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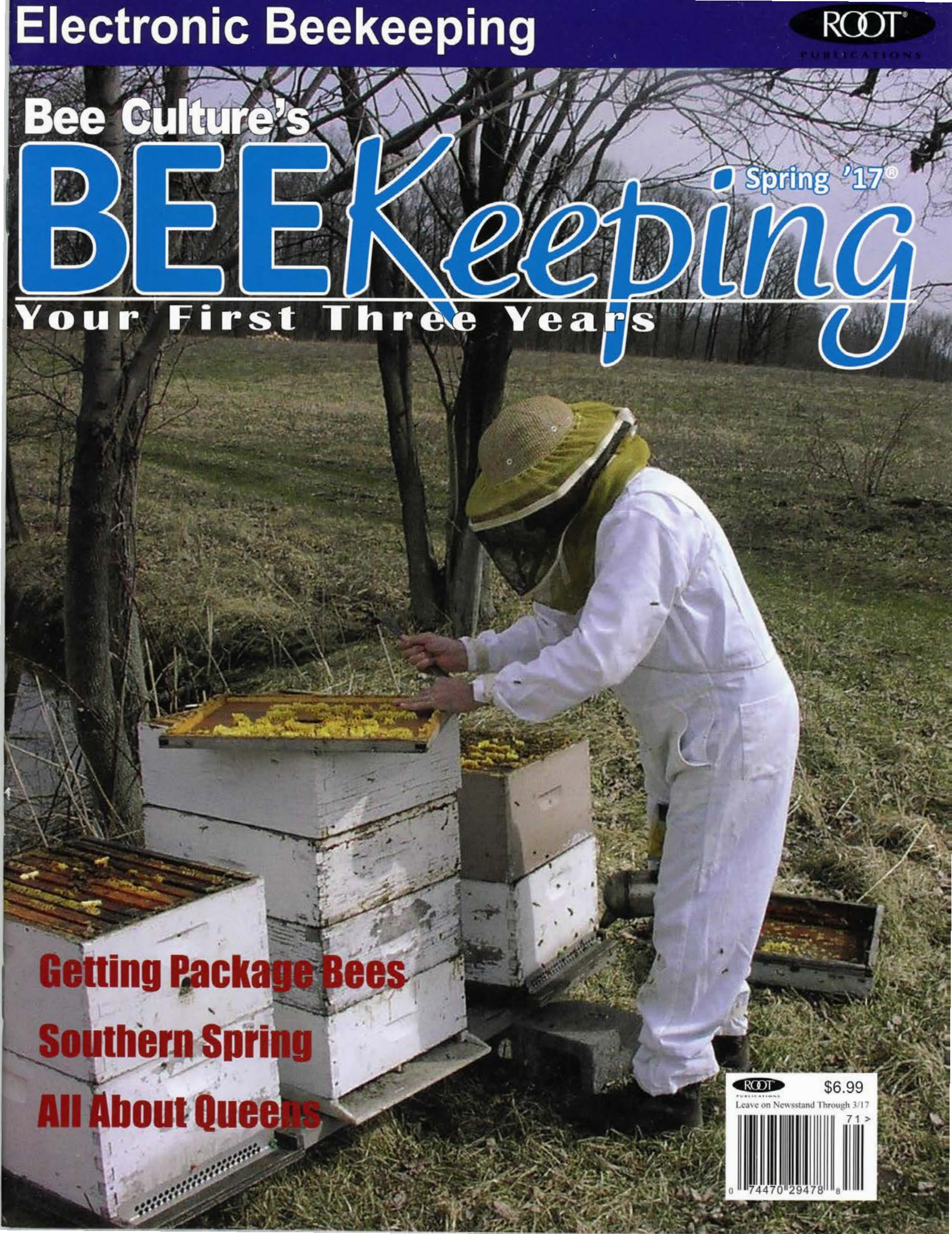

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BEEKeeping

Your First Three Years

Spring Is On The Way 4
Kathy Summers

Hive Tasks 6
Ann Harman

The Editor's Hive 7
Kim Flottum

Phil Knows! 12
Phil Craft

City Bees 13
Toni Burnham

Selling Honey 15

All About Queens 18
Larry Connor

Honey Bees & Humans Mimic Each Other 25
Robert Weast

Bee Informed Partnership 29
Karen Rennich

Southern Spring 31
Ann Harman

Get Rid Of Mites 33
Jennifer Berry

Let's Make Some Candles 37
Ross Conrad

Page 37

Electronic Beekeeping 41
James Wilkes & Huw Evans

Honey Bee Packages 48
Ross Conrad

Pollinator Decline & Self-Medication 50
Rachael E. Bonoan

Restocking Winterkilled Hives 53
James E. Tew

Do Bees' Feet Have Suckers 56
Ian Stell

Spring Is On The Way!

On Christmas Eve we received the first Burpee Seed Catalog of the season. It seems a little earlier than usual, but not much. A sure sign that it's time to think about Spring is getting those first seed catalogs. We've gotten several already - some from companies I've never heard of. I find it so much fun to sit on a cold Winter afternoon and look at all of the tomatoes, squash, flowers - all of it. And to check out all of the new varieties that folks have come up with. We get most of our plants locally, but I do order squash and zinnia seeds from Burpee. They seem to always have some new variety on both of those.

As I write this we are at the very end of 2016. We had a mild enough day today that the bees were flying and we went out and did a frost planting. Frost planting is done in the Winter when the ground is frozen. The seeds are tossed onto the ground, not worked in and not covered up. As the ground thaws and refreezes the seeds are worked down into the soil and in the Summer we'll have a nice field of wild flowers all of which are inviting to the honey bees. The seeds we planted are a mix of annuals and perennials. But even the annuals will reseed themselves and stay vibrant for several years. The one we did today was at our home, but we've done several of these plots on the Root property where we have a large garden area with wildflowers, a Monarch garden, the Master Gardeners have a plot and the Ohio State Beekeepers have a plot there. This is an easy way to eliminate mowing if you have large pieces of unused yard and it also provides a feast for your honey bees and other pollinators ~ bumblebees, monarch and others. Think about it. You can buy large bags of wildflower mixes at your local feed store or Tractor Supply.

So in some ways it is already time to be getting ready for gardening, beekeeping and even chicken keeping. A good way to spend part of your down time in Winter is to make sure you're ready for Spring.

As a brand new beekeeper you should be searching for and signing up for a Beginning Beekeeping class in your area. If you're anywhere near Medina, Ohio we'll be holding our beginning classes starting in February. Visit **www.medinabeekeepers.com** for the exact dates and times. Our very own Editor-Author-Beekeepeer, Kim Flottum will be teaching the Tuesday night classes. You should also be joining a local beekeeping association. The best way to learn beekeeping and glean valuable information is by being with other beekeepers.

One thing other local beekeepers can help with is where to get your bees. Is there someone local who sells nucs or packages? Does someone bring in truckloads from California or Georgia to your area? Or will someone set you up with a full-size hive? These are all options. And the local guys can give you that information.

We went into Winter with nine hives and from what we saw today they are all still alive. We wrapped them all and gave them all food at the end of November. So far here in northeast Ohio we've had some really cold weather, not much snow, and the past few days fairly mild. So it will be interesting to see how many of the nine survive and what will the rest of Winter will bring. We've got all of January, February and most years we get some of our coldest, snowiest weather in mid-March. We don't breath easy about our bees until mid to late April. And that's when our packages arrive. But you have to get your bees ordered much earlier than that - as early as possible to make sure you get on the list.

Spring will be busy - especially if you're gardening and having chickens. All of these activities are the busiest right about the same time. The baby chicks and ducks usually arrive the end of March and need to be cared for and gotten through the cold nights until the weather changes and they get those first feathers.

You'll be getting your seeds ordered for the garden, ordering your bees and ordering your new chicks all about the same time.

We're very fortunate in our area. We have several large garden centers where we get most of our plants for the garden - we always plant lots of tomatoes and squash, our favorites. We have two feed stores in town where we can order almost any kind of chicken or duck and have them arrive at the feed store safely for our pick up and we have Queen Right Colonies just down the road where we pick up our packages in the Spring and can get any bee equipment or supplies that we need.

If you have a garden and you have bees and you have some amount of extra space I encourage you to think about getting chickens. The three just seem to go together. We've enjoyed our chickens tremendously. They're funny, they provide eggs and are just pleasant to have around. We have 15 hens right now. We live in the country and could have roosters if we wanted. Some cities allow you to have chickens inside the city limits, but not roosters because of the noise. Five of our hens will be five years old this Spring. The other 10 will be two years old. So it's time to get a few more babies. We expanded our coop this year and have easy ways to keep them separate until the babies are big enough to defend themselves. We didn't have good luck with ducks - lost all six to predators. But we're going to try again, because they are really fun.

So I wish you good luck with your bees, your garden and your poultry.

Kathy Summers

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Buzz Riopelle, keeping his bees alive in Medina County, Ohio. (photo by Kim Flottum)

Hive Tasks

Spring Is A Busy Time For Beekeepers

~Ann Harman

Repair or replace any damaged or worn out equipment.

- Review all current equipment.
- Make a list of equipment needed for coming year.
- Take advantage of equipment supplier January sales.

Get outside and see what is blooming.

In warm climates requeen if necessary.

Queen excluders need to be clean and not damaged.

- Check hives and beeyard after Winter storms.
- Check colonies once a month but do not break cluster. Wear your veil.
- Frames of honey can be moved closer to cluster.
- In cold climates if food is needed, feed 'wet sugar' blocks.
- In warm climates feed 1:1 or slightly weaker sugar syrup to encourage egg laying.
- If any dead colonies, block entrances until you can inspect for a problem.
- In temperate climates bees will take cleansing flights if bright sun and 40° or more.
- The arrival of Spring depends on climate.
- Be a Weather Watcher and a Plant Watcher.
- Drones seen at entrance mean swarm season is beginning.
- In warm climates strong colonies can be split.
- Read the bee book you got for Christmas. Learn something new about honey bees.
- Attend your local club meetings.
- Plan to be an apprentice mentor this year. You are certain to learn something.

In warm climates swarms can occur.

Check your protective gear.

Check at entrance for bees bringing in pollen, essential for brood rearing

And Don't Forget Your Next Club Meeting

The Editor's Hive –

Welcome to our second season of BEEKeeping. We're off to a good start this year we think with a great collection of articles and how-to's and what-for's and why's and when's and how's and who's. Because we do more with honey bees and beekeepers than anybody, anywhere, we have such a breadth and depth of beekeeping skills and knowledge, facts and figures and lifetimes of experience to draw on and to share with you it's almost unbelievable. But, believe it. We figured it out and guess what... on the pages of this issue alone we share more than 400 years of beekeeping experience. Over 400, from Georgia, Michigan, Ohio, Alabama, Kentucky, Wisconsin, Vermont, Maryland, North Carolina and even the UK! Because of our Sister issue *Bee Culture*, the single largest beekeeping magazine on the planet, we can draw on the best and brightest and most talented beekeeping instructors, beekeepers, and honey bee scientists in the world. And we do, every issue. Rest assured, what you get in *BEEKeeping* is the best there is, anywhere.

I'm writing this the day after Christmas and because we had a mild and easy day, I quickly walked the beeyard to see what I could see. And it was a very pleasant stroll. We keep the bees mostly in the back yard here in Northeast Ohio, but we have a couple on the front porch, just because we like them close. Every hive was active and humming and the 55°F temperature made it easy for them to take that (probably) last flight for (maybe) a long time. This isn't typical Christmas weather, and, as a result, the bees are more active than usual for this time of year – and you'll learn that's a mixed blessing – activity means they can move around in the hive and get resettled near more food, but it also means they'll eat more food because they're busy flying and moving. The world our bees live in is mostly dictated by what the weather is, and what you are going to do about it. Good weather means lots of food, bad weather means, maybe, not enough food. You have to know to check and see. And this is just one of the many facets of keeping bees you are now a part of. Welcome to *BEEKeeping*, to honey bees and to the incredible world of being a beekeeper.

– Kim Flottum

Dear BEEKeeping

One of the main reasons I assist and encourage people to start beekeeping is the hope that they will increase the amount of planting for pollinators they do on their property. Much like feeding a pet, people plant pollinator-friendly species in order to provide forage for their honey bees. In doing so, however, important native species that largely go under the radar are provided for, too. Native bees don't provide people with delicious honey, and the Milkweed assassin bug, for example, which preys on these bees and other pollinators, is downright ugly!

Convincing people to help such a species would be a hard sell, but convincing them to protect honey bees and share in their delicious crop is a walk in the park.

What I hadn't considered was the possibility for the hive itself to act as a focal point for various species' interactions. Other than the obvious, and undesirable, pests and parasites that take up residence in the hive, I was surprised at how many other creatures found a use for it. Green anole lizards hanging out on top of the hive, gobbling up earwigs as they scuttled across the damp wood; spiders making webs across the legs of the hive, as well as others taking up residence in nooks of the wooden hive body; snakes warming themselves on the concrete slabs I placed under the hive to discourage small hive beetle propagation (whether that works or not!); birds feeding on dead bees pushed out of the hive as part of the living bees' house-cleaning behavior; and even mud-dauber wasps making their adobe homes on a quiet side of the hive.

What set these apart from the interactions we beekeepers more often talk (and complain) about was that they posed no threat to the hive and some may even be seen as beneficial. More than that though, the simple joy of not knowing what you'll see when you go out for a hive check, or what they'll be using your hive for this time, is just one more, slightly unexpected, reason to love being a beekeeper.

Sincerely

Peter Keilty

Got Questions?

Phil Knows!

Sugar spread on the inner cover is an easy way to feed.

A beekeeper in Virginia writes:

Q: I started as a beekeeper two years ago and successfully wintered my one hive the first year. This year I even got two supers of honey! Now I am worried that I should have left one of them on – that they do not have enough food for this Winter. Is it okay to feed them sugar syrup during the Winter if I catch a warm enough day to open the hive?

Phil replies:

A: Congratulations on your success so far. I won't give you the lecture about autumn's being the time to make sure of food stores – I'm sure you already know that – and it's not too late to do something. However, there are better choices for cold weather feeding than sugar syrup.

The problem with using syrup in Winter is excess moisture. During most of the year, honey bees store nectar or syrup uncapped until it is reduced to the 18% or less moisture content which is the consistency of honey. In Winter, the hive is typically less well ventilated (because of entrance reducers and the colony's diligence in sealing cracks and openings with propolis), and the problem is compounded by the fact that air holds less moisture when it's cold. Instead of evaporating and being fanned out of the hive, the water is trapped inside. Bees end up, not only cold, but cold and damp. This was really brought home to me several years ago when I overwintered an observation hive in the house. Because it was only two frames between sheets of glass, it didn't have much room for food storage, so I fed the colony a syrup of two parts sugar to one part water. The bees quickly sucked it down and filled most of the cells, but within an hour the glass was fogged with condensation.

Homemade fondant, or sugar candy can be poured into a temporary mold and left to harden, then placed on a hive for food.

Fondant, also known as bee candy, provides the carbohydrates bees need in a concentrated form without excess water. The candy is not hard to make, and recipes are easy to find on the internet. One calls for combining two cups of granulated sugar, 1½ cups of water, two tablespoons of light corn syrup, and 1/8 teaspoon of cream of tartar in a saucepan over medium high heat until it reaches 238°F. A candy thermometer is helpful. Once it reaches the desired temperature, the mixture is removed from the heat, beaten until thick, poured into a mold (such as a cookie sheet lined with wax paper), and allowed to cool and harden. Then it's just a matter of breaking the slab into pieces and placing them over the inner cover of the brood box. Some beekeepers use variations, such as fondant feeders, but that is the basic method.

An even simpler alternative is to buy winter patties from a beekeeping supplier. Very similar to homemade bee candy, they are sugar in a low moisture form. Open the hive just long enough to place a patty on the top bars of the top box, replace the lid, and you are done. A last resort is to sprinkle dry, granulated sugar on the inner cover. This is clearly a desperate measure, but beekeepers have told me that using it has saved colonies from what they thought was certain Winter starvation. Fondant, patties, and sugar can all be placed in the hive any day when the temperature is at least in the 40s.

Be aware that most hive losses from starvation actually occur in late Winter or early Spring as the hive starts to rear brood and runs out of provisions. Keep an eye on your hives and their food stores as Spring approaches.

A beekeeper in Missouri writes:

Q: Help! I am a first year beekeeper, and live in Missouri. Last year I purchased my first hive of bees, which was a nuc through my local bee club. I went to bee classes, and tried to stay on top of things. As cold weather approached, and I looked into my hive for the last time, all looked well. Maybe too well my beekeeping friends tell me. I hope to make honey next year, but am afraid that they will swarm in the Spring. I heard a talk on swarm prevention, but it seems complicated.

Continued on Page 10

I'm feeling a little stressed out. What suggestion might you have?

Phil replies:

First of all, relax. You seem to be taking all the right steps, and the problem of a colony so strong that it is ready to reproduce itself is a good one to have. Swarming is nature's method of making new colonies, and honey bees are hard wired to do it. I think that many beekeepers, and especially new ones, are overly concerned about it. Just as honey bees are programmed to swarm, they are also programed to leave behind enough bees to rebuild the old colony. In most places in the country, given a good nectar flow, you can still make honey in a hive that has swarmed. That said, no one likes to loose bees, and beekeepers have devised a number of tactics to reduce swarming in their hives – some complicated, and none 100% effective. I say reduce, because we can never stop this very natural process. However, you asked for advice on swarm prevention, so I will tell you how I approach the problem.

Swarming is triggered by overcrowding in the hive, so the most effective and straight forward method of discouraging it is to give the colony more space. In the spring honey bee colonies react to the increased flow of nectar and pollen into the hive by rearing lots of brood. The result is often crowding and a lack of open comb where the queen can lay eggs. The colony responds by beginning preparations for some of the bees to depart, along with their queen, to a new location. There's a practical limit to how many brood chambers a hive can consist of (no more than two or three), so the best way to provide more room is to make a nuc.

Nuc is short for nucleus hive, as in the nucleus of a new colony. Making one involves transferring frames of capped brood and a frame or two of food from a strong hive or hives into a new box, then adding a queen. The frames that are removed to make up the nuc are replaced by frames containing foundation. The bees left behind will quickly draw the foundation out, giving the original colony new brood space, so that both crowding and the risk of swarming are reduced. Here is my basic recipe for making a nuc:

Replace with a frame of foundation.

Remove frames with bees, brood and honey from your strong hive.

If you have drawn comb you can use that, too.

- two frames (or more) of capped brood, along with the bees on the frames
- one frame (or more) containing honey and some stored pollen, also with any bees
- one frame (or more) containing new foundation.
- Some extra bees, shaken from an additional brood frames
- A young, mated, caged queen from a beekeeping supplier

Many beekeepers use a nuc box (smaller than a standard hive body and usually designed to hold five frames) for setting up a nuc. Colonies started in them must be transferred to standard boxes after they draw out the foundation and begin to increase in size. Nuc boxes are not a requirement; they are just more convenient for nucs that are intended to be sold or moved later. A nuc is a nuc regardless of the size of the box it is set up in. Starting with a standard size box provides the new colony plenty of room to grow and saves the beekeeper from having to buy a special piece of equipment.

There are two essentials to setting up a nuc. First, avoid accidentally moving the old queen into the nuc. Before transferring any frames, search through the strong hive, find the queen, and place her along with the frame on which you found her in a separate box. Once you have finished making the nuc, move the frame with the queen back into the original hive. If you have difficulty finding her, ask a more experienced beekeeper for help. Second, start the nuc with plenty of bees. After you have set it up with the desired number of frames and inserted the queen cage, take another couple of brood frames and shake bees from them into the nuc until you think you have shaken in too many. The young wax makers and nurse bees needed to grow the new colony will stay (they haven't yet learned to fly), but the foragers will return to their home hive.

After a week or so, remove the cap or cork that covers the opening, allowing the bees to remove the candy and release the queen.

If your efforts at prevention are futile, all is not lost. Listen for a louder than usual sound of buzzing and keep an eye on the trees near your hive. After all, a swarm is basically an unhoused nuc.

To introduce a queen to your nuc, spread two frames apart, NOT *centered, and place your queen cage between, making sure the bees have access to the queen inside.*

A beekeeper in Illinois writes:

Q: Last month I heard you speak at the Ohio Valley Garden Conference. I am interested in becoming a beekeeper. Do you have some tips on the best way to get started? And I loved your talk!

