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SPEAKERS

Amy, Cameron, Honey Bee, Jamie, Stump The Chump, Guest

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, and welcome to this episode of Two Bees in a Podcast. In our first segment, we will be talking with Dr. Ben Oldroyd, who is a professor from the University of Sydney in Australia. He will be discussing his new research on how to use drones at drone congregation areas to estimate the density of wild honey bee colonies. We will follow that with a segment on Nosema where we'll be interviewing Dr. Cameron Jack from the University of Florida who's an expert on the topic. And of course, no Two Bees in a Podcast is complete without our famous question and answer segment. Welcome to this segment of Two Bees in a Podcast. I'm really excited for today's guest. He's Dr. Ben Oldroyd, who's a professor in behavioral genetics at the School of Life and Environmental Sciences at the University of Sydney in Australia. But he's not actually joining us from Australia today. He's actually joining us from Berlin, Germany, where he is on a 10-month sabbatical in the Institute of Advanced Studies in Berlin. Dr. Oldroyd, thank you so much for joining us on Two Bees in a Podcast.

Guest 01:55
You're welcome. Good to be here.

Jamie 01:58
Absolutely.

Amy 01:59
Was that supposed to be punny?

Jamie 02:02
Of course it was. Right, Amy? I mean, so the thing is we're recording this in early September 2020. So Ben has just arrived about a month ago in Germany, and I was fortunate to do a sabbatical in Germany as well. And while he's there, he mentioned to us beforehand, Ben, that you were saying that you just have to go there and think and interact with other scientists. That sounds pretty cool.

Guest 02:24
Yeah, it's sort of like a holiday camp for academics. It's really fantastic.

Jamie 02:31
That's great. Well, we're going to talk a lot about what we brought you on for today. You're going to be telling us about some research project that you and a student did on using drones to discover the density of wild honey bee colonies. But then before we get there, I really like to introduce our listeners to the interviewee. So could you tell us, very briefly, how you got into bee and bee research, how you ended up where you are, what institutions you passed through along the way, etc.?

Guest 02:59
Okay, so I grew up in the early part of my life up, until age nine, in New Zealand. And I grew up on an orchard, and they had some bees there. And I was absolutely fascinated by the bees and would sit there and watch them come and go and catch them on plants and wonder why they didn't make any honey, etc, etc. And then my parents moved to Australia when I was nine. And I got into Boy Scouts, and by 11, I had two or three beehives, and I've never looked back. I did an agriculture degree at Sydney University. I studied genetics because I wanted to breed better bees. And then I got interested in bee behavior and all that sort of thing. So that's become my career. I study the genes which affect behavior of honey bees.

Jamie 03:55
I saw that you did some time at the Baton Rouge Bee Lab, the USDA lab there. Were you there for a postdoc or doing a degree? Or was it employment?

Guest 04:04
I was employed as a research scientist. It was a fantastic experience. I had a great deal of mentoring from John Harbo and Tom Rinderer, had a wonderful time and learned a lot. Very grateful for my years in the Baton Rouge Bee Lab. I was there for about four years, I think.

Jamie 04:23
Yeah, I saw that. That's really neat. I don't think I was aware of that. That's pretty cool that you were able to do that.

Guest 04:28
I was a running mate of John Harbo.

Jamie 04:31
So, I did my undergraduate at the University of Georgia where I worked in the lab of Keith Delaplane. And Keith Delaplane, of course, was a student of John Harbo and speaks very highly of him. And we interviewed Jeff Harris a few weeks ago, and he was talking about John.

Amy 04:44
I feel like we need to bring John Harbo. Yeah, we need to bring him on to the podcast, I think.

Guest 04:50
Yeah, you do. World's greatest inseminator. Amazing. I've seen him in inseminate a queen bee, take out the semen from the spermatheca, and inseminate her daughter. And I think he did that for two generations.

Jamie 05:03
That's incredible.

Amy 05:04
That is so cool. Okay, so we're gonna have to interview him for the podcast and get a video recording of him at the same time. Life goals. Okay. So when I had reached out to Dr. Ben, I asked you about different topics that you'd want to talk about. And you had mentioned using trap drones to discover the density of wild honey bee colonies, which is kind of funny, because I feel like we haven't really talked a lot about drones in a lot of our other podcasts. But just recently, I've been speaking to different associations throughout the state, and they've been asking me a lot about drones. So I think that they're gonna really enjoy this segment. And this will kind of be the beginning of a lot of, I think, drone episodes that we could talk about in the future. But I guess we just wanted to talk about your research. What was the backstory behind this research? What was the motivation behind it? Who was involved? And what did it really involve and entail?

Guest 06:00
Yeah, okay, so the number of bee colonies or wild bee colonies that are out there is of great interest. Of course, you might have all sorts of reasons for wanting to know how many colonies around you, but I'll give you a few. If you're a farmer, you might want to know if there are enough bees out there to pollinate your orchard or whatever. But you might want to know that you need to rent colonies, because there are not enough wild bees out there to pollinate your crop. Or you might want to say, "Well, I don't have to, because there's plenty of wild bees around." So that's one motivation. Another one might be if you have a new exotic disease outbreak, you'd like to know how many colonies are out there and whether it would be feasible to go find them all and kill them. If you're doing bee breeding and you want to use controlled mating of some sort, and you don't want to use AI, you want to know how many colonies are out there. So there are lots and lots of reasons for wanting to know how many colonies that are out there. One more would be some people are concerned about feral bees adversely affecting the environment so they know how many colonies are out there. So how do you do it? You can't attract

