteris* is a decent sized bush that is covered in blooms and produces deep blue pollen. GreatGardenPlants.com sells them for about $14 per bush and you can't get them in seed form. They are supposed to be drought tolerant, deer resistant, and fairly easy to grow in zones 5-9. The true test with this bush is the deer resistance. If it has all of these qualities, there might be an entire front yard of these bushes in the next couple years, or at least circling the garden.

Last but not least is the "probably not but just for science" section. Most of these originate from Johnny's Seeds, and have something to do with blue, but it might just be the color of the flower. We have:

- Lisianthus "Blue Picotee" *Eustoma grandiflorum*, probably yellow pollen
- Larkspur "Sublime Dark Blue" *Consolida ambigua,* probably yellow pollen
- Delphinium "Belladonna Mix" *Delphinium x belladonna,* who knows what color pollen
- Statice "Supreme Blue" *Limonium sinuatum*, probably yellow pollen
- Scabiosa "Black Knight" *Scabiosa atropurpurea,* probably black pollen
- Oriental Poppy "Beauty of Livermere" *Papaver orientale*, dark blue/black pollen

In a secondary garden of somewhat already established plants, we have the bulbs. Siberian squill was added to the fray, which seems to be a popular choice of blue pollen production. There are also a myriad of tulip bulbs of varying sizes and colors (minis to jumbos) that will hopefully produce black or dark blue pollen. Terrain, an outrageously overpriced side store to Anthropologie (also outrageously overpriced but sometimes they have some really cool stuff), started a new line of bulbs this year and I couldn't resist. Somehow I ended up with four different colors of hyacinth and Bobby politely pretended he didn't notice the other 8 packets of designer flowers as he admired colors of hyacinth I was previously unaware existed. I don't know what color their pollen will be, but maybe it will produce pollen similar to the flower color and I'll have apricot-colored pollen to compliment the blues.

To add to the new collection, we will also be augmenting with our normal standards that include a large planting of buckwheat, sweet yellow clover, crimson clover, and hairy vetch. There's already a pretty good stand of blue salvia that has some nice blue pollen coming from it as well as a stand of bee balm to keep the ladies entertained. We have a decent amount of Queen Anne's Lace in the front field, if we don't mow it, that bring joy to the entire pollinator community and our carrot section of the garden if we forget about it for too long.

A smattering of purple pollen in the depressingly yellow sea of baskets.

I'm not sure if we will really have time to monitor each and every flower type for bee attractiveness and pollen color, or if we will even end up appropriately labeling each plant group with the corresponding name (that happens more than I care to admit, with an internal monologue of "What's this? It's nice, but now I don't know what it is"). I'd like to also make this a two-year project in some cases, with planting in a different area if it looks like it might have been planted in an area not conducive to growth. Some of these will be planted in the orchard row as a cover instead of grass. Coincidentally, this is about 20 feet in front of the hives. My hope is that we can plant in blocks, put a nice plant tag with each section, possibly with a pollen guess just for kicks, and get a couple thousand pictures of bees collecting blue pollen for a *Bee Culture* front page photo. At the very least, if most of these plants turn out to be bee attractive, then the girls will have a busy Summer and I can at least get a few nice shots of pollen frames in the hives…or there will be a whole lot more organic matter to till back in for next year. BC

Native Serviceberries

Make Excellent Bee Plants

Connie **Krochmal**

The snowy white blossoms of the native serviceberries are a familiar sight during the Spring in most areas of the country. Also known as shadblow, sarvisberry, and shadbush, these trees and shrubs are members of the rose family. A source of beauty year-round, they've earned a place in the bee garden.

Worldwide, there are perhaps 25 or so species. They're found in Asia, Northern Africa, Europe, and North America. About 20 of those are native to America. These occur in both the East and West. Around eight species are cultivated.

The most common habitats are mountainsides, rocky slopes – especially dry ones, dry canyons, bluffs, clearings, woods, hillsides, and swamps. They grow to 8000 feet elevation.

The delicate flowers of these spreading shrubs and small, much branched trees are welcomed by bees and beekeepers alike. Nectar and pollen from serviceberries help to build up colonies in the Spring. When enough of the plants are available, they can yield a small crop of honey. The amount can vary by species and location.

General Description

The graceful plants are relatively small – usually less than 35 feet or so in height. In the wild, the plants can be difficult to identify because they readily hybridize. The furrowed, scaly, light gray to silver bark lends color to the landscape during the Winter months.

When grown in landscapes or in the open, these generally develop into a round crowned tree, often multi-stemmed. In the wild, they're often stunted, crooked, and quite picturesque.

The alternate, leathery, entire, partially toothed leaves, usually hairy on both sides, can be greenish-gray to greenish-yellow. Usually at least 1¼ inch long, they're paler underneath. The foliage provides exquisite Fall color.

The plants are best known for their masses of small, delicate, star-like blossoms that cover the plants. Appearing in long clusters at the ends of the shoots, these emerge as the leaves unfurl. They're generally white, but can occasionally be pink.

About an inch across, the unisexual or bisexual blooms contain five narrow petals and a green, bell-like, five-lobed calyx. A cluster can contain a dozen or more flowers.

Usually tasty and edible, the showy, seedy fruits, which are enjoyed by birds, vary in color and shape by species. Forming clusters, these are quick to ripen in Summer. Round to pear-shaped, they can be red, almost black, purple, purplish-black, or blue-black. About the size of a blueberry, the fruits were an important food for Native Americans and pioneers.

Growing Serviceberries

Commonly grown in landscapes, these are excellent choices for screens, informal hedges, and windbreaks. As understory plants, serviceberries do reasonably well in partial shade. However, they're more floriferous in full sun.

Most species prefer a well drained, neutral soil although certain ones are adapted to acid conditions. They thrive in a range of soil types, including clay.

With a moderate growth rate, serviceberries are generally strong enough to withstand storm damage due to their strong limb structure. Typically, minimal pruning is needed, mostly the removal of root suckers that emerge around the trunks.

The plants are drought tolerant once they're established. These withstand pollution and are suited to urban spaces. For the most part, serviceberries are relatively free of most pests and diseases although they can occasionally suffer from the same ailments as fruit trees. Most cultivars are generally disease resistant.

Easy to transplant, serviceberries are somewhat easy to grow from seed. These can also be grafted. Softwood cuttings are usually less successful...

Recommended Species

Some of the best native serviceberries for bees are the following.

Allegheny serviceberry (*Amelanchier laevis)*

Also called smooth serviceberry, this dense, somewhat short lived plant is hardy to zones four through eight. It adapts to a range of moisture levels from dry or well drained, moist soils to wetter conditions. Preferring partial shade, it is tolerant of various pH levels from acidic to slightly alkaline.

Allegheny serviceberry occurs in Washington, Minnesota, and Iowa. In addition, it is native to much of the East except for Florida, Mississippi, Louisiana, Arkansas, and Missouri. This plant typically grows on ridges.

The species is similar to downy serviceberry but is slightly smaller. This small tree or narrow shrub typically reaches 25 to 35 feet in height and ten to 20 feet wide. The smooth, blue-green foliage, three inches long, is initially purplish-bronze.

The large white flowers open in early Spring on drooping or nodding clusters. The deep purple fruits are especially delicious.

Bartram's serviceberry (*Amelanchier bartramiana)*

Bartram's serviceberry, also known as oblong fruit serviceberry and mountain-juneberry, occurs in Minnesota, Wisconsin, Michigan, West Virginia, Rhode Island, Pennsylvania, New York, Massachusetts, Vermont, and from New Hampshire to Maine. Suited to zones three through six, this species grows in bogs, peaty thickets, slopes, and along stream banks. The plant adapts to a range of soil types, including acid ones. This species is tolerant of both dry and moist conditions.

The tough, spreading, rounded, much branched, free flowering shrub reaches three to six feet in height and up to four feet across. The greenish-gray, oval foliage is somewhat hairy. The new leaves are slightly bronzed.

The small, white blooms open singly or in few flowered clusters in Spring from April to May. Ripening in July, the blackish-purple to deep purple elongated fruits are bloomy and ½ inch across.