Phil replies:

A: Thanks. People become interested in beekeeping for many reasons. Most think it would be neat to be able to produce their own honey. Some just find insects fascinating. Others, like you, are gardeners and find having bees a natural extension of that hobby. And yes, I have lots of tips, but here are my top 10:

1. Buy a good beginning beekeeping book and read it. It will provide you with background information and an overview to beekeeping. There are a lot of good titles out there, but one I recommend is *Backyard Beekeeper: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden*, **by Kim Flottum.**
2. Search online or contact your state association or state bee inspector to find a local beekeeping group. By attending their meetings you will make contacts with beekeepers who live near you, some as new to the

Continued on Next Page

craft as you are, others with many years of experience.

3. Attend a beekeeping school, or beginning beekeeping class. Many local and state associations hold evening classes or one day seminars where you can get basic instruction with an opportunity to ask questions. Learn about them through your beekeeping association or your county agriculture extension office.
4. Buy a bee veil and beekeeping gloves, and consider a bee suit or coveralls. This will prepare you for step #5.
5. Find a mentor through your local bee club, or at least seek out an opportunity to visit with a local beekeeper when he or she is opening and inspecting hives. Some bee clubs host field days, hands-on meetings often held on a Saturday afternoon at a beekeeper's home or apiary.
6. Buy new woodenware. Used boxes and frames may seem like a bargain, but it's difficult for novice beekeepers to tell the difference between gently used and used up. Moreover, used equipment can harbor honey bee disease pathogens.
7. DO NOT buy an established hive from a beekeeper! A full sized, mature colony can be overwhelming for a beginner. It's better to start with a small colony which will grow with your beekeeping skills.
8. Begin with a nuc or a package of bees. A nuc, short for nucleus, is a fully functioning small colony with bees, a queen, brood, and food stores installed in a small hive box. You just transfer it to the standard hive box which you purchased in step #6, and you're ready to go. A package of bees is a screened box containing several thousand bees and a queen in a separate cage, which require installation in your new equipment. Both nucs and packages have their advantages and drawbacks. You will learn more about them from the book you read in step #1 and classes you take in step #3.
9. Start with two hives, if possible. Two are as easy to care for as one, and give you more management options. They also provide a point of comparison when problems arise. It can be difficult for a new beekeeper to recognize abnormalities, but having two hives side by side makes it easier. Even if you don't know what to do, you'll know when to ask for advice from you state bee inspector or members of your local group (step #2.)
10. Once your hives are set up, put on your bee veil and gloves, and look inside the brood boxes at least every week to 10 days. This is where all the information you've acquired will come to life, and you will also be checking to make sure all is well with your bees.

Continue your education by subscribing to a beekeeping magazine, attending meetings of your local bee club, and ASKING QUESTIONS! Good luck, and feel free to send some of those questions to me.

A beekeeper in Kentucky writes:

Q: From time to time I see used bee equipment, hives, etc. for sale on craigslist. Isn't there a risk that they could have mites or diseases?

Phil replies:

A: I have two concerns on behalf of beekeepers, especially new beekeepers, considering the purchase of used equipment or existing hives – particularly when they

Packages are available in the Spring, but must be ordered in late Winter.

are responding to ads from anonymous sources such as newspapers or the internet. My concerns are lessened if the seller is a member of a local beekeeping group where you attend meetings. However, acquiring equipment is not cheap, and you need to get good value for your money. In terms of disease, the greatest danger is from brood diseases – those associated with developing bees in brood comb. American Foulbrood is the most common example. This risk may be minimized by avoiding the purchase of frames with drawn comb or even of used frames. When I buy used comb or existing hives, I always conduct a careful examination prior to the purchase. The problem faced by novice beekeepers is that they usually lack the experience to determine whether hive and comb are disease free. I have always cautioned new beekeepers to purchase existing hives only with the advice and assistance of a trusted, more experienced beekeeper (or local inspector if required, and it is in some places). I also suggest that they avoid the purchase of used frames or comb since the cash savings is not worth the risk. For more about disease concerns in used equipment, see the related Q&A, in my February '13 Ask Phil column.

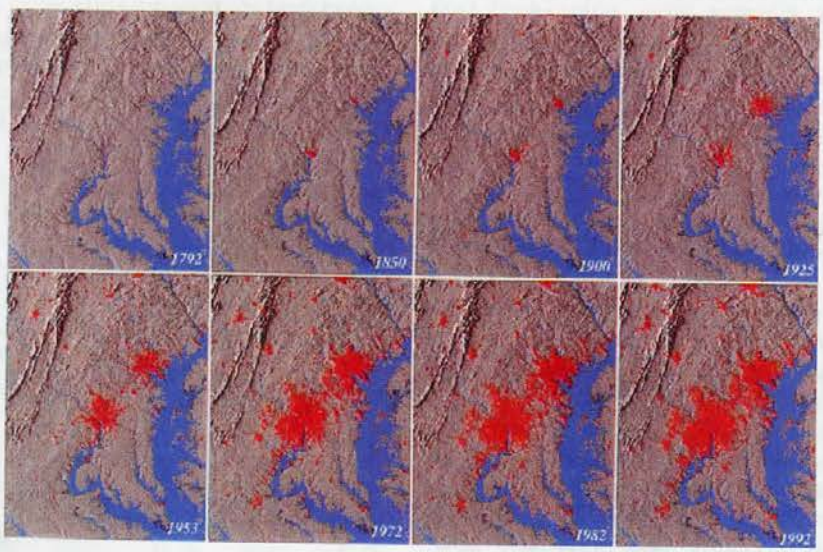
My other concern for newer beekeepers buying used equipment is the risk of over paying or of paying for something of little value, i.e. worn out equipment. Judging the value of such equipment, especially wooden ware, requires experience that new beekeepers have not yet had time to acquire. So my advice for the novice beekeeper interested in buying used equipment is the same as for those considering the purchase of existing hives. Seek the assistance of an experienced beekeeper in evaluating the used equipment prior to making the purchase. There are some exceptions. Protective clothing: coveralls, gloves and veils, can be evaluated like other used clothing. If it looks new or has only minor wear, it still has value and a fair market price would be a percentage of the catalog price for similar, new items. If it looks worn out, it probably has little value left in it. Another exception is metal ware. Though I would not encourage a novice beekeeper to spend hundreds of dollars on expensive extraction equipment, some inexpensive tools made from metal (such as smokers and hive tools) can also be easily evaluated by observing the amount of wear and comparing the asking price to catalog prices. In summary, if you are unsure of the value of equipment offered for sale, don't make the purchase. Buy new equipment from a beekeeping supplier.

In the U.S., cities are about as native as honey bees.

~Toni Burnham

Since it's Winter for many of us, and the best we can do for our bees is wonder and worry about how they are doing, we could consider doing something else with our mental energy: making alliances and building bridges.

There are very few things you can say about Big Cities that begin with "always . . ." and "never . . ." but here is one I'm pretty sure of: "You can *always* rest assured that one city beekeeper will *never* own all the resources that the bees in those colonies will need in a year." The bees forage for anything from a mile or two to four or five in any direction, each hive sucks up a gallon or two of water (and whatever is in it) on a hot day, your bees bring home in the nectar and pollen what your neighbors put in the soil.



In the city, we depend on the aggregate choices of people who will never see inside a hive, including some folks who would oppose their presence at all. We therefore need friends, especially folks who are working on urban green spaces, and they need us. They might need to be told that, however.

If urban beekeeping is going to gain a safe and permanent foothold, it needs to be woven in with the fabric of the organizations and activists who strive to make cities a decent place to live (for everybody in them). My secret evil plan is to have urban beekeepers wind up, in the minds of the average citizen, as somewhat less boring than the orchid growers and somewhat more boring than the model railroaders. Normal, run-of-the-mill geeks.

Why is this so important? The future is urban, and lots of groups are trying to figure out how to make that work. For example, here's a picture of the Chesapeake Bay Watershed, the place that nine million Washingtonians and Baltimoreans (and our suburban neighbors) call home. It shows land use changes between 1792-1992. In 1997, Maryland's governor predicted that by 2020, if trends held, the amount of land you see used for development would double.

Trends held. They held almost everywhere in North America (the exception is Maine, but if you move there you might ruin everything). [Source, *United States (Census) Summary: 2010*]

There are all kinds of predictions about urban growth, some based on percentage of the population (the WHO says 70% of us by 2050) or by land use (triple the current space by 2030/Sante Fe Institute). Many of us are urban beekeepers because we want to play a role in making this work somehow.

If you talk to the hardcore landscape restoration groups, they might not think that there is an obvious place for honey bees in their mission. At a recent conference of the Chesapeake Conservation Landscaping Council – a lovely group with whom I have no problem at all – most of their eight guiding principles include some version of the word "native," and *Apis mellifera* is not that.

But here in the US, cities are about as native as honey bees (most towns less so). Eva Crane points to the first arrival of European honey bees in 1622, Dr. Deb Delaney of UDel has found traces of Spanish Conquest DNA in West Coast bees that may be older than that. As crazy as our neighbors might think us for harboring colonies of 50K (or more) stinging insects in our gardens or on our roofs, colonists on small wooden ships 400 years ago thought it was a great idea to travel in close quarters for months on end. For about 5,000 years that we know about, people and honey bees have lived together in cities and countryside. Any reason for getting rid of one sort of

Continued on Next Page

If you want to help people, especially kids, connect to the insect world, Apis mellifera *is hard to beat.*

logically requires you to think about extirpating the other. (Personally, I do not feel like being removed.)

And, in desperate cases, you can point out that North America did have native honey bees – 14 million years ago [Engel, M. et al. 2009].

So why should folks who work on greening the city listen to us? Some maintain that there is plenty of pollination without the presence of bees, but the anecdotal data from managed gardens in DC points to higher yields with managed bees, especially for non-native crops and early bloomers. As for native species, it *is* possible and instructive to have kids make and place *Osmia* tubes and blocks, for example, but participants have to take your word for what is going on inside unless you destroy the nest to show them, there's activity for maybe six weeks a year, and repopulation of your block is a roll of the dice unless *Osmia* are already common in your area (begging the question of why you needed to bring any in...just like honey bees).

From a program development standpoint, it is tough to overestimate the effectiveness of honey bees. If you want to help people, especially kids, connect to the insect world, *Apis mellifera* is hard to beat.

Why? Honey bees are there all year (if we can keep them alive). You can open up their colonies and see everything that is going on without killing the subject, you can watch the foragers go out and the pollen go in, and connect it with what is blooming right-here, right-now. At some point, you can experience what your hometown tasted like that Summer, and link it to probable source plants. You can put hives on imperfect land in almost any neighborhood, and later move them around if your program has to shift. Over time, you and your participants can develop a gut relationship to them and their ties to the green world based on human/bee cooperation. If that does not restore the relationship between people and the ecosystems around them, I do not know what does.

And presenting honey bees to people is almost cheating. In my town, the hardest sell comes from the lowest income areas. DC's arborists, for example, report that poorer wards both request fewer trees and resist the expansion of the green canopy. For them, nature is a place where assailants can hide, and leaves are things that clutter the sidewalks and clog the drains. This Spring in the Washington Post, a longtime DC resident said "The trees create more problems than when they weren't there." So you can imagine the response when yuppies show up with boxes of stinging insects.

But in schools and community gardens, face to face contact with bees has an almost magic effect: fear turns into advocacy. An observation hive will first bring titters of concern, but will soon be surrounded with kids and adults glued to the drama within. Find the queen, show the eggs, try the honey, joke about the drones, link the whole thing to pumpkins and apples and ice cream, and then release your new battalion of converts onto the streets. Our bees can make the gardens of landscape restorers come to life in new ways.

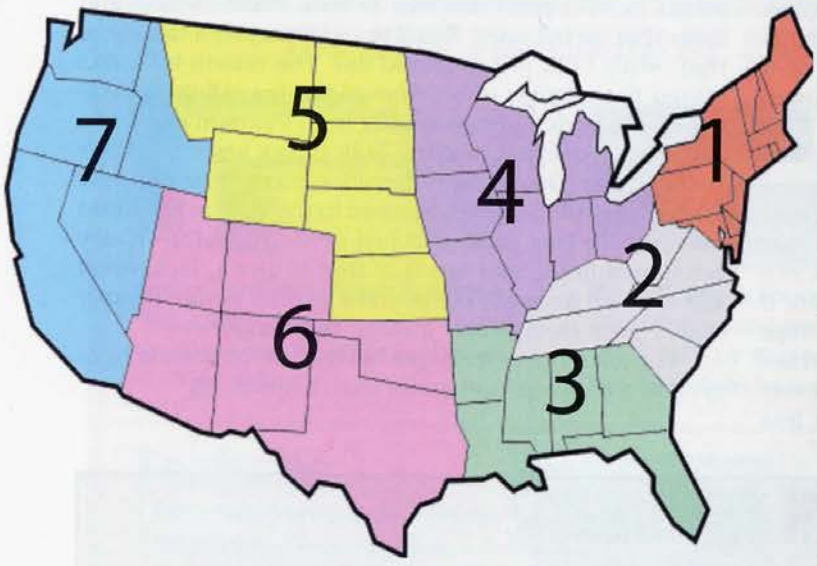
What can the activists whom we are trying to persuade do for us? There's the political part, where they show up for hearings and defend our right to bee here; they also create potential apiary spaces, reach widely different populations and neighborhoods, support issues like limitations on pesticide use, and might choose to join our ranks. They plant bee forage, clean waterways, insist on remediating contaminated areas, and educate adults and children about why nature matters. They are part of our habitat, and we are glad!

In times when our communities are prone to tearing themselves apart over the issues about which we cannot agree, rather than riding the principles which we share as far as we can take them, beekeepers can make another contribution to a crowded future. We can make friends and take them for what they are, and make other friends for different goals. We could do a lot worse than joining up with people who plant stuff and mind the soil and the water in the best way they know how. A healthier place for people is probably a better place for bees.

Toni Burnham keeps her bees on rooftops in the Washington, DC area where she lives.

> If you don't have a seat at the table, then you're probably on the menu.
>
> Elizabeth Warren

SELLING HONEY



People keep bees for a lot of reasons, and only one is to have them make money. We didn't say honey here because many, maybe most of us small scale beekeepers enjoy sharing this delicious, hard-won product of our bees with friends, family and special people in our lives. Especially other beekeepers, because, you know, even though their honey is really, really good – ours is so much better.

But at some point things may change. After a couple three years, after you've gotten the hang of this hobby, one harvest you'll find you have much more than you can give away, so then what? Or, after sinking what seems like more money that you ever thought possible into more hives, more bees, more, more, more – somebody at home will remind you that not too long ago you actually said that beekeeping could actually pay for itself. So now, beekeeper, it's time your bees start earning a living.

So, three questions. What do you sell, who do you sell it to, and how much do you sell it for. The chart on this page pretty much lists anything you can sell that's made in a bee hive, except propolis, which isn't commonly sold by small scale operations like ours. But it starts out with bulk honey in barrels (a gallon of honey weighs 12 pounds and there's 55 gallons in a standard honey barrel, which will come in at right about 660 pounds, plus the

	2016 Monthly Averages											
	January	February	March	April	May	June	July	August	September	October	November	December
EXTRACTED HONEY PRICES SOLD BULK TO PACKERS OR PROCESSORS												
55 Gal drum light /lb.	2.14	2.20	2.22	2.24	2.21	2.31	2.19	2.17	2.26	2.27	2.16	2.19
55 Gal drum ambr /lb.	2.09	2.08	2.14	2.11	2.10	2.20	2.06	2.08	2.18	2.12	2.10	2.06
60# Drum (retail)	189.23	204.84	203.68	203.88	200.91	200.46	203.74	208.34	218.59	205.81	209.50	203.63
60# Amber (retail)	189.73	204.35	205.40	201.12	197.16	201.83	200.47	204.07	217.64	202.48	205.87	202.11
WHOLESALE PRICES SOLD TO STORES OR DISTRIBUTORS IN CASE LOTS												
1/2# 24/case	80.43	83.82	81.16	84.97	77.67	83.00	80.42	79.06	81.37	83.08	84.29	84.80
1lb# 24/case	117.20	119.04	115.81	118.83	118.50	119.48	119.27	117.58	119.60	124.28	124.70	127.53
2# 12/case	105.03	106.11	104.07	108.33	105.48	108.54	110.42	104.40	104.49	110.67	107.07	117.04
12oz. Plas. 24/cs	92.92	97.15	96.23	97.76	92.91	97.84	95.06	95.91	96.47	99.08	95.91	99.48
5# 6/case	121.70	119.11	118.60	121.16	116.61	122.75	117.16	115.92	120.86	129.45	130.13	125.49
Quarts 12/case	138.59	138.22	140.00	141.24	140.01	144.41	135.48	142.72	141.21	149.32	141.63	142.72
Pints 12/case	89.15	91.32	90.37	87.87	89.98	90.44	83.11	91.05	91.70	91.94	87.25	89.21
RETAIL SHELF PRICES												
1/2#	4.30	4.49	4.42	4.36	4.24	4.57	4.57	4.20	4.44	4.55	4.61	4.74
12 oz. Plastic	5.35	5.43	5.48	5.38	5.32	5.73	5.64	5.67	5.75	5.83	5.53	5.75
1# Glas/Plastic	7.01	6.98	6.94	6.93	6.88	7.40	7.11	7.11	6.89	7.20	7.30	7.75
2# Glass/Plastic	11.59	12.16	11.73	11.75	11.90	12.31	12.03	12.02	11.59	12.35	11.97	13.03
Pint	9.67	9.65	10.73	9.73	9.65	10.61	9.91	9.91	10.43	9.84	9.67	9.84
Quart	16.14	15.92	16.00	16.10	16.35	16.76	15.82	16.48	16.63	16.72	16.89	17.13
5# Glass/Plastic	25.81	26.45	25.07	26.16	25.92	26.88	26.22	26.71	25.84	26.80	26.52	27.74
1# Creamed	7.80	8.56	8.28	8.41	7.97	8.33	9.17	8.25	8.64	8.86	8.79	8.68
1# Cut comb	9.40	10.79	10.70	10.88	10.63	10.65	10.67	10.61	9.63	10.75	10.96	11.08
Ross Round	8.36	9.92	7.77	8.73	8.75	8.74	8.70	8.10	8.90	8.94	8.84	9.68
Wholesale wax (Lt)	5.75	6.04	5.84	5.82	5.82	5.93	6.35	6.31	6.09	6.16	6.27	6.17
Wholesale wax (Dk)	5.09	5.23	5.47	5.39	5.60	5.21	5.42	5.61	5.60	5.58	5.60	5.60

weight of the barrel), and five gallon pails (60 pounds of honey, plus the weight of that plastic pail) that are sold to specialty food processors (typically called honey packers), or other beekeepers who then bottle your honey and put their label on it. Then it moves to the typical sized cases that are sold at wholesale prices to places like grocery stores, specialty markets, gift stores and the like, and finally the retail prices of each of the containers and types of honey, and even wax sold by individuals – perhaps by the grocery store you sold that case of honey to, or it may even be your price if you sell direct to a customer at a farm market, at work, or out your back door. That answers the first two questions – what do you sell, and who do you sell it to.

But for how much you ask? Well, our sister magazine, *Bee Culture*, features a Monthly Honey Report that shows the prices for each of these products every month in each of the seven regions shown on the map. Then, it takes the prices from every region and finds the average price across all regions for that month. So what the chart shows are those monthly averages for all regions for every month. We agree that an average of an average is less that spectacular data, however, the trends they show are very telling in what the honey market is doing across the country. You'll note some prices gradually increase over time, some stay the same while others actually decrease.

Overall, wholesale prices for honey rose about 5% for the year, which is just a little above the cost of living increases we experienced in most places, so selling honey seems to be a profitable way to both make money, and move that extra honey. Retail prices were just a tad above that, while bulk prices stayed flat. The reason bulk has stayed flat all year is because of the big influx of inexpensive imported honey, mostly from Vietnam and India and South America, keeping bulk prices lower than one would expect. One factor to consider, however, is that only 20% or so of the honey consumed in the U. S. is produced domestically (yes, we import just under 80% of the honey consumed here), and much of that is direct, local retail sales, which normally command a slightly to significantly higher price than poorer quality, bulk imports.

For reference, a quart jar holds three pounds of honey, and a pint a pound and a half of honey.

