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

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.

Amy 00:47
Hello, everyone, welcome to this segment of Two Bees in a Podcast. Today, we are joined by Kathleen Dogantzis. She also goes by Katie. She's a PhD candidate with the Zayed Laboratory with the Department of Biology at York University in Toronto, Canada. And we brought Katie on today to discuss the origin of Apis mellifera. And, Jamie, I know that you're pretty interested in the origin of Apis mellifera, and you've gotten really into honey bee genetics and just understanding different species and subspecies and where they came from.

Jamie 01:22
Yeah, for sure. Biodiversity has just become a really interesting thing to me as I age as a scientist, so I was really excited that we're able to bring Katie on and talk with her about it.

Amy 01:32
Yeah. So thanks for joining us today, Katie.

Guest 01:34
Thanks for having me.

Amy 01:36
So we always like to introduce our speakers to our listeners. And so can you tell us just a little bit about yourself and how you got into honey bee research?

Guest 01:46
Yeah, for sure. So, I'm currently in my final year of my PhD at York University. But I started my University career earning a Bachelor of Science in Forensic Science at Trent University. I then went on to complete a Master of Science in wasp eusociality at York. And really my interest developed during my undergraduate journey, where I developed a really strong interest in using DNA to answer questions about animal populations. And during that time, I worked on some really interesting projects, such as working with black bears and working with bats. And from there, my interest really grew. I was lucky enough to connect with my current supervisor at York who was starting this really interesting, nationwide project on honey bee health. So when I started my PhD research at York, I was put on some really cool projects involving honey bee evolution, as well as honey bee ancestry, which is what I'm currently working on today.

Jamie 02:47
So Katie, your research really sounds so interesting. So I'll just tell you and our listeners how we found you. So my team and I, we do a lot of journal clubs. Every Tuesday at lunchtime, we'll read a couple of manuscripts and we'll decide, do we want to follow this up with an interview of the scientist. In your case, we found a video that you had done where you had talked a lecture about the origins of Apis mellifera, and our team watched it during one of our learning lunches. We just got really excited about what you were talking about. This is, as Amy suggested, it's a topic that I just love to think about and read about these days. And for all of you listeners out there, we're going to make sure and link that video in the show notes. So Amy and I will be speaking with you, Katie, as kind of an interview. But folks can come back later and watch all that you were able to say about this very interesting topic. So kind of with that background, could you tell us a little bit about why you decided to investigate this topic, the origins of Apis mellifera? How did you arrive at this topic?

Guest 03:49
Yeah, so the origins of Apis mellifera has been a topic that's been really hotly debated in the community. This debate revolves around two competing hypotheses for the species' origin. So the first is what we called the out-of-Africa hypothesis and this suggests that Apis mellifera diversified and expanded out of Africa into its current distribution via two to three different colonization routes. The alternative hypothesis is that the species expanded out of Asia to its current distribution. We really wanted to settle this sort of ongoing debate because this knowledge is really important for understanding how traits have evolved in the species and how the species has been able to adapt. So for example, knowing which traits are ancestral to the species, or, for example, knowing what traits are newly derived in a species has a lot of implications for species management and really understanding the genetics behind traits we're interested in.

Amy 04:05

It's really interesting that you say that those are the two competing hypotheses, like Africa or Asia, right? I think, I want to say a lot of the listeners probably thought Apis mellifera originated in Europe because we call it the Western or the European honey bee. So that's really interesting.

Guest 05:14
Yeah, so I guess the Apis genus, there are about 10 different species in the Apis genus, but Apis mellifera is the only species that exists outside of Asia. So Apis mellifera's distribution is within Africa, Western Asia, and Europe. But the remainder of the species are all located within Asia. So kind of what we think happened was, I guess these two competing hypotheses are like, okay, well, after they've separated from the rest of the bees in Asia, did this species then diversify, like go into Africa and diversify out of Africa? Or did it diversify out of Asia after separating from the rest of the genus?

Amy 06:01
So that goes into my question of how did you conduct your research? I mean, where do you even start as far as trying to figure out where they actually came from?

Guest 06:11
Yeah, so for this research, we had a really comprehensive data set that was composed of several different Apis mellifera subspecies that we were able to collect from the native range of Apis mellifera. So the native range is Europe, Western Asia, and Africa. And in our study, we had a really big focus on obtaining the samples that were historically under-sampled. So particularly from regions in Africa and Western Asia. Sampling within these regions is really important because this is where our competing hypotheses are situated. So being able to have samples representative of this region really helps us paint a better picture of their history. So after collecting the samples, which we were able to do by working with a really collaborative team, so kudos to them for being able to send me samples or collect samples on my behalf. But after collecting the samples, we performed genome sequencing on individual honey bees. By doing this, we can look at really fine-scale detail of the genomes of individual bees, and look for genetic differences that exist between bees. These differences then allow us to construct a better picture about the genetic variation of bees, as well as how individual bees are related to each other, and allows us to look at their evolutionary relationships.