Canada serviceberry (*Amelanchier canadensis)*

Hardy in zones four through nine, Canada serviceberry occurs in the East in swamps and lowlands. This is most commonly found a couple hundred miles or so from the coast. Its range extends from Maine, New England, New York, Pennsylvania, and West Virginia southward to the Atlantic region, Alabama, and Mississippi.

Sometimes spreading by suckers, this rather narrow crowned, multi-stemmed tree or shrub is usually fairly low growing. Canada serviceberry is often ten to 20 feet tall and equally wide. It features attractive, smooth gray bark.

The young foliage is gray-green. This floriferous species bears white blossoms that are smaller than those of most serviceberries. They open on erect, short clusters and produce deep purple berries.

This species is suited to moderately dry and wet soils. It has provided an early crop of honey in some locations.

Downy serviceberry (*Amelanchier arborea)*

Downy serviceberry typically grows at the edges of woods and rocky outcrops. This species covers much of the East westward to Minnesota southward to Texas and the Gulf states. It is quite similar to Allegheny serviceberry except this one is taller and has smaller blooms. Suited to zones four through nine, it adapts to various moisture levels from dry to wet.

Several varieties of this species can be found in some areas. Usually 20 to 30 feet tall and eight to 15 feet wide, the multi-stemmed tree with a narrow rounded or oval crown features striking furrowed bark with conspicuous, narrow, vertical lines. The trunk can grow to two feet in diameter.

Emerging on long leafstalks, the young foliage is initially somewhat hairy above. The underside is paler and densely hairy. Deep green to greenish-gray, the finely toothed, tapered leaves are up to four inches long. Somewhat variable in shape, they're mostly ovate.

The showy white blossoms appear in Spring on long clusters that contain up to 15 blossoms. The petals range from strap-like or linear to oblong. The calyx is cone-shaped. Often inedible, the purplish-red, red, or deep purple fruits ripen in clusters in mid-Summer.

Inland serviceberry (*Amelanchier interior)*

Inland serviceberry, also known as Wiegand's chuckleypear, can be found from Minnesota, Iowa, Wisconsin, Illinois, Ohio, and Michigan to New York and Maine. It is hardy to zone three. The small tree or straggly shrub reaching 25 feet in height resembles the downy serviceberry except for its smaller size and the smaller blossoms in shorter clusters.

The finely toothed leaves are nearly three inches long. Emerging from May to June, the white blooms open in long clusters containing six to 12 blossoms. The blackish-purple fruits ripen in July and August.

Roundleaf serviceberry (*Amelanchier sanguinea)*

Preferring dry soils, this species grows in thickets and woods in New England, New York, Pennsylvania, New Jersey, Delaware, and Maryland.

A small, slender shrub or tree reaching 20 feet in height, roundleaf serviceberry has spreading, slender stems. The Latin species name refers to the red twigs. The bark is brownish-red. It is hardy to zones four through eight.

The alternate, oval-oblong to roundish-oval, coarsely toothed leaves are nearly 2½ inches in length. The young foliage is hairy and vivid green.

The white blooms open in May on loose, nodding clusters. The strap-like petals are ½ inch long. Slightly smaller than those of most serviceberries, the very tasty, sweet, almost black to deep purple fruits ripen in August in pendant clusters. These are considered superior to other serviceberry fruits.

Running serviceberry (*Amelanchier stolonifera)*

This suckering plant is native to the Dakotas, Minnesota, Iowa, Missouri, and throughout the East except for Arkansas, Louisiana, Mississippi, and Florida. It is most common in the mountains. Preferring full sun, this species does well in dry, well drained, acid soils.

Its habitats include upland woods, and rocky or sandy soils. Hardy in zones four through nine, this is only one to six feet tall but can be three to 10 feet wide. The ascending stems are hairy when young.

The oblong to elliptic foliage is slightly over two inches in length. The very pale pink blooms open on erect clusters. In the South, this can begin blooming in March or April with the berries ripening in May and June.

Some sources consider dwarf serviceberry (*Amelanchier pumila)* to be synonymous with running serviceberry, while others classify it as a separate but quite similar species. Sometimes called low serviceberry, this is found throughout the West from Washington to Montana, New Mexico, and Colorado. This favors limestone-rich soils.

Saskatoon serviceberry (*Amelanchier alnifolia)*

Also known as western serviceberry, this species can be found along the Pacific Coast eastward to Montana through the Dakotas, Nebraska, Minnesota, Iowa, and New Mexico. It is by far the most widely distributed serviceberry in the area. Hardy to zones two through six, it generally grows at 4500 to 9000 feet elevation.

Preferring low humidity, this drought tolerant species adapts to dry and moist soils. It inhabits thickets, streambanks, and prairies. Several serviceberries that used to be considered separate species are now classified as varieties or subspecies of the Saskatoon.

Usually a low growing shrubby tree with an open, rounded, upright crown, it typically reaches four to 15 feet in height and is almost as wide. This plant features hairy stems that can spread by rhizomes.

The Latin species name refers to the alder-like foliage. The coarsely toothed, leathery leaves, 2½ inches long, are light green above and lighter colored and hairy below. The lightly scented, white blossoms open on short, dense, silky flower clusters that contain up to 20 blooms in early Spring.

The purplish-red to black fruits are egg-shaped to round. Ripening in clusters in Summer, these are said to be the best tasting serviceberries.

This is considered an important source of nectar and pollen. It has brought an early honey crop in some areas.

Utah serviceberry (*Amelanchier utahensis)*

This species grows on mountain sides, woodlands, rocky slopes, and canyons in dry areas. It can be found in the mountains and plateaus to 8000 feet elevation. Hardy to zones four through nine, Utah serviceberry occurs over much of the West from Washington and Idaho to Montana, Wyoming, Colorado, New Mexico, Texas, and California. The drought tolerant plant requires a well drained soil.

This can be a dense, irregularly shaped shrub or an open crowned, spreading tree. Typically up to 15 feet in height, it has reached 25 feet under good growing conditions.

Hairy on both sides, the greenish-yellow, toothed, alternate leaves, 1¼ inch in length, are almost round. The white or pink blossoms open in Spring from April to June in oblong clusters containing three to 12 flowers. The blooms feature five strap-like petals. The purplish-blue berries ripen in clusters in late Summer and Fall. BC

Connie Krochmal is a writer and a beekeeper in Black Mountain, South Carolina.

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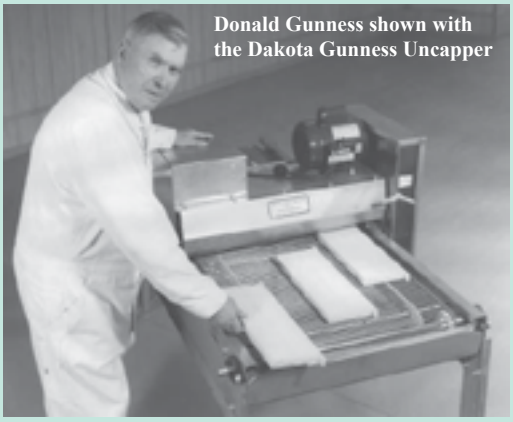

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HONEY LABELS

Ann **Harman**

Bees produce a wonderful product – honey. It is up to you, the beekeeper, to make their product attractive for sales as well as gifts to relatives and friends. Your label introduces your bees' honey to the public, as well as to those relatives and friends. Before you decide what sort of honey label will be on your containers, you need to do some 'homework.' You are going to do several things before you attempt designing and printing your own label. And you might actually change your mind about doing that.

First you are going to take a walk through your local supermarket, not to buy anything, but as a Label Education Trip. Pay particular attention to some of the foods that have many competing brands. Some of these are breakfast cereals, spaghetti sauces, chips, and, most important, the wines. (There is no need to stop at the section with honey.) Slow down in such sections and notice the colors and designs. Do you see one particular spaghetti sauce label that seems to attract your attention more than the other ones? Labels on wines are extremely creative. Which ones grab your attention? Remember, these labels have been designed by professional graphic artists with a purpose in mind – 'here is a fantastic product, buy me!'

Study the front labels. Take a cereal box off the shelf and take a good look at the information on the front. You also want to take a look at the information on sides and backs of containers in the sections you are visiting. The labels are not designed once and never changed. They are continuously updated to keep a modern, current appearance. However, it is interesting that the Wheaties® cereal box is practically unchanged over the many years that has been on the market. The Coca-Cola® letters have not changed since 1885, and will not change.