CATCH THE BUZZ

New Loans Available For Small, Beginning, Urban Growers

USDA announced the availability of a streamlined version of USDA guaranteed loans, which are tailored for smaller-scale farms and urban producers. The program, called EZ Guarantee Loans, uses a simplified application process to help beginning, small, underserved, and family farmers and ranchers apply for loans of up to $100,000 from USDA-approved lenders to purchase farmland or finance agricultural operations.

"Over the past seven years, we have been transforming our loan programs at USDA so that they can be attainable and useful to all kinds and sizes of producers," said Agriculture Secretary Tom Vilsack. "These EZ Guarantee Loans will help beginning and underserved farmers obtain the capital they need to get their operations off the ground, and they can also be helpful to those who have been farming for some time but need extra help to expand or modernize their operations. USDA's Farm Service Agency has offices in nearly every county in the country, and we encourage all farmers, including those in urban areas, to stop in and inquire about this program."

USDA today also unveiled a new category of lenders that will join traditional lenders, such as banks and credit unions, in offering USDA EZ Guarantee Loans. Microlenders, which include Community Development Financial Institutions and Rural Rehabilitation Corporations, will be able to offer their customers up to $50,000 of EZ Guaranteed Loans, helping to reach urban areas and underserved producers. Banks, credit unions and other traditional USDA-approved leaners, can offer customers up to $100,000 to help with agricultural operation costs.

According to the 2012 Census of Agriculture, 75% of all farm operations gross less than $50,000 per year. EZ Guarantee Loans offer low interest rates and terms up to seven years for financing operating expenses and 40 years for financing the purchase of farm real estate. USDA-approved lenders can issue these loans with the Farm Service Agency (FSA) guaranteeing the loan up to 95%.

USDA is providing a 90-day period for the public to review and comment on program improvements. To review program details, visit www.regulations.gov, reference RIN 0560-AI34 and follow the instructions to submit comments.

More than half of all FSA loans go to new farmers and more than a quarter to underserved borrowers. FSA also offers loans of up to $5,000 to young farmers and ranchers through the Youth Loan Program. Loans are made to eligible youth to finance agricultural projects, with almost 9,000 young people now participating. More information about the available types of FSA farm loans can be found at www.fsa.usda.gov/farmloans or by contacting your local FSA office. To find your nearest office location, visit **http://offices.usda.gov**.

All About Her Majesty The Queen

Larry **Connor**

Before obtaining the first bee colony, the future sustainable apiculturist must master key aspects of bee biology. Here we look at the activities of queen bees.

Queen Bee

Queen Activity, Behavior and Lifespan

When everything is working in a colony there is usually just one queen bee. This queen is a female bee that has been selected by her sister bees and is the only female bee that is fully reproductive. The queen is sexually active during the early part of her life, mating with multiple drones before spending the rest of her life laying eggs.

Worker bees feed and groom the queen, as well as take care of her waste products. She produces odors, chemical signals called pheromones and which we also call the 'queen substance' or 'queen signal'. There may be a link between the number of eggs a queen lays and the amount of these chemicals she produces.

Who Decides Queen Activities?

New beekeepers often assume that the queen bee is in charge inside the hive, but she has no such power. In fact, the queen is chemically reactive to the needs of the entire colony. Queen feeding, waste removal, and her eventual supersedure replacement are all the results of the collaborative decision-making nature of worker bees. These decisions are based on chemical information (feedback) the bees receive from the body of the queen. She also produces eggs that hatch into larvae and pupae. This is the brood. Both open and sealed brood influence worker bee behavior. The queen decides very little.

A queen pupa in her cell, just before emerging.

Developmental Time and What it Means

Queens are one of two female castes of bees found inside the hive, the other caste being the worker bees. Queens and worker bees develop from apparently identical eggs that are deposited into cells by their mother queen following successful mating with multiple drones. These eggs have two sets of chromosomes, making them diploid individuals. Worker bees are unable to mate and, in queenless and broodless situations, produce eggs with a single set of chromosomes. These become drones. Both queens and worker bees produce haploid bees.

Queen bees have the shortest developmental time, running 15.5 to 16 days from the time the egg is placed into the cell to the new queen's emergence from her queen cell. Some strains have shorter developmental times; African queens are known to develop in just 14 days.

Once a queen emerges from the cell, she will feed herself and is fed by nurse bees inside the hive. After a week or so, the queen will make orientation flights, then mating flights, coupling with 12 to 20 different drones. After several days of grooming and feeding by nurse bees inside the hive, the queen will start to lay eggs into worker cells which have been emptied and polished by the bees in the brood nest. Once she begins laying eggs, the queen does not mate again. Any shortage of sperm will not be corrected, and the fate of the queen, and her hive, is set.

In Nature, old and inferior queens are replaced through a process called supersedure. This happens when the queen's pheromone and brood production drops to about half of its normal level. Then several larvae are selected, their cells are enlarged, and peanut shaped queen cells are built on the surface of the comb. There are three to nine supersedure cells produced in the average colony, and these cells may be located anywhere on the surface of the brood frame. The production of queen cells requires the contributions of many worker bees. Nurse bees are required for the production of royal jelly, the substance key to the development of new queens. Other bees are concerned with temperature stability to ensure proper queen development, wax secretion and cell building.

Continued on Page 21

Mating, Egg-laying and Sperm Storage

Queens and drones fly on warm and calm afternoons to Drone Congregation Areas (DCAs) where the queen is receptive to the many drones that follow the queen's pheromone plume and dark form against the sky. DCAs may be located anywhere around an apiary, and can be found by careful tracking with helium balloons or kites or radar and lures containing queen pheromone. Mating occurs 50 to 150 feet off the ground, and are thus rarely seen by humans. These are often associated with geographical 'edges.' Tree lines near a field, bottoms of hills, openings in heavily wooded areas and the like.

Once laying, queen bees in the wild produce about 150,000 eggs per year and depend upon two large ovaries that nearly fill her abdomen. The ovaries are made up of about 370 thin tubes called ovarioles that produce eggs on a continuous basis. In the peak of the season, a queen will produce about 1,500 or more eggs per day. Favorable weather, food supply and genetic programming stimulate her productivity. Reports of queens with egg-laying rates of 3,000 eggs per day may be a reflection of a second queen in the colony (a mother queen and her supersedure daughter, an event that occurs in over ten percent of vigorous spring colonies.)

Sperm are stored at the end of the queen's abdomen in a clear, fluid-filled sac or sphere located called the spermatheca. This structure is covered with a fine network of breathing tubes, called trachea, that bring oxygen to the sperm stored there. The spermatheca floats in the blood (called hemolymph) of the queen and receives constant nutrition. The spermatheca holds five to eight million sperm, but a failing queen may only have a few thousand sperm and are identified by drone cells within the worker brood pattern in the hive.

Research has shown that when the queen finishes her reproductive flights, her median and two lateral oviducts are filled with sperm. The nurse bees massage her body and remove the surplus sexual fluids, while about 10 percent of the sperm successfully migrate through a spermathecal duct into the spermatheca. In one to four, days the queen will begin to deposit eggs into worker-prepared cells.

Longevity of Queens

Some queens only live a few weeks before the worker bees decide – for reasons we do not completely understand – to replace her with another. Sometimes queens stop laying eggs after several days, and no queen cells are produced from the eggs and larvae in the hive. Other queens produce a good brood pattern for several weeks before the colony replaces her with a daughter.

Once a queen is well-established in a hive, we expect her to remain there for a year or more. Reports of older queens are common, some as old as five years. Commercial beekeepers usually replace queens once a year or once every two years in non-migratory, northern operations. Small-scale beekeepers often keep queens in a hive for a longer time period if the queen continues to perform well for the colony. Bee breeders attempt to select queens that maintain egg laying for as long as possible in an attempt to select for genetic longevity within the bloodline. With selection, breeders keep productive queens for five years.

Behavior of Queens and Workers

As queen cells develop, the fully formed adult queen confined inside the queen cell produces some of the chemicals that make up part of her queen substance (pheromones). Worker bees surrounding the queen cell to keep it warm and remove the wax tip of the queen cell to expose the silk cocoon tip. It is widely thought that the workers will keep these cells under close surveillance, monitoring the development of the queen inside the cells. When the queen is ready to emerge, she will use her sharp mandibles to cut her way out of the cells. Almost immediately, she will move to other queen cells, her sisters, and chew a hole into the side with her mandibles and sting the queen inside the cell. Worker bees do not interfere with this behavior, but will remove the dead queen and her cell.

Sometimes supernumerary queens are produced in a colony and held hostage inside their cells until the bees determine the proper time for their emergence. The worker bees add beeswax to the incision the queen makes to cut herself free from the cell. While preventing her emergence, the workers carefully feed such queens to keep her healthy.

Newly Emerged Queens

After a newly emerged queen has finished killing her sisters, she moves rapidly over the combs. She does not produce as much pheromone as she will when she is a laying queen and, for the first twelve hours or so after emergence, her odor level is quite reduced. After 12 hours her queen substance production is enough for the workers to respect her as an unmated queen and to attract drones to her in the DCA for multiple mating.

Some beekeepers try smoke, strong odors and other techniques to introduce virgin queens. These may work under certain conditions but, as a general rule, virgin queens should be introduced in a queen cage with a candy release plug. This candy can be a mixture of honey and powdered sugar or common baking fondant. Virgin queens are able to fly and may escape while being handled, unlikely to return to the hive. Though a virgin queen is unmated she is a queen and is producing the pheromones and she should be treated as a queen by the hive. I place the virgin queen in a cage for three to five days before I allow the bees to remove the candy for liberation!

Virgin Queens at the Time of Mating

Worker bees may fly with the queen when she leaves for the mating flight. I have not learned of a reason for this mating swarm, but it is common in other social insects – perhaps it is a method of increasing security against predators. Back at the colony, there is a change in the

Continued on Next Page

behavior of the house bees while mating is underway: where bees had been storing pollen and nectar, they remove these products and polish them as a place for the queen to lay. Even the sharpest-eyed beekeeper may not be able to find the virgin queen before her abdomen starts to swell with egg laying (This is a hormonal response to the mating process.) Once mated, there should be a large area of polished brood cells for the queen to use. From the time of the last mating flight to the first eggs, queens may require one to three days for the hormonal changes and heavy feeding by workers to stimulate egg production.

Newly Mated Queens

From the time she emerges from her queen cell, it takes at least four weeks for a queen to fully mature, mate and start to lay. During this month-long period, it is possible to disrupt the delicate balance between the queen and her colony (remember, these bees are not her daughters but usually sisters). If the queen was introduced to the colony from another hive, she may not be genetically related to the queen and the balance is even more fragile. There are reports of poor introduction and early rejection of queens introduced into unrelated stocks, like putting a Russian queen into a yellow Italian hive. There are undoubtedly genetically determined variations in pheromone production, as well as key queen behaviors that worker bees monitor which we know very little about.

Laying Queens

Once established, a queen only needs to be checked every three or four weeks to make sure she is doing her job. I like to have a queen that is clipped and/or marked so I am able to confirm her bloodline. If you find eggs and young larvae and a nice brood pattern, you have seen evidence that the queen is doing her job. This means you do not need to see the queen on every inspection! For many small-scale beekeepers some colonies may only require a queen check once or twice a year; commercial beekeepers rarely check their queens.

Grand Old Ladies!

Many beekeepers develop favorite queens and want to keep them forever. Other beekeepers want to have a set schedule of queen replacement. I view older queens, those two years or older, as Grand Old Ladies. In breeding programs older queens get special respect when they continue to produce a quality brood pattern and a gentle, productive, winter-hearty hive in their third and fourth season. She can be converted over to drone production if she is not used for grafting to introduce longevity traits in your apiary – stock development is a never-ending challenge in beekeeping.

Sometimes beekeepers move older queens into smaller hives and keep an eye on them and use them for grafting. A two-deep five-frame nucleus is great for this. The older queen can be used to establish a five-frame nuc and then a super added as the colony expands. If the colony gets too strong, remove a frame of graftable larvae and give it to someone who is producing queen bees. This reduces the population of bees, spreads good genes to other colonies and keeps the older queen in balance with her reduced egg laying. Pull out frames with supersedure cells and make increase hives with them to keep her genetics in your apiary. This is part of the Sustainable Art of Beekeeping

that provides me with so much satisfaction. Letting these Grand Old Ladies die a natural death seems like a fair trade for a number of highly productive seasons. It has nothing to do with being a business person, but says a great deal about your appreciation of genetic diversity, longevity and productivity.

Consult ***www.wicwas.com*** *for the latest quality books on beekeeping.*

Believe It Or Not –

Honey Bees & Humans Mimic Each Other

Robert Weast

Have you ever wondered who so many thousands – maybe even millions – of people are fascinated with honey bees? There are probably hundreds of different reasons: They are fun to watch and study; they are wax builders, prodigious honey producers, and pollinators of one third of our food. The bee colony is an ever changing living organism – a dynamo of energy and industry – always and forever interesting and a constant and always unending challenge. And it's fun to become an "expert" answering the public's many questions.

One thing that struck my mind was that the behavior of honey bees parallels human activity in its many, varied aspects. When you think about it, there are dozens of similarities between bees and their keeper guardians. Here are a few:

Kick the bums out. When the breeding season is over, drones become worthless and they are expunged, dragged from the colony and left to starve. Families, too, sometimes have ne'er-do-wells sponging off them – serial loafers. They eventually kick them out of the house as well.

Killing the queen. Bees sometimes smother their queen by forming a tight ball around her, such as when they refuse to accept her as a new introduction by the beekeeper, or when the hive is disturbed she becomes nervous and runs over the combs. Killing queens is nothing new. In the 16th Century King Henry VIII beheaded two of his six queen wives.

Suicide bombers. Honey bees dive towards intruders, be it the beekeeper, bear or whatever else. After stabbing the victim, the embedded barbed sting becomes ripped from their bodies, no doubt causing excruciating pain, enraging them all the more. Death quickly follows.

In World War II, Japanese kamikaze pilots dove at U.S. warships and blew up the ships and themselves. The difference from the hapless bees is that kamikaze pilots knew in advance they were on a suicide mission. I used to think, "How unbelievable! Pilots deliberately commit suicide!" But today, it is common for terrorists in the Middle East to blow themselves up among the innocent populace.

One queen per abode. A bee colony will tolerate no more than one queen, with rare exceptions. When two queens are present they enter mortal combat, or the bees themselves may "do one in" – one queen per colony. In households, a teeny bopper daughter may challenge her mother, but usually the mother reigns as the sole queen of the family. The unwritten rule prevails: One queen per family.

Guard duty. Sentinels are stationed at the entrances of hives and attack intruders, threatening, grappling and stinging them. Guards are everywhere in society, from the colorful Queen Guard at Buckingham Palace to those of the ceremonial

Swiss Guard of the Vatican, to guards in all walks of life, from banks to the armed services, to guards for presidents and the pope. Bee guards are armed with stingers; people guards have guns and sometimes spears. Guards are ubiquitous.

Home hunting. Bee Scouts roam the countryside to look for a new abode. They report back to the waiting clustered swarm and by dancing they offer several possibilities. The swarm eventually chooses one, takes flight and moves in with carefree abandonment. They actually seem to be happy. People hire real estate agents who scout neighborhoods to help find a new home. With cheery

Continued on Next Page

enthusiasm, they tell clients of promising leads. After looking several over, the new owners move in to the one of choice with excitement and delight.

Drifters. Bees, on their first maiden flight, or those just released from their packages, frequently drift to the nearest, most busy hive because they haven't yet oriented themselves to landmarks. Their lack of nervous, sneaky behavior gains them easy entrance to any of the adjacent colonies, especially those with numerous bees in flight. Strong hives become stronger and the weak become weaker. Human drifters wander aimlessly, sample and explore towns and locales of all sorts. Some even sneak into houses not of their own. They are invariably not welcome, to say the least.

Dancing in the dark. In 1927, Karl von Frisch, in his epic work, "The Dance Language and Orientation of Bees," demystified the wagging and circle dance of the honey bee, interpreting how the bee reckoned and communicated distances of nectar sources to other workers. In 1958 Chubby Checkers created the Twist dance, an exuberant wiggle of fannies and shimmering hips on the dance floor. The happy, smiling dancers communicated fun and excitement.

Preparing honey and syrup. When bees bring in fresh nectar it has a high, excessive content of water, which needs to be removed. By fanning air across the open combs, the excess water is evaporated. When men or women collect sap from maple trees, it too, has excess water which must be removed. The watery sap is boiled until the correct viscosity is achieved to produce delicious maple syrup.

Cleaning house. Bees use their mandibles to glean debris from their hives and then take flight and drop the refuse. Bees also polish their hives by "scrubbing," by moving back and forth. People scrubbed clothes with washboards and today use washing machines, brushes and brooms. They carry their debris outside into garbage pails and dumpsters.

Nursing. Nurse bees feed royal jelly, plus two other ingredients, to young larvae for their first few days. Nutrient rich jelly is produced by their hypo pharyngeal glands. Nursing human mothers start newborns on nutrient rich mother's milk, produced by their mammary glands.

Orientation. Bees use landmarks, trees, shrubs and topography to locate their hives. They also use ultraviolet and polarized sunlight for navigation and for communication of food sources. Before the advent of electronic wizardry, ships, pilots and landlubbers used landmarks, coastlines, compasses, the sun and stars, sextants and dead reckoning to find their way. Today, advances include the amazing GPS, global positioning satellite systems in vehicles. Nonetheless, people still include some landmarks in their search quests.

Home construction. Bees are wonderful architects producing pure white combs of wax. They instinctively gorge themselves with honey which produces little platelets of wax scales which they masticate and manipulate into hexagon cells. Men and some women are wonderful carpenters producing beautiful edifices. After eating a hearty breakfast they construct homes, piece by piece from lumber and many other materials.

Kissin' cuzins. Honey bees and humans share alike the popular nomenclature of race. The origin of bees is Europe, Africa and Asia, but named races, i.e., Italian, Caucasian, Carniolan, German, (black bee) Russian, African, Syrian and numerous others, including those of Southeast Asia, are, many times, named after their locales. Most of these races have been bred and developed (and improved?) by beekeepers.

Storing food. Honey is stored and preserved in sealed combs to prevent it from being walked on. People preserve fruits and vegetables in sealed jars to keep moisture and debris out.

Wrestling. Rival queens wrestle and fight in deadly combat until one stings the other. Lady wrestlers put on a show and fight in feigned, usually harmless combat, for the enjoyment of spectators.

Air conditioning. Bees deposit water in their combs and then fan their wings to evaporate the water to cool their hives. People use fans and air conditioners, and some residents in desert areas have roof top air conditioners which use the cooling effect of water dripping through fibers. A fan blows the cool air into the house below.

Heating systems. During the cold of Winter, bees form tight clusters, generating and preserving heat. Even during the throes and depth of a cold January in northern states, outdoor temperatures might descend to zero degrees, but through metabolic processes, the temperature within a cluster can rise to 93-96°. At that temperature the queen begins to lay and brood is reared during January and February. People select wood, coal, oil, gas or electricity to heat

their homes, and with a thermostat, temperatures can be regulated and kept constant.

Sealing cracks. Bees gather propolis from sappy tree buds to seal cracks and holes in their hives; people seal cracks and holes in their homes, using caulking and weather stripping.

Shopping. Bees gather nectar from flowers for food; people gather food from their gardens.

Ladies in Waiting. Notice how worker bees circle, fawn, primp and preen their queens. In times past, in castles and courts of royalty, Ladies in Waiting did the same circling, fawning, primping and preening over their queens and princesses.

Robbers. Strong colonies will attack, plunder, rob and decimate weak hives, till not a drop of honey remains. In the 1930s, Bonnie and Clyde were notorious bank robbers, who attacked and plundered weak, vulnerable banks for their infamous capers, taking all the money.

Weapons. Bees use stings as their attack weapons. A single bee sting usually does little harm, but massive attacks from Africanized bees can sometimes prove fatal. Nature abounds in creatures that have poisonous venom. Attacks by the Black Mamba snake of Africa and the Sea Wasp jellyfish of the South Pacific are fatal; the Gila monster lizard of southern Arizona and Mexico and the Black Widow spider can cause severe pain.

One wonders why it is an advantage for the honey bee to possess a barbed stinger, after all, to sting is a sure road to death. Wasps, hornets and bumblebees can sting more than once, as their stingers are not barbed, but if they were barbed and caused death, the loss to the small nests, especially when they are getting started, would be significantly harmful. However, the loss of a dozen or so honey bees in a single attack does not at all effect the overall welfare of the colony, which numbers in the thousands. The loss of stinging honey bees is expendable. The reason that bees have barbed stingers that become pulled from their bodies is that their stingers have muscles attached to them that continue to pump venom into the wound, which ultimately produces a maximum dose of poison. Moreover, even after the bee is mortally wounded it will continue to harass and scare its victim. Some native tribes use spears, bow and arrows and blowguns through which poisonous darts are blown.