the workers to a site and study them because they come from all over the place, you don't know how far they've come, so that's not going to work. And wandering around in the forest looking for bee colonies is, while it's fun, a little bit hit and miss. You might be able see them, or they're right up on the top of a tree and you can't see them. Actually, I'll tell you the story. I once did a study with Wayward Youth from Europe, in Whitfield National Park in Australia, so they were part of a trust that sent people to Australia to do environmental work. And I got 10 of these volunteers. And we walked around to the National Park to find all the federal colonies that we could. And we found 120 colonies per square kilometer. So you can't do that on your own. You've got to have volunteers. And of course, it gets very expensive, difficult. So you can do it a different way. And the different way is to have the drones from every colony come to you. So how do you do that? Well, you get a helium balloon, a weather balloon, and you lift up this trap gizmo, which is basically like a wind sock at an airport. And you raise that up and inside it, you've got some cigarette filters, which you've made black, and you squirt queen pheromone onto those cigarette filters. And all the drones in the area smell this, and they're attracted to them, and they go into the net. So you can collect hundreds of drones in a few minutes if you've got the right spot.

Amy 09:01
Did you come up with this method? Or is this a method that's commonly used?

Guest 09:05
This is not a commonly used method. It's by John Williams at the Baton Rouge Bee Lab, actually, many years ago. But all he was interested in was tracking them. He didn't really know what to do with them afterwards. So that was back in the days when Africanized bees, we were terribly concerned about Africanized bees. And the notion was that you trap the drones and then you put some insecticide on them and let them fly back to their nest, and the nest would die. That will be a good way to get rid of feral bees. But we thought, and other people have thought, that it would be a great idea to catch the drones and then you'd be able to do some genetics on them and find out how many colonies they came from. So if you've got 300 drones that you track, you genetically analyze them and you find there are 30 groups of brothers, then you know 30 colonies were sending drones to your trap. So that's the gist of what we do. So the difficulty with that is you have to get the area right, you have to know from how far the drones come. And so we've been doing lots of experiments on that. And one I'd like to share with you is where we took a colony of bees from Sydney University that we built up to have lots and lots of drones in it. And we took them over the mountains in Sydney to where it was still quite cold last spring, and then we put our balloon up, 250 meters from the colony and put some drones, and we painted all the drones in this colony white. So we knew on the 250 meters, they fly at least 250 meters, so then we went 500 meters on the other side of the colony and put up our balloon and collected some drones and did this in a pendulum fashion, backwards and forwards until we worked out that the drones fly, wait for it, 3.75 kilometers. So that's how far drones will fly from their colony. And you can track them with this trap. So that makes an area of 42 square kilometers that you draw your drones from. So, say there's 30 groups of brothers in your track doing your genetics on them, then that means that you can divide 30 by 42, and you've got slightly less than one colony per square kilometer.

Jamie 11:34
So that's pretty fascinating, Ben. So this has been a topic that has interested me as well. I had a masters student go down to South Africa, and we were just trying to look at indexing, not actual estimating colony densities, but just an index based on workers at feeders, we're getting large volumes or not. Of course, that's problematic because if you're too close to a colony, they can be overzealous for that honey and lead to problems. But the drone thing I've seen before. I'm really intrigued by this, and I've got 1000 questions, but I'll try to keep it to just one or two for this for the sake of the podcast. But I'm curious with regard to this system, what is your overall average density of colonies per square kilometer?

Guest 12:19
It varies a lot, but we usually find it that we collect about 100 colonies in our trap. And then you divide that by 42.

Jamie 12:30
So it's about 2 point something.

Amy 12:32
So I have a really silly question. Do the drones communicate the same way that the workers communicate when they're out foraging? Is that how they --

Jamie 12:42
Drones aren't out foraging. They're going out to mate at these DCAs, so that's what they're collecting them at.

Amy 12:49
But do they communicate like workers do when workers are out foraging? Like with the waggle dance?

Jamie 12:54
Nope, no. Oh, man, you can answer that one for me.

Guest 13:00
They don't dance. They do not dance. There's one species where they do a kind of protodance [inaudible] in Thailand and places like that. These little bees, the drones do a dance, but what they're doing there is just encouraging each other to take off.

Jamie 13:21
Okay, so let's get this. It's like the pregame warmup. Right? So Ben, I'm intrigued. I want to follow up my question about the varying densities with this question here. So my interest in it years ago, I haven't done much with it since, was to be able to estimate the quality of an environment and its ability to support colonies based on the density of wild or feral colonies. So do you have any insights to that or is it a little premature in the research where, for example, you're seeing on highly managed land, you

have lower densities and old, say, maybe, more natural land, you have higher densities of wild colonies or vice versa? Are you heading there? Have you already done some work on this?

Guest 14:07
We have actually done that in Australia, we got matched sites. So, an area which is a pretty pristine environment, and then an area which has been found outside it and then cleared for agriculture. And it's consistent that you always find more colonies in the natural areas, than you do in the farming areas, which is interesting, since honey bees are not native to Australia, but they still seem to be attracted to the preserved habitats.

Jamie 14:42
Yeah, that is interesting. I've thought about that, again, from the US perspective, but I think we'd probably find out something very similar. I think we'd find a higher density. With that said, we have African bees in the southern half of our state and the density is incredibly high in urban areas, just really, really high. So let me ask you then, what level of differences are you seeing in the density, say, between your natural areas and your farm areas? Or is it too early to tell for sure? Is that like a two-to-one ratio or 1.5-to-one ratio?

Guest 15:13
Yeah, it's about that, about two to one. It's not 10 times. But we do have the world record, I think, for honey bee colony densities in Whitfield National Park. That's where I did the study with the Wayward Youth from Europe. We got 160 colonies per square kilometer. That, in miles, it's about 300, isn't it?

Jamie 15:38
That's incredible. So how in the world were there enough resources to support that density? That's just incredible.