Now that you have finished your Label Education Trip it is time to begin thinking about your own label. First, and most important, it must be a legal label. That means it must follow the requirements set by the U.S. government, the Food and Drug Administration (FDA), and also those of your state. Generally the states follow the U.S. requirements. The FDA website is not very useful at this time so I recommend you use the information given by the National Honey Board (NHB) and your state department of agriculture. In some states the label information may be from the state department of health. Stop whining! The requirements actually are excellent for sales appeal! The National Honey Board, a marketing board, is full of all kinds of information about honey. For label information go to **www.honey.com**, click on Honey Industry on the right hand side of the bar just above Discover . . ., then click on Honey Testing and Regulations, then on Honey Labeling. I found that miscellaneous Internet sites are not to be trusted.

You need legal labels to sell at farmers' markets, shops, roadside stands, fairs and, of course, in such places as supermarkets. Yes, state inspectors can and do visit such places. The word 'honey' needs to be in large legible type on the front of the container. Yes, you do have to put the net weight on in pounds or ounces **and** in metric. You may use 1 lb (454 g). You do the arithmetic for other weights. Font size and placement are specified on the Honey Board website. I hope you noticed the net weight information on your supermarket trip.

You may certainly use decoration but it cannot obscure the essential information. In the United States a cartoon bee (silly, humorous) is acceptable but a bee photo or realistic drawing is definitely not recommended. A National Honey Board marketing survey found that realistic bees on a label made customers pull their hand away and select another honey with a different, non-threatening label.

The word 'pure' is acceptable and does encourage sales. The word 'natural' has not been defined officially although its definition and use will be announced by the FDA perhaps during 2016. Also there are no definitions for words such as 'raw' that is frequently used for honey. When floral sources are used, such as 'clover,' you must be prepared to show evidence that is the main source of the honey in the jar. You can have a batch of honey tested for its identifiable pollen at the Texas A&M pollen identification laboratory. You cannot use the word 'organic' or that special label unless you have the official organic certification.

Contact information is required and today is considered very important. Consumers want to know the source of their foods. This information goes on the bottom third of the front label and in type 1/16 inch tall, 10-point type. If the honey is all from your bees you would use 'Produced by' but if you also bought honey from another beekeeper you need to use 'Packed by' or Produced and Packed by.' You may use your name or your apiary name, but you need an address and phone number. Some states will permit an email address but you need to find out. Beekeepers who think contact information is unnecessary because they only give it away, not sell it, are missing the point. The jar of honey, with no contact information, may be sitting in a home on a table where visitors will see it. With contact information they know where to buy some.

You are familiar with the Nutrition Facts Label, that black and white label found on just about every packaged food you buy. You can apply for an exemption if you are selling less than 100,000 units per year. Fortunately this Label, especially for honey, is available from beekeeping equipment suppliers. It can go on the back of your container. If you are using the word 'healthy' you *must* have one. However making health claims can put your honey into the category of an unapproved drug and can

be investigated by the Food and Drug Administration. Although it is an unattractive label, it does sell honey! I have sold quite a number of jars because that label states Fat 0%. Yes, fat in honey seems strange to beekeepers but it does catch customers' eyes!

If you decide to add flavorings or other natural or synthetic additives to your honey you are required to list the ingredients in order of quantity, highest to lowest. You may need to change the Nutrition Facts Label to include the additives. It is essential also to identify any spices or essential oils. Some people are sensitive or allergic to those, as well as to peanuts and tree nuts.

Most packaged foods you buy have the 'bar code' somewhere. It is actually called the Universal Product Code (UPC). If a shop is going to sell your honey it may ask you to obtain a UPC. It is usually used for inventory – keeping track of purchases and need to reorder. You cannot invent one. Visit a website under Universal Product Code where you will find out how to obtain your own bar code.

Now that you know the various requirements you can make some decisions about what your label will look like. Perhaps the first consideration is your choice of containers, their shapes and sizes. Will one size and shape label fit *all* the sizes and types of containers you use? No. A label suitable for a one-pound inverted container will not fit a one-pound glass hex jar. A label that is appropriate for an eight-ounce jar will seem too small for a one-pound jar. The label is presenting your product! When your label is on your container you want honey visible. After all, honey is beautiful so let it be seen surrounding your label. If you use different sizes and shapes of containers you need their appropriate labels.

What about the background color of your label? Yes, it can be white. In food products color can indicate a type of food. Green can mean decaffeinated or low fat. Yellow suggests cheap. Black is used for upscale or gourmet foods. Blue is frequently used for seafood. However, a yellow flower would indicate something about bees, not cheap. It is very important to consider the usual color of your honey, which could be from water white to dark brown. That color is particularly important if you choose a transparent stock for your label. Black letters on transparent stock against dark honey become invisible.

Small labels are available commercially. Ones with 'Local Honey' are effective, especially in shops frequented by tourists. A label explaining crystallization and how to reliquefy is a useful label. Many people think that partially crystallized honey has spoiled and throw it out. You can find round labels to put on jar caps to make an eye-catching table at a farmers' market.

Many beekeepers now are designing and printing their own labels. It may seem easy, and even cheaper to do this but many problems exist with this approach. It would be a good idea to have a commercial artist review your design, keeping in mind the legal requirements, as well as your choice of containers and usual color of honey. College students who are taking commercial art classes could use designing a honey label as a class project.

If printing your own, what paper stock will you use? Ordinary label paper has one great fault as a honey label – the paper is not waterproof. In addition it tends to get somewhat rough and fuzzy. Think about any container of honey, even the dripless inverted one. The container gets sticky with ordinary use. So the customer takes a wet sponge or dishcloth to wipe it clean. After a few swipes the ordinary paper stock begins to disintegrate. The label is then unattractive. Special waterproof paper stock is available for labels.

Now what about the ink in your printer? The ordinary ink is not waterproof either. So after a few swipes with the wet cloth the printing smears. Disintegrating paper, smearing ink. The label is now a disaster. This is not a good impression to make on your customers and friends.

Waterproof ink is available but will it print on and stay on the waterproof paper you chose? You will simply have to experiment.

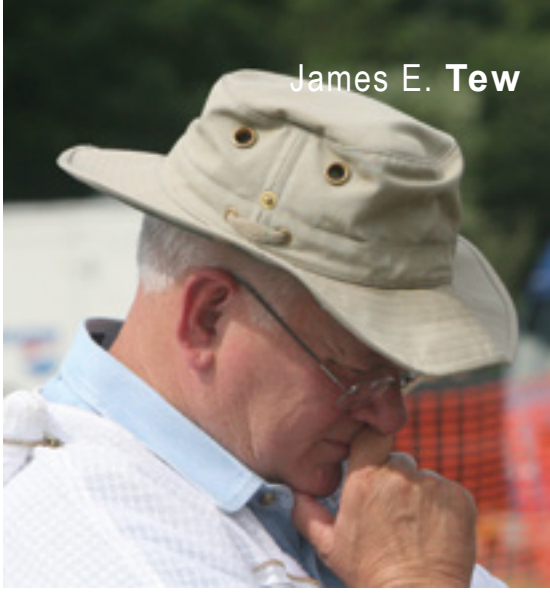
What are alternatives? You could take your design to a local printer and discuss printing options and prices. Local printers have access to various kinds of commercial label stocks and inks. You could contact the label companies advertising in the beekeeping journals to see if they could take your design and print it with their commercial stock and inks. And, of course, you could select a honey label from the selection offered by those advertising in the beekeeping journals and from the beekeeping equipment suppliers.

If you haven't yet, now's a good time to look at that collection of labels on page 12. What works, what, if any, don't and why?

Your bees worked hard making the honey. You worked hard keeping your bees and processing their honey. Now that honey is going to meet friends and customers with a good, well-designed legal label, matched to its container to show the pride you take in your operation. BC

Ann Harman reads labels, teaches beekeeping and keeps her bees at her home in Flint Hill, Virginia.

Beeyard Thoughts



The chajotic honey bee Internet – Love it/hate it

Honey extractors from 1922. They were impressive.

Odds and Ends – Extractor Bases, A Memorable Dead Bee

For the Brand New Beekeeper – Will I get stung if I keep bees?