Does Might Make Right? On occasion a swarm may invade a weak colony, overwhelm it, take over and sometimes kill the workers and their queen. This phenomenon seems endemic to the human condition beginning with primitive tribes to present day warfare nations: Strong warriors invade and overcome weaker adversaries. Peace is elusive.

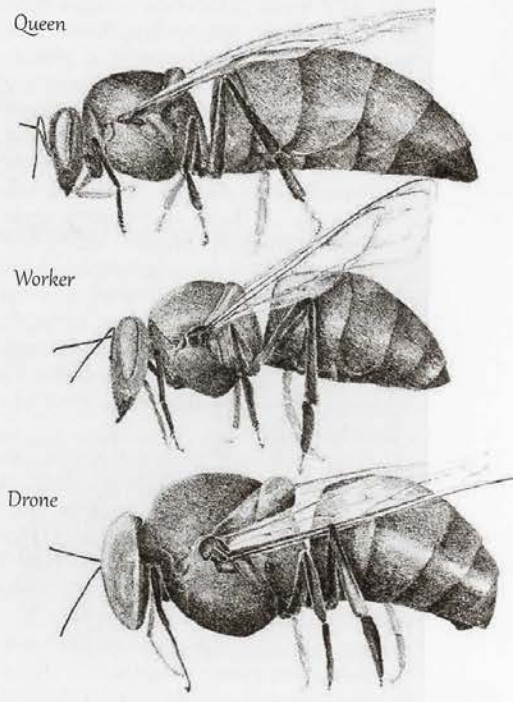
Castes. Honey bee castes consist of queens, workers and drones, each with different duties and each with distinct body types. Ant castes include formidable soldiers with large mandibles that plunder other ant nests. The human caste system, that of social stratification, still exists in several world cultures, such as in India, which includes the lowest caste called the Untouchables.

Peaches 'n Cream? Not all behavior is benign. Bees don't tolerate imperfection and will jettison their crippled sisters. Should a worker emerge with incomplete or crumbled wings, she will be hauled out of the colony and left to starve. Hitler did the same with people he considered inferior and had them gassed.

Parasites. Bees have mites, moths and mice and that spells real trouble. People have lice, fleas and bedbugs, and that spells itching.

Dysentery. Bees get this affliction after consuming inferior stores. People get dysentery from a pathogen which infects their lower intestine, or, from eating inferior food.

Loafers. During arid Summers, when no nectar is coming in, entire hives may simply go dormant; the workers just "hang out" and the queen stops laying. The drones of course, provided they are not evicted, free load as usual. One breeder, through selective, intensive inbreeding, produced a strain of beautiful golden yellow workers; he predicted and warned me they would simply would stop working after they reached a certain number. He was so right. They were almost queen-like Italian in their purity of yellow but lacked genes that would induce work. The entire hive simply loafed and did nothing. Some people are like



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that. They don't have the work ethic, but simply sit around and watch the world go by. A human loafer might be a relative who just sleeps all morning, sits around watching TV all day and raids the refrigerator at night.

Keeping cool. When a hive becomes crowded during the hot, dry, torrid days of Summer, many of its bees will cluster outside of the hive to keep both themselves and the interior of the hive cool. Before air conditioning became popular, people would do the same thing: Entire families would sit outside on gliders and swings, or sit on the steps of their front porch to keep cool.

A Fanciful dialogue. In the 1942 movie "Tortilla Flat" a doctor asks young Alfredo what he had for breakfast. "Tortillas and beans." "What do you eat at noon?" "Tortillas and beans." "At night for supper what did you have to eat?" "Tortillas and beans." "Is that all you eat, tortillas and beans?" Alfredo replies, "Sure. What more do you want?"

Jimmy Cricket asks Sue Bee what she had for breakfast. "Honey." What do you eat at noon?" "Honey." "At night for supper what did you have to eat? "Honey." Jimmy Cricket can hardly believe what he is hearing. "Is that all you eat, honey?" Exasperated, Sue Bee replies, "Sure. What more do you want?"

In many ways honey bees are a reflection and mirror of ourselves. For better or worse, is it any wonder that we admire the honey bee?

CATCH THE BUZZ

So, How's Your Schlumbergera?

Embarrassing question? Too personal? Not at all – I'm just asking about that cascading plant so many of us have in our homes – the Christmas cactus. 'Tis the season, and I thought a word or two about this popular houseplant might be in order.

It seems there is a lot of confusion and even irritation about this plant, usually stemming from the fact that, originally bought to bloom at Christmas, it insists on blooming at some other time entirely. Perhaps that is because what you actually have is a Thanksgiving cactus – or even an Easter cactus. First of all, don't think of these as "desert style cactus." Called epiphytes, they are really natives of the cool mountainous reaches of Brazil and live in conditions similar to what orchids like: shade and high humidity. They are often found in the forks of tree limbs, growing in the litter that accumulates there.

The genus Schlumberera includes both the Christmas cactus and the Thanksgiving cactus. The Easter cactus is in the genus Hatiora. So which one(s) do you have? Schlumbereras bloom white, pink, yellow, orange, red or purple. Hatioras have vivid scarlet blooms. Hmmm, not clear yet, right? Okay, Schlumbergera can be further divided by the color of pollen and stem segment shape (none of the plants have true leaves): those with yellow pollen typically have segments with pointed teeth and bloom earlier (can we say Thanksgiving?) than those with pink pollen and segments that are more rounded and symmetrical. (Think Christmas.).

Well, we could think that back in the early 1800s before hybridizers got into the act and began crossbreeding. By the 1860s, a large number of cultivars were available with a number of habits and flower colors. Collectively they were given the name Schlumbergera in honor of Frederic Schlumberger, a French collector. Easter cactus was included in the group at that time. Looking at my own: the two large ones both have rounded segments, but they are distinctly different shapes. One blooms light pink, the other dark. In the kitchen I have two little ones which for years have refused to grow much at all, have white blooms and pointy segments. All of them bloom quite randomly whenever they darn well feel like it!

I will say in my own defense that I do try to care for them properly. It's not hard: any container soil will suit them but it needs to be well drained. They do want humidity, which you can achieve by filling a waterproof saucer with gravel then adding water to about half way up the gravel. Set your container on top, being careful not to have the pot sitting in the water, incurring root rot. Water thoroughly, then allow the top inch of soil to dry before watering again. Your cactus wants indirect sunlight and dislikes drafts. Feed with low nitrogen (the first number) liquid houseplant fertilizer from April through September. In warm weather you can set your cactus outside in the shade, but bring it back in when nights go down into the 50s. A word to the wise: it likes being crowded: don't be in a hurry to re-pot.

Now, do you really want your cactus to bloom for a specific holiday? I have long ago made peace with this option, since the process is almost as picky as that for poinsettias. But if you must – A period of about 8 days with 16 hours of darkness at 61° has been shown to cause flower buds to form. Even streetlights or car lights at night can interfere with the process, so that sounds like a closet to me. Then you encounter the problem of bud drop off the plant. My kitchen duo are famous for that. Lack of humidity, insufficient light, too much water – or not enough – can all cause it. Frankly, I just don't worry about it. When we do get it right, what joy! What rejoicing! Serendipity!

Take Advantage Of

BEEINFORMED PARTNERSHIP

The best beekeepers keep the best bees. Declining honey bee health does not always have a single cause or a single solution, but putting the best tools, techniques, and technologies in the hands of the people on the front lines – the beekeepers – makes a huge impact.

The Bee Informed Partnership has been working alongside beekeepers on the front lines for over five years. You may know us for our annual Winter Loss report or National Management survey, but the greatest asset of the Bee Informed Partnership is undeniably our Technical Transfer Teams.

Our teams of highly trained honey bee experts work closely with commercial beekeepers in the field to share best practices, monitor and sample colonies over time, and provide near real-time diagnostic data. This data helps beekeepers make informed decisions about treating hives for diseases and prevents unnecessary losses. ***All told, commercial beekeepers working with us lose 35.6% fewer colonies annually than their counterparts who are not serviced by our teams. For the typical 2,000 colony operation this means that our beekeepers, on average, save almost 300 colonies per year - a savings conservatively estimated at $74,000.***

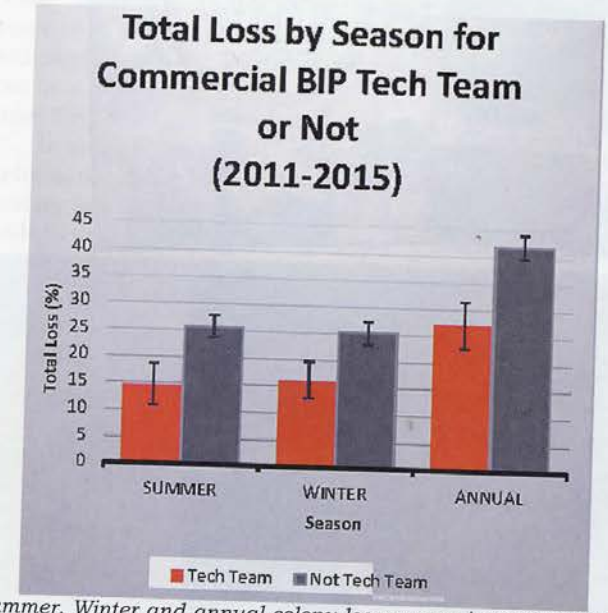
Healthier colonies in orchards and on farms mean that less disease is spread to neighboring colonies. We think this is a win-win for everyone. From backyard beekeepers to large-scale commercial operations, the Bee Informed Partnership offers several ways for beekeepers to participate and gain value from our research. But we can't do it alone.

We began over five years ago with a USDA/NIFA grant to monitor colony loss, management practices, and to start a single Technical Transfer Team in northern California. The grant has ended but the work continues. Now an established 501(c)(3) non-profit research organization, the Bee Informed Partnership has expanded to include five Technical Transfer Teams based in California, Oregon, Texas, Florida, and Minnesota and our outreach efforts and management results can be found on our highly utilized website. We want to keep growing and we see a great need for our services. Our teams are making a difference across the country every day, and we need your help to support their efforts and expand our reach.

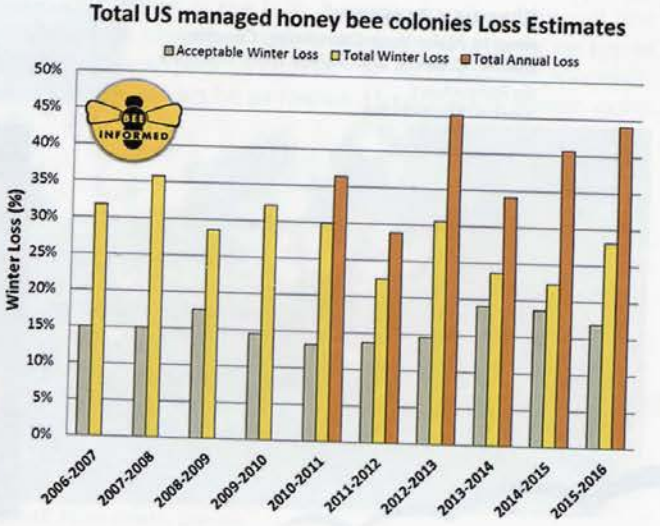
The success of the program has created demands beyond the scope of our existing funds. To scale our impact, we're launching a crowd funding campaign to raise 50K, a small portion of the funds we need. You are uniquely positioned to support our cause. As a beekeeper or general honey bee enthusiast, you can help expand the Technical Transfer Team program and ultimately improve honey bee health to safeguard the food supply.

Visit **beeinformed.org** to learn more about our work and get involved.

Karen Rennich
And the BIP Tech Team



Summer, Winter and annual colony loss comparison of BIP TTT participants versus those who are not participating. Data from years 2011 (start of BIP) through 2015.



Southern Spring

Ann **Harman**

January is a quiet month for actual beekeeping unless you are a big commercial pollinator. Then you are getting your bees ready to travel to their first crop. No matter where you live the queen will be increasing egg laying in preparation for Spring. Just when does Winter become Spring? Well, that depends on where you live. During these months in a cold climate you are watching snowflakes flying with the Winter wind. In the warm climate of the South you are watching honey bees flying in the warm sun. So let's leave wooly sweaters and warm gloves behind and go South to watch the bees flying and see what they are doing and consider their plans for the next three months.

If we follow the South from East to West we will find the African bee in Florida as well as our European stock bee. As we travel west we may encounter only pockets of the African bee until we reach Texas and westward. In this region the African bee is well-established. The African bee does require a different approach to beekeeping from that with European stock. More about the African bee later.

In general throughout the deep South something can be found blooming every month of the year, even if it is only the ubiquitous dandelion. Brood rearing does decrease from October into December but the queen never really stops laying. She was just not yet laying as many eggs as in the Spring months. As January arrives brood increases. Swarms can appear in February but in many places early March can be considered peak season. If you plan to collect swarms, either from your own hives or from your area, have your swarm-catching equipment ready. If this is your first swarm-catching season perhaps you can find a more experienced beekeeper to help you. Although you may be determined to catch a swarm it may not be a wise idea if it's 35 feet up in a swaying evergreen tree. You don't want to risk injury – your bees need you!

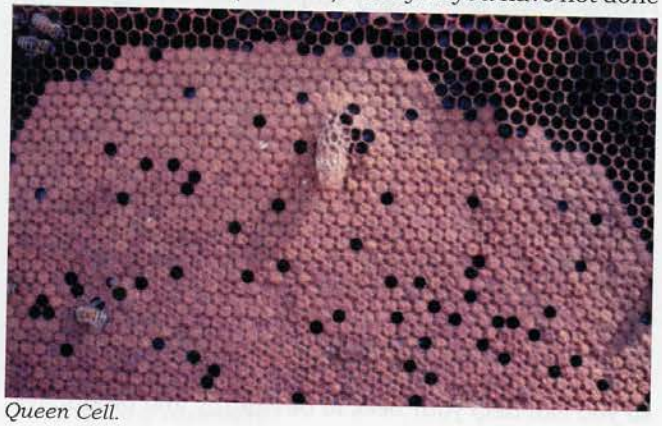
In some areas you will want to start looking for queen cells during February. Although these are signs that your colony is planning to swarm, you can use these queen cells to make a nuc (nucleus) colony. If you have not done this before you may wish to have a mentor help you select the frames to put in the nuc and also to remove and install the queen cell from the original colony.

At this time of year you need to be a good Plant Watcher. In these warmer areas of the country bee plants will be blooming. Have you learned what the bee plants are around you? You do need to be a member of your local beekeepers club because there is where you will find information for your locality.

Beekeeping books are good for information but some might have a bias toward the large temperate part of the United States. Here in the South, especially in Florida, the climate is approaching sub-tropical in temperatures throughout the year. General lists of garden plants for bees may need to be modified for your locality. Fortunately field guides to wildflowers indicate where various plants grow. With the help of your club members you can make your own list of pollen and nectar plants in your bees' forage area. Maybe your club already has a useful list. There's another good reason to belong to a local club.

The main nectar flow does depend on the area of the South. For some beekeepers in the Gulf states it can start in mid-April and continue into June. At one time large crops of honey could be made from citrus in Florida, Texas and California. However with the advent of the citrus greening disease vast acreages of citrus trees have died. So the amount of orange blossom honey has decreased. Cotton is one of the main agricultural crops and a good crop of cotton honey can be made. At one time cotton fields were heavily treated with an array of pesticides. However the cotton itself and the pesticide schedule has changed in recent years making cotton a more desirable crop for honey production.

Throughout the year colony size in the southern tier of states may not approach that of colonies in temperate and cold areas of the U.S. A common size of hive is one deep brood chamber with a medium hive body on top of that. Honey supers, of course, can be of any size you wish. Winter stores can be as low as 25 pounds of honey, quite



Queen Cell.

Small Hive Beetle larvae.

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Varroa.

Africanized Honey Bees.

adequate when forage is available 12 months of the year.

Since the soil in the South tends to be sandy, the small hive beetle (shb) can be a very serious pest in the eastern part. The sparse rainfall of the desert part of the southern states does not provide the damp soil necessary for the beetle's pupation. So the desert areas, and also those with African bees, have the least problem with shb. Where shb is a problem, hives will be fitted with several beetle traps. If the hives are not sitting on the ground but are raised up on hive stands beekeepers will frequently put a trough of water under the hive entrance. As the beetle larvae exit the hive quite a number tumble into the water and drown, certainly a cheap and easy help for control. Don't hesitate to apply your hive tool if any shb are seen during hive inspections. If you live in an area where you can keep free-range chickens, you will find they do love to hunt and eat the migrating larvae.

If this year is going to be your first honey harvest, keep the shb in mind at all times. Southern beekeepers quickly learned to pull honey supers off as soon as capped and extract immediately before shb invaded and slimed the honey. The 'honey house' where beekeepers will extract or otherwise harvest their honey must be kept clean. Honey is the attractant for shb so cleanliness from spilled honey is important for all stages of honey harvest.

Varroa is actually the number one pest of bees in the U.S. The problem is not so much the mite itself but the viruses it carries and transmits. With year-around brood production, even if decreased in autumn, beekeepers need to have a plan of monitoring for varroa. The threshold for treatments is finding more than three mites per hundred bees. Monitoring can be done at any time in the South. But opportunities for treatments can be limited. The labels on your chosen miticides need to be read carefully for the safe temperature range during use. That means the entire time a product is kept in the hive. So be a Weather Watcher and keep your bees safe.

Perhaps it is time to see what is happening in Texas and westward – into African bee territory. Here you will find not only a different bee needing a different approach to beekeeping but also different climate in the desert areas with different honeys.

Let's try to use the correct term for the African bee. It is overly *defensive*. Although the term *aggressive* is frequently applied, an African bee out foraging is no more aggressive than a European stock honey bee. The African bee is very sensitive to anything approaching the colony, whether the bees live in a beekeeper's hive or somewhere else in a chosen 'nest site' that could be in a water meter cavity, an abandoned car or an unused barbecue grill in someone's garden.

As such, keeping African bees is more 'let-alone beekeeping' than 'managed beekeeping.' They are unpredictable – one day calm, the next day very defensive. Beekeepers learn how to live with them. The African bee has a strong swarming instinct and may cast swarms at any time. The queens are prolific egg layers so if one or more swarms are cast from a colony, the bees are replaced readily. They are also very good at absconding. If they consider something is not satisfactory with their home all the bees and queen will simply leave, abscond. Sometimes brood and food are left behind.

The African bee does respond to heavy smoking. So a big smoker and plentiful fuel are helpful.

If possible smoke entrance very well and wait a minute or two before opening a hive. That little bit of time allows them to engorge with honey and become more calm. Beekeepers in the African bee areas do produce honey, collect pollen for sale and harvest wax. The African bee can certainly be considered a good honey producer with sufficient forage. Fortunately the African bees do not tolerate small hive beetles or *Varroa* so those health problems are not a major concern.

Some experienced beekeepers try to keep European stock bees in African bee areas by frequent requeening. However this has two problems – constant requeening is expensive and requeening can be difficult. African bees simply do not like European queens to be introduced so an expensive European stock queen can be killed. In addition the African bee is quite clever at usurping a European bee colony. So a hive thought to be filled with European stock bees can, in time, actually be filled with African bees, much to the surprise of the beekeeper.

In Texas and westward the several species of mesquite provide a very good honey crop. Bloom depends on the area and also elevation. In general late May and early June are bloom times but later in the mountains. Texas has different climate areas and bees there do produce a variety of honeys. So it is important to know the honey plants and their bloom times in your particular area to obtain a honey crop.

If you live way up North you are probably reading a good bee book in front of a roaring fire in the fireplace. Your bees, still in Winter cluster, are making their swarm plans right now. So your busy time will come soon. Perhaps one day you might move South where you will be interacting with your bees the year around. Learn your beekeeping area of the U.S. – its climate and its plants so you can help your bees to be healthy and productive.

Get Rid Of Mites

Using Oxalic

Jennifer **Berry**

Years ago at a state meeting in Georgia, Dr. Marion Ellis gave a lecture about the benefits of using oxalic acid for *Varroa* control, and I listened with great interest. At the end of the lecture, someone from the audience posed, "Where does one purchase this 'oxalic acid?'" Dr. Ellis replied, "At your local hardware store. It's wood bleach." From the back of the room, I could hear some of the comments rising over the crowd, such as, "Wood bleach? Is he kidding us?!? I'm not putting wood bleach on my bees. It'll kill them, for sure!!!"

