Episode 152 PROOFED

Wed, Jan 17, 2024 4:09PM • 56:06

SUMMARY KEYWORDS

hive beetles, beekeepers, small hive beetle, bees, hive, small, beekeeping, years, beetles, question, varroa, research, colonies, technology, honey bees, talking, bee, areas, place, cold climates

SPEAKERS

Amy, Stump The Chump, Serra Sowers, Guest, Jamie

Jamie 00:10
Welcome to Two Bees in a Podcast brought to you by the Honey Bee Research Extension Laboratory at the University of Florida's Institute of Food and Agricultural Sciences. It is our goal to advance the understanding of honey bees and beekeeping, grow the beekeeping community and improve the health of honey bees everywhere. In this podcast, you'll hear research updates, beekeeping management practices discussed and advice on beekeeping from our resident experts, beekeepers, scientists and other program guests. Join us for today's program. And thank you for listening to Two Bees in a Podcast. Hello, everyone and welcome to another episode of Two Bees in a Podcast. Today, we are joined by Dr. James Wilkes, who is a professor in the Department of Computer Science at Appalachian State University in Boone, North Carolina. He is also the founder of HiveTracks, which is what we're going to be talking about with Dr. Wilkes today. James, thank you so much for joining us on the podcast.

Guest 01:08
Yeah, thank you so much for having me.

Jamie 01:11
It's really, really, really great that you are recommended to us by listeners. So we know that you've already got fans out there in our listenership, so we're excited to be able to talk to you. But before we get into the details associated with what we brought you on to discuss in the first place, could you tell us a little bit about yourself and how you got into beekeeping or the beekeeping world?

Guest 01:34
Sure. We could probably take the whole podcast for that but I'll give you the condensed version. Actually, my dad had bees when I was growing up. So, it's a great story. I was born in 1965. So you can age me from that. The year before that, my dad had decided to start beekeeping for whatever reason. Him and a neighbor ordered some bees from Sears and Roebuck and got a package of bees in the mail. And so when I was born, I had bees in my backyard. I grew up in small town, North Carolina, kind of Piedmont area, a town called Eden, North Carolina. And yeah, my dad had bees growing up so I

was around them. We had two or three hives all the time. But then, in the year 2000, I got my first hives when I first started actually beekeeping myself. I got a couple of hives from him. He was moving, and at that point he had probably had 10 hives or something. So I started keeping bees in the year 2000. In 2005, I moved with my family to a farm in Creston, North Carolina, it's in Ashe County. I had space and time and energy, well, not really time, but the energy to increase my beekeeping. And as you know, once you get a few hives, it's kind of hard to keep the numbers down. And that became part of our farm life and farm business. That grew into a sideliner operation. So I'll kind of stop right there. But that was my journey, just from the beekeeping viewpoint into beekeeping.

Amy 03:22
That's always really fun to hear everybody's story. Every time I work with new beekeepers, I always tell them, it's a slippery slope. I'm like, be careful, because next weekend, you're going to want more equipment, you're going to want to find more bees, and then you start to split and it kind of just goes downhill from there, doesn't it?

Guest 03:41
Yeah. I mean, if you have healthy bees, you're gonna have more bees than you know what to do with. That's my conclusion. So, yeah, you're gonna have to do something with all the bees.

Amy 03:54
Absolutely. So Jamie introduced you and said that you were a professor in the Department of Computer Science. We've discussed in past podcast episodes before about computer science and technology and how that relates to beekeeping. So I know that you're a computer scientist at App State University. But can you tell us a little bit just about the research that you've done? I mean, was this part of your being a professor? Or was this kind of just for fun? Or how did this kind of all mesh together?

Guest 04:26
Right, so there was a convergence, I would say, of my beekeeping and my computer science. That happened, as I said, in 2005, I moved with my family to this farm property and we began to do farm things and go to farmers' markets and sell honey and that sort of thing. At some point along the way, I was getting more hives than I knew what to do with or to keep up with and to keep in my head or to keep good notes. And, in fact, I had started a, what I call, backyard beehive program, which is quite prominent these days. There's a lot of big businesses that are built on that model of placing hives on people's property or corporate property, that sort of thing. And so I was trying to figure out a way to keep up with these distributed apiaries, and I was in my backyard. In the early days of mobile phones, I think it was about 2008, and I was standing at a hive going, "How can I remember what was going on with his hive?" And this device in my pocket ought to help me. So it was really a seminal moment of in my head where these two things came together. And I said, we ought to be able to bring technology into the beekeeping space to give an assist for the beekeeper, just to help them to make better decisions. So that was sort of the aha moment for me. So that's 2008. And then subsequent to that, I began to try to figure out how to marry the two together. HiveTracks was born out of that shortly thereafter. And then on the academic side, I was used to writing grants, and I'd been part of a grant program that I started in 2002, pretty big NSF program. So I kind of knew how that system worked. So I was sort of looking around for some place. I knew this was fundable work in the academic space, and