Jamie 07:36
Katie, I know that the beekeepers are listening to this, they're going to ask like, what in the world did you find? Are they from Africa? Or are they from Asia? We got to know.

Guest 07:46
So, after being able to look at these genetic differences between the different bees, we were able to answer sort of two objectives from our research. So the first focus on identifying the ancestral origins of contemporary populations. And what our research showed was that Apis mellifera likely descended from Asia, and then colonize its current distribution out of Western Asia. So this colonization likely happened via three expansion routes. After the species sort of colonized its current distribution, it diversified into seven genetically distinct lineages. So the second objective we had with our research

was identifying the genetic differences that were associated with the adaptation of these lineages to these diverse regions. So what are the genes? Or what are the genetic changes that have occurred that are unique to either subspecies or particular lineages that allow them to survive and thrive within their current range?

Amy 08:49
So you've mentioned lineages a couple of times with what you're finding. So can we talk a little bit more about lineages of Apis mellifera? So what are they and where do they occur?

Guest 08:59
Right. So honey bee lineages are groups of bees that are geographically and genetically distinct. There are two lineages in Europe, there are two lineages in Western Asia, and there are three lineages in Africa. So each of these groups is composed of several different subspecies. So, for example, there's a group in Western Europe, which we've sort of dubbed the M-lineage. This group is composed of two different subspecies. So this includes Apis mellifera mellifera and Apis mellifera iberiensis. So each of these lineages are composed of several different subspecies, and there are at least seven that we've been able to identify in Western Asia. We have the O and the Y lineage. And then in Africa, we have the A, the U, and the L lineage.

Jamie 09:00
So Katie, that's absolutely fascinating. I have like 1000 questions I want to ask you now because I just absolutely love this topic. But before I go to some of those questions that are coming out of what you're saying, I just want to, for our listeners, could you differentiate for them the difference between a lineage and a subspecies?

Guest 10:12
Of course. So lineage is a genetically distinct group of bees that are composed of several subspecies. So between lineages, the genetic differences between the groups are very big, but within a lineage, if you're comparing subspecies within a lineage, the genetic differences are very small. So a subspecies is a morphologically and genetically distinct population of bees that compose a lineage. So subspecies are generally very distinguishable based on morphological differences, as well as behavioral differences and genetic differences that exist between the subspecies groups.

Jamie 10:57
So one of the things that I want to know that's coming out of your discussion about these lineages, I'm fascinated, I've known about the M and the C and the O and the Y, I think the U and the L -- is the U Madagascar, if I'm not mistaken?

Guest 11:10
Yeah.

Jamie 11:10

Okay, so that's the honey bee that's in Madagascar. And the L, what bees compose the L lineage?

Guest 11:16
So the L lineage is composed of Apis mellifera lamarckii, which is a subspecies of bees located in Egypt.

Jamie 11:25
So that one subspecies is distinct enough to potentially be its own lineage?

Guest 11:30
Yes, it is. It's very interesting.

Jamie 11:31
It's absolutely fascinating. That's why I'm just -- my mind's racing as I hear you talk about it. So one of the things that I'd like to ask that I don't think we have listed one of our three pre-interview questions is, is there a lineage or a subspecies that appears to be more ancestral? I'm thinking about what you just told us a few questions ago where you said they distributed and diversified out of Western Asia. So is there a lineage or a subspecies that appears to be the more or most ancestral of those lineages or subspecies?

Guest 12:12
Yeah, so when we were doing our research, we constructed something called a phylogenetic tree. So what this does is it allows us to look at the relationships between subspecies as well as our lineages. What we find in our phylogenetic tree is that there's a very clear separation between our O and our Y lineage, which are located in Western Asia. So we find that one of our lineages groups with other bees from Europe, but the other lineage groups would be from Africa, or at least more closely groups with these other bees. If we look at different configurations of the phylogenetic tree, which we can do looking at different subsets of these genetic differences between our populations, we find that our Y lineage branches first. So this suggests to us that this may be the most ancestral to the group, or at least the one that's most closely related to our outgroup or other bees in Asia.

Jamie 13:24
So what bees are in that lineage, what subspecies?