Guest 15:42
This was in a habitat that was along a creek. So there were these big old red gum trees along the creek, which were full of hollows. And many of those trees had four or five colonies in them. But the surrounding habitat was quite deserty. Even though there was probably nectar resources out there, there was nowhere for the bees to live. So they were subjected to this line of trees. And that's where we're doing our transect. So it's probably a little bit of an exaggeration of the overall number of colonies in the area. And they had an incredible propensity for this population to fluctuate. So in one year, it was down to about 50 colonies per square kilometer in a drought. And then the other year was around 160. So amazing capacity to increase and decrease in population size.

Amy 16:37
Hmm, that's so crazy. So I guess a lot of our listeners always want to know, how can this research be applied? So how can this be applied to them or to other beekeepers around them? We have a lot of calls just about feral colonies in general and wild colonies in general. So how would this be applied to them?

Guest 16:58
Well, as we talked about at the beginning, this is of great interest as to the number of colonies in an area for whether or not there's enough colonies to pollinate your crops with, you can muster up enough resources to go in there and eradicate colonies if there's a new disease outbreak. I mean, we're terrified in Australia of Varroa. But, if you were in an area where there was 150 colonies per square kilometer, there's no way that you're going to --

Jamie 17:30
Exactly.

Guest 17:32
Whereas if you estimated that was only one or two, you might have a chance over a reasonable area. And you can sometimes tell whether or not there is Varroa because I guess you'd find them on the drones. So there's great potential for using this technique for monitoring disease outbreaks. I'll tell you a little story, you may be aware or your listeners may be aware that we have Apis cerana now in Australia. This is the Asian honey bee from which Varroa came. And it has established a wild population in Cairns, which is the northern sea in Queensland in Australia. There's been a second outbreak in Townsville, which is a small city 200 kilometers, no, 400 kilometers south of Cairns, so there's the main infestation, and there's another one, which is in the south. And they got in there, and to their great credit, they eradicated it. But then it came back. And there's two ways that we detected them. One was by looking at the poo of bee-eater birds, so you can see the wings of the bees in the poo. Or you say poop, don't you?

Jamie 18:46
Well, for the purposes of everybody, we're talking about feces here.

Amy 18:55
Poo is a scientific term, though. That's okay.

Guest 18:58
And the other way was we put up the balloons to attract the drones of this species. And that was the first way that the second infestation was detected by the balloons. There's another application using it to detect invasive species, new species.

Jamie 19:16
So that's interesting. Are the drones from cerana attracted to the same pheromone that you use for drones for mellifera.

Guest 19:24
Yeah, they are attracted just as much but they're very shy. So whereas with mellifera, if you've put your balloon up, the drones just mob the thing. You can see hundreds and hundreds of them chasing each

other and going up into the trap. But cerana are different. They're very shy, and they hide in the trees. Actually, we think they may even sit on the leaves in the trees. And then they dart out and look at your lures, but they won't actually go into the trap. So because they're too shy, they're too scared of this big thing up there. So what we generally ended up doing was getting fly paper, put sticky glue on fly paper. So we would smear the nylon line that was holding up the lures with the sticky stuff. And they would bang into it and get stuck on it and then you lower it. That's so fun. It's awfully good fun, but you get terribly sticky. You don't want to be that.

Jamie 20:31
So one of the things I'd like to ask, Ben, you've already talked a little bit about some other projects that one could do with, for example, attracting cerana. We just finished talking about that. But I'm wondering, what are some other future implications? Of course, you've talked about the applicability to beekeepers, but I'm thinking about things like bioindicators. Can you look at the density of feral or wild honey bee colonies to get an indication of the quality of the environment or the ability of the environment to support say, commercial beekeepers or other pollinators? Can you use it to establish information about conservation status, etc.? So where are some directions that you see this heading?

Guest 21:11
Well, I think everything you say is completely right. So, for example, after the recent bushfires in Australia, as you might have heard about, at the beginning of this year, we had terrible fires. And we did some studies post-fire to see whether we could detect any colonies. And it was remarkable how many bees were still out there, colonies were still out there after these devastating fires, which you would have thought would have killed everything. So that was a bit of an eye-opener that we still found lots of drones after the fires. The other thing that we've been doing, this is kind of a fun thing, at Sydney University, we have our sports oval, number one sports oval, which is a drone congregation area. So this is where the drones naturally congregate every afternoon. If you go down there, I discovered this in 1980, that shows you how old I am, and if you go down there and throw a stone in the air, the drones will approach it and try and make it. That's how many drones are there. We do an animal behavior crack at that place with our animal behavior students where they put the balloons up and estimate how many colonies are in the area. So a very fun afternoon, as you might imagine, six balloons in the air with all these students running around. We put this balloon up at this oval and then another one in outer Sydney every month for two years, and analyzed the colonies that were there. And it's absolutely fascinating. You can trace the demography of the population, you can see this one swarmed, this one died, this is a new one, this is the daughter of that one, and you don't know where they are, but this whole story, you can piece together just by looking at the drones. It's fascinating.

Jamie 23:04
That's really cool because I've often wondered about the relatedness of colonies in an area. So I really think that what you're doing there and that example that you just gave is a good example of how you can do that. And you can see, just like what you said, demography, how things change over time, the relatedness of these colonies in the environment. That's really neat. You had mentioned early on,

though, that you really wanted to make sure to give some credit to the student who did a lot of this work with you. Can you tell us a little bit about that student?

Guest 23:29
Yeah. So the main one who's with us now, and she's about to submit her PhD, is wait for this name, it's Patsavee Utaipanon. She is from Thailand, and she has been with us for three years. And she's absolutely amazing, loves getting out there, catching drones. She's been all over the country, catching drones and bringing them back to the lab and doing amazing genetics on them and developing new techniques of statistical analysis of them to infer. She is just a fabulous person.