so I went looking at different directorates, the biological directorate, but then I started thinking, I'm a computer scientist, and if I'm submitting a grant application to do bee research, I should probably have some bee researchers as part of that for them to take me seriously. And through a long series of interesting events that are worth a longer story, I was taking a queen-rearing workshop from David Tarpey of NC State. I had a prototype of HiveTracks, and was showing it to him on the side and said, "I'm really looking for a fundable research stream to do." And Dave Tarpey said, "Well, hey, man, Dennis vanEngelsdorp had this project that we are working on that we had proposed, and I think we could revive that." That was the genesis of the Bee Informed Partnership. The whole thing was that conversation, and that was in April of 2010. So that launched me into a whole stream of bee research with Dennis vanEngelsdorp and Dave Tarpey and Marla Spivak and Keith Delaplane, I think there was just like, a who's who of beekeeping in the US on that original Bee Informed Partnership grant. And then subsequent to that, we had multiple other grants that were funded. I was essentially the IT lead on those projects, and that was about a 10 to 11 year stream of research. A lot of those were funded grants with Dr. Steinhauer, you've had her on before, I saw. With that whole group, and again, figuring out how to bring technology to sport, the objectives of the Bee Informed Partnership work. In addition to that, this was less research and more of just participating in the community with Honey Bee Health Coalition, I've been engaged with them, and I don't know if you've seen the Varroa decision support tool that they had, the little one where you can ask questions, and it leads you through possible treatment methods for Varroa as part of creating that. So again, all sorts of interesting little projects along the way, but I would say Bee Informed Partnership from a research standpoint was the biggest one.

Amy 09:11
Sounds like teamwork makes the dream work. Seems like you all had everything in place and had all this specialty set in place to be very successful. We always recommend, well, we always promote the Bee Informed Partnership, and then we're always recommending that our beekeepers go to Honey Bee Health Coalition for that Varroa management tool. So thank you so much for that.

Guest 09:34
Yeah, I really appreciate the Honey Bee Health Coalition, the Varroa guide and treatment. They have some super high-quality content that they push out.

Jamie 09:45
Yeah, James, I tell everybody that stuff's the best Varroa control stuff I've seen in the world. It really is good. In fact, when we talk about Varroa control, I often don't even give a presentation. As long as I have internet access, I just bring up that website and teach Varroa control from that website, and I've walked audiences live through your decision support tool many, many times.

Guest 10:07
Cool.

Jamie 10:08
So yeah, we definitely believe. It's neat Amy, that you were able to ask that question to him, because it's really cool, James, for you to be able to disclose all the other ways that you've been impacting the beekeeping industry, not just here in the US, but around the world. Now, that brings us to why we have

you on in the first place, though, as I said, in your introduction, you've been recommended to us by a listener. And they told us about HiveTracks, which we've now mentioned multiple times, but our listeners at this point, probably want to know what is it and what does it do? So could you elaborate a bit more about what this is?

Guest 10:39
Sure. And I'll rewind back to the beginning. As I said, in 2008, I was in the bee yard, actually just right out the window here, where I live, and had this aha moment of how can technology help us as beekeepers, and the mobile device was there. Again, it was brand new at that time. And if you think about that, where we are now versus where we were 2008, technology-wise, the crazy acceleration of the development of technology is amazing. And so at that time, the cloud technologies were just coming on, YouTube was a thing, Google was pretty big. And so in that context, I had this idea, we ought to be able to keep our records about our beekeeping operations, or just our beekeeping activities. We should be able to keep that in a place that's accessible. Clearly, at that time, that was what was happening from a technology perspective, the cloud was coming on. So it was natural to create a web-based application where you could keep up with your beekeeping data. That was the genesis of HiveTracks. At the same time that I had that thought, a friend of mine, and again, this is some of those serendipity moments, you can't create them, they just happen. Kind of like you said, with Bee Informed Partnership, the pieces were in place, and they just all came together nicely. In this case, there was a fellow in Boone, North Carolina, which is where I teach and lived for many years. He was a new beekeeper, hobbyist beekeeper, but he was also a professional software engineer. And he had a similar idea to me. As my idea was percolating, his idea was percolating, and we got together, somebody said, "Hey, you ought to talk to him, and he ought to talk to you." So we had lunch in February, I think it was of 2009, and got together and started down the trajectory of HiveTracks. So that was the beginnings of HiveTracks. And it's been through multiple iterations in terms of technology and the technology platforms that we use. It's been reinvented and reimagined over the years. But the core idea is to bring technology as an assistant, if you will, to a beekeeper to help them make better decisions, again, like that Varroa decision support tool. Technology can give us an assist, and in your beekeeping operation, at least for me, and I think this is true, one of the ongoing questions that you have as a beekeeper is, what do I do next? If anything, right? So equipping you with the information you need to answer that question well, is part of the driver focus for HiveTracks. And so what is HiveTracks? It's a tool. It's a cloud, web, mobile, now, based tool that essentially keeps up with your beekeeping information. So where are your hives located? How many hives do you have? When was the last time you visited those hives? What are your observations? What management actions have you taken? All the normal things that you do as a beekeeper we try to capture one way that's described as a digital twin of your beekeeping operation. So have a digital copy of that again, so that you can have access to it from wherever you are that you've got internet access, and again, to help you make better decisions.