The modern chaotic honey bee Internet

The answer is out there. Can you find it?

Well here it is – another monthly article beginning with another monthly justification about why it's okay if I look backward a bit. In previous articles, I've asked this question before, *"When am I an aged, experienced beekeeper and when am I simply boring and irrelevant?"* It's hard for me to tell.

The early beekeeping Internet was very limited but generally factual and correct. It was mostly academic or government agency text with very few photos and no video. Access to some of these resources required setting dipswitches on printers; inputting nonsensical keystrokes on our Tandy computers as we marveled at the clarity of our newest monochromatic screen and the huge amount of storage that was available on the new 5¼" formatted floppy disk. You did not drag and drop anything. That feature did not exist.

Interestingly, my early high-end **Z80**-based **S-100 bus** Cromenco computer looked much like the Apple IIe. *(I got all that old technical information off the Internet. I have no idea what it all means.)* This was the first machine with which I was able to perform early email transmissions.

My point? Our best computer equipment at that time is quaint now, but the information that was distributed by this simple, quaint equipment was free (no ads anywhere), generally accurate, and presented in a plain, uncluttered (*boring*?) manner. Man, those days are truly gone!

Now it seems that every beekeeper and all their brothers and sisters now have a presence on the Internet. For instance, load the search string, *"types of honey bees"* in the search field in days of yore and you probably got a pictureless article on the various races of honey bees with a written description of their characteristics. Now, type that string into the current search engine of your choice, and you will be bombarded with all types of queens for sale, *the best queens available – buy them here!* There will be ads and popups all over the page about everything and maybe even a little something about queens, cemetery searches, where to buy leaf vacuums, arrest warrant records, and often a side ad offering to show you pics of *"entertainers' clothing equipment failures – pics they don't want you to see!")* Stay focused.

Somewhere in this pulsing, jumping, hot-key loaded, looped video virtual minefield of distraction, your answer may or may not be found. With so much to lure you off subject, it may not be easy to avoid *The Siren Song of the Lorelei*. Yet, in this increasingly chaotic morass is where we now get our virtual beekeeping information. More and more, it seems amazing that beginning beekeepers manage as well as they do when electronically searching for practical information that is new to them. It is difficult even for experienced beekeepers.

A test case . . .

A simple way to see the confusion and informational clutter present in even the simplest search, key in the string, *"Is honey a harmful food."* I bet most of you will be surprised. I don't want to select any specific web address. No doubt, I would get slammed so I ask that, from the list, you select the URL address of your choice. As I was pursuing the sites for this article, I did get lured away from the honey topic to a listing announcing *ten toxic foods you probably have in your kitchen – right now!* Yes, honey was one of them. The other nine were: any fruit with pits, rhubarb, nutmeg, potatoes, almonds, tomatoes, tuna, cassava, and cashews. I suppose that I just might have to give up rhubarb.

The Internet has given any one who wants it a soapbox for shouting their electronic opinions and concerns. Ironically, this is a good thing, but it puts great pressure

I couldn't use a bee page so I chose another of my interests – bluebirds. As you have seen, look at all the side and upper ads. I could not show the pop-up screen that came later. This is just a typical web page.

on the searcher to select proper, correct, and timely information.

When searching for bee information, the suggestions that follow are just my way. I am well aware that my criteria will not satisfy all and will even annoy some of you. Everyone must decide whether or not a web site meets his or her expectations.

If a web site wants to sell me something – queens, hive equipment – anything, unless I am actually looking for something to buy, I go more slowly with their educational information. There is a chance of bias on these commercial sites. If the web site is shrill on any issue such as: GMOs, pesticides, pollinator losses, hive designs, I again explore just a bit more carefully. Sometimes, such sites have strong emotional agendas with which I may or may not agree. I generally expect educational facilities, medical facilities and state, and federal agencies to provide me with balanced bee information.

Obviously, all web sites presented in the list merit some review and caution. Even accepted facts can be presented in different ways with the results being different conclusions. An example would be American foulbrood control. Destroy and burn or shake onto clean equipment and feed antibiotics? In fact, both recommendations are academically correct, but you must decide which of these *"right"* recommendations aisbest for you.

Many of you already knew this – I had not fully realized it.

During past decades, the honey extractor market has dramatically changed. The last time I purchased an extractor was sometime in the late 1980s and even then it was for the Ohio State bee lab. At that time there were about four major manufacturers of honey processing equipment in the U.S. Happily, they are all still with us today, and no doubt also experienced changes. But now modern honey extractors are available all over the world. Whereas there once were 15-20 models across all manufacturers, today there are hundreds. Times have changed, but it's mostly good changes.

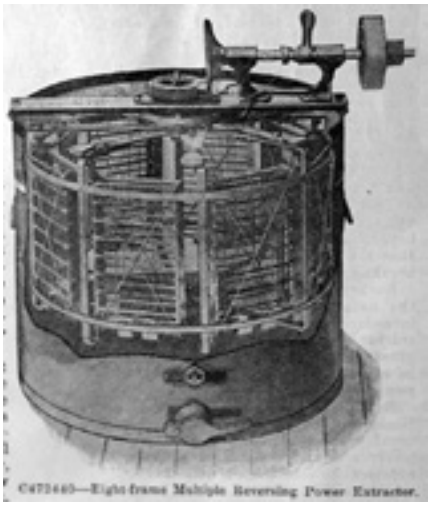
This is not the first time that extractor production has been through evolutionary changes. In my earliest beekeeping years in south Alabama, I had a two-frame galvanized, hand-cranked, gear driven, extractor with a brass valve for draining honey. It had been abused, but my beekeeping family and I were able to bring it up to standards. The Standard Churn Company in Wapakoneta, Ohio, manufactured it. Isn't life funny? I was using that antique extractor in Alabama, and now I live in Ohio hardly one hundred miles from where it was manufactured. Do I treasure that extractor now? Well, I would if I knew where it was. Thinking that we had been given the device and having made it a part of our small beekeeping operation for nearly 15 years, a family member of the original owner, contacted us and said, *"They needed it back."* That was a surprise. We gave it back. I have no idea where it lives now.

Apparently, all those years ago, companies such as the churn company branched into honey extractor production. It makes sense. Fruit juice presses, honey extractors, milk churns, sausage stuffers – these devices are all of a similar concept. I can only surmise that as the bee manufacturing industry advanced, the secondary companies increasingly were unable to compete. However, there was mention of a new Standard Churn Company extractor for sale in 1940.

In our earliest years of honey extraction, the big honey producers had not yet risen to the top. The equipment mega-beekeepers use today is just short of spectacular. From my antique collection of old bee supply catalogs, I selected the A.I. Root Company's 1922 edition. During those years serious beekeepers with fairly small numbers of hives were *"King of the Hill."* The few supply companies with metal shops produced equipment that cannot be found today. Today's hobby equipment is efficiently manufactured from stainless steel and is reasonably simple. Either you crank them or they have an electric motor to drive the basket. Not the old equipment. Check out the two poor quality photos I have presented below. They are all I could get.

The second extractor shown in yet another poor photo is of an eight-frame unit. All of that operational equipment for only an eight-frame extractor.

This is simply a four-frame extractor that was available in 1922. It was made from a combination of metals. The tank was galvanized with soldered seams. Of course, this is unacceptable today. It was gear driven. The gear drive could be disengaged and separate hand brake was available for stopping the spinning extractor basket. Amazingly, it was equipped with reversing baskets so frames did not need to be removed to extract opposite comb sides. Though it could be tied down. it was very nearly heavy enough just to use without tie downs.



A.I. Root was not the only company manufacturing these husky extracting machines, but the Root equipment is the one for which I have a catalog. This machine was flat belt driven most likely by hit/miss 1½ hp gasoline engine. There was no mention of gasoline fumes in the extracting room. Later and more conveniently, electric motors were used. Notice that on the cross shaft there are two differently sized flat pulleys. The larger was to run the extractor basket while the smaller of the pulleys was to run the honey pump. The basket could be

disengaged allowing the cross shaft turned all the time. The belts were exposed and would be considered dangerous by today's standards. I suspect they were dangerous by 1922 standards.