Jamie 24:04
Oh, that's exciting. I can tell you, as a supervisor of students, myself, it's always great to get those students who were able to do these things that are cutting-edge and lead to these great new discoveries. So, Ben, I really appreciate you joining us in Berlin today. It's been great to have you on this podcast.

Guest 24:18
It's been my pleasure, Jamie and Amy. That rhymes, doesn't it?

Jamie 24:22
It does. We get that a lot.

Amy 24:23
It does. People don't realize it.

Jamie 24:26
Yeah, I wanted her to legally change her name, but she wouldn't do it.

Amy 24:29
Yeah, to Shmamy.

Jamie 24:32
But I do appreciate having you. I look forward to seeing you again in the near future. Everybody, that was Dr. Ben Oldroyd, who's a professor of behavioral genetics at the School of Life and Environmental Sciences at the University of Sydney in Australia. He's currently on sabbatical at the Institute of Advanced Studies in Berlin, Germany, and he was talking to us about using trap drones to discover the density of wild honey bee colonies in an area.

Honey Bee 24:56
Have questions or comments? Don't forget to like and follow us on Facebook, Instagram, and Twitter @UFHoneyBeeLab.

Jamie 25:07
Hello everyone, and welcome to this segment of Two Bees in a Podcast. One of the things that I get a lot of questions about here at the University of Florida is the impact of Nosema on colonies and how to control Nosema in colonies. And frankly, I know a fair amount about Nosema, but oftentimes, not enough to be able to help the beekeepers quickly and directly because a lot of beekeepers believe their colonies are struggling with this particular issue. We struggle with some of the control options available for this pathogen. So one of the things that we wanted to do with Two Bees in a Podcast is bring in one of our own local experts to talk about this disease. That local expert is Dr. Cameron Jack. He's a lecturer here in the Entomology and Nematology Department at the University of Florida. Cameron, thank you for joining us on Two Bees in a Podcast.

Cameron 25:57
Well, thanks again. I'm glad to be back. It's been a while. You and Amy have had such a good thing going that I just worry now that I'm gonna mess it up.

Jamie 26:06
Yeah, I think, Cameron, the issue is that your name doesn't rhyme with either of our names. It's easy to be Jamie and Amy. But Jamie and Cameron just doesn't roll off the tongue. Well, Cameron, I mean, obviously, you know this, but one of the reasons we brought you on is that you are what I consider an expert on Nosema. In fact, anytime I get questions about Nosema, I almost always come and ask you that question. And then I will answer the beekeeper, basically, with whatever you tell me. So could you just very quickly, tell me how you got interested in studying Nosema? I know that you did a Nosema-based project when you were a master's student at Oregon State. Could you tell me how you got into that line of research in the first place?

Cameron 26:50
So at the time, I was finishing my undergraduate degree, and I was just looking at different opportunities across the country. And I was emailing a lot of honey bee researchers and there were a number of different projects that people were proposing. But I really liked this idea of studying Nosema, which I ended up going to work with Dr. Ramesh Sagili at Oregon State University. And I guess I was just drawn to Nosema because this was, at least at the time, a number of years ago, this was something that was relatively new. A lot of beekeepers were really worried about it, and really my whole graduate career, I just wanted to do something that I thought was really going to be beneficial and helpful to beekeepers. So that's kind of how I gravitated towards Nosema. And then once I kind of got into it, I just found it really interesting. And I enjoyed my time looking under a microscope all day.

Jamie 27:52
So, Cameron, I've actually never done a project on Nosema, myself, at least when I was in graduate school. I've done a couple of things since then while working at University of Florida. But I would say, without question, that I'm not an expert on this topic. So before we really go further into the control, how this impacts bees and beekeeping, could you tell our listeners what Nosema is in the first place?

Cameron 28:13
Sure. So Nosema is basically a single-celled organism that is a fungal pathogen. So it basically is what it sounds like. I mean, they are classified as microsporidia, which I mean, they are microspores. That's what they exist as. And if you follow the levels of classification down all the way to genus, there is a genus of microsporidia called Nosema. And this particular genus will infect insects, primarily. And so there are different species of Nosema, and they will infect different insects in different ways. And we actually have a few different species that will just affect honey bees, specifically, but these microspores will get into the guts of the insect, and they basically hijack ATP, which is going to be the energy of cells and then they hijack some other nutrients to just replicate within their gut cells. And that's basically how they exist. And then, that organism will basically poop them out somewhere and they'll maybe get into the water and then another insect will pick that up when they drink that water and then it just kind of spreads all over again.

Jamie 29:38
Yeah, that's kind of crazy and scary-sounding. One of the things that I think a lot of people don't know when they get into bees and beekeeping is it honeybees have a lot of pests and pathogens that need to be addressed. And when we talk about things like Nosema, and I'm just listening to you talk about it, to me, there's a lot of parallels between it and some of the human intestinal issues that we get. I mean, I often teach Nosema as if it's the bee version of cholera, right? It gets into their system, causes a lot of digestive issues, and then it spread through fecal material because of, in the human case with cholera or diarrhea, but with bees, it's very similar. So before we go to all of that, and get in the weeds of that, you mentioned that Nosema is a genus of the single-celled microsporidia that impacts a lot of different insects. And you mentioned that there are some species, specifically, that affect honey bees. So how many Nosema species exist that impact honey bees directly? And what are those species?