Amy 14:29
I guess when you're talking about HiveTracks, I'm just trying to think of what to expect if I were to download and have HiveTracks. So what would I go into? How does the app help me make these different decisions? For some beginner beekeepers, especially with the Varroa management tools, it's great because they have these How-To videos at the very end of what you could apply, depending on

what decisions you want to make in the colony. And so for our listeners that are downloading it, what can they expect if they download HiveTracks as far as the platform goes and what that looks like?

Guest 15:08
Sure. In our most recent iteration, which we just released this spring, we shifted everything to mobile. So it's going to be kind of a mobile native app. So hopefully, that experience will be similar to what you get with other apps. With the HiveTracks app itself, the first thing you're going to do is set up the location of your apiaries, you're going to set up your hives, how many hives, the type of hive that you have, those sorts of baseline information, when you created the hive, you can put your queen source, your source of the bees. Again, all this context information about your beekeeping. And then just that, by itself, again, kind of helps you, when you go into the app, you can see this is what I'm looking at. If I went to my bee yard, this is what it would look like. And the other things that we add to that are some location-specific information. So, the environment around your hives. Are you in mid-Florida, and sort of swampy or moist subtropical areas? Are you in the mountains of North Carolina? So the context for your bees, we all know, is super important to how you manage your bees. So that context of your beekeeping is part baked into the app. Beyond that, what you begin to do is to record information. Whenever you do anything with your bees, you record that information. One of the focus areas is the inspection process for your hive. So I spent a lot of energy and time kind of coming up with what is the kind of sweet spot, literally, for inspecting the hive or doing a hive assessment. This is the case where you're actually going all the way in, going deep into the hive, not just to pop the lid and see how the honey flow is going. But this is a full assessment of the hive. And that just in itself is a great guide to really, I would say, research-based guidance on what are the important things to look for when you're inspecting your hive. We have those key elements highlighted throughout the inspection process. There is a quick path, if you know what you're doing, you can get through it super quickly. If you're not so sure what you're doing, there's help along the way, again, kind of what you're talking about, you can take it slower. If you don't know what we're talking about when we're talking about a brood pattern or frames of bees or queen status or stressors on your bees, there's more information there. And there's kind of an endless list of things that you can add as help. But there's a decent start there already. So again, that's the baseline of what you're going to see when you go in. The value-add, if you will, is, as you go along, you look back and you say, "What happened the last time I was at this hive?" This, "What do I do next?" really depends on what's happened before. And we all know that each colony has its own sort of life story, if you will, throughout a season. And so your role as the beekeeper is just to monitor that and to intervene if you need, if you see things going south and you need to get in there sooner to correct things. And so staying on top of things in a timely manner is a challenge for beekeepers, especially hobbyists where they've got normal life going on, and they might not know how long it was since the last time they were in or what they saw last time. But that information to give context to the next visit is super helpful, I believe. And then a new thing that we've added, there's a couple of things that are beyond just the record-keeping, one of those is kind of a recommendation engine, if you will, that we are developing. And that's based on observations that you make. We can make recommendations based on how you've answered those questions. And that not only hinges off of your own observations, but also of what's going on in the community. There's something we call community intelligence, and for newer beekeepers, this would be super valuable to know what's going on in your beekeeping neighborhood. What are neighborhood beekeepers or beekeepers in your area, what are they doing right now? Because quite often, it's very similar and you need sort of a guidepost to say, "Hey, what

should be happening right now? Is that happening in my hive? Am I diverging from that?" So there's a piece called community intelligence. That's a very forward-looking, aggregating community information and feeding that back to the beekeeper. And then one other cool thing that we're doing is what we call "what's blooming." And, again, as a beekeeper, you begin to become sort of a biologist and look at what's blooming, you begin to recognize nectar sources, those sorts of things. And so capturing that information is kind of along the lines of like the phonology network, or these other sort of crowd-sourced blooming, spring is on its way information. And that's baked into the app as well. So that's just a few of the pieces that we're working on.

Jamie 20:48
So James, I have two follow-up questions related to this. And you've talked a lot about this as you've discussed what the app does, but how do most beekeepers use the app? What do they consider the most valuable features when they're using it? That's number one. Number two, we have an international audience who listens to this podcast. Is this something that can be used overseas as well?