As it became time to reverse the baskets, the brake would be partially applied and the speed momentum would flip the baskets to the other side. Eight frames could be extracted without removing them. The honey pump ran constantly. The sheer heft of the full basket running on ball bearings, with the clutch released, would continue to extract as the basket slowed for refilling. It was said "*the breeze given off by the spinning basket was refreshing.*"

The down side – the unit cost $160. I would assume that freight was not included. In today's dollar money, that would be $2171.67. The average annual salary of the typical American worker in 1922 was $3,143.46. Okay . . . I'm not sure where to go with this. These units were really expensive. Yet, through the years, thousands were sold. If you can find one today, it can, most likely, be made to run – there is the business about the galvanized tank and soldering.

I suspect that the typical beekeeper of 1922 purchased the Novice two-frame extractor that is much like ours today – but now made of stainless steel. The 1922 unit sold for $28, which would be $380 today. Bottom line – extractors have always been expensive. That should help explain all of the *build your own plans* that have always existed in print and on the Internet.

Is there good news for beekeepers today? Fundamentally, extractors have not changed since the earliest concept. Though lighter and simpler, even today's smaller metal extractors seem to last forever. You may have to remodel, repair, or tie them down, but today's extracting devices have similar life spans to the old classic units. Get one, treasure it, and put it in your will, and as soon as you can, put a motor on it.

For the Beginner - Will I get stung if I keep bees

Yes, bees will sometimes sting you. If bees did not occasionally sting, I suppose everyone would consider keeping bees. The fact is that in the wild, a lot of other animals would just love to get that great hoard of honey and all that high-quality protein in the brood nest. Obviously bees could never have succeeded as a species if they were not able to defend their food supply, and they have become pretty good at it.

Beekeepers are prepared for this reaction. There is traditional protective gear available from bee supply companies that will prevent ***all*** stings if the beekeeper chooses to wear it *(... but most will be a very hot outfit in the Summer)*. People who are not prepared with proper protective clothing and do not have a basic understanding of bee behavior can easily see defensive bees as something to always be avoided and feared. That's not exactly correct. Defensive bees should always be respected – even highly respected – but to fear them is excessive.

It is very true that a few people do have a serious sting sensitivity that requires medical attention. I'm not talking about these people. If you are an average person, a bee sting will be a motivational event, but not life threatening. As you become familiar with the ways of bees, your attitude and understanding of the bees will quickly change and you will acquire those special clothes that can protect you. Yes, bees will sting; but, no, for most beekeepers – even novices – it is not a big deal.

Odds and Ends

Extractor stands

In recent articles, I had a great time discussing and reviewing many designs of hive stands that you people have devised. Since I now have extractors on my mind, I would like to ask what clever ways you are using to prevent your extractor from bouncing all over the room while extracting honey. I know you have devised something. I would like to see your photo of your extractor bases.

Bee stings that have been removed.

In death, a lonely bee that made herself known to me.

This single, dead bee made a lasting impression on me

So far as I can count and remember, this is my 43rd year of keeping bees. During all those years, I have interacted with millions of bees. Individually, I remember very few of them, but I will always remember the one pictured here.

Just before this past Christmas – for me now, about three weeks ago – I noticed that a bee was hanging on my bedroom window screen. I didn't give her much thought. A few days later, the bee was still there. By now there was no doubt that she was dead. It was an interesting event, but not *that* interesting. Now after all these weeks, the bee is still hanging there and still hanging by a front single leg. Each morning I generally check the sunrise. Now, checking the bee, suspended by her unyielding single leg, is a second morning ritual for me.

If this bee wanted to be a special memory that stands out from all the great number of bees I have been around, she has certainly scored. I won't forget this one. I admit, that when her bee body finally falls to the ground, I will miss her a bit. From the masses of bees, she made herself known. How long can that leg hold out? BC

Dr. James E. Tew, State Specialist, Beekeeping, The Alabama Cooperative Extension System, Auburn University; Emeritus Faculty, The Ohio State University. ***Tewbee2@gmail.com; http://www.onetew.com; One Tew Bee*** *RSS Feed* ***(www.onetew.com/feed/); http://www.facebook.com/tewbee2; @onetewbee*** *Youtube:* ***https://www.youtube.com/user/onetewbee/videos***

Scotland's Legendary Heather Moors

Ann **Chilcott**

If you have never experienced a Scottish hillside in August with the heather in full bloom, and its unmistakably sweet scent drifting upwards towards you in the heat of the day, then you are missing something very special. When you sit down you are almost lulled to sleep by the silence, broken only by the humming of bees, and the call of moorland birds such as grouse, curlew and our spectacular skylark. For bees, birds and humans alike, to be on a heather moor in full bloom somewhere in the highlands of Scotland is a true delight.

Moor burning. (photo by Peter McKinney)

Scotland is a small country with a land area of 30,414 square miles in the northern third of Great Britain. It has 6,160 miles of coastline and 790 surrounding islands. Its border with England is but 60 miles wide and it has a population of only approximately five million, about the same as Colorado or Wisconsin.

The landscape is remarkably varied with high rugged infertile northern mountains, sweeping wide valleys with rich glacially formed alluvial soils, deeply indented coastal lands and the gently rolling Border lands. The reason for such diverse landforms lies in the history of Scotland which was shaped by tectonic plate action, and glaciation. It was formed by several pieces of the Earth's crust joining together. It also made an epic journey from way down near the equator to the South Pole, and then north to its present location. Along the way it was once part of North America, and what is now part of South America, and amazingly, Scotland was once closer to the Amazon than to England.

The last main glaciers wiped out any humans living here and the post glacial hunter/gatherers arrived around 12,800 years ago. The land then was covered by woods of hazel, oak, alder, willow, pine and birch and when it

Heather honey.

became warmer elm, lime, and ash trees followed. This was the only truly wild natural Scotland. It lasted but a relatively short while, and today we can only imagine what it must have looked like.

We do know from pollen analysis how the landscape began to change as soon as Neolithic humans began to colonise and farm the land between 6,000 and 4,000 years ago. Trees were cleared to make way for agriculture and this was pivotal in the formation of the heather moorlands. Ling heather (*Calluna vulgaris*) is the source of our most highly prized honey and it will thrive only on poor acidic soil so the clearing, burning, and grazing of the land depleted it of nutrients, making it an ideal environment in which heather now flourishes.

Politics and land use in Scotland are inevitably and inextricably linked with relatively large tracts of land owned only by a relative few. Ecologists may see a flourishing heather moor not as an indicator of land health but rather as an outcome of ecological destruction. The landowner, on the other hand, develops the moor for grouse shooting which may provide a tidy income in a good year, and gives local employment in an uncertain economy.

Management of the moors for grouse benefits beekeepers who would otherwise not have heather good enough in quality and quantity to produce pure heather honey. Grouse require young heather shoots to feed on and this is achievable through regular and rotational heather burning known as "muirburning". In early Spring, before the moor birds' nesting time, strips of heather are set alight in controlled operations and, combined with limited grazing by sheep, heather is kept in optimum condition. Factors such as cold wet weather and heather beetle are unpredictable and uncontrollable so a good crop of heather honey annually is not a given. And if there is not enough rain in June to "wet the heather's feet" it may not flower well in August. In some years the heather beetle destroys the young heather shoots and both grouse and bees suffer.

In the United Kingdom, the term heather honey is used to describe honey derived from Ling. Beekeepers who can access well managed grouse moors usually have top quality forage for their bees, and the honey produced is regarded by most as the "Rolls Royce" of honeys because of its unique flavour and properties. Sought after by connoisseurs, it commands a much higher price than any other honey, selling for upwards of £9/ lb. ($13.50/ lb. compared with £6.50/lb. ($9.75/lb.) for other types of honey.

Heather honey has an amber color and settles naturally, like the honey above, to give a creamy soft caramel consistency. It has a strong aroma and tastes like the heady scent of the flower with a hint of delicate cinnamon. It is thixotropic, which means that it normally has a jelly-like consistency and only becomes liquefied through agitation. It later returns slowly to a jelly-like state. Because of this idiosyncratic property, it must be pressed from the combs in a special and expensive heather press, or the cells must be agitated by needles before centrifugal extraction. Many beekeepers avoid these complications by giving the bees starter strips of thin beeswax foundation and selling the honey as cut comb.