Cameron 30:35
Sure, so you have three different species that have been found to infect honey bees. So you have Nosema apis. And now this one has been very well-studied. This has been around for a long time. I think it was first described in the early 1900s. And so there's been quite a bit of research done on Nosema apis. And then the next species that came to be discovered was called Nosema cerana. And this is, you might recognize that name cerana from the Asian honey bee Apis cerana. So Nosema cerana came from Apis cerana. And then what happens is you have beekeepers who are moving honey bee colonies all across the world, and you kind of have these overlapping of regions that you don't normally see, then you have these two very similar species, Apis mellifera, and Apis cerana, and they start sharing each other's pathogens, basically. And so that's when we start to see a shift, we see Nosema cerana start showing up in Apis mellifera. And then once everybody started looking for it, about 2006 is when Nosema cerana was first discovered to be in Apis mellifera, then everybody started looking for it. And then lo and behold, it happened to be all over the world already. It's just that people didn't know about it. And so those are the two primary ones that are very heavily studied. Back in 2017, so just a few years ago, now, there was another Nosema species that was described affecting Apis mellifera. So far, it's only been found in Uganda, and it was called Nosema neumanni. And so you've got these three species, the third one being so relatively new and that nobody really knows very much

about it. There's no reason to think that it's that much different than the other two species. So there are three of them that are in existence right now.

Jamie 32:34
So that's a fascinating story. I will tell you, when I first started keeping bees, literally 30 years ago, almost to the month, I was told by my mentor that I had to worry a lot, specifically about Nosema apis. And so everything I learned about managing Nosema was with Nosema apis. Things to look out for, how to treat it, all that stuff. And then as you mentioned, somewhere around 2006 2007, we had this worldwide issue that was brought to attention, these high gross loss rates of managed honey bee colonies in the US that originally was called colony collapse disorder, but now is broadened to be called colony losses. And I remember right about that time is when Nosema ceranna was discovered, and very early on, it was implicated in a lot of the deaths that we were seeing were these widespread losses of bees, but then people backtracked on that, and people started trying to really tease out what the differences between Nosema apis and Nosema cerana were, how responsible cerana was for bee losses. It was at that time, Cameron, that I just got more and more and more confused about Nosema. Because it seems like every paper that came out would contradict the previous paper. "Nosema apis is hard to find now and it probably has been supplanted by Nosema cerana. Now, Nosema cerana is the one that's killing bees. Wait a minute, it doesn't kill bees. Wait a minute, it does kill bees." And then lo and behold, just three years ago, we've got this new Nosema, Nosema neumanni, named after a colleague, Peter Newman in Europe, and now we're not sure what it does. And so there's all this confusion, as far as I'm concerned, about Nosema. So let me ask, is it true that Nosema apis is harder to find in North America and has largely been supplanted by Nosema cerana?

Cameron 34:21
That's a great question. You make a lot of great points about how confusing it can all be with all the research that's come out in the last decade and a half. So to answer your question, yes. At least that's what it seems like when people are monitoring and actually looking for Nosema in their colonies, by and large now, they're finding Nosema cerana in North America. And so it does seem that Nosema cerana has kind of taken its place as the number one Nosema species and has kind of displaced Nosema apis. Now, Nosema apis is still around. Just to make things even more complicated and confusing, Jamie, you can have bees that are simultaneously infected with Nosema apis and Nosema cerana. So it gets really mixed. But it seems that, by and large, if you're doing maybe something like quantitative PCR, so we're looking molecularly and trying to quantify how much we have, we might see both species, Nosema apis and Nosema cerana, but you tend to see a bit more Nosema cerana.

Jamie 35:31
I mean, all of this is interesting to me. One of the things I want to do is kind of drill into this impact on bees thing. Like I said, with Nosema apis, I felt like we all knew what it was supposed to do to be easy. If you look at the old books, it tended to be a problem more of a problem in winter, you'd get colonies that were heavily infected, a lot of the worker bees would exit those colonies, especially in later winter, and defecate the moment they leave the hive, so you'd get this fecal streaking on the front of the hive that was very characteristic, or at least said to be characteristic of Nosema apis. But then along comes

Nosema cerana and it's this mystery pathogen. All the bees seem to have it or at least a majority of colonies seem to have it. Some colonies seem to suffer from it, others not. So let's drill down a little bit and talk about it. You've already mentioned a bit about what Nosema does to bees, how it gets in the bees' midgut and competes, literally gets into the cells of bees and competes for energy resources and reproduces in cells. But what does this do to the overall colony? And is every colony that has Nosema going to display signs of infection? Are they all doomed?

Cameron 36:39
Good question. So let me start with that first one. So what is it actually doing to the colony? Well, if you look at an individual bee that is infected with Nosema, so it gets into those guts, and as we said, it's stealing resources, and it basically is starting to drain that bee. So what will happen is you have an individual bee that is getting hungry because they're getting drained, basically. And so they are eating and consuming more food. But at the same time, during this process of replication inside the bees' midgut, those Nosema are replicating to the point where they're actually bursting open and destroying the honey bees' guts cells. And so the bee is hungry, and it's eating more, but it can't actually absorb more of those nutrients. So it actually kind of continues this cycle of making it hungry and more and more hungry. And then, think about, I mean, knowing the dynamics of a honey bee colony, there are some important bees that don't actually feed themselves, the queen being the most important. She's being tended to by workers. But when you have a bunch of hungry bees, you see this kind of behavioral shift where they're not actually sharing food as readily as they normally would because they're feeling more hungry. And then what can happen in a really severe infection is you can have bees that are not tending to the queen as well. And then, when mama ain't happy, ain't nobody happy, right? So you can have some hard, or some really drastic colony effects when the queen is not being able to be fed. And she's not producing, she's not egg laying, you have bees that are not sharing their food, so things can tend to go south really quickly when bees become really infected. Now, something really interesting from one of my projects as a Master's student, it was just, it's a terrible project. And it makes me like kind of shiver a little bit thinking about it. It was actually a really good project, it was just a lot of work. But what we did was we created these colonies where we were marking bees individually, and we were merging them in the lab. Then, we were creating these colonies of just completely marked bees. And so I knew the age of all the bees in the colony, and then we would introduce some Nosema spores to them. And then, we would basically kind of give it a period of time, and then I would harvest that entire colony and look at the guts of each bee in that colony. So it was just a tremendous amount of work. But what we were able to see is that when we have these Nosema infections, it's not even a colony that is what we would consider to be like very infected, you'll tend to have these bees that just have crazy numbers. I mean, we're talking 50 million spores in one bee and then, we only see like maybe 10% of those bees that are actually infected. So it's not so much that all the bees get infected, but you might have some bees that are incredibly infected and then it can spread pretty fast. With Nosema apis, the route of infection from bee to bee tends to be, as you mentioned, at least, what we currently think, is that it tends to be kind of like a fecal-oral route. So you have these bees that have dysentery. And then, you have some that might actually defecate inside the hive or they might leave and defecate just on the front of the hive or something and you have bees, I mean, they're very hygienic, they're going to try to clean it up. And when they're cleaning it up, they're going to become infected. And that's how it will