Guest 21:12
Yes, so an answer to your first question, I would say the inspection process is the most valuable piece. And in addition to just your normal management actions, when did I treat? When did I harvest? Again, just capturing that story of your hive is super valuable, especially at the end of the year, when you want to look back and have time to assess what happened during the year. And then, as far as international goes, yeah, there is a quite an international presence that actually uses HiveTracks. And with the original version of HiveTracks before our most recent mobile app, which is kind of a reboot of the whole thing, we call the old one the Legacy HiveTracks, without much marketing, or trying to on my part, it just kind of went all over the world. We've had over 40,000 registered users in 150 countries over the years. And so it's been used in a wide variety of settings. We had the Google Translate version out there with the legacy app. With the new one we've actually had -- and this is too long of a conversation for today -- we've had some really interesting projects that have been driving some of our development and directions that we want to go as a company. So we've had a project in Ethiopia, in Uzbekistan, and Lebanon. So we actually have versions in [inaudible], Russian, and Uzbek, and Arabic that are for those specific projects and for those groups, but we are translating the mobile into these other languages, and not just with a Google Translate where it may or may not get it correct. This is where we're going to those populations of beekeepers and having them make sure that we're translating it well. So the short answer is yes, it can be used pretty much anywhere bees are kept.

Amy 23:31
Very cool. So I do have to ask, is it free to use HiveTracks? Or does it cost money?

Guest 23:36
Great question. It's used all manner of business models over the years. So the original was free. The current version is a free trial for 30 days, no credit card, no nothing. And then after that, it's a fee. It's a software as a service. I want to say, I should know the prices, I think it's $69.99 per annual, and then $7.99 per month.

Amy 24:03

So you were talking about just the future of your collaborations and your international collaborations specifically, but where, in general, do you see the future of just computer science, these apps, the honey bee industry? What's next? I mean, what do you feel like is the next step with the computer science research?

Guest 24:26
That's a great question. There is so much to talk about there that we could dive into. I think what you'll see is just a continual development process of trying to bring technology into the beekeeping industry. And there are some very clear indicators of where that's going on. I don't know if you've had any of these folks on the show or not, but the whole sensor space where you put sensors into the hive, where you're measuring temperature, humidity, weight of a hive, all that sort of thing, I've been tracking with that for years as well, because it obviously adds an element to the data around your beekeeping operation and adds another layer of data, if you will, that could be valuable to you as a beekeeper. For example, we make sourwood honey in our operation. And the scale data is very helpful to us to know when the flow has started, how strong it is, and when it ends. And so there'll be continual development in that direction. The place to look for that is people like Bee Hero and Nectar and other technology providers that are bringing sensors and things into the hive, the IoT space into the hive. The other side that HiveTracks is really interested in and putting a lot of energy toward is beekeeping data. And this was also part of the Bee Informed Partnership. And you've seen that the data from the Bee Informed Partnership now has become sort of de facto measure of losses in the US for good or ill. That's what it's become. And so beekeeping data, I have argued for years, is super valuable in a lot of different ways beyond just for the beekeeper. So how can we incentivize the beekeeper to keep good information about their bees and about the health of their bees? Because it can answer a lot of the research questions that we have, for one, and then just a lot of the monitoring of the health of honey bees and pollinators in general. So HiveTracks has taken a pivot a little bit into how can beekeeping data add value downstream to other stakeholders? There's a number of different places that happens. And it really just depends on business and how the markets respond and value that information. One area that I'm super interested in pursuing and figuring out is honey authentication. Data-driven honey authentication is one of the areas that I'm interested in personally because of our sourwood honey and the number of non-sourwood versions that are out there being sold. But then the other area that Max, my CEO, and he's in Europe right now working on some of this, it's really an emerging space, is honey bees and pollinators in general clearly impact the ecosystem and add value to our natural systems. And so how can we account for that? Just like in almond pollination, the beekeepers are compensated for providing their bees to the almond growers. What about all of our obvious beekeeper bees, they're providing an ecosystem service to the surrounding community, is there a way to account for that? So we're working on kind of, I think, interesting ways of doing that, which would then incentivize those beekeepers because they could eventually perhaps be compensated for providing good data that's helping to monitor the ecosystems in the areas where they live. So along those same lines of trying to create a system where beekeepers are compensated for their ecosystem services, the critical piece of that is getting a volume of data that would make a difference. So we're continually looking for collaborators, either from businesses or others who would like to adopt the HiveTracks platform and use it in their operation or as individuals or clubs or that sort of thing. We're interested in working with them. And again, we have some projects all around the world where we're doing this. So I would just invite anybody who's interested in that angle, feel free to reach out to me for that.

Jamie 29:04
Well, James, thank you so much for spending some time with us today. I really am a firm believer in the idea that technology is going to shape our industry for the better, and it's really great to hear what you guys and others are doing. I also really appreciated this perspective of where things might head with technology, assisting the beekeeping industry and healthy bees etc. So thank you so much for joining us and sharing your insight on this issue.

Guest 29:28
You're very welcome and I'm glad to be here with you. Appreciate the opportunity.