You can always tell heather honey by the air bubbles resulting from it being thixotropic: they can be up to 2mm in diameter in a pure sample. The protein content of up to 1.86% is higher than in most other honeys (0.2%) delaying crystallisation for months. The water content (up to 23%) is also markedly higher than other British honeys making it more susceptible to fermentation. One local beekeeper friend was dismayed to find his precious bucket of extracted Ling heather heaving and frothing when he removed the lid some months later.

Skilled beekeeping and careful planning are required before the bees are transported to the heather. They are taken up usually around the first week in August but it depends on the season, and in 2015 the heather flowering was at least two weeks late. It is imperative that the bees arrive just as the heather flower buds are opening otherwise the bees will find other flowers nearby to feast

A protected site.

on and produce honey with a low heather content. If the honey is for export then at least 30% of the pollen it contains must be from *Calluna vulgaris*

Permission must be sought from the landowner since few beekeepers own grouse moors and so the head gamekeeper presides over this domain and allocates hive sites. These must be sheltered from the prevailing winds which, even in Summer, can be ferocious. Protection from grazing stock is also key since sheep like nothing better than to rub against objects, especially when the midges are out in full force. The photo shows a good sheltered position close to the heather on Cawdor Estate in Nairnshire.

Preparation starts in the Spring and colonies chosen to go to the heather should have a young fertile queen so that the brood chamber will contain wall-to-wall brood thus forcing the bees to store honey only above in the supers. Rearranging frames in the brood chamber with unsealed brood to the outside, and sealed to the centre will allow the queen to lay in the centre as the workers emerge thus forcing honey to be taken up into the super.

A couple of weeks prior to moving, *Varroa* treatments with formic acid preparations are given and only healthy bees are taken up to the moors. Ensuring that adequate honey stores are available, should the weather turn bad, is also essential since the bees are usually away from the home apiary for a month, or just over. The moors are also much higher and naturally colder.

Transporting bees requires attention to the usual safety precautions thus preventing them from being jolted and upset in transit. The journey would be made in the early morning or late evening The crown board/inner cover is usually replaced with a mesh travelling screen for the journey so that air can move up and out through the screen. The bees may need to be sprayed with water if at risk of overheating.

Once the bees are settled up on the moor the beekeeper will cross fingers for a spell of good weather which will make or break a perfect honey harvest and, in the meantime, cakes and sandwiches must be prepared for the heather picnic. There will be no doubt in the beekeeper's mind that the glorious grouse moors are a paradise.

If you would like to see all this for yourself, then why not come and join us in the small city of Elgin, in the Scottish highlands on 9th, 10th, and 11th September 2016 for the Tartan Weekend and Scottish Beekeepers' Association Convention. Professor Tom Seeley (USA), and Professor Francis Ratnieks (UK) will be the key speakers. There will also be a talk on the history of skep making and beekeeping, a ceilidh (dance with Scottish music) and a visit to bees at the heather.

While you are in Elgin, you can get into the spirit of Scotland by visiting some of the many whisky distilleries in the region, and even before you travel you can enjoy the beauty of Scotland by watching this video. **www.youtube.com/watch?v=nqU0u9v6U0I.** BC

For more information on the Tartan Weekend you can visit The Scottish Beekeepers' Association Facebook page or website.

Climate Change

A bee problem we can potentially solve – Part 3

Ross **Conrad**

The dramatic increase in the earth's atmospheric carbon levels and the accompanying weather changes are part of a natural cycle that was described by Hamaker and Weaver in 1982 and is fully supported by all available scientific evidence. As plants and trees grow they remove and sequester atmospheric carbon. Over time so much carbon is removed from the atmosphere that the earth starts to cool down triggering an ice age. As the glaciers grow and move from the poles toward the equator, they cover and destroy huge areas of forest and vegetative growth releasing significant amounts of CO_2 into the atmosphere. As the levels of carbon dioxide in the atmosphere climb, the overall temperatures of the planet increase eventually leading to a global warming period and a resulting retreat in the glacier ice. As the glaciers melt, they leave behind ground up rocks that re-mineralize the soil helping to nourish plant life that grows in abundance with help from the warmer temperatures and abundance of carbon in the atmosphere. Over time the earth's plants become so abundant and sequester enough carbon to trigger another ice age and the cycle repeats over again.

The difference today is that the increase in atmospheric carbon we are experiencing is a result of human civilization removing it from deep in the ground and burning it in the form of oil, coal and natural gas. Thus, the atmospheric carbon buildup that normally takes place over thousands of years, has occurred in just a few hundred years and regrettably most plants and animals are simply not able to evolve and adapt fast enough to survive the major shift this is causing in our climate.

While the gathering of nations in France to address greenhouse gas emissions and climate change issues known as COP21 resulted in some progress, it did not come close to reaching an agreement that is going to quickly reduce atmospheric carbon to a significant degree any time soon. Things are bad and they're going to get worse before they get better. As a result, I am thinking about how to prepare for a significant increase in the kind of unpredictable weather events we have witnessed in the past decade.

Climate risk

Researcher and farmer, Laura Lengnick points out in her book *Resilient Agriculture: Cultivating food systems for a changing climate, that changing weather patterns have created a new type of risk for agriculture that scientists call climate risk. Climate risk is defined as the increased uncertainty created by increasingly variable patterns of temperature and precipitation and in increase in frequency and intensity of severe weather events associated with climate change. Part of the unpredictability of climate change is that changes are not uniform throughout the world, within various countries, or even in specific regions. The situation is further complicated by the fact that in some areas, the weather patterns have always been fairly unpredictable.*

Exposure

To effectively evaluate the degree of your climate risk as a beekeeper you will want to consider your degree of exposure. Your degree of exposure will have a lot to do with the area where your bees are kept. For example, according to Lengnick, "Heat waves are projected to increase throughout most of the United States, and droughts are likely to become more intense in the Southwest. The growing season will continue to lengthen, increasing by as much as a month in many parts or the nation and as much as two months in the West, while the number of frost days will decline by twenty to thirty days in most of the nation and by even more in the West. Dry periods will lengthen, with the greatest increases expected in the Northwest, Southwest and southern Great Plains, and hot nights are expected to increase by more than eighty per year across the southern U.S. by the end of the century."

Lengnick goes on to say "There will be more winter and spring precipitation in the northern part of the U.S. and less precipitation in the Southwest, while Summer and Fall precipitation is likely to remain about the same or decrease in most regions. Both the frequency and intensity of heavy rainfall events are projected to increase."

Sensitivity

The amount of climate risk we face as beekeepers is also a factor of the degree that our beekeeping operation may be impacted, either positively or negatively by climate related effects. For example, do you have beeyards in a flood plain or exposed to prevailing winds? Is your operation already subject to existing stresses that may be aggravated by projected climate changes such as

While this location by a pond is a beautiful spot for a beeyard, an extreme precipitation event could flood a nearby apiary and threaten the health of the bees.

This hive is located at a high elevation in the Green Mountains of Vermont and has no wind break to protect it from exposure to strong winds on a regular basis. Instead, it has been strapped to four concrete blocks at the base which help prevent the hive from being blown over.

limited water supplies or a business that is struggling financially?

Will your level of exposure potentially push demand for resources above the level of supply? The huge increase in demand for nucs and package bees has already created shortages in many areas of the country. How dependent are you on local farms in order to produce a honey crop each year? Are your bees dependent upon a single crop for the majority of their forage? Are your bees in an area where the available forage is already marginal in order to keep hives well fed and provide excess honey for harvest? Could water supplies in your area drop below the level needed for hives to maintain themselves? How many months or years could your beekeeping business continue without any income? Thinking about the minimum resource conditions required, before the growth and development of your hives declines, will give you a good idea of your climate risk sensitivity.