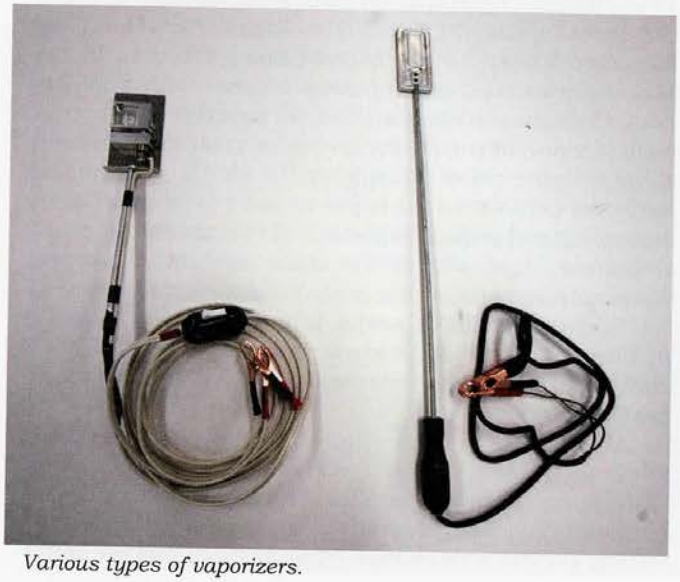
I was right there with them, thinking to myself how horrible it would be for the bees. Afterward, I sat down with Dr. Ellis, and we chatted about the research that he and his graduate student Nicholas Aliano had conducted. They tested various application methods (drip and vapor) and treatment concentrations. Their results showed that oxalic was not harmful to the bees, but that it did do a number on the mites. Following that discussion, we tried it at the UGA bee lab, and we experienced the same outcome. Oxalic killed mites by the thousands! As a result, I started inquiring into getting oxalic acid registered for use as a miticide in the US, but quickly found out it was NOT going to be easy. It hadn't been easy for the Canadians either.

Getting a pesticide approved takes a lot of time and money. It took six years from the time that the Canadian testing was completed for the registration process to move at a glacial pace through the proper channels. But, finally, the Canadian Honey Council officially registered oxalic acid in November 2010.

This brings to mind a conversation I had with Steve Forrest, former president and owner of Brushy Mountain Bee Farm, when he was trying to get Api Life Var (thymol) registered. Not only was there an incredible amount of legwork involved, but, like I mentioned previously, there's also a huge amount of money required for testing, research, data analysis, labor, etc. Fortunately, the company that produces Api Life Var paid the costs and it was successful.

However, this was not the case for oxalic acid – a widely available, generic chemical. Think about it. Now, I'm just going to make up numbers here, but let's say that it costs $500,000 to get a typical miticide registered by the EPA/USDA for use in bee hives. When a proprietary formula is invented, trademarks and intellectual property right protections can be obtained to secure such an investment to get the chemical approved and marketed. But who is going to put up big bucks to have a ubiquitous product approved for use in a bee hive when such an investor would have no control over its ultimate distribution, and, therefore, have no ability to recoup her/his investment? Today, anyone can stroll down to their nearest hardware store and purchase enough oxalic to treat 200+ colonies for just a few bucks.

In the mean time, the bees need our help. *Varroa* mites aren't going away, and, without every safe and effective remedy at our disposal, our bees are suffering. The latest research suggests the economic threshold for varroa is now three mites per 300 bees. In the old days, before the recently introduced viruses, small hive beetles,



Various types of vaporizers.

Popular commercial grade vaporizer.

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The EPA label assures you of what you are receiving and gives you the applicable instructions to follow so that you can safely achieve the results desired without the risks of winging it after watching a YouTube video.

rising stresses from limited nutrition and growing toxin levels in the environment, upwards to 15 mites per 300 bees was considered tolerable.

So, in accordance with President Obama's 2014 initiative on pollinator health, the EPA expedited the review on the registration process for oxalic acid. The EPA collaborated with the USDA and the Health Canada's Pest Management Regulatory Agency to move as quickly as possible on the evaluation of oxalic acid. It takes years to research and evaluate product toxicity, exposure risks, environmental impact and transport-related issues along with effectiveness data. All of these concerns need to be addressed, analyzed and the resulting data deemed accurate and favorable before a product can be registered for safe use in the US. While these assurances are certainly good things, it just takes time - lots of time - which is why the president stepped in and said, "Ok, folks. Let's figure out a way to speed up the process to get beneficial products to those who need them." And that's where Canada helped out. They had already completed the years of testing and, as part of the NAFTA "work share" agreement, they could share their data with the EPA risk assessors and managers to speed up the process; it saved years. We didn't have to re-do all the same research. We built on what the Canadians had already accomplished. And, once all the data was reviewed, the conclusion was that oxalic acid should be registered for use in the US.

Italian queen cage.

What is Oxalic acid? It's an organic acid found just about everywhere in the environment including in plants and vegetables. It is bitter to the taste and irritating to the eyes, mouth and skin. It is a natural plant defense against herbivores. It is also found in honey. Since it is not fat soluble (a lipid), it doesn't build up in wax comb. Back in 1957, it was registered as a pesticide (disinfectant/sanitizer), but, by 1994, the renewal of the product registration was cancelled.

There are risks involved if you plan to use oxalic acid. Given its caustic effect on the eyes, skin and respiratory system, it's labeled with the highest degree of toxicity, "Category 1." So, as with all pesticides, caution must be taken when handling it.

How can oxalic be applied? Oxalic can be applied several ways: drip (trickle), vaporization and spraying. It can be used on existing colonies, packages or swarms. The two most popular are the trickle and vaporization method. The trickle or solution method is taking the acid and mixing it with a warm 1:1 sugar-to-water solution. Next, the solution is drawn into a syringe and 5 ml is trickled (scientific term for "dribbly drop") down the seam between each frame and directly onto the bees; the maximum dose is 50 ml per colony (5mls per seam). It doesn't matter whether it is a nuc or a hive with a single or multiple brood chamber, but reduction in dosage for smaller colonies obviously.

The vaporizer method is only to be used on colonies outdoors. And, what ever you do, do not inhale the vapor! Basically, you use a vaporizer (Figure 1), which is a metal wand with a plate at one end and a cord which connects to a battery at the other end. One gram of oxalic acid is placed on the metal plate. The plate is then slid into the entrance of the colony. The entrance opening and any other cracks and crevices are then sealed with the vaporizer in place to avoid the gas from escaping. Once connected to a battery, the heat from the plate causes the oxalic crystals to melt and turn into a gas (sublime). The vapor will permeate the hive. When it contacts the mites, it kills them. Each vaporizer is different. Some take only a few minutes to activate the acid, while others take a little longer. Since you don't have to open the colony in order to treat, this seems to be the easier of the two methods to implement, especially on cold, rainy days.

You can also spray (mist) packages or swarms. Over the last few years, we've followed this protocol to ensure that we're starting our research projects with mite-free bees. Once the packages arrived, we placed them in a cool, dark location in the lab for 24 hours to cluster the bees. Several hours prior to applying the oxalic solution, we spray the bees with a 1:1 sugar solution to fill their honey stomachs and reduce ingestion of the upcoming oxalic treatment. Next, we mix the oxalic acid in a 1:1 sugar water solution and evenly apply the solution to the bees.

Why use oxalic? It works. It has been used for years in Europe. According to numerous studies, it's 90-99% effective at killing the mites with minimal damage to the bees and brood.

Does trickle or vaporization work better? A recent study at Sussex University examined the effectiveness of different doses and application methods on mite and bee mortality. The experiment involved 110 hives. The results showed sublimation (vaporization) was far better

at reducing mite populations and showed no increase in bee mortality.

Is Oxalic perfect? No – it works on phoretic mites only, i.e., those mites crawling around on the frames or adult bees. The mites breeding under the cappings of the brood cells are unaffected by oxalic administrations, as well as most other miticide products. Therefore, applications are most effective when no brood is present. At beekeeping meetings, when chatting about this product to others, I've heard folks say that they are applying oxalic once-a-week for three weeks during the Summer months while brood is present. This isn't really advisable since it's not very effective (and there's data coming out that shows this) and can be detrimental to the bees. But there may be a way to still treat during the Summer months.

A few months ago, a group of commercial beekeepers came over from Italy to learn about small hive beetles. Apparently the beetles have crossed the border and are starting to be a problem there. During our discussion, we also talked about varroa control and what beekeepers do in Italy. They said that they treated twice-a-year with oxalic acid vapor. They treat once in the Winter when colonies are naturally broodless, and once again in the late summer after inducing an artificial state of broodlessness by caging their queens for 14 days. The cage they use is made out of queen excluder material so the bees are able to take care of the queen plus move QMP throughout the colony to decrease queen cell production (Figure 2). At first, I thought this was nuts, but, after we talked a bit more, it made sense.

The Italians explained that by August or September, the nectar flows are over and the colonies are about to start producing winter bees. If mite populations are high, then the related virus loads that cause winter mortality will be high, as well. Plus, by caging the queen, the foraging population (no longer needed) drops faster, and more colony resources (needed for winter survival) are conserved. Why maintain a pipeline of replacement bees to sustain a large foraging force after the nectar flow is over? A hive full of bees eats regardless of whether or not there is work to be done. So, interrupting the brood cycle not only knocks down the mites (and the viruses vectored) prior to the winter bees being reared, but reduces bee populations as well. Less mites equals improved health, and less bees equals less food consumed; both circumstances contribute directly to improved winter survival. Yeah, I know that it is a bit of work to first cage and later release each queen, but think about the money and work it will save by Winter or next Spring!

Ok. So, now what? Brushy Mountain Bee Farm has been authorized by the EPA to be the sole distributer of oxalic acid for use as a miticide on honey bees. What does this mean? Well, in order for any application of oxalic (in beehives) to be legal, it must have the EPA approval label on it; Brushy is the only distributor registered to use the EPA label. It may seem silly, but it really is there for a reason. If you start searching the internet for oxalic acid application in bees, there's a whole host of information out there on recipes for taking 100% oxalic acid down (wood bleach) to the 2 or 3% recommended application concentrations. Some advice may be sound, but other advice can be reckless and dangerous to you and your bees. Plus oxalic acid purchased at your local hardware store is only 95% pure oxalic acid. The material sold through Brushy Mountain Bee Farm is 99% pure. Certainly, you don't want to get hurt or inflict undue stress on your bees. The EPA label assures you of what you are receiving and gives you the applicable instructions to follow so that you can safely achieve the results desired without the risks of winging it after watching a YouTube video.

Be good to you and your bees.

See ya!

CATCH THE BUZZ

Mylan launches Cheaper Version of Epipen Allergy Treatment

Drugmaker Mylan has started selling a generic version of its emergency allergy treatment EpiPen at half the price of the branded option, the cost of which drew national scorn and attracted Congressional inquiries.

The launch of Mylan's long-promised generic alternative is expected to still generate millions of dollars in revenue for the drugmaker while also protecting its market share against current and future competition.

Mylan says it will charge $300 for the generic version of its life-saving injections, which come in a two pack.

Honey Bee Viruses in Wild Bees: Viral Prevalence, Loads, and Experimental Inoculation

Adam Dolezal , Stephen D. Hendrix, Nicole A. Scavo, Jimena Carrillo-Tripp, Mary A. Harris, M. Joseph Wheelock, Matthew E. O'Neal, Amy L. Toth

Evidence of inter-species pathogen transmission from managed to wild bees has sparked concern that emerging diseases could be causing or exacerbating wild bee declines. While some pathogens, like RNA viruses, have been found in pollen and wild bees, the threat these viruses pose to wild bees is largely unknown. We tested 169 bees, representing four families and eight genera, for five common honey bee (*Apis mellifera*) viruses, finding that more than 80% of wild bees harbored at least one virus. We also quantified virus titers in these bees, providing, for the first time, an assessment of viral load in a broad spectrum of wild bees. Although virus detection was common, virus levels in the wild bees were minimal – similar to or lower than foraging honey bees and substantially lower than honey bees collected from hives. Furthermore, when we experimentally inoculated adults of two different bee species (*Megachile rotundata* and *Colletes inaequalis*) with a mixture of common viruses that is lethal to honey bees, we saw no effect on short term survival. Overall, we found that honey bee RNA viruses can be commonly detected at low levels in many wild bee species, but we found no evidence that these pathogens cause elevated short-term mortality effects. However, more work on these viruses is greatly needed to assess effects on additional bee species and life stages.

Let's Make Candles

Ross Conrad

Candle Making

When thinking of products from the hive, most people will think of honey. Honey, however is simply a by-product of pollination, the most valuable and abundant product that honey bees provide. Beeswax while not produced as abundantly as honey is a byproduct of liquid honey production and is a valuable commodity which should not be wasted.

One of the most common uses for beeswax is to make candles. Beeswax candles are superior candles in that they burn longer and cleaner than other waxes (paraffin and soy). In this article we will explore the process and some considerations that should be taken in to account when making beeswax candles from the beeswax your bees produce.

Clean Wax

The most important thing you will need to make beeswax candles is clean beeswax. Any foreign debris in the wax (honey, propolis or pollen, etc.), will prevent candles from burning properly. The easiest thing to do is purchase filtered beeswax that is clean and ready to go. If you are planning on using hive scrapings, broken combs and capping's wax left over from the honey harvest, you will need to clean the wax first.

Cleaning beeswax is a two-step process. First the wax must be melted down in water. This facilitates the removal of the water soluble contaminants in the wax. The wax is then allowed to cool and harden, the water at the bottom of the pot (now muddy with dirt, honey and who knows what) is disposed of and the majority of the non-water soluble contaminants will have floated to the top of the water and become imbedded in the bottom of the hardened wax block. This dirt and debris should be scraped off with a hive tool and the remaining wax block be allowed to dry, before moving to the next step which is re-melting the wax so that it can be poured through a filtering material in order to remove the remaining impurities. While some folks may use a paint filter, or some other filter for this job, I prefer to recycle my old clothing and use sweatshirt material, fuzzy side up as a filter, both because I think recycling is a good thing but also because I find sweatshirt material works better than paper paint filters. Paper towels, too work well and make excellent fire starters when done.

Do not try to rush the process and skip the first step, since any honey that is mixed in with your wax will easily pass through a filter and the resulting candles will spit and sputter and not burn well at all. Once you have good clean wax, you're ready for the next step.

Selecting A Proper Wick

A properly wicked candle burns cleanly without carbon buildup, evenly without flicker, gives a reliable burn time and, for scented candles, will throw fragrance well. When a candle is under-wicked, meaning the wick diameter is too small for the candle; it will not melt the wax out to the edge of the candle and will instead burn

Continued on Next Page

Dirt and debris that clings to the wax should be scraped off before remelting.

down the middle or 'tunnel.' An under-wicked candle is likely to extinguish itself before all the wax is burned.

When the diameter of a candle wick is too large for the candle, the flame will be too tall and will flicker continually. An over-wicked candle will produce excess carbon as it burns, create a mushroom effect at the tip of the wick, and allow pieces of carbon to fall off into the pool of melted wax at the base of the burning wick. Over-wicked candles will produce wisps of soot or smoke from the flame periodically and will not burn as long as correctly-wicked candles.

Melt the wax again and use a filter to remove impurities. I like sweatshirt material, but paper towels work too.

While most candle making suppliers will provide recommendations when it comes to candle wick sizing, there are many variables that factor into matching a candle with the proper wick such as wax type, fragrance load, dye type, mold or container diameter, etc . . . As with any process, when manufacturing your candles, it is a good idea to always test burn a candle or two to ensure proper wick selection.

When various size candles are being made and numerous types of wick are required, consider labeling the rolls of wick so that they can be easily identified and used for the appropriate candle type.

No matter what size wick you use, I suggest that you consider only using pure cotton wicking. While zinc core wicks are the most commonly used wick type for many kinds of candles (it saves time as it allows for a wick that stands straight when pouring the wax), it may not be the best choice overall. The zinc core inside the wick will slowly burn and release zinc particle into the air. Reports of heavy metal toxicity from people who spend a lot of time around burning candles suggest caution should be taken when choosing a wick type.

The one exception to using 100 percent cotton wicks is when making a candle that sits in a large container. For such a candle, a paper core wick is called for as they burn very hot, and yield a large melt pool appropriate for a large container candle.

Be Sure To Lubricate

If you are not making a container candle, chances are you will be using a mold (unless you are making hand dipped tapers...a topic for another article). While there are a few basic types of molds available from candle supply companies (metal, polyurethane, and silicon), a mold can potentially be made out of anything, including a paper cup, though the cup is usually destroyed in the process. The critical element is making sure that the candle will release from the mold once the wax is cooled. Silicon molds will tend to release easily on their own, but most other molds will require use of a lubricant to keep the beeswax from sticking to the mold. You can purchase mold release sprays or in a pinch, I have found that washing the mold between uses with a natural liquid castile soap, leaves enough oils on the mold after rinsing that candles will slip out easily from a mold. Alternatively, spray on cooking oil can also be used be help keep candles from sticking to molds.

Do Not Overheat

Candle making is not a dangerous activity – definitely messy – but not dangerous, as long as you take some common sense safety precautions.

First and foremost, use a double boiler (or a pot within a pot of water) to heat up your wax. The basic rule of thumb is to never let a flame touch the pot that contains the wax. While beeswax melts at around 145°F (63°C), wax will not boil to tell you that it is overheating.

It just keeps getting hotter and hotter until it starts to smoke. Continue to heat the wax and it may eventually burst into flame. Using a double boiler and taking care to never leave your melting wax unattended will prevent this from ever happening.

It is a good idea to keep an eye on the temperature of the wax with a quality thermometer. Generally speaking, when the beeswax in the pot reaches a temperature of about 170°F (77°C) it is time to pour your candles.

Keeping It Clean, Organized and Safe

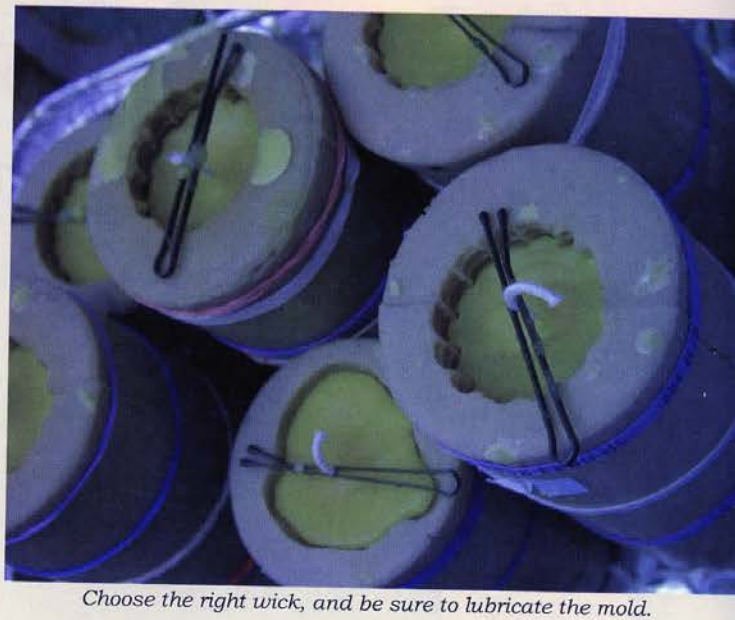
It is important to prepare your workspace by covering the work area with newspapers, a tarp or a tablecloth that you don't mind spilling wax on. No matter how careful you are, you will spill some wax. My suggestion is to cover the floor as well as the counter top, and wear clothes that you don't mind getting wax on – just in case.

Keep safety in mind and create a safe workspace. Make sure all children, pets or other inquisitive parties are not going to disturb your work area. Gather everything you will need (tools, molds, ingredients, etc.) so everything you will need is on hand and within easy reach before you start. Keep a bunch of rags, newspapers or paper towels handy in case of spills. Wax covered papers, rags and spent sweatshirt material can then be cut into strips and used as fire starter in the fireplace or wood stove. It is also a good idea to have a fire extinguisher nearby and a heavy pot lid on hand just in case the wax catches fire during the melting process.

Cleaning Up

Mistakes happen when we rush. Work slowly and methodically, and when you are done, fight the urge to pour water from the double boiler down the drain. No matter how careful you have been, the water is liable to have some wax in it and this may clog your drain over time.