Amy 29:42
So I'm not gonna lie, Jamie, when I first became a backyard beekeeper, I was really good at keeping records. I was really good at taking notes and knowing exactly when I went out into the apiary. I had two colonies at the time, so it's easy for me to say, "Oh, I added a super on today. Oh, I saw eggs." And I think just through time, I stopped being as good at keeping track of what was going on in my apiary. So yeah, what were your thoughts on that as far as record keeping? I thought that was great. I mean, it's nice to have a platform to be able to do that. And my phone is always with me now, especially when I'm going out into the bees. And that kind of takes us to that second piece of the interview, which is the technology piece of it. I love the interdisciplinary work that's being done between computer scientists, beekeepers, and just again, James working with the Bee Informed Partnership and with the Honey Bee Health Coalition. That computer science component and technology is, I think, where it's at, and where we are headed even more so with the acceleration of technology these days.

Jamie 30:19
Well, there's something to think about with just straight-up record-keeping, So they developed the technology to help us with record-keeping. So the first question is, is record-keeping important at all? My mentor told me years and years and years ago, when he was still alive and just teaching me about bees, how important record-keeping was and I literally copy stuff on notebook paper and had it in a three-ring binder. But I was one of those folks who collected records and then never used them. I know how I educate people about keeping bees today, I talk about record-keeping. And here in our lab, we keep records. In fact, we subscribe to a record-keeping technology. And one of the old ways we do it, and kind of still do it in some ways, is we have a brick where each side of the brick is painted a different color, and depending on which side is standing up, which color is up, it will tell you whether it's a queen problem or whether the hive's good, etc. But the take-home message is that record-keeping is very important, especially when you get a large number of colonies because you need to know what was the status of that colony the last time it was inspected? Did they need food or not? Were they queenright or not? Did they have evidence of brood disease or not? So I think what James and his colleagues have done is they've created an easier way to facilitate record-keeping, which has additional features like bloom timing of plants, and all those other things that they're able to do now. I've really enjoyed seeing people who are beekeepers or are interested in bees in general use whatever skillset they have to help the industry. And James was talking about his father being a beekeeper and that he grew up around bees, and he developed a love for computer science and still keeps bees and he's like, "Hey, I can use my skillset in computer science to help beekeepers. And here's how." And I just love those stories for

the fact that there are individuals who want to help bees and beekeepers, but also I like it in this regard, especially because I really believe that our industry is starting to move very quickly, very rapidly into the use of technology. I think that's only going to balloon in the future. And I believe with something like what James has done developing an app, developing this kind of technology-assisted record-keeping, all these other strategies that HiveTracks will be able to do in the future, I really think that this will all be commonplace among beekeepers very shortly. And not just technologies like this, but also technologies that help us work our colonies better, maybe read some of what we're seeing in our colonies better. It's really neat to be able to have someone on to talk about this because it's really where the industry is heading.

Amy 33:23
I cannot agree more.

Stump The Chump 33:27
It's everybody's favorite game show, Stump The Chump.

Amy 33:36
Hello, everybody, and welcome to the Q&A segment. Jamie and I are going to try something new today. I cannot promise we're going to do this all the time. But this is brand new. We are going to leave our video on. We almost never do that. So now there's this like other layer of the podcast. Now, we actually have to stare at each other. What our listeners don't realize, Jamie, is that most of the time we have our cameras off. We're talking to each other in different rooms. I'm usually sitting here slouched down, staring at my fish tank. And what do you do? You close your eyes while you're answering questions?

Jamie 34:14
I close my eyes or I look out this amazing window that I have here. Amy, I tell you, I knew we wanted to try to do this, but I remember the first time -- so I used to listen to a radio a lot when I was a kid-- I remember the first time I was able to see the people who were the DJs for the radio stations. I'm like, "Oh my gosh, you look like that?" Because you create, in your head, this image of what the folks you listen to all the time look like and it turns out, they're not who you thought. So I apologize if I'm not who you thought. Amy, I'm sure is who you thought. This amazing, awesome individual, Amy, right?

Amy 34:47
That's right. That's exactly right.

Jamie 34:48
A lot of you're going, "Oh my gosh, this was the worst idea they've ever had."

Amy 34:52
It's funny. Now that I see myself, I feel I didn't realize how short I was, but I also know that I'm pretty short. And I feel like whenever I go to a talk, I'm at a podium, and someone tells me like, "We can't see you." I'll just hide under the podium like this. Anyway, alright, let's get this Q&A started. Some people have seen us do Q&A live. So some people have seen us, others have never seen our faces before. So

what we'll do is in this episode, we will release this episode in the podcast, but we will also link it to a YouTube video and you all can listen to it, watch us if you want to see our faces, watch us kind of fall asleep while the other person's talking, whatever you feel like doing. All right, Jamie. So the questions for today, the first question we have, this is actually kind of fun to have this because I can actually -- let me ask the question. Do separate subspecies of small hive beetles exist in the United States? This questioner has said that they've seen quite a variation in both shape and size. So now I can tell you like, I don't know, maybe it's a square shape. Maybe it's a circular shape. Maybe it's this big. Maybe it's this big. Anyway, are there different subspecies of small hive beetles in the United States?