Guest 13:27
The Y lineage?

Jamie 13:29
Yes.

Guest 13:30

So this includes Apis mellifera yemenitica. So these are bees that we've collected from Yemen, as well as Saudi Arabia.

Jamie 13:41
That's absolutely fascinating, as I was wondering if that was going to be the case, and it's really neat to hear that. So yemenitica is a very interesting bee, because -- does its distribution also go into Eastern Africa? A little bit? Aren't there some suspect yemenitica populations there?

Guest 13:57
Yeah, we think that might be the case. In our study, we didn't find distinct populations of yemenitica. And that may be because we weren't able to sample them, or potentially that the species distribution isn't as wide as we may think. So that is a question that's sort of up in the air that needs further exploration.

Amy 14:21
That's very cool. You just were discussing distribution, can you talk to us about what your research suggests about the origin, which I know you kind of talked about, but the movement?

Guest 14:35
Yeah. So what our research shows is that Apis mellifera likely descended from Asia, and then colonized its current distribution from Western Asia. So the species likely colonized its current distribution via three independent routes. So the first route would have colonized Western Europe and would have been composed of the M lineage subspecies. The second route would have colonized Africa. So this would have included bees in Africa, as well as Madagascar. And then finally, the last route would have colonized Eastern Europe after its split from other bees in Western Asia. So this would have included the C lineage, which is located in, sorry, Eastern Europe, and the O lineage, which is located in Western Asia.

Jamie 15:31
There are just too many follow-up questions I want to ask. I'm just thinking about what you just said. Okay. So you're in Western Asia, there's this ancestral Apis mellifera in Western Asia, and then it makes its first independent route, you're saying, through Europe, and to Western Europe, and only the third route out of that Western Asian branch colonized Eastern Europe? So I'm curious, does that mean the bees in Eastern Europe and Western Europe are more related to bees in Western Asia than they are to one another?

Guest 16:12
Oh, this is an interesting question. Yeah. So the bees from Eastern Europe are more closely related to bees in Western Asia than they are to other bees in Western Europe.

Jamie 16:25

That's crazy stuff. I love science. Guys, if you're out there listening, this is why you got to watch this video and read the corresponding papers. That's fascinating to me because if you think about it, that first one, to get to Western Europe, you have to go through Eastern Europe from Western Asia, right? So it seems like they'd be establishing populations along the way. So then, when that third branch came out of Western Asia, how did they not just like hybridize? It's just crazy. It's crazy. Science is cool.

Guest 16:52
For sure.

Jamie 16:53
All right, I'm gonna go back to my scripted question here. So one of the things that you talked about in your lecture was about selection. Where does selection happen more so? Is it more so with queens or more so with workers? So what did you guys find? And why do you think you found what you found?

Guest 17:13
So we found that selection is more often associated with worker phenotypes. We think this might be because of the eusocial nature of honey bees. So in a honey bee colony, there is a single queen who lays the eggs. But there are several thousands of workers who contribute to really important colony tasks, such as brood rearing and resource provisioning. So although workers don't lay fertilized eggs, they can't directly pass on their genetics like the queen does, what we think is happening is that natural selection and maybe indirectly selecting for worker phenotypes helped to optimize the colony success. So if we think about this, if you think about a trait that's present in honey bee workers, so something like parasite removal from a colony, if the workers are really good at fending off disease, the genes that contribute to that trait may be indirectly selected because they help the colony succeed, and they help the colony to continue. Versus if you have a colony who can't fend off disease as well, that colony will eventually die out.

Amy 18:26
So Katie, something that you mentioned during your talk was about something called advantageous traits and you mentioned that they can become fixed. So I mean, just for someone who's not like -- I'm trying to figure out the word. I don't really know much about some of these traits and I don't even know what advantageous traits means. So can you elaborate a little bit on what this means and the idea of them becoming fixed? So what does that look like?

Guest 18:55
Right. So an advantageous trait would be something that helps the colony's fitness. So what that means is it helps the colony survive and thrive. I think, here, what I mean by fixed is that the genetic variants that underlie these traits of interest can become fixed in a population. So for example, let's say we have a group of bees that has evolved tolerance to extreme heat. And then if we compare that population of bees to a group that is not tolerant, what we're likely to find is, if you look at the genetic differences, there's going to be mutations associated with that tolerance in the tolerant population that will be absent from the non-tolerant population. So what happens over time is that, if this trait is

advantageous for the population, the variants will increase in frequency in the population such that, eventually, everyone who's in that population, in the tolerant group, will