If you need to clean up wax that has spilled on a smooth, hard surface, just wait until the wax cools and hardens and then scrape it up. To clean up wax on soft surfaces like carpets or clothing, lay several layers of paper towel over the stain and press on it with a hot iron. The paper towel will soak up the wax as it melts, though you may need to do this several times to get all the wax out.



Choose the right wick, and be sure to lubricate the mold.

A great thing about candle making is that there really is no wrong or right way to make candles as long as the end result is a candle that has a desirable appearance and burns safely. The key to making consistently good candles is to try to develop consistent procedures during the candle making process taking into account the many points identified in this article. And feel free to experiment. Some candle companies have developed their most popular candles as a result of a mistake or through experimentation. Keep this in mind and candle making can be a fun and satisfying activity for the whole family to enjoy.

Ross Conrad is the author of Natural Beekeeping: Organic Approaches to Modern Apiculture, 2nd Edition, published by Chelsea Green.

Electronic Beekeeping

James **Wilkes**

Introduction

Hive Tracks is beekeeping software created by beekeepers for beekeepers with the goal of improving the quality and experience of beekeeping for everyone. It is a web application, which simply means you can access the Hive Tracks software through a web address, hivetracks.com, using any internet enabled device including smart phones and tablets. The vision for Hive Tracks was born in the minds of two beekeepers who live and keep their bees in the Blue Ridge mountains of North Carolina, an area rich in beekeeping tradition and well known for tasty honey varietals including world famous sourwood honey. These two beekeepers, Mark Henson (above right) and me, James Wilkes (above left), dreamed of utilizing cutting edge technology to build easy to use tools and services to help beekeepers, ourselves included, have healthy and productive honey bee colonies. Our hope is that by maintaining information like records of inspections and events in hives and beeyards, every beekeeper will be equipped with the information needed to make wise management decisions for their bees. Whether you have a couple of hives in your backyard or a couple of hundred in varietal honey production or several thousand colonies for pollination, knowing the current state of your bees is essential to being a successful beekeeper. This article gives a brief backstory of the development of Hive Tracks.

Founders

The story of Hive Tracks is full of coincidence or divine providence or whatever you want to identify as the cause of events that come together in just the right way. One example is how the creators of Hive Tracks found each other.

Mark Henson is a professional software engineer with 30 years experience in software development and a masters degree in computer science. He lives in Boone, NC, with his wife and daughter and telecommutes to work very early in the morning with a software team in Great Britain. He has been a backyard beekeeper

arnia

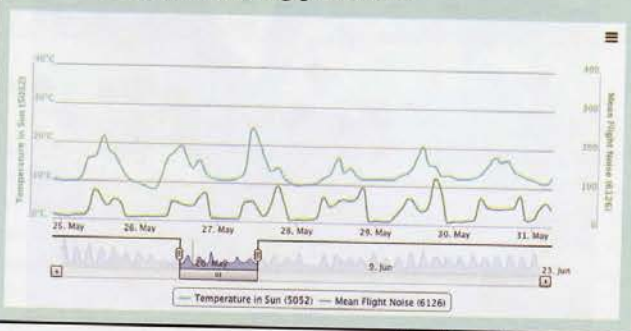
Huw **Evans**

The Benefits of Electronic Data Collection

When compared with manual collection, electronic hive monitoring offers scientists a less intrusive means of collecting more objective data at much higher resolutions, several times per minute if required. Multiple parameters can be simultaneously measured and recorded. The measurements are more consistent as probe positions and settling times do not vary. Remote monitoring simplifies data management; the data is automatically collected and stored in a database saving a huge amount of work while minimizing any potential 'mix ups'. The data can be graphed from within or downloaded from a single user interface accessed from any Internet enabled device. Which measurements are taken and how often can be configured remotely from anywhere in the world with Internet connectivity. The same user interface allows beekeepers to enter inspection data such as hive manipulations, diseases, *Varroa* counts and treatments.

Bees do Nothing Invariably

One of the issues facing scientists researching bee health is that "bees do nothing invariably", as we say in the UK or "bees, its like herding cats" as is more commonly used in the U.S. That's certainly the case with my bees. On good years I think I'm a great beekeeper, on bad years I think I must have done something horribly wrong. The truth is despite doing the same thing every year I get very different results. OK, I'm not saying that there is not a correlation between how well you look after your bees and how well the bees do, but the health of my bees is a multi factorial thing and I'm only one of those factors. Our suggested approach to this problem is 'Big Data' supplied by thousands of monitors. Not only does the sheer amount of data provide buffers to variance, (or buffers to deviations encountered on smaller scale data samples) it can also reveal trends when correlating bee health geographically with potential environmental stressors and different beekeeping practices.



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for eight years with a hive count varying from a few to more than 10.

I am a Professor and Chair of Computer Science at Appalachian State University in Boone, NC, where I have been teaching for 23 years and I have a PhD in computer science. My wife and eight children and I live in Creston, NC, which is very close to Boone, on Faith Mountain Farm. We are sideliner beekeepers as part of our farm business with about a 100 hives, although we had about 40 hives when Hive Tracks was born.

Mark and I moved in the same beekeeping circles, namely the Watauga County Beekeepers Club and as honey sellers at the local farmers market, so it was no surprise when we were considering our nascent ideas for Hive Tracks that mutual acquaintances suggested we get together. So, on a snowy afternoon in late February 2009, Hive Tracks was born over lunch.

Early Days

From the beginning, our ideas were very similar. I was standing at a hive in my beeyard that previous summer of 2008 ready to perform an inspection. I scratched my head trying to remember what I observed the last time I was inspecting this hive. Ever done that? In a moment of clarity, I caught a glimpse of what

Environmental Effects

Agricultural practices, be it the use of Plant Protection Products (PPPs) or the landscape picture being dominated by vast monocultures, have been implicated as one of the major causes of pollinator decline. Effects of different PPPs, presence of wildflower margins or the proximity to wooded area could all be considered statistically on a wide scale. Similarly, correlations could be drawn with different habitats, urban or rural, managed and unmanaged. The data could also be used to identify trends between bee health and the proximity of things like electric power lines, mobile phone masts, wind farms, electric trains or even motorways.

A recent study at Southampton University has shown that diesel exhaust, in particularly nitrous oxide, rapidly degrades floral odors used by honey bees for the recognition of floral nectar sources such as Canola (Oil Seed Rape). This could have a negative impact upon a honey bee's foraging efficiency and the pollination services that the bees provide.

Beekeeper practices

Beekeepers ultimately have bees' interest at heart but making correct management decisions is not always straightforward. There are no hard and fast rules, there are recommendations but experience shows quite different results. *Varroa* treatment is an obvious example, do different treatments disrupt normal colony behaviour and if so how badly?

What effect does breaking the brood cycle have on long term survival? Does queen age affect colony's future prospects? What type and amount of supplemental feed should the beekeeper provide? There is plenty of circumstantial evidence but surely a large mass of data collected over long periods of time over a wide geographical area will identify real trends and help clarify these and many other bee husbandry issues.

Suitability of Bee Breed

One species of honey bee, *Apis mellifera*, has evolved to survive in widely varied environments and climates, which has through the course of evolution led to the emergence of a number of locally adapted subspecies. However, man has moved bees about the planet without giving much thought to the consequences. Most of us believe that local bees do better than the imported bees, but still there are plenty of queens and packages of bees being shipped around the world. Others argue for greater genetic diversity. Trending the performance of different subspecies in different climatic conditions could provide the necessary empirical evidence to help better understand bee breed suitability or even to be used for legislative purposes.

Queen Health

In recent years there has been a lot of debate regarding factors effecting queen health and fitness. As shown in the previous article, instability in brood temperature data can reveal when a queen fails or stops laying. The benefits of being able to trend queen

it could be like – walking up to a hive, a handheld mobile device (smart phones were not so smart back then) recognizes the hive being inspected and shares information with the beekeeper that will help with this inspection, like the health or strength of the hive, the queen status including her age, any unusual observations at the last inspection, medications or feed that should be checked, honey flows in the region, tips on what to look for at this time of year, etc. I saw the future, but did not see how to make it a reality.

Mark's innovation came to life in a conversation with his wife on a long car trip home during Thanksgiving of 2008. With two years of beekeeping under his belt, Mark's interest in improving his own beekeeping combined with his software expertise resulted in him being driven to create a prototype hive information system being in place by Christmas of 2008, a month after his initial brainstorm. It was this prototype that he showed to me at our first meeting, bringing life to ideas that previously lived only in my head.

Mark had already shown the prototype to Shane Gebauer of Brushy Mountain Bee Farm at a bee meeting and later we showed it to David Tarpy from the Entomology Department at NCSU at the North Carolina state bee meeting. Shane and David have both encouraged us and have been supportive of Hive Tracks over the years.

Launch

Ideas are relatively easy to dream up, but implementing them is the real challenge. In the case of Hive Tracks, a plan was made to develop the first production version of the software with a launch date of August 1, 2010 coinciding with the 2010 Eastern Apicultural Society Conference, which happened to be held in Boone, NC that year. One of those happy coincidences referenced earlier. The first production version of Hive Tracks was created during the year preceding the conference with innovative features including a digital representation of each hive in an apiary based on the hardware components of the hive and graphical indicators of hive health and queen status. The first of its kind (that we know of) hive editor allows the beekeeper to maintain the proper hive configuration as it changes throughout the season. Mark never knew how many different components beekeepers used until trying to represent them all! Components are still being added to this day so send us your favorite non-standard component to add to the list. Just kidding! Following the initial launch, we were excited to see 400+ users signed up by the end of August.

Growth

By the end of 2010, 800+ people had registered accounts with Hive Tracks with no real marketing other than a favorable review in *Bee Culture* and word of mouth through bee club presentations. Growth in user accounts has always been steady with over 6000 users by the beginning of 2013 and continuing to this day with our current list of more than 13,000

failure geographically are obvious as we would know with considerably better precision when, where and in what order queens were failing. However, in a similar but opposite way, monitor data can also show when queens start laying, which in turn gives us a pretty accurate idea when they mated. For most beekeepers this is currently a bit of a guess as we are trained to leave virgin queens undisturbed for several weeks to mate. Bad weather at the time of mating has been implicated as a potential cause of drone laying queens. Our system also records weather conditions that can be correlated with mating times, even retrospectively.

Hive type

A myriad of hive types exist and new ones are being developed continuously using new materials and technologies which can effect, for example, thermal insulation and humidity. Wide scale mapping of, for instance, hive humidity levels against hive type in different climatic conditions may help recommendations to beekeepers for more efficient housing of their bees.

Daily flight profiles

The importance of taking measurements regularly and simultaneously should not be underestimated. Using acoustics, we can economically plot daily flight profiles on a scale and at resolutions that would be practically impossible by human observation as flight profiles vary widely throughout the day. An example of this is shown in fig 1 where we can see that following a flurry of flight activity in the morning there is a lull in activity around lunch time. There is then a second wave of flight activity in the afternoon, which could well consist of foragers, young bees learning to fly in groups or even bees preparing to accompany the queen on mating flights. The 'character' of the flight profile therefore changes throughout the season.

Statistical consideration of daily flight profiles could provide a valuable insight into colony behaviour and potentially identify quite subtle trends in relation to exogenous and endogenous factors. Not only could the profile be correlated with other parameters such as what temperature they get going in the morning or how willing they are to fly in light rain, but also how this behaviour may be influenced by other environmental factors such as exposure to PPP's or in-hive treatments.

Furthermore, an observer moving from one hive to the next throughout the course of the day could mistake a moment of inactivity for an inactive colony; a colony strength assessment would be perverted in a similar way. Therefore, simultaneous data collection is the only way to objectively compare different scenarios.

Forage Efficiency

Weight of the hive is a pretty clear indicator of that colony's productivity, both in terms of colony size and stores. Typically, the slope of the weight increase is proportional to the abundance of and the distance to the forage source. This information becomes more valuable when combined with measurements such as flight activity and meteorological data, as seen in fig 2.

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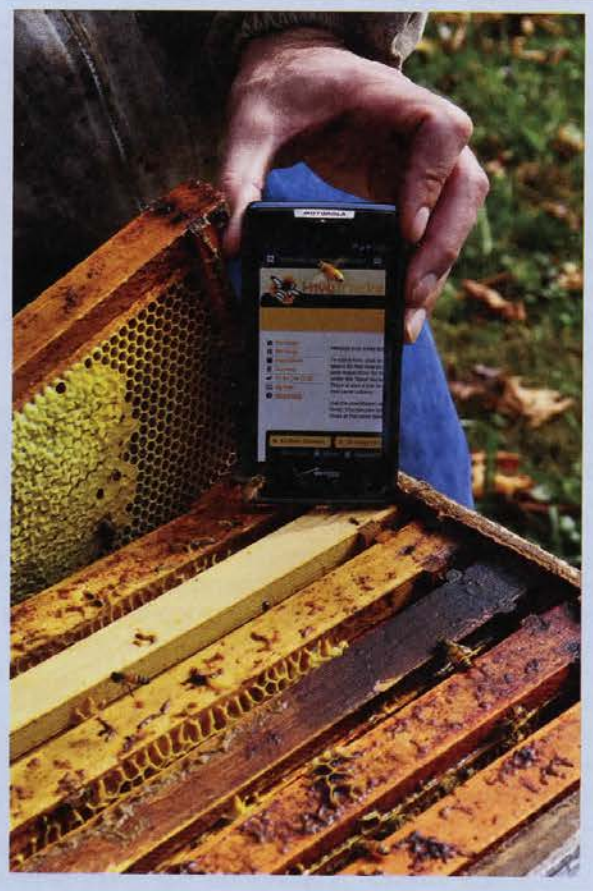


users. Most of this growth has predictably been in the United States and more specifically in the eastern half of the U.S. where there are more backyard beekeepers who make up the majority of our users. The average number of hives per user is around five, but we have a surprising number of sideliner and even commercial beekeepers who are finding it useful for their operations (more on this aspect later!).

International

A fascinating aspect of our growth has been the number of Hive Tracks users around the world; a great illustration of the interconnectedness of our world via the internet. We now have users in over 130 countries, with the top numbers being in United Kingdom, Canada, Belgium, Greece, Australia, and New Zealand. Numerous users have offered to translate Hive Tracks to their native language, which we expect will happen in time. And then there is dealing with the variety of beekeeping practices around the world including different hardware types, queen breeds, treatment strategies and products, and even the reversed calendars of the northern and southern hemisphere. So, although there is great commonality among beekeepers worldwide in their love for bees and the desire to keep them well, providing software that is relevant to them all without making it unwieldy is a challenge! However, it is a challenge we are facing head on by developing a strategy for engaging more fully in regional beekeeping markets by creating "localized" versions of Hive Tracks built specifically for local beekeeping practices.

The amount of flying necessary to bring in a certain amount of nectar can be considered a measure of 'forage efficiency'. Typically, flight activity is proportional to the net weight increase, however we can see that following morning rain, despite an increase in flight activity, there is little nectar brought in. Fanning activity can be added to indicate nectar processing, showing when it takes place and to what relative degree. Like the daily flight profile, this gives us further insight into bee behaviour and even potentially useful circadian rhythm information.

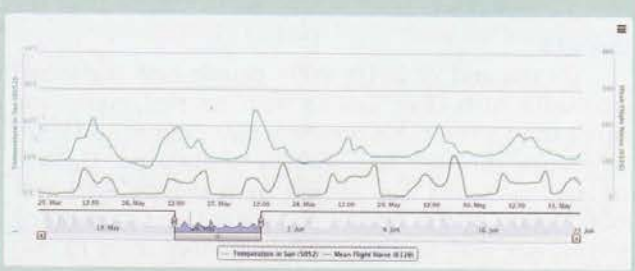
Moreover, tracking weight over longer periods also offers insights into the occurrence and availability of forage. Hive weights were used by Dr Wayne Esaias to draw up maps of flowering vegetation, which in turn have shown the effect of urban warming on the timing of flowering. When there is dearth, the resulting drop in weight is a useful indication of the colony's metabolism, in other words, how much energy the colony requires when there are no external sources of nectar are available.

Black Box

Electronic hive monitoring can also help explain sudden and unexpected colony loss. When a plane crashes, all flight data preceding the crash is saved on a flight recorder or 'black box'. A lack of 'black box' data often makes it difficult for scientists to establish the cause of colony collapse. In the last article we demonstrated that by considering a sudden drop in weight with a sharp increase in flight activity successfully diagnosed robbing as the cause of a colony's failure.

Recently a beekeeper was transporting bees a relatively short distance, on arrival the weather was bad so he returned 24hrs later to open the colonies and discovered one of the hives was full of dead bees. Luckily that colony was being monitored, so we had a look to see if we could work out what had gone wrong. From Fig 3 we can see the day started with a nice healthy colony with a stable brood temperature. There was then a sudden increase as the brood temperature rose sharply to 46°C. Initially we suspected some kind of hornet attack, however using acoustics we were able to include fanning activity at which point the cause became obvious.

It was a warm day and the bees could have done with a little bit more ventilation. As they began to warm up, they began to fan which generated more heat and this positive feedback cycle lead to self-destruction. From that point on the brood temperature follows ambient temperature with a small lag as the



Tanzania

The example in which we are most advanced in working out this plan is in Tanzania. To get us to Tanzania, I must relate to you another installment of a "what a coincidence!" story. I travelled to Kiev, Ukraine in October of 2013 for the Apimondia 2013 conference representing Hive Tracks with the simple goal of gaining a better understanding of the international beekeeping market. Before I left on the trip, a business friend suggested that opportunities tend to come from unexpected places and to be on the lookout. So, it should not have surprised me when I looked across the big vendor hall with thousands of people milling about and see a familiar face of a lady I had only seen through facebook on her Follow the Honey business page. I approached her and said "Are you Mary?" and she replied, "Yes, who are you?" After the introductions, she immediately whisked me over to the Tanzania vendor booth where I was warmly welcomed by the government contingent and David Camara, the owner of National Beekeeping Supplies, Ltd, from Tanzania. David and Mary and the Tanzanian government are working to market and promote honey from Tanzania. Hive Tracks was recognized as a useful tool to accomplish their goals by helping individual beekeepers be organized and more productive. We have partnered with David to make Hive Tracks a part of the beekeeping landscape in Tanzania and Africa.

Free Helps Growth

Hive Tracks is free (you can also pay, but more on that later!). How can it be free? We are generous and want to share this tool with everyone, but it is not that we are independently wealthy and do not need to make money. No, we made an early business decision that we would always provide a free version to make it as easy as possible for all beekeepers to have a great tool for record keeping and to fuel the growth of our user base. We may have set the bar too high on how much we are giving away (like I said, we are generous), but our strategy is in line with many other cloud based software providers like Google, Survey Monkey, and Mail Chimp to name a few. The thinking is that once you have a large user base, you can then figure out

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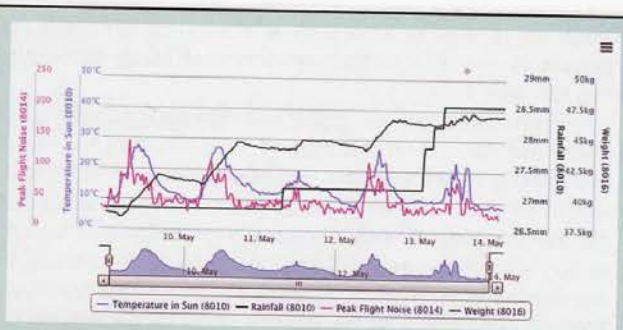


temperature sensor is inside the hive. Using the monitor data we could pinpoint both cause and time of death, without this data we would still be guessing what had gone wrong. This is indeed a tragic tale, however it did furnish us with a new 'overheating when being transported' alarm feature.

Conclusion

It is not the intention of this article to be prescriptive about how the data may be useful to a scientist. However, the benefits of wide scale data collection with its ability to deal with variability and trend bee health appear obvious.

When compared to taking measurements manually, electronic monitoring offers less intrusive and simultaneous data collection at much higher resolutions. Sceptics may fear that relatively uncontrolled data may lack 'quality'. However, this is where we can turn to 'crowd' or 'collective wisdom'.

This data has benefits beyond bee health, "If the world is our coal mine then bees are our canaries". Bees can be considered an indicator species, with a forage range of 10km^2 they make perfect bio sentinels. A lot of good science has already used bees' data to help to map air pollution, toxins in the environment and even global warming.