Jamie 36:07
Well, I will start with that question because it's a very clear question for which I can give a very clear answer. There are no identified subspecies of small hive beetles. They're all Aethina tumida, which is the genus and species but there's no subspecies designations. Now, there are different strain designations as you might imagine. So small hive beetles are native to Sub-Saharan Africa, that would be everywhere in Africa south of the Sahara Desert, right? And so you can imagine, over that really large area, you get natural variation in small hive beetle populations. There was some early research in the United States when they were trying to figure out maybe where small high beetles came from, who's related to whom, etc. And they did identify some strains, some ecotypes of small hive beetles, but those identifications have not been elevated to the level of subspecies. So the reason the questioner is asking this is because the questioner is saying, well, I'm looking at these small hive beetles and they don't all look alike. And I can explain that a couple of different ways. Way number one is it is possible that you're not looking at small hive beetles. Before you feel, maybe, that I'm calling you out, I will tell you, I made a mistake 15-20 years ago, when we were doing research -- Yeah, yeah, with small hive beetles, I make lots of mistakes. When we were doing research with small hive beetles, we went down to Charleston, South Carolina where we were going to collect some small hive beetles, some colonies, mark them, release them and see what their spread was in this particular apiary. So we spent a day, a colleague of mine from the University of Georgia and I spent a day collecting these beetles that were hundreds, maybe thousands of them in colonies. We were marking them, we released them, and I could not figure out why we didn't find them in colonies the next day. I had a few samples that I took back with me to the University of Georgia. Well, it turns out that they were another species of Nitidulidae, which is the family that small hive beetles are in, but they were not even the same genus as small hive beetles. But to my eye, at the time, because I hadn't seen lots and lots of small hive beetles, they were so new, I wrongfully identified them as Aethina tumida when they were, altogether, a different genus of Nitidulidae. But they had the same shape, the same characteristics, they just had a different color pattern. So it is possible that you're seeing things that aren't small hive beetles but that are otherwise very closely related. And you might think they're small hive beetles but I will say, at this point, small hive beetles are so common, that's not the mistake people usually make. The better answer, I think, to your question is that the size of small hive beetles varies significantly based on the quality and the quantity of the diet they fed while they were larvae. I think that is far more likely the explanation for what you're seeing. So imagine this scenario. Imagine that you've got a dwindling colony, and adult small hive beetles move in and the female beetles start laying eggs. Well, those first few larvae that are produced have a smorgasbord, they have a buffet of food available to them in that colony. They've got all the pollen, all the bee brood that they want, and so they get unlimited quantity, and a high-quality of diet. So those larvae eat everything they can eat, and then go

into the soil, pupate and come out as large adults. But imagine as thousands of these larvae are being produced while the food reserves and those colonies shrink. So the eggs that are laid later in the dwindling of that colony have less food and lower quality food available to them. In fact, once the resources are fully consumed in that nest, the small hive beetle larvae that are available at that time might have their food access completely cut off before they are fully developed. So small hive beetle larvae seem to be very plastic, unlike honey bees. Honey bees seem to have a set amount of food they have to eat in order for them to develop successfully at all. But small hive beetles don't seem to have nearly that fixed amount of food they have to consume. So larvae that don't get all of the food that they need can still pupate, and they come out as much smaller adults. And so what you're probably seeing when you see a range in sizes of adults, you're likely seeing that related to the availability of food that they had and the quality of food that they had while they were eating. If they have less food and lower quality food, they're going to be smaller adults. And again, it just all depends on where in the colony cycle they might have been born. And so that's probably the explanation for what you're seeing.

Amy 37:22
Noooo. Well, you're talking about the amount of eggs that small hive beetles will lay. How many eggs do small hive beetle adults lay?

Jamie 41:11
That hasn't been worked out conclusively. But it does look like each female can lay at least a few hundred eggs.

Amy 41:17
Okay. All right. So I think this Q&A is going to be all about small hive beetles, and the fact that you did your PhD with small hive beetles, you are the small hive beetle expert. So we're just going to keep going with the small hive beetles track during this Q&A, if you're okay with it.

Jamie 41:31
I'm okay with it. I don't want to take credit for being the full expert. There's lots of us around the world, but I'm certainly someone who knows at least a little bit about small hive beetles.

Amy 41:38
That's alright. Knowing a little bit about a lot is a good thing. Knowing a lot about a little is also a great thing. Okay, so the next question I have for you, let's talk about the different types of research that is being conducted on small hive beetles. We always go to talks, we always discuss, if you have small hive beetles, this is what you do. We know a little bit about their behavior. We know a little bit about how honey bees manage having small hive beetles in their colony. What type of research happens with small hive beetles?