continue to spread. Nosema cerana, on the other hand, is thought to not cause dysentery as much, to make it even more complicated. You've got kind of an oral-to-oral route. So as bees are feeding each other and sharing food via prophylaxis, they are passing some of those Nosema spores. And so it can kind of take hold and take root and inside of colony, and then what will happen, kind of large scale effects, is you'll have reduced longevity. So the bees aren't living as long, you have usually a reduction in the amount of food that they're storing because, again, they're going to be really hungry, they're not going to be storing as well for winter. And then you kind of move into winter, or in the fall months, when there's not as many nectar resources available, the risk of starvation is really high because you have bees that are extra hungry, and they don't have as much food source. So lots of colony losses that you tend to see in the winter and in the early spring.

Jamie 41:30
Yeah, this whole thing is mind-boggling to me because back in the past, when I've done one or two projects looking at Nosema, it seems like we found them in every colony. So then you're wondering if there's like just universal poor performance in those colonies because they're all infected with Nosema. But then you hear of some reports where they just got it, like what you mentioned, even high loads, but there seem to be no impacts. I feel like there's so much more we need to know specifically about Nosema cerana, which, of course is why people are beginning to study it all around the world. And as you know, Cameron, all of this is good. The science part's good, the biology is all good. But ultimately, a lot of our listeners are beekeepers, and they want to know what they can do about it. So let's talk a little bit about that. Is Nosema controllable? If so, how? What are some of your recommendations regarding addressing this issue? Beekeepers are going to want to know what they can do to stop Nosema before it impacts their colonies negatively.

Cameron 42:26
So this is something that has been on my mind a lot and something that over the years, as I've received a lot of these questions about, "Okay, what do we do about it?" It's just kind of sad to report like, I just don't really have a great answer to that question. So there's an antibiotic out there with the active ingredient being something called fumagillin and this was in one product that was readily available, and then it went away, the manufacturer started stopped producing it. And then there's been other products that have kind of come out on the market that have used this active ingredient. But, there's been some studies that have shown that Nosema cerana, for instance, has kind of like escaped fumagillin controls, so the antibiotic is no longer really effective at controlling it. And from my own personal experience, I hate to go here a little bit, but it may be a little bit of anecdotal evidence, I mean, I've had to do number of projects. I've seen that using fumagillin tends to bring down the Nosema levels. Nevertheless, it just doesn't really wipe it out. And it doesn't really, in my opinion, matter so much. This is kind of a tricky thing in terms of monitoring, because if somebody asked me, "Should I monitor for Varroa?" I mean, I'm just shaking them saying, "Yes, you need to monitor for Varroa. You need to know your mite counts so that you can make appropriate management decisions." But when I talk about Nosema, I still teach my students how to monitor for Nosema because I think it's a worthwhile skill. And it's something that, maybe, later we'll find that it is really important, but at least right now, it doesn't seem that knowing your Nosema counts really correlates to very much. I mean, we don't know what a great threshold is. Is it 1

million spores per bee? Is that when your colony is in danger? Well, we don't really know. And not necessarily because like, again, as I said before, we've seen that you can have some bees that are just crazy infected, and then the majority of the bees can be perfectly healthy. And so basing it off of spore counts is not super useful and basing your monitoring off of proportions of infected bees, in my opinion, would probably be more useful, but that's a lot of work to go through bee by bee in a single colony and to come up with a good proportion. So there's not a really effective way of monitoring and there's not really an effective way of treating. So now everybody's just panicked because I just told everybody the horrors of Nosema. But I can share something that, hopefully, will provide some level of comfort. So, one of the studies that I did for my masters and has been demonstrated by others as well throughout the world, is that when you have honey bees that have access to good nutrition, so they are healthy otherwise because they're eating well, they have enough pollen, they have enough nectar and honey, so they're they're otherwise nutritionally set, they actually tend to have more Nosema spores than those bees that are malnourished. And when I first saw this, I was just freaking out, "I'm like, Oh, my goodness. Something must have been wrong in my study." And then the more that we thought about this, we're like, "Well, think about what Nosema is. It's an obligate parasite. It's going to have to rely on its host for energy and for nutrients." And so if you have a malnourished bee, the Nosema can also not replicate as effectively. So you have these bees that have access to good nutrition, they end up having more Nosema. However, we do see that they will survive better than malnourished bees that maybe have lower Nosema counts, but still have Nosema. And so really, what I tell beekeepers is the best thing you can probably do is to just make sure your bees have access to good nutrition, that you're feeding them when they need to be fed, that you're putting them in areas that have abundant floral resources. And I know this is one of those things that a lot of beekeepers are probably rolling their eyes right now thinking, "Yeah, obviously Cameron, if we could do that, we would do it." But if you can do that and if you are doing that, I feel like you don't really probably need to worry about Nosema too much in most cases.