So how do you persuade thousands of beekeepers to start strapping hive tech to their hives? You simply offer them a useful beekeeping tool! arnia's monitoring system brings benefits directly to the beekeeper which both aids recruitment and maintains beekeeper participation in wide scale long term field trials.

Large scale data collection is underway in the U.S. under the auspices of the Bee Informed Partnership. Arnia is one of the registered suppliers of equipment for this project.

As with the application of electronic monitoring to bee husbandry, the true value 'big bee data' can bring to scientists will continue to evolve over time.

Huw Evans is the co-founder of arnia, a research and development company that designs and builds hive monitoring equipment. arnia hive monitors are currently for sale in the U.S., for more information contact sales@arnia.co.uk.

ways to monetize through advertising and offering premium services to the users who already find value in your free tool.

From early on we accepted donations, and a few users did donate which helped with some of the costs, but mostly expenses were out of our pockets along with a healthy dose of sweat equity (funny, that sounds a lot like beekeeping to me). About a year and a half ago, we added a business partner with the goal of advancing the development of Hive Tracks into a sustainable business. Toward that goal, in December of 2013 we released a completely rewritten version of Hive Tracks with better graphics, more features, and faster response.

Shortly thereafter in March of 2014, we released Hive Tracks Pro, a subscription based paid version with very modest price tag. After three and a half years of users telling us what new features they wanted and based on our own needs, the Pro version includes a number of value added features including additional hive types like nucs, uploading of photos and videos, a hive hardware inventory, integrated calendar and todo lists, group sharing of data, and recently an Android mobile app for offline work.

We also do some advertising and expect that to increase. We do plan to make money, but also want to make it accessible to as many beekeepers as possible. Trying to find that balance is the challenge. We hope people will see Hive Tracks as their "digital hive tool" and make it a necessary part of their beekeeping practice and will choose to support us.

Tip of the Iceberg

As the realization of the vision we had more than five years ago continues to take shape, we believe the fun has just begun in terms of what is possible with only the tip of the iceberg exposed so far. Hive Tracks is built on a solid foundation of fundamental data of yard, hive, and inspection information that is important to all beekeepers no matter the size of their operation.

Building on this foundation, much more is technologically possible including collecting data from instrumented hives (sensors for weight, temperature, humidity, and audio), connecting beekeepers through social media, forums, and information sharing, analyzing the combined data of beekeepers (big data for beekeepers), and an endless list of cool features including any number of reports like honey production per hive or per yard, longitudinal queen performance, hive success when started from a nuc vs. split vs. package, etc.

The area of instrumented hives has always been one of high interest to us since combining observational data from Hive Tracks with instrumented hive data yields incredibly valuable information for a beekeeper. Perhaps even more importantly, this combination of data from a world wide network of beekeepers would be a very strong data set for honey bee research. In the past three years, there has been rapid development of commercial solutions for the hive scale problem with multiple vendors in the market now with one of the most extensive monitoring systems being offered by Arnia (featured December '14 and this issue in *Bee Culture* articles), which includes weight, temp, humidity, and sound, as well as analysis of the data to detect hive events.

Future

The potential benefits to our beekeeping experience offered by technology are endless and exciting to consider and pursue, and I invite you to join your fellow beekeepers and us at Hive Tracks as we strive to be better beekeepers by equipping ourselves with the right tools and information to make wise hive management decisions. Hive Tracks is committed to pursuing excellence in beekeeping and will continue to work to add native features and functionality useful and affordable to all beekeepers. In upcoming articles, I will dive into more details of how Hive Tracks works and what value it can add to your beekeeping experience. In the end of course, the most important part of your beekeeping is still to be in the bees!

http://www.hivetracks.com
http://www.facebook.com/hivetracks

James keeps his bees in too many yards in the mountains and foothills of northwest North Carolina.

CATCH THE BUZZ

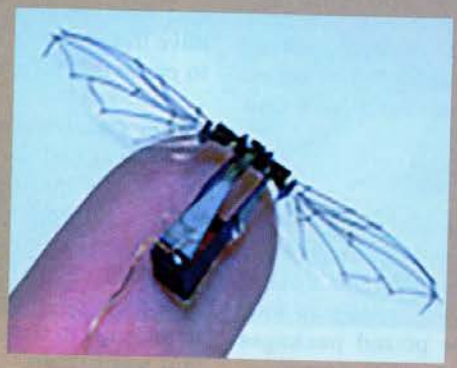
Creation Of Robot Bee To Pollinate Crops

Scientists at the Polytechnic University of Warsaw have created the first robotic bee designed to pollinate artificially; a miniaturized drone that is able to find a flower, collect its pollen, and transfer it carefully from the male to the female flower to fertilize it.

This robotic insect has already been successfully tested in the field and its ability to pollinate is offered as a "hopeful alternative" to address the steady decline in the world bee population, as stated by its creator, engineer Rafal Dalewski.

"Last Summer, we carried out a test and we already have the first seed obtained through this artificial pollination, so it has been proven that our robot can do almost the same as real bees," explains Dalewski.

Dalewski, however, acknowledges that he has not been able to design a drone that can produce honey, "although technology development is moving increasingly fast and can at times be surprising," he jokes.



In any case, the pollinator robot "is not intended to replace insects, but to help their work and complement it," explains the engineer, who refuses to assess whether the drone can pollinate better than real bees.

The truth is that this biodrone not only helps nature, but also does so in a clever way, since it can be programmed to focus on a particular area and look for flowers of a particular type to pollinate, all through a computer program.

The Polytechnic University of Warsaw has created two types of pollinating drones, one flying and one terrestrial, both armed with a kind of duster that is impregnated with pollen to later distribute it among other flowers.

The terrestrial one has more autonomy and its battery is more durable, "so the grower can go home with his/her mind at ease and leave the drone working until it returns autonomously to its energy source."

Its creator claims that these robots can also be used for "precision agriculture, as intelligent dispensers of fertilizers or pesticides," since they can be programmed to deposit certain amounts, depending on the type of plant or location.

The university wants to put the first prototypes to work from 2017, and start their mass production in two years.

The invention is especially significant when one considers that the mortality of pollinating insects, on which most crops depend, is greater each year, without the causes being known.

Two decades ago, a group of French farmers drew attention for the first time to a phenomenon that was unusual at that time: the depopulation of hives because of the disappearance of bees, whose pollination makes most of the world food production possible.

This phenomenon is already global, especially in countries with highly developed agriculture, and has caused many scientists to warn of the consequences of a world without bees.

In 2014, the EU carried out its first study on bee mortality, which showed figures ranging between 3.5% and 33.6%, depending on the country.

The bee is a pollinator for both crops and nature; if this does not happen, yields in agriculture would fall, and the survival of plant species which rely on bees as a means of pollination would be endangered.

The Plants That Help Monarchs Also Help Honey Bees

Monarchs are in decline across North America. With milkweed loss in the east identified as a major contributing factor to this decline, the national call to action has understandably focused primarily on planting milkweeds, which are the required host plants for monarch caterpillars, and a favorite for honey bees, too. Yet while restoring the millions of milkweed plants that have been lost is certainly an important strategy, monarchs need more than milkweed to support them throughout the year. Adult monarchs need nectar to fuel them during Spring migration and breeding and to build up stores of fat which sustain them during fall migration and Winter.

There are many sources of information about which species of native milkweeds are best for your region, but information on which nectar plants are best for monarchs has not been available for large areas of the U.S. Working with the Monarch Joint Venture and the National Wildlife Federation, the Xerces Society has created a series of nectar plant lists for the continental U.S. based on a database of nearly 24,000 monarch nectaring observations. Each of the 15 regional guides highlights species that are commercially available, are native to and widely found in the region, and are known to be hardy or relatively easy to grow in a garden setting.

Read more about this project at http://www.xerces.org/blog/to-save-monarchs-we-need-more-than-just-milkweed/ or find a nectar plant guide for your region here http://www.xerces.org/monarch-nectar-plants/

These plant lists are works-in-progress and benefit from your help. You can submit additional monarch nectaring observations via our online survey. We are grateful to the many different researchers and monarch enthusiasts across the country who have already contributed to our database – thank you!

Honey Bee Packages

Ross **Conrad**

Honey Bee Packages

The majority of beekeepers in the U.S. today get their start by purchasing a package of bees with a mated queen included. Bee packages can also be used to replace dead colonies or rejuvenate colonies that are weak and have a low population.

This article is intended to provide a quick overview of whether a package of bees will work for you in your situation, suggest questions you should consider asking your packaged bee supplier, and take a look at some of the things that can go wrong with packaged bees and what to do when it does.

What is a package of bees?

A package typically contains bees and a separately caged queen with several worker bees to attend to her, all enclosed within a screened box. These screened shipping boxes come in different sizes ranging from two to four pounds of worker bees, though three pound packages (containing about 10,000 bees) are most common. Packaged bees are also shipped with a pint can of sugar syrup to keep them fed until they can be installed in their new hive. Bees for packaging usually are shaken from the brood combs of strong colonies, so that mostly young adult bees will be included. The bees are shaken through a funnel into the packages or into a "shaker box" until about 10 pounds of bees have accumulated; then several packages are filled from the shaker box. Cages for shipping packages are made of wood and screen, in a way that combines lightweight, sturdiness, and a maximum of screened area through which the bees can ventilate their cluster and prevent overheating.

Readily Available

Packaged bees are the most abundant option available to someone looking to get a new hive started. Most queens and packaged bees are produced by beekeepers who concentrate on this specialty within the beekeeping industry. For the most part, such operations are located in mild wintering areas that allow queen and bee production during the winter and spring...the time when most people want to receive delivery of their bees.

One of the Least Expensive Options

Purchasing a package of bees is the least expensive option available for getting a hive started next to capturing a swarm or being given bees as a gift. This is in part because of the abundance of package producers in the country and because the price of equipment is excluded when bees are purchased as a package rather than as part of a nucleus colony or complete hive. In 2017, you can expect a three-pound package of bees to typically cost somewhere between $99 to as much as $160 or more, plus shipping. Much depends on the size of the package and the type of bees you are purchasing with bees that have the potential for disease and mite resistance tending to come in at the high end.

Super Convenient

Packaged bees are one of the most convenient options for getting a colony of honey bees started. They may be shipped through the mail via the United States Postal Service or UPS right to your door or to your local post office. With a little advance planning and clear communication with your supplier, you should be able to arrange to have your bees arrive on the exact day that you want them.

Local or Distant Sources

When possible, finding a supplier that provides bees that are raised within your region is likely to be preferable in most instances. Besides helping to support your local community economically, when you buy bees raised locally they are more likely to be adapted to your local climate conditions. If you want local bees and are unable to find a local source for packages, but can find a local queen supplier, a package of bees can be purchased from a distant supplier and hived with the locally raised queen. Remember, the bees in a package are only there to support the queen as she gets her hive established. In five to six weeks, most if not all the bees that came in the package will have died and they will have been replaced with new bees from the eggs your queen is providing. Also, since travel time within the package can be stressful for the bees, the closer you are to your supplier the less miles the bees have to travel within the package. Contact your local or state beekeeping association if you need more information on who may have packages available in your area.

Questions to Ask Your Queen and/or Package Supplier

- Where are the queens raised? Some queen and bee suppliers will purchase bees from another supplier and simply resell them.
- How have pests and diseases been managed in the hives? It is good to know the kind of care the bees have

received and what treatments they have been exposed to, or what they haven't been exposed to.

- How long will the bees be in the package? Do they ship the bees out the day they package them or will the bees be sitting around before the hit the mail?
- Is the queen raised from disease or mite resistant stock? Getting bees that have some ability to deal with diseases and pests will make your job easier.
- How long do you let the queen lay eggs before she is shipped? One of the problems with queens in recent years is that some suppliers are shipping out queens too early. Ideally, a queen will be allowed to lay eggs for at least two weeks before she is caged and shipped.
- How do you ship, and when will the bees be shipped? You need to know so you will know what to expect and you can be ready for the bees when they arrive.
- Have the bees been inspected? Many states have bee inspection programs and your supplier should be able to supply you with a copy of their inspection report if they have had their bees inspected.

What can go wrong and what to do when it does?

- *Delays in shipping* – Life happens. Suppliers can get backed up with orders. The weather can be uncooperative slowing down hive development and causing the bee supplier to get behind on their schedule. The best you can do in this situation is be patient. It also helps to plan your shipment of bees several weeks ahead of any expected trips so if there is a delay, your bees don't end up arriving when you are planning to be out of town.
- *Stress during shipment* – Travel by Parcel Post is not the honey bee's preferred method of transportation and it is stressful on them. Shipping your package overnight will help limit the amount of time the bees spend in this stressful situation. However, overnight shipping can be expensive. If your package is not being shipped overnight, have your supplier ship on a Monday or Tuesday so that the bees are most likely to arrive a day to two before the weekend. This provides a day or two buffer and will help prevent the poor critters from sitting in their shipping crate for an extra few days over a weekend should an unexpected delay occur. For the same reason, it is good to try to avoid having bees shipped around holidays. Have the supplier repeat your shipping address back to you after you provide it. This is a simple way to confirm that they have the correct shipping address and avoid delivery delays that can be lethal. If the supplier is close to you, it may be preferable to drive down and pick them up and take them home yourself. You want to get your bees transferred into their new hive and start feeding them ASAP. Therefore, be sure you have prepared all the equipment you will need to hive the bees, before your shipment arrives.
- *Large bee die-off during shipment* – While some dead bees in the bottom of the package can be expected upon arrival, the number should not be excessive. Lots of things that can happen during shipment, from trucks breaking down to packages being left in the sun or in places where their ability to ventilate becomes compromised. Unfortunately, many bee and queen suppliers relinquish responsibility for the condition of the bees once they are in the hands of the shipper. If most, or all of your bees appear to be dead when you receive your package, immediately file a claim with the shipper in order to get reimbursed for your loss. It is a good idea to photograph the package of dead bees in the presence of the delivery driver or postal clerk and submit the photo with your paperwork to help expedite a claim.
- *Pests hitching a ride* – Since a package of bees does not contain any comb, there is less of a chance that your bees will be infected with diseases or pests. However, it is still possible for packaged bees to harbor pests such as the Varroa mite or Small Hive Beetle, especially if they have not been treated or inspected prior to packaging and shipment. Be on the lookout for such pests when transferring the bees into their new hive. Varroa mites are ubiquitous these days and all bees have them, or will have them soon. Expect to see a mite or two if you are paying attention and looking closely. However, if more than a few varroa mites are observed on bees in the package, or during their transfer into their hive, consider a treatment option.

If small hive beetles are seen in with the packaged bees, install a beetle trap in the hive. Be sure to also match the size of the hive cavity to the population of bees and don't add a second box until the first hive body is 80-85% filled with bees, brood, honey, pollen and drawn comb.

- *The can of sugar syrup in the cage is empty* – The sugar syrup provided with a package of bees typically is more than enough to keep the bees bellies full until they are transferred into their hive. However, if delays occur in shipping or there is a delay in transferring the bees and queen into a hive and feeding them, the can of syrup may become empty. To feed bees in a package that you suspect needs feeding, simply spray sugar syrup onto the bees through the package's screening, and get them hived ASAP.

Honey bee packages can be a good way to get started in beekeeping. By planning ahead and asking the right questions, you may avoid some of the common pitfalls that can jeopardize your initial beekeeping success.

Ross Conrad is the author of Natural Beekeeping: Organic Approaches to Modern Apiculture, *2nd Edition.*

Pollinator Decline

Secondary Compounds In Pollen & Nectar Really Do Help Bees & Butterfli

Pollinator Decline

Through pollination services, butterflies, bees, and other insect pollinators contribute more than $24 billion to the U.S. economy annually. Moreover, these pollinators are necessary for the production of 70% of the crops we eat. If we did not have insect pollinators, our diet would consist of mostly corn, wheat, and rice products. While it may be hard for us to imagine such a boring plate of food, it may be closer to reality than we anticipate: insect pollinator populations are declining at alarming rates. Bumble bee populations have declined 30% since the 1870s, honey bee populations have declined more than 50% since the 1940s, and monarch butterfly populations have declined 80% since only the 1990s!

Pollinators Can Get Medicine from Their Food

While there are plenty of activist groups raising money to help pollinators, there may be something we're missing, something simple that we can do to help pollinators help themselves. Recent research shows that pollinators are able to naturally medicate themselves by using certain plant chemicals – termed secondary compounds – that are found in their main food source: pollen and nectar. If we learn about how pollinators naturally medicate themselves using secondary compounds, we might be able to naturally mitigate their decline.

The use of plant secondary compounds by animals is not new knowledge – caffeine is a secondary compound that we are all familiar with. Though caffeine is toxic to most leaf-eating insects, many other animals (including humans) use caffeine to their benefit. According to Ethiopian legend, the energizing effect of caffeine was discovered by a goat herder named Kaldi. One day, while Kaldi watched his goats, he noticed that after they ate berries from a particular shrub, they became uncharacteristically energetic, frolicking wildly through the pasture. Kaldi tried the berries for himself and found a similar energizing effect; he spread the word and shared the berries with some monks in the area – the monks spent the night awake and alert. Today, we know that in addition to eating plant parts with secondary compounds for energy, many animals eat plant parts when they are sick – this is called self-medication.

Most medicines, whether it be for humans or for butterflies, are derived from secondary compounds. For example, the main ingredient in aspirin comes from willow trees. Secondary compounds are plant chemicals that are not used for growth or reproduction but rather for defense against leaf-eating insects. Leaves have high concentrations of secondary compounds which are toxic to many insects. In contrast, pollen and nectar – the main food sources for pollinators – have low concentrations of these compounds which are toxic to only the microbes that infect pollinators, not the pollinators themselves. Thus, pollinators may benefit from eating certain secondary compounds that are found in pollen and nectar. "Secondary compounds are present in nectar as an unavoidable consequence of plants protecting themselves against herbivores" explains Dr. Leif Richardson, a research fellow at the University of Vermont.

Therapeutic & Preventative Self-medication in Pollinators

There are four types of self-medication that animals use. The simplest types, preventative and therapeutic, consist of the animal directly medicating itself. For example, as a preventative measure, if you know you have allergies and the pollen count is high, you might take an allergy pill before going outside. Therapeutic self-medication is defined as taking medicine once you already have symptoms: you may have forgotten to take that allergy pill before you left the house, so you take aspirin once you get a headache. Preventative self-medication was found in monarch butterflies in the 1980s and more recently, therapeutic self-medication has been found in both bumble bees [1] and honey bees [2].

Monarch butterflies lay their

& Self-Medication

Self-Medicate

Rachael E. **Bonoan**

eggs on milkweed plants, but out of the 108 milkweed species found in North America, monarchs only lay their eggs on 27 of those plants. Research in the 1980s by Stephen B. Malcolm and Lincoln P. Brower showed that compared to the other 81 milkweed plants, the 27 plants that monarchs lay their eggs on have much higher concentrations of a certain secondary compound which has detrimental effects on a common monarch disease. Thus, it is likely that monarchs lay their eggs on these specific 27 plants in order to preventatively protect their offspring.

Examples of therapeutic self-medication are found in both bumble bees and honey bees. Bumble bees infected with a common fungal disease, and then fed a sugar solution infused with a secondary compound, ended up with lower parasite loads compared to infected bumble bees fed a plain sugar solution. Moreover, "when you give choices in the lab, infected bees will eat more of the chemical that drives down their parasites." states Dr. Richardson. Similar results were found in honey bees by Dr. Silvio Erler, a molecular ecologist at Martin Luther University in Halle, Germany.

"We show that [honey] bees can in some way self-medicate by selective consumption of honey." explains Dr. Erler. In Dr. Erler's study, honey bees infected with a common fungal disease were given a choice of various honeys: sunflower honey, linden tree honey, black locust honey, or honeydew. Overall, sick bees preferred sunflower honey. When the different honeys were tested for antimicrobial activity, the sunflower honey killed the most microbes, as expected. Somehow, infected honey bees knew which honey would help their infection. Based on Dr. Erler and Dr. Richardson's work, it is likely that pollinators know what they need to heal themselves.

Trans-generational & Social Self-Medication in Pollinators

The last two types of self-medication, trans-generational and social, are self-medication where the animal is helping its family and therefore ensuring its relatives survive. Ensuring the survival of your relatives is important – you share the same genes. Helping your relatives helps your genes persist in the population. Monarch butterflies medicate their offspring – trans-generational medication – and social bees likely medicate their neighbors in the hive – social self-medication.