Jamie 42:07
Well, it's fair to say, Amy, that lots of different types of research are on the table right now for small hive beetles. So let me give you my own personal example and then expand it significantly to give a better, maybe, global picture of this issue. So when I first started studying small hive beetles around 1998-2000, and then when I went to South Africa in 2001 to do my PhD over the next two and a half, three

years, not much was known about small hive beetles. There were two papers in Africa, one by Lundie, and one by Schmolke. And both of those, so Lundie was in South Africa and Schmolke was in, at the time Rhodesia, which is now Zimbabwe. Their two papers are largely just biology papers. What do they consume? Where can they be found? How can you tell the difference between males and females? What diets do they reproduce? Things like that, some very basic biology. So when I became a PhD student, I had a postdoc colleague, Peter Neumann, he and I were essentially the ones who were studying small hive beetles at the time. Some colleagues here in the US were Mike Hood, Keith Delaplane. And at that time, everything was fair game. We knew so little about small hive beetles that all of us were contributing mostly biology type information to small hive beetles, as well as some trap. The reason small high beetles became in vogue, again in 1998-2000, is because they had just been found in the United States and they were decimating colonies here. And so obviously, we wanted to know about their biology, but we also wanted to know about their control. How can we stop these things from being a problem in colonies? So over the last 20 to 25 years, there's been an explosion in small hive beetle research. A lot of it on small hive beetle biology, what temperatures can they survive? What substrates can they pupate? What are the diets that seem to be limiting their dispersal? But there has also been a ton of research in small hive beetle control, biological control, chemical control, mechanical control, like traps. I would say biology and control really are the two biggest areas of small hive beetle research as well. The next set of research that I would argue that is really gaining in popularity now is research related to diagnostics and dispersal of small hive beetle. Let me set the stage for that. In 1996-98,those those two to three years is when small hive beetles were starting to pop up everywhere in the United States. We knew they were native to Sub-Saharan Africa, we knew that's where their populations were indigenous, but because they were found in the US and became a beekeeper problem, the research on them really started to grow. Then, they were found in Australia, I believe around 2000-2001, somewhere in there. Well, then they were found in other places. And now, they're, I think, on every continent around the world except Antarctica. So, they were found in Europe and Italy, they were found in Brazil, they were found just all over the place. People are really discovering them, really, alarmingly, all over the world. And so as a result, there's been quite a growth in diagnostics to help people know when they have beetles, to do early surveillance for small hive beetles, to ensure they know when beetles show up in an area. And there's also a lot of research done on dispersal, how do they move? How far can they move on their own? And things like that. So if I had to put it in four broad areas, there's a lot of research being conducted on beetle control, biology, diagnostics, and dispersal and a lot of that owes to their movement around the world. And I will say, Amy, I use the word explosion a lot. There's a huge explosion in small hive beetle research because they're being found in so many different places around the world.

Amy 46:04
Well, what's really interesting about you saying that is we've, I feel like, I don't know, this may not be true, Varroa has spread, Varroa is everywhere. Small hive beetle, I feel like even the time that I've been working in the honey bee world and just around honey bees, that's been about 9-10 years now, I mean, we had people from Canada who came down to Florida and in their part of Canada, they had not seen hive beetle before. Just this year in February of 2023, I was in the Dominican Republic, they also did not have small hive beetle. So I mean, I know that they're spread. I know that beekeepers see small hive beetle, but I'm wondering, it seems like the movement has been a little bit slower with small hive beetle versus something like Varroa.

Jamie 46:50
Yeah, it's a very troubling thing to me because a lot of countries have been really good at keeping it -- some countries, at least, have been really good at keeping out Varroa. For example, Australia, for the longest time. They weren't in Hawaii for the longest time. I know, Hawaii is part of the United States. But that illustrates this point. Small hive beetles, like I feel like they are showing up on other continents maybe even faster than Varroa was. So while it is true, like what you mentioned, colleagues in Canada, certain Caribbean islands, certain countries in South America, certain countries, maybe in Europe, etc. haven't found them yet, the fact that they are on these continents means that it's really just kind of a matter of time. So people are very vigilant, they're looking for these things, there are national efforts to screen for small hive beetle to try to slow their dispersal. But, I feel like I'm kind of a realist and it just seems like it's a matter of time before they show up in a lot of the places. Now, the good news about small hive beetle that makes them quite different maybe from Varroa is that they do not survive, they don't thrive in colder climates, as well as they do in warmer climates. I hesitate to say they don't survive. They absolutely do. They can survive winters, in cold, cold winters. But they don't thrive in these places. We've actually got a question coming up about what small hive beetles do in winter so maybe this is a nice segue for it. But I'll just say that if you're in a colder climate, you are likely to have beetles, but not nearly the damage that you would expect if you were in a warmer or much, much milder climate.

Amy 46:59
Well, you've already asked my last question. So the last question is, what do small hive beetle do during the wintertime?