Adaptive capacity

Once we have an idea of our climate risk and level of sensitivity we can evaluate our ability to cope with the challenges ahead through adaptation. The vulnerability of one's beekeeping operation to climate disruption will be a combination of the potential impact of changes to our situation and the capacity of our operation to adapt. Generally speaking, the adaptive capacity of large commercial and migratory beekeeping operations to produce honey or pollination services regardless of local resource conditions, arises from the management of large numbers of bees and apiary locations, purchased inputs such as mite treatments, antibiotics and sugar syrup, and government subsidies (in the form of education, research, development and extension, insurance programs, and agricultural labor exemptions)

In contrast, the adaptive capacity of less vulnerable and potentially more sustainable beekeeping operations is typically a result of managing smaller numbers of hives and locations, most inputs produced by the apiary itself, natural pest and disease suppression through beekeeper management and genetic tolerance, and social capital (such as direct markets) to produce high value products adapted to local resource conditions. The choices that beekeepers routinely make about the assets they manage – people, apiary locations, numbers of hives, kinds of honey bees, infrastructure, inputs and finances – will largely determine the ability of the apiary to sustain production and keep bees alive and healthy under challenging climate conditions.

As beekeepers, we have to recognize that they occupy a place, which has a unique combination of ecological, social and economic conditions. These conditions will impact our capacity to act and develop new abilities to learn, plan and adapt to changing climate conditions, all of which may increase costs and will likely require a high level of financial and emotional flexibility. This creates unique place-based opportunities that enhance an apiary's capacity to adapt.

Successful beekeeping management under changing and unpredictable climate conditions will tend to be determined by a willingness and ability to take action to reduce climate risk. Once the apiculturist decides to take action, access to various options and existing knowledge for effective action is the final component of adaptive capacity. For example the ability of a beekeeper to move their hives into areas primarily surrounded by ecologically-based agriculture (e.g. bio intensive, organic, biodynamic, permaculture) that tends to raise a wide diversity of crops that bees may forage on, is an example of the adaptive capacity to respond to climate related nutritional stress in the beeyard. The development of high value, direct retail specialty markets that reduce climate risk through improved profitability and the development of social capital can also help beekeepers to respond to, and recover from, climate related damages.

The resilient beekeeper

In the context of adapting to a changing climate, resilience is defined as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, as well as be able to maintain the capacity of self-organization, and the capacity to adapt to stress and change. (Parry, M.L., 2007) The capacity of a system (or in this case a beekeeping operation) to cope with, recover from, and adapt to stress and change reflects adaptive capacity. The capacity to buffer a beekeeping operation from the impacts of a changing climate, results in resilient beekeeping.

Since resilience thinking is focused on the behavior of a system (in this case a beekeeping operation), since the scale of one's operation is an important consideration in assessing and managing for resilience. While the number of hives managed by the beekeeper will tend to define the scale for cultivating resilience in the apiary, resilient thinking also encourages consideration of related issues such as the amount of available forage to support a given number of hives, or state and federal regulations which often have a direct influence on performance, activities and the apiary as a whole.

Diversity

There are two forms of diversity that are important to resilience: functional diversity and response diversity. Generally speaking, diversity results in redundancy which tends to make systems more stable when facing stress. An example of functional diversity is having a wide variety of honey bee races represented in your apiary or having a hand-crank manual extractor on hand when the power is out or the

motor on the extractor is broken. An example of response diversity is a beekeeping business with a wide range of products and markets so that dramatic and sudden shifts in consumer preferences can be absorbed more easily. A diversified apiary operation or business that can design each part of its enterprise to relative self-sufficiency by limiting interactions between them promotes the strength and sustainability of the whole. Management strategies that emphasize efficiency over response diversity tend to do so at the expense of resilience. (Lengnick 2015)

Transformation

While resilience practices can be used to maintain an existing operation or system, they can also be used to help guide transformation to new structures, functions and purposes. Practicing resilience tends to bring up important questions about the desirability of a system or process. Does the current system meet management goals and objectives? By stepping back and examining the structure and function of a beekeeping operation (as well as underlying assumptions and rationalizations), ways to improve performance, reduce costs, or increase benefits may become visible. If the beekeeping business or operation is performing well, the beekeeper's goal should be to consider enhancing its adaptive capacity; if it is not fulfilling its purpose well, resilience practices can be used to transform the operation to something more desirable. (Meadows 2008)

Beekeepers who choose to manage their apiaries for general resilience will work to enhance three key system behaviors: 1) Response Capacity: the ability to respond to disturbances quickly and effectively; 2) Recovery Capacity: the ability to restore damage to the apiary relatively quickly and; 3) Transformational Capacity: the ability to transition to a new identity or purpose when necessary.

Strategies for adapting to climate change used by beekeepers are likely to fall along a resistance, resilience and transformation continuum. Actions that protect the existing operation from climate effects are referred to as resistance strategies (e.g. planning for likely weather related hazards by moving hives away from rivers and streams to high ground). Resilient strategies will improve the operation's ability to cope with and recover from climate-related stresses, shocks and disturbances (e.g. developing a back-up electrical supply, or stocking up on critical apiary materials that might prove difficult to obtain during a catastrophic weather-related disturbance). Transformation strategies facilitate the transition of a beekeeping operation to one that is more resilient to current or projected climate conditions. Typically, some characteristics of all three strategies are found in resilient systems. Taken as a whole, this range of management approaches can be seen as the beginning of a climate change resilience tool-kit for beekeepers.

Additional Resilience Considerations

Weather has always been an important factor in beekeeping, but climate risk – and the damage that may be caused by increased weather variability and extreme weather events associated with climate change – is a unique hazard that is likely to increase in intensity for the rest of this century. Ironically publically subsidized programs that insure against climate risk, while not requiring investment in climate adaption strategies, can act as a barrier to the enhancement of the climate adaption capacity of the beekeeping industry.

Since conditions of climate change exposure, sensitivity and adaptive capacity vary across the United States, we are likely to see climate vulnerability emerge in regional patterns. Sustainable and resilient beekeepers that are successful in navigating these challenges will have to do more than simply keep their bees alive through the Winter or produce lots of honey. Many will have to manage the production of their own inputs rather than seek them outside the apiary. This will mean learning how to keep bees well-nourished without having to regularly purchase sugar and syrup, how to control mites and diseases without having to use commercial treatments, how to maintain and increase hive numbers without having to regularly purchase packages or nucleus colonies, and receiving top dollar for hive products such as by selling directly to consumers rather than rely on insurance or agricultural foreign-labor programs to help manage costs.

Despite the recent increases in the number of new beekeepers, the beekeeping industry (and our agricultural industry in general) does not appear to be economically or environmentally sustainable. (Heller and Keoleian, 2003) Key indicators that support this position include the high rate of yearly colony losses, the low genetic diversity of the honey bee population in the U.S., the low profitability of beekeeping businesses generally, the age distribution of beekeepers, the wide proliferation of agricultural pesticides, and the fossil fuel intensity of the beekeeping industry. Similar issues are faced generally by the U.S. agriculture system, a system that operates under the assumption of a stable climate and an unlimited flow of global energy and resources to which the beekeeping industry is dependent upon. While we are working to bring our climate back into balance, rather than invest in trying to protect the beekeeping industry by resisting disturbances, we might be better off investing in the knowledge and assets that enhance the sustainability and resilience of U.S. beekeepers. This will likely mean changes in focus such as from optimum to robust; from efficient to redundant; from best practice to learn as you go; and from disposable to reduce, reuse, and recycle. In the meantime, for reasons outlined in last month's article I will be avoiding industrial factory farmed food, and buying and eating ecologically produced food every chance I get. BC

Ross Conrad is the author of Natural Beekeeping, Revised and Expanded 2nd edition. He'll be presenting at the 2016 WV Master Gardener Association's Conference in Greenbrier County at the State Fair Grounds in Fairlea/Lewisburg on April 15-17, and leading an Organic Beekeeping class for beginners May 7-8 at Metta Earth Institute in Lincoln, VT. Call 802.349.4279 for information.

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CALENDAR

♦ARKANSAS♦

The Arkansas Beekeepers Association will hold its Spring Conference March 11-12, at the Ramada Inn Convention Center in Mountain Home.

See **www.arbeekeepers.org** for information.

♦CONNECTICUT♦

Back Yard Beekeepers Association 2016 Speaker Schedule – March 29: John Boyce, Yale, Honey as Medicine; April 26: Roberta Gantz, NYS; May 24: James Wilkes, Hive Tracks – technology for record keeping; June 28: Dinner & Silent Auction Meeting; September 27: Brenna Traver, Penn State, Honey Bee Pathogens; October 27: Anne Frey; November 17: Jennifer Tsuruda, Clemson TBD.