When monarch butterflies pass on medicinal compounds to their children, it's the father that is important. Humans, however, passively achieve trans-generational self-medication via the mother. When a mother breastfeeds her child, she is passing on antibodies that her body has made over the years. To examine this effect in monarch butterflies, Dr. Eleanore Sternberg, a postdoctoral fellow at Penn State University, and her colleagues raised monarch caterpillars on one of two plants: "medicinal" milkweed with high concentrations of secondary compounds, or "non-medicinal" milkweed with low concentrations of secondary compounds [3].

Once the caterpillars became adult butterflies, Dr. Sternberg and colleagues mated males and females that were raised on the different types of milkweed. Following matings, the eggs were infected with a parasite that commonly targets both monarch caterpillars and butterflies. No matter the diet of the mother, the eggs that had a father raised on the medicinal milkweed were more resistant to infection than eggs from a father raised on the non-medicinal milkweed. Dr. Sternberg explains "the most interesting aspect is the fact that we do find a paternal effect. There's been quite a bit of interest in what mothers can provide to their offspring in terms of protection from parasites but much less is known about what fathers can provide."

Continued on Next Page

Many beekeepers medicate their honey bee colonies with expensive chemicals and man-made compounds but it is likely more productive, and definitely less expensive, to simply plant more flowers and let the pollinators make the best choices to naturally medicate themselves.

As a social insect scientist myself, I find the fourth form of self-medication, social self-medication, the most exciting. But, it is also the most complex. Social self-medication consists of giving medicine to the people you live with. For example, if your sibling has the flu, you may give him or her medicine. Not only does this benefit you – if your sibling gets better quicker, your sibling will survive, and you might not get sick – but it benefits the rest of your family too: they might not get sick either.

Social self-medication has yet to be found in pollinators but given that bumble bees and honey bees are highly social insects, it is likely that both medicate their young, and neighbors, in the hive. Discussing his research on bumble bee self-medication, Dr. Richardson explains "The really interesting aspect is that [bumble] bees are social, and the workers are feeding the queen and larvae, sometimes the males." In both bumble bees and honey bees, the adult workers take care of their younger siblings (larvae) by bringing food back to the hive and feeding the young. The adult workers also take care of their queen bee, the only female in the colony that lays fertilized eggs, and sometimes their older brothers. Since the workers are the ones choosing which food to bring back to the hive, it is possible that upon an infection of their younger siblings, or the queen, the workers would find the right medicinal food to feed them.

Hence, social medication could reasonably occur in bumble bees and honey bees, but social self-medication is not easy to study; Dr. Erler explains that running hive-level experiments means "we have the environment as a factor including climate, humidity, rain, wind, we have the availability of different food sources, which varies much over the seasons, and we have many more different individuals of different ages." Although difficult to study, it is important to study social self-medication in pollinators – in our fight against pollinator decline, it is much more powerful to keep a whole hive healthy rather than only one individual.

So, what can *we* do to help?

The answer is simple: plant lots of flowers. Monarch butterflies know which plant to lay their eggs on, and bumble bees and honey bees know which flowers to visit when they are feeling under the weather. But, in order to let pollinators get the medicine they need, we have to provide them with choices.

Just as monarch butterflies choose which plants to lay their eggs on, bumble bees also make choices in the field. In nature, "when a [bumble] bee is infected, it forages longer, and on flowers with high concentrations of these [secondary] compounds rather than flowers with low concentrations." explains Dr. Richardson. Thus, sick bumble bees are making a choice – based on their health – to seek out the best quality medicine.

While aspirin might work for your headache, it will not work for your runny nose; when you walk into a drugstore, you have your choice of which medicine to take. This may also be true for pollinators; sunflower honey worked well against a particular fungal infection in honey bees but a different type of infection may require a different type of medication. Regarding honey bees, Dr. Erler explains that "they should live in natural environments with a high diversity of plants" so that they have access to diverse types of medicines. The same is true for both monarch butterflies and bumble bees.

While there is still more to learn about self-medication in pollinators, when it comes to self-medication, the more choices you have, the more likely you are to find what works. Many beekeepers medicate their honey bee hives with expensive chemicals and man-made compounds but it is likely more productive, and definitely less expensive, to simply plant more flowers and let the pollinators make the best choices to naturally medicate themselves.

1. Richardson, L.L., et al., *Secondary metabolites in floral nectar reduce parasite infections in bumblebees.* Proceeding of the Royal Society 2015. 282(1803).
2. Gherman, B.I., et al., *Pathogen-associated self-medication behavior in the honeybee Apis mellifera.* Behavioral Ecology and Sociobiology, 2014. 68(11): p. 1777-1784.
3. Sternberg, E.D., J.C. de Roode, and M.D. Hunter, *Trans-generational parasite protection associated with paternal diet.* Journal of Animal Ecology, 2015. 84(1): p. 310-321.

Restocking Winterkilled Hives

A routine aspect of beekeeping

~James E. Tew

It is a beehive fact of life

Occasional dead bee colonies – at any time of the year – are a honey bee fact of life. In total, the possible reasons for these seasonal die-offs are too many to discuss. In fact, all of the reasons are not even known. In the wild, the bees seem to have a system to address this routine die-off phenomenon – if at all possible, a wild colony will cast swarms as often as possible. Somewhere, someway, some of these many swarms will survive the cold season and live long enough to . . . *(you guessed it!)* cast many smallish swarms the next season – and so it goes.

Natural colonies also do many other things to help with its constant struggle to survive. They have a well-known defensive system – the sting – that is used to defend food supplies (honey and pollen) that have been stored for dearth seasons. They use propolis to guard against bacterial invaders and other insects. They have internal nest structures that limit invasion by pests and predators (e.g. bee space), and, if possible, they put the nest in a sheltered location with a defendable entrance. Ironically, a colony even has ways (foreign odors and behavior perceptions) to defend against one of its most common invaders – robber honey bees from other colonies.

To survive genetically, a colony seems to have two cards to play – (1) newly mated queens leading new swarms, and (2) the occasional drone that is successful in passing the colony's genetic characteristics along to a new queen during the mating process. In any way possible, the struggling colony fights to survive. Many times they fail. Make no mistake – it's hard out there for a wild bee colony.

Enter the beekeeper

At the most fundamental level, all that any beekeeper is trying to accomplish is to assist with these wintering problems or even eliminate the challenges that a colony faces. We provide housing, food, protection from the elements, and we try to help them stay healthy through chemical or behavioral means (e.g. screen bottom boards). We try to reduce the risks of swarming by taking over the genetic future survival of the colony. Beekeepers install selected queens that are well suited for this type of assisted existence. Many times both beekeepers and their bees fail. Make no mistake – it's hard out there for a beekeeper and his/her bees.

Anticipate it – sometimes colonies die

In the wild or in my hives, sometimes colonies die. I don't like the occurrence in either wild locations or in my managed hive boxes. In managed beehives, it is a discouraging, messy task to clean the residue. The heavy odor of decay makes the situation just a bit worse.

I do the best I can to forestall any colony's death, but when one goes, I can, at least, truthfully tell myself that the colony would not have fared much better on it's own. The beekeeper's prime Winter goal is to address as many challenges as possible, and then wish the bees good luck. We hope that most – if not all – will survive the season. Sometimes they don't. What then?

The dead colony's autopsy

Depending on your location, various procedures are required to recoup losses. In warm climates, the wax moth is a relentless taskmaster. The combs are often destroyed before the colony is completely dead. Warm climate beekeepers must be doubly alert or their problem is compounded – they have lost bees and comb.

In cooler climates, the situation is still bad, but not so urgent. The first thing with winterkilled equipment is to determine what caused the colony to die. The obvious concern is that spore-forming American foulbrood (AFB) may have been the problem. If foulbrood has been a problem in the past, contact the state apiary inspector and have a competent assessment made. At times, Nosema is a problem. Unfortunately, Nosema is difficult to diagnose, and the remedy is somewhat expensive. Increasingly, Nosema treatment is simply queen replacement. Excessive defecation spotting is an indication of this type of dysentery.

Apparent dysentary.

Continued on Next Page

Mites and their viruses

And there are always mites in the mix. *Varroa* is probably the most serious problem that a colony faces. It appears that even a small population of *Varroa* mites can vector viruses that are perfectly able to kill or maim bees on their own. As scientists and beekeepers grow in their understanding of the full effects of these viral invaders, our respect for the damage that they cause is increasing. At this point in our hive management recommendations, our best control of invasive viruses is to vigorously suppress *Varroa* populations. A hive killed by mites can be safely reused. *(But stay tuned. While this looks like a solid recommendation, viruses and other microscopic invaders might change this recommendation. I have no science to suggest that this is happening and will continue to re-use such equipment. I am only suggesting that we stay alert.)*

Starvation

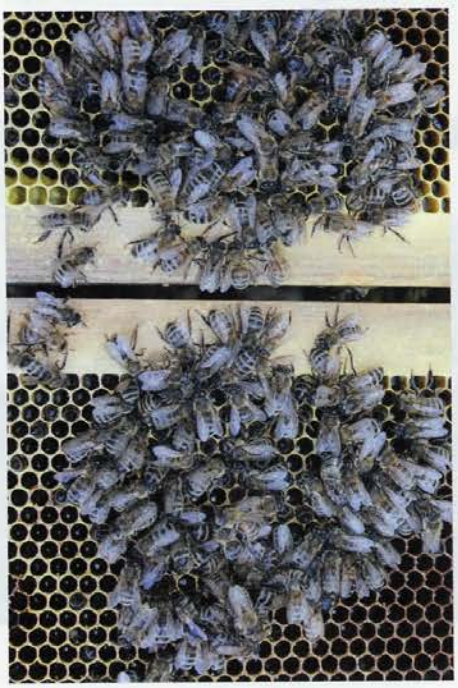
Starvation has distinct characteristics. The cluster will be in a tight (and dead) group, probably near the center of the colony with single dead bees scattered about. Frequently, the dead cluster is right at the top of the colony. Upon removing frames from the colony, many bees will be seen in cells with their heads toward the center of the comb. Meager amounts of honey, if any are usually all that remains. Occasionally, patches of honey can be found scattered throughout the hive, but bees were unable to get to it before chilling.

Once the reason for the winterkill has been determined, you need to decide what to do with the equipment. Diseased equipment should be destroyed or sterilized depending on the disease pathogen. Colonies that starved should have dead bees shaken from the equipment and comb as much as possible. True, new bees will remove all the dead bees from the frames, but assisting the bees with the task can save critical time.

Even after most of the dead bees are removed, a stench will be noticeable and unpleasant. Many bees will have filled cells with their bodies. If the humidity is high, their dead bodies will fill cells and become soggy. Bang the frames on the side to jar as many out as possible. Rarely are all of the bees removed, but do what you can.

If possible, don't give the new colony only frames that need clearing. Let the new bees become established, and as they grow, add the occasional frame of dead bee combs. I stack such obnoxious equipment outside on a solid board, and soundly close the top. If cracks remain, I use tape to cover these holes. Mold will grow on the combs, and they will look unusable. Keep mice out of the stacked equipment. Stacking outside keeps the stench outside.

A sad mess. This smells as bad as it looks.



Starved – Winter killed frames of dead bees.

Reestablishing winterkilled hives

Spring colony splits

Unless you've had extremely bad luck, some of the colonies probably survived the Winter. Depending on the strength of the surviving colonies, bees and brood can be taken from surviving colonies, along with a new queen, and put in refurbished winterkilled equipment. The strength of the split is an arbitrary decision you'll have to make. The stronger the split, the more likely the colony will survive. However, the stronger the split, the more likely you'll not get a honey crop from the original colony.

Provide mated queens

I usually suggest placing a mated queen in the reestablished colony as opposed to letting the bees produce their own. If winterkills have been a problem, you should do everything possible to improve your chances for the next Winter. If bees are required to produce their queens, too much time is lost during the nectar flow. Brood and bees from several colonies can be mixed to form a new colony. Smoke or some other disruptive agent (air freshener or newspaper barriers) should be used to mix bees from different colonies and minimize fighting.

Buying package bees

Book your package bees as early as you can. Increasingly, package bees are expensive but readily available if you book early. Package bee installation is a simple and proven procedure for getting hive equipment back into operation. Package producers, listed in the bee journals, should be contracted as soon as possible in order to book the arrival dates most convenient for your location (around dandelion and apple bloom time.) Check with you local bee club. They sometimes buy in bulk.

If bees are all that's needed, queenless packages can be purchased. Colonies that survived the Winter in weakened conditions, but alive, can be boosted with the addition of a few pounds of healthy adult bees. Contact individual package producers for the details on queen right or queenless packages purchases. They may or may not be available.

Buying colony splits

Colony splits have the advantage of not having the *"post package population slump."* After a package of bees is installed, the adult population declines until the colony's queen produces new bees. Since brood is included in a colony split, adult population decline is not as great, and the colony builds up faster and is better prepared to face the cold weather.

To the best of my knowledge, there is not a "standard" split. Contact beekeepers who are selling splits. Ask how many frames, how many adult bees, and how much brood will make up the splits. Determine if frame replacement is expected. It would probably be a good idea to check with the state inspector to be sure the individual has a good record of disease control. Occasionally special deals may be worked out with another beekeeper for you to provide some of the manual labor required to make the splits. Prices range from$100-$150 per split depending on the size of the split in brood, adult bees and number of frames. It makes sense that on-site pickup of the splits is required. Shipping splits would be difficult.

Swarms

I seriously doubt that there's a beekeeper in the world who doesn't have a slight rise in blood pressure at the mention of a six-pound swarm. In fact, swarms are an excellent way to restock winterkilled hives. The only problem is that they are so unpredictable and, due to mite predation, they have become somewhat uncommon. They are also inaccessible at times – requiring great feats of strength, bravery, and agility (maybe other descriptive terms would have been more appropriate here). I must confess that they are sometimes simply not worth the risk. Another confession? Sometimes I hold some winterkill equipment for the swarms that come my way. If of course, such swarms are never from my hives.

The "Dead-Outs"

"Dead-Outs" are simply colonies that die during the Winter – for whatever reason. There are few reasons to wish for colony winterkills, but if it happens, you have a window to perform routine hive maintenance and late season busy work.

Fix and Repair Old or Busted Frames

Increasingly, I am agreeing with those people, who years ago, were recommending the disposal of old, dark combs. Use common sense. If the frame is still perfectly useable, then use it, but if it needs extensive repair, is distorted, or has a lot of drone brood, toss it. (Actually, they make great kindling for a fire to keep you warm while working.) The reason for my change-of-heart is the possibility that pesticides are accumulating in the old wax and the increased concerns about old combs harboring viral and bacterial pathogens. My general recommendation . . . use old comb, but don't become attached to it. Toss it when necessary.

Scrape Propolis and Burr Comb

Bees busily apply propolis in the spring; you busily remove it. While the frames are out, scrape propolis and burr comb so the frame fits more easily within the hive body. I'm not sure why, but always save the propolis scrapings. I've never sold any, but I confess that I do like the smell of fresh propolis. Use a heat gun to soften propolis before scraping. It makes the hardened propolis much easier to remove.

Repair and Paint

There will never be a better time to scrap, repair, and paint the hive equipment. It's cathartic. From a dead hive, you remodel, restore, and reinstall a new colony. I feel frugal, but a radio and a warm fire help prevent boredom during this task. If you mark or brand your equipment, do it now, just before repainting.

From the ashes

From the bleak disappointing death of a colony arises the birth of a new, refurbished colony in a clean hive. High colony losses are indicative of management procedures that need to be improved. But clearly, you should be prepared for some colony deaths each year. Take it in stride and prepare the equipment for the re-establishment of a new colony the next Spring. Thoughts of Spring can make the coldest Winter day more tolerable.

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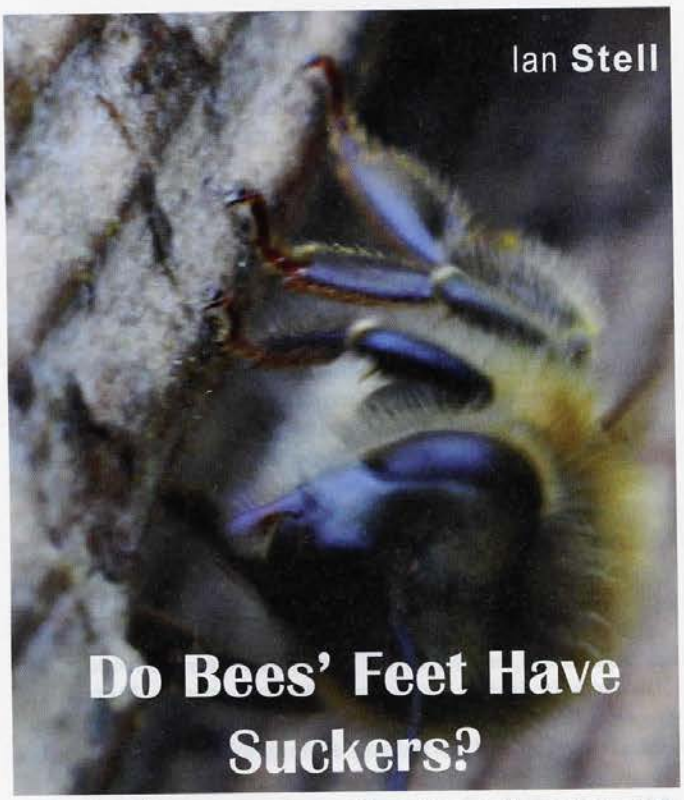


Do Bees' Feet Have Suckers?

The short answer is: no, they do not. So how do they hold on to completely smooth vertical surfaces?

To answer this question we will need to look at their legs in detail.

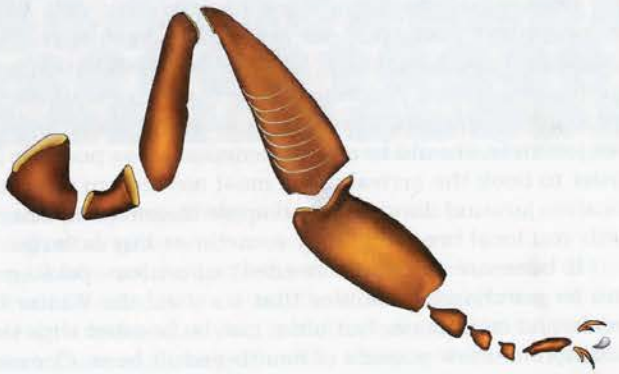
Figure 1 shows the 12 components of a bee's rear leg. The number of segments in other legs is the same, although their shapes and functions are slightly different. From left to right the segments are: the coxa, trochanter, femur, tibia, basitarsus, three tarsomeres, pretarsus (foot), two pairs of claws (ungues) and the arolium. Only the first four contain the muscles which move the leg joints.

In considering the bee attachment to surfaces, we must focus on the last part of the leg, the thin part containing the three tarsomeres, the foot and its appendages. In figure 2 we see that the leg ends with quite substantial claws (known as ungues), and between these an upturned structure, the arolium.

The claws each have a joint with the top of the pretarsus (foot) so that when the single tendon (the unguitractor tendon), running down to the foot is operated by its muscles in the femur and tibia the claws are pulled downwards (flexed) and their points hit the surface (figure 3). If they fail to gain a grip they continue to move outwards and the arolium pivots around the lower end of the manubrium, and flattens out onto the surface. If we observe this happening under magnification we see that the flattened arolium attaches to the surface strongly, providing a strong anchoring point for the leg. So how does it grip on?

We only need to look at the surface of the arolium at high magnification to see that it is not a 'sucker' (figure 4), it is not the right structure to create a cup shape and rely on a 'vacuum' to grip on. Instead it has a number of ribs with a fine raised network running over them. Recent work on geckos, small lizards capable of running across ceilings, has shown that their club-ended toes actually hold on using Van de Waal's forces rather than suction.

These are electromagnetic forces produced between molecules close together. A similar process has been described in jumping spiders. It is likely that the same forces are at work when bees hang on surfaces. The size of these adhesive forces is small (figure 5). In attempting to quantify them, the adhesive pressure must be at least about 2 kPa for a bee to hang upside down by all six legs (a vacuum cleaner, by comparison, produces a suction; a negative pressure, of about 20kPa). However it is likely that the maximum adhesion pressure is somewhat greater than this as one bee can easily support several others hanging from it.



Although the ability to grip to smooth surfaces using the arolia is enough for one bee to support its own weight and one or two others, this is far less than the attachment that the claws are capable of. If the surface is rough enough then bees will grip using their claws (figure 6) and the entire weight of a swarm is supported by the claws of those at the top gripping to a branch, and other bees gripping to each other.

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