Jamie 47:03
It's really funny that you say that because I often have felt unable to address beekeepers who say, "Look, you can tell me how to find it. You can tell me how to quantify it, but you can't really tell me how to control it." And that's true. And oftentimes, what I default to is, well, we need to control the things in bee colonies that we can control. Varroa, queens, nutrition, things like that. And it's funny that you mentioned the link to nutrition because as you are well aware, a lot of beekeepers report one of the most significant stressors impacting their colonies is nutrition. And so then we start to get into chicken and egg arguments. Well, is nutrition a stressor for bees because Nosema has an underlying presence there all the time? Or is Nosema a problem for bees because bees become nutritionally stressed? Or are both an impact because bees have consumed pollen that are laced with pesticides? So then we start to question, what's important to control first? We get these issues of who's impacting who? So at the end of the day, throughout all of this interview with you, one of the things that just kept popping up in my mind is we need to study Nosema a lot more. And beyond that, we need to study Nosema control a lot more. So that leads into kind of one of these final questions that I have for you, which is what does need to be done about Nosema? What more do we need to know? What future research is needed on this topic?

Cameron 48:22
So I think in my mind, the very first thing that we would really want to do is to be able to find the threshold. I mean, find, at what point of our Nosema levels, I mean, is that an issue? And are we quantifying this correctly? And before we even worry about controls, in my opinion, I feel like we just need to understand the dynamics of this infection better to be able to understand how we can monitor it. And I preach this pretty hard, I guess, when I'm talking about Varroa is that it's so important to monitor because based on what your results are of your monitoring that might determine what type of control and what level at which you are controlling Varroa. We don't really have that, anywhere near that for Nosema. We just have, like, as I said, you can just kind of crush up a bunch of bees, look at their guts, and people usually do that in one big sample, maybe of like 100 or 50 bees or something like that, and then kind of look at it. But you might have one or two bees that are really skewing your results. So coming up with a good way to monitor and set some thresholds, I feel, would be really important. And then, you move into more of the control. So what do we do about it? Well, maybe there are some things that are non-chemical control. It's just some kind of cultural type of controls. The way that we are managing, the way that we are feeding, the way that we're providing them access to water and things like that. I'm just kind of throwing some ideas out here. But those are some questions that I think people would need to know. And then we kind of move into the chemical controls. Okay, so let's say that we've done all these other things, and we still have high Nosema infections. Now, what do we do? Well, we pretty much have been relying solely on just one antibiotic that may or may not be super effective. And so there is a need to kind of look for other alternatives. But, I would probably put some of those other topics first before we focus too heavily on all the controls. But truthfully, I mean, that's not how it works for Varroa. I don't expect people to back up that far to work on those types of research questions for Nosema either. I know that there are lots of labs and groups that are looking at new alternatives to fumagillin for effective Nosema control.

Jamie 50:53
And I think that's needed, Cameron, because a lot of our listeners are in countries around the world that don't have access to chemical options, or whose countries might not even allow that option with regard to addressing bee diseases and pests in the first place. So I agree with you completely. We need to know a lot more about these diseases, and maybe a lot more about thresholds, like what you said, and certainly, a lot more control strategies need to be developed. As always, in the research world, there's more to do and more to know. I guess that keeps us busy.

Cameron 51:22
It does. And it's one of the reasons that I'm so excited to be in the field that I am because there's always something to do. But it also is something that confuses my family. Sometimes when I'm when I'm talking, they're like, "Oh, what are you going to do for Christmas break?" I mean, I have Christmas off. The rest of the time, I've got something to do always, there's always research, even if I'm not teaching, there's something to be done all the time. So it's exciting, and it's exhausting, and it's fun.

Jamie 51:51

So Cameron, I really appreciate you joining us. I think one of the take-home messages about this Nosema, like a lot of other things, we need to know more, we've got to get a handle on this to help reduce the stress of this particular pathogen in bee colonies. And I know that a lot of people around the world are looking at this. So that's certainly encouraging. There's a lot more that, I think, we need to share with our listeners about this topic. So we're going to have you back on in the future, maybe some other scientists who are experts on Nosema as well, to talk about a lot of the different aspects of Nosema. So Cameron, thank you so much for joining us on this segment of Two Bees in a Podcast.

Cameron 52:24
Yeah, thank you.

Jamie 52:25
Absolutely. Everybody, that was Dr. Cameron Jack, who's a lecturer here and the Entomology and Nematology Department at the University of Florida.

Stump The Chump 52:36
It's everybody's favorite game show, Stump The Chump.

Amy 52:47
It's that question and answer time, Jamie. I've got three questions, and I've only prepped you for two. I've got one surprise one.

Jamie 52:53
I know. You've got me nervous because you said it was a surprise. Now ,I'm like totally worried. But let's get through the two I think that I know are coming and we'll see what that third one is.

Amy 53:00
Alright, fine. Okay, so the first question, in a recent podcast, you had stated that honey supers shouldn't be installed on a colony during mite treatment. So this person has been using a two-inch shim that is to be installed on the hive to allow bees full access to the treatment but, now, they're wondering if they're doing this wrong or maybe it was a mistake?

Jamie 53:23
Yeah, basically, I can explain what happened. So I was saying that many mite treatments cannot be applied to colonies per the label of these treatments, when you are making marketable or honey that is to be consumed by humans. So when I said the word honey super, I was basically saying supers that you were putting on colonies for the purpose of producing consumable or marketable honey. In this case, you can actually have supers on colonies while treatments are in if you follow the label and the label permits you to do that. However, in those cases, you can't eat the honey and in most instances. So what I do, my standard colony, for example, is a deep brood box and a medium super that I leave on all year long for the bees as their food. So it's okay for me to have that on during my treatments because I never intend to eat that honey. Again, if the label permits, the label is ultimately the law. So

what this listener was describing was a situation where he or she wasn't supering for marketable honey purposes, they just had a super on to give a space around the treatment, etc. All of that is fine. Again, at the end of the day, the general rule of thumb is and, again, you've got to follow the label, I have to say that 1000 times, but the general rule of thumb is you can't treat for Varroa with most treatments and extract the honey that is produced in that colony while those treatments are in the hives. So that's the key there.

Amy 54:44
All right, so the second question -- I'm not even going to edit this out. I don't know how to say the word. What wasit? Demaree?

Jamie 54:52
Yep, demaree.

Amy 54:53
All right. So this beekeeper has been a beekeeper for eight years, and they've been trying to find better methods for swarm control. So they've tried brood box rotations, the demaree method, the problem is the bees keep filling back in those empty brood frames of honey so you end up with half-filled frames, and then nothing to return back down to the brood chamber. Is there a better way to prevent this? Or, is this person doing the process wrong?

Jamie 55:15
Well, what I would do is I would do a completely different strategy for controlling swarming altogether. I'll tell you what I do in my own colonies at home. And again, this is just an opinion as a beekeeper, not as a fact as a scientist. But I clip my queens' wings so that they can't swarm, they physically cannot fly from the hive. They might try but they can't. I also, during production season, go through my colonies every seven to 10 days to remove all the queen cells and I super colonies appropriately during swarm season to alleviate some of that density in the hive that's leading to some of the stimulus. When there's a lot of bees in the nest, they want to swarm, especially if the honey flow is coming on. So I super appropriately, I cut queen cells every seven to 10 days, and I clip my queens, and those three things tend to solve most of my swarming issues. There are lots of other strategies for swarm control, you mentioned the demaree method and others, a lot of things can be used. A lot of commercial beekeepers will split colonies, etc. I just wanted to tell you the three things that I focus on during swarm season. I've actually written a document about swarm control and managed bee colonies, and we'll make sure to link that document in the show notes so that you can see some other tips and secrets about trying to manage swarming. I want to give out one little final caveat with this comment. Swarming is reproduction at the colony level, and reproduction is hard to control on anything. So sometimes even the best swarm management strategies will fail. So, I will tell you, for every 10 colonies that I clipped the queens and cut the queen cells and super appropriately, I might lose one colony to a swarm. Probably less than that. But, I would still say that occasionally, you're going to have colonies swarm despite your best efforts. But again, look at that document linked in the show notes and it'll explain some of the methods that I just talked about here.

Amy 57:05
I was about to say, it's an EDIS document, correct? That's right. Yep. Absolutely. So I'll try to link that. Okay. So I had a meeting with the Tropical Beekeepers the other day, and one of the members said that when you work Africanized bees -- I just want to make sure I get this right -- okay, so people will breathe through a 50-foot tube to avoid the carbon monoxide so that the bees don't know that you're coming. Have you ever heard about this before? Is that a common practice? I did not know how to answer that. And I was like, I'll have to ask Jamie on the podcast.

Jamie 57:41
So there's a couple of things at play here. I am going to answer your question directly, first. I have never heard that. So that doesn't mean it's not true. It just means I've not heard it. But if it's true, it's built on the premise that when bees start attacking a would-be intruder to their nest, they often focus in on dark colors or carbon dioxide emissions. And so in the case of carbon dioxide emissions, they're coming out of our nose and mouth and bees will often concentrate their attacks there. So the premise behind that question is actually really interesting and correct. I just don't know if people actually do that management practice. Usually, what most people do, who I know who work African bees, who live in an area where African bees are the dominant bee, they'll use full bee suits and mess loads of smoke. And they'll also do things like keep colonies on single hive stands so that you're upsetting one colony and not all the colonies on the stand and things like that. But generally speaking, they suit up really well and they smoke the bees a lot. Those are the two main things. Again, I want to say that doesn't mean that they don't do this breathing thing, but I've just never heard of it.

Amy 58:43
Yeah, I didn't either. And I thought it was really funny. And they were like, "You need to ask Dr. Ellis, but don't tell him beforehand." I'm like, "Alright, I won't tell him."

Jamie 58:49
That's okay. And like I said, it may be true. I'm not saying it's not. All I'm saying is that I've never heard of it before. So for what that's worth.

Amy 58:57
That's fair. All right. Well, I'm sure there's someone doing that out there. So anyway, yeah, that was great. We have a lot of questions. And for some reason, the past week, we've had a ton more questions come in.

Jamie 59:08
Keeping asking those questions so we'll keep having something to talk about.

Amy 59:12
Yeah, and something else that we just started was I had just received a voice message on Anchor. So if you all are listening to us through our Anchor page, which is the link that's linked straight from our

Facebook and straight from our Instagram, you can actually leave voice messages for us. And so what we'll try to do is incorporate some of those voice messages into the Q&A section, so that we can answer them while we're receiving them. So there are definitely ways that you all can ask questions, whether that be through social media or email, or just doing a recording. That would be fun, too. So we look forward to seeing how you all start asking questions to us. Hey, everyone. Thanks for listening today. We'd like to give an extra special thank you to our podcast coordinator Lauren Goldstein and to our audio engineer James Weaver. Without their hard work, Two Bees in a Podcast would not be possible.

Jamie 1:00:10
For more information and additional resources for today's episode, don't forget to visit the UF/IFAS Honey Bee Research Extension Laboratory's website ufhoneybee.com Do you have questions you want answered on air? If so, email them to honeybee@ifas.ufl.edu or message us on Twitter, Instagram or Facebook @UFhoneybeelab. While there don't forget to follow us. Thank you for listening to Two Bees in a Podcast!