Each month we have weekend hands on inspection workshops, bee school, mentor program and more. For dates and locations visit **www.backyardbeekeepers.com**.

♦FLORIDA♦

FL Bee College will be held Whitney Marine Laboratory in Marineland March 4-5.

Guest speakers are Kim Flottum and Zachary Huang.

For more information and to register visit **www.eventbrite.com/e/2016-college-tickets-18659128957**.

♦MICHIGAN♦

The MI Beekeepers Association will hold their Annual Spring Meeting March 11-12 at the Kellogg Hotel and Conference Center at MI State University in East Lansing.

Keynote speaker will be Gary Reuter. Breakouts offered for beginners and microscope session with Zachary Huang.

The cost is $30/one day or $50/both days.

Southeastern MI Beekeepers' Association (SEMBA) will hold its 78th Annual Beekeeping Conference March 19 at Wayne County Community College District's Western Campus, 9555 Haggerty Hwy. Belleville, MI 48111.

Admission is free. Please register by March 12 at **SEMBAConfReg@gmail.com**. There is a potluck lunch. Please bring a dish to pass and table service.

♦MISSOURI♦

Will County Beekeepers will present an all-day conference – Bee Prepared. Healthy Bees Make Happy Beekeepers – for the beginner and the expert. April 2 at Joliet Junior College, Weitendorf Ag Ed Center, Joliet.

For information visit **http://willbees.org/beeprepared**.

♦NEW YORK♦

The Champlain Valley Beekeepers Association will hold its annual meeting April 30 at the Beekmantown Town Hall. Bring your lunch.

Guest speaker will be Medhat Nasr. The cost is $20.

For information contact Dick Crawford 518.561.7167.

Geneva Bee Conference will be held March 19 at the Scandling Center in the Vandervort Room at Hobart and William Smith Colleges, 300 Pulteney Street, Geneva.

Speakers include Mike Palmer and Tom Seeley. There will be four breakout sessions and an evening social.

Visit **www.GenevaBeeconference.com**.

♦OREGON♦

Pollinator Conference will be held March 12 at the Holiday Inn, 105 Opal Court, Albany, will open to the public at 7:45 a.m. with the first speaker at 8:30. There will be four speakers. The cost is $30 per person.

Visit **http:// extension.oregonstate.edu/linn/beevent**.

♦PENNSYLVANIA♦

Introduction to Beekeeping Temple University, Ambler, March 19-20.

Visit **http://vincemasterbeekeeper.com/courses/**.

♦TEXAS♦

The Central Texas Beekeepers will host a Beginners School April 16 at the Washington County Fairgrounds in Brenham.

For information contact Michael Kelling, **centraltexasbeekeepers@gmail.com** or 979.277.0411.

♦VIRGINIA♦

5th Annual Mid-Atlantic Honey Bee Convention will be March 5 at American Legion Post 242, 21 J.B. Finley Road, Sandston. $50/person or $90/family.

For more info visit **www.maohbc.com**.

♦WEST VIRGINIA♦

Corridor G Beekeepers Association will host the WV Beekeepers state Spring meeting April 9 at Chapmanville Middle School, 300 Vance Street, Chapmanville.

Featured speaker is Michael Bush. The cost is $30 including lunch.

To register contact Kathy Watson, **kathymullarkywatson@gmail.com**, 304.855.8504.

♦WISCONSIN♦

Beekeeping Classes, Madison – Beginners Classes will repeat through the Spring. Second Step Class is in March. The fee is $50 and covers handouts, coffee, and more. Individual hands-on mentoring available, $20/two hours in the apiary. Classes held at the Dane Co. Extension Building.

For more information and registration contact Jeanne Hansen 608.244.5094 or **jeannielabeannie@yahoo.com**.

♦WYOMING♦

The Wyoming Bee College will be held in Cheyenne March 19-20.

For information visit **www.wyomingbeecollege.org** or Catherine, 307.633.4383.

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I like to mound snow around my beehives for insulation, and this clear, bitter-cold January day would be a good day to do it. Unfortunately, I'm house-bound following my "blue light" treatment yesterday for the scabby little pre-cancerous lesions on my face and bald head.

I really don't mind my bald head. My gal Marilyn still loves me, but that head does get cold, and pre-cancers pop up all the time on my scalp. I asked the dermatologist why. He said, "Because that's where you're getting a lot of sun exposure."

This didn't make sense, because for years I've never gone outside without some kind of a hat, and before that, I had hair. I put sunscreen on my face, but I never put any on top of my head. Why would I?

The light popped on when I noticed the ventilation holes in the mesh on top of my beekeeper pith helmet. Some sunshine gets in. Apparently those long hours in the beeyard added up. I could have put sunscreen on top of my head and maybe never gotten a sun-damaged pate, but it never occurred to me. I assumed my helmet protected me.

Skin doctors all emphasize that you should always put on sunscreen when you go outside, but they never warn you that scented sunscreen irritates honey bees and makes them want to sting you. You'd think they'd learn this in medical school textbooks in the chapter on sunscreen. But if you mention it to doctors, they look at you like you just stepped out of a flying saucer.

Marilyn had a melanoma removed from her arm last Summer. That's the bad skin cancer. To me it looked like a big freckle. The visiting Mt. Sinai doctors at a free skin cancer screening last Summer in Aspen found it. The whole team gathered around and poked and stared. Then, remarkably, one of the docs took Marilyn under her wing. She counseled first and foremost quick removal. She gave Marilyn her card and said she'd be her advisor and advocate. When the local health care system more or less broke down with delays, insurance hang-ups, and scheduling problems, Marilyn's guardian angel made phone calls and wrote e-mails. She even offered to remove the melanoma herself – for free – if Marilyn visited her in her office in New York. As weeks turned into months, Marilyn mulled over her offer.

Marilyn didn't have to get on a plane, after all. It ended well, with two surgeries and a three-inch gash on her arm. She healed very nicely, thank you, and on a follow-up visit blurted out to her surgeon that she used honey as a wound salve. "I didn't hear that!" her doctor retorted.

Honey – nature's miracle healing agent. Don't they teach that in medical school?

As for me, I switched dermatologists. The one I went to before was nearing retirement. Maybe his eyes were failing. He used liquid nitrogen to freeze pre-cancerous lesions. On my last visit a few years ago, he looked over my face, froze a couple of spots, and said, "You're good to go!"

I was his last patient of the day. I'd already left his office when I thought, "How about the top of my head?" I marched back in and said, "Take another look." He pulled out his nitrogen blaster and froze another dozen spots, right there in the waiting room.

My pert young new doctor takes Medicare. And she's married to a beekeeper. Good for her! She'd still never heard about scented sunscreen and angry bees.

This Mary Poppins of dermatology loves her job. She loves helping people! No old-fashioned liquid nitrogen for her! She won't sit still. She dances around the room as she outlines the latest in high-tech treatment options. Yesterday I held my breath as her nurse washed my face and scalp with acetone, then smeared aminolevulinic acid cream on my skin. The acid binds with pre-cancers, creating a light sensitive chemical. Next she bombarded my face and scalp with blue light for an hour, thus (hopefully) destroying those lesions.

Today I feel acid-burned. My take-home instructions said to moisten my skin with Vaseline, but instead I used a 50/50 mixture of honey and Aquaphor, a healing ointment. I'll be fine.

My dad played a lot of tennis back before sunscreen got invented. Surgeons cut a melanoma out of his nose before he turned 60. I worked as a lifeguard that Summer, and my goal was to get as bronzed as possible. I sat in that lifeguard chair with no hat and no sunscreen, even though sunscreen by then was on the market. I did still have a head of hair. Dad warned me, but I had the good sense of a teenager. Now I look back and wonder.

Be careful out there in the beeyard. You might feel like you're in the shade under that hat and veil, when you're really not. Like miles on a car, the sun takes its toll. With luck, one day you'll wake up and be as old as I am. Don't make the same mistakes I did.

Ed **Colby**

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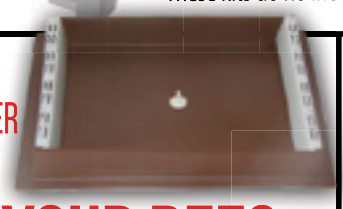

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