Jamie 48:34
Yeah, so that's an interesting question. It's going to be born out of kind of anecdotal experiences that beekeepers suggest but also some research that we've even done at my own lab. As I said earlier, small hive beetles can survive winter. But, they don't thrive in areas where you get truly cold winter. So what do they do during winter? Well, small hive beetle adults seem to be able to survive winter just fine. What appears to happen and again, this is research we did in our own lab, we had a PhD student years ago, Eddie Atkinson, he took observation hives that were designed in a way to have small hive beetles in these prison systems around the perimeter of the hive so that we could observe it. And then he would move these observation hives into different environmental chambers that we had here at the University of Florida to look once it gets certain temperatures, what do these beetles do? Below around 50 to 60 degrees Fahrenheit, which is the same temperature at which bees will cluster, we would notice the beetles would leave these prison sites and go into the clusters with the bees. We've actually frozen colonies before that contained small hive beetles and dissected these colonies to see where the beetles were found. What we found in these dissected colonies that were frozen is that when you freeze a colony, the bees will start to cluster the way that they ordinarily would. And when bees cluster, they will actually go headfirst into empty cells, as well as form layers of bees between combs so that they kind of have this contiguous layer of bees from one edge of the cluster to the next. When we would go into these clusters and remove the bees from these cells that they had frozen headfirst into, we actually found small hive beetles at the bottom of those cells. So small hive beetle is going into the cells, bees are going into the cells as part of their normal clustering behavior, and we would see small

hive beetle adults right in the center of these clusters. So we believe that the beetle adults can overwinter with the bees in the clusters. It's a research topic waiting to be investigated on the interactions between bees and beetles in these clusters. How in the world do the defense systems of the bees break down in the cluster such that small hive beetle can survive? Now, there's a big question on whether small hive beetle adults are the only lifecycle that can overwinter. There's great supposition, maybe even some data, to suggest that those late larvae that come out of the colonies and go into the ground to overwinter when the temperatures are cold, can slow their pupation such that they can spend winter in the soil as pupi. Now, they probably cannot do this in the upper few centimeters of the soil in cold climates because in really cold climates, the soil can freeze centimeters into the soil. But, certainly, 10 centimeters or lower into the soil, which is a depth that we know small hive beetle larvae will tunnel before they start to pupate, we certainly believe that they may be able to survive as pupi in soils at certain depths. So we have strong reason to believe the adults and the pupi can survive over winter. But I will tell you, in very cold climates, you can lose a lot of those individuals. And when bees come out of winter, you still have a low population of adult beetles that survive these temperatures. And because so few of them survive that way, it really cuts back on what beetles are able to do in cold climates. It takes a long time for spring and summer for them to rev up their populations. Whereas here in Florida, we do get reduced beetle populations over winter, but they can still come out relatively strong in spring and kind of start the cycle quickly over again. But that's why they're such a minor issue in cold climates. Their populations get hit so hard in the winter, and they have to rebuild in these colder climates, whereas in warmer climates, they just seem to keep going.

Amy 52:50
That's interesting. So I don't know why it made me think of this but developing larva in soil and kind of just slowing down that process reminds me of -- are you familiar with sea turtles and how they --

Jamie 53:01
Yes, I have heard of sea turtles?

Amy 53:03
Are you familiar with sea turtles? Like the symbol for them? Well, you know that sea turtles, when their eggs are laid, they will wait for each other, and they'll be at different depths, and they kind of wait for that temperature. They all kind of wait for each other to hatch together to emerge together. But, it's also just really interesting that something can pupate, but also their climate, the temperature, all this stuff around them are factors for when they're actually able to emerge.

Jamie 53:33
Yeah, so in insects, the system's called diapause. Certainly, insect development is slowed in cold temperatures and different insects have different cold temperatures below which they'll die all together. And so for a lot of insects, it slows so much that they can go into this state of diapause, which is kind of like a hibernation where they just stay static until the environmental conditions favor the continuation of their lifecycle. And we think that that could be happening with small hive beetles. Amy, for that matter, just one of the major news stories just last week is they found nematodes that had been frozen in Siberian permafrost for 46,000 years. And they brought those nematodes back out of that suspended animation. So we do know there are organisms that can, essentially, for lack of a better term, freeze,

and their lifecycle stops. Then, when environmental conditions favor their continuation, they do that. I don't think small hive beetles can do it to that extreme, but there's certainly strong evidence that they can survive winter just by going into this state of almost like a diapause-like state where they just wait until the environmental conditions favor their reemergence.

Amy 54:48
That's pretty cool. All right. Well, thank you so much. Those are the three questions that we had today. First time ever doing video on. It was kind of trippy doing that because, I don't know, maybe we weren't in our natural state just sitting there awkwardly the whole time. If you liked just staring at us while we were speaking, we're happy to try it again some other time. Keep your questions coming. Be sure to send us questions on our email, or write to us on social media. We are on Facebook, Instagram, and/or Twitter.

Serra Sowers 55:27
Thank you for listening to Two Bees in a Podcast. For more information and resources on today's episode, check out the Honey Bee Research Lab website at UFhoneybee.com. If you have questions you want answered on air, email them to us at honeybee@ifas.ufl.edu or message us on social media at UF honey bee lab on Instagram, Facebook and Twitter. This episode was hosted by Jamie Ellis and Amy Vu. This podcast is produced and edited by Amy Vu and Serra Sowers. Thanks for listening and see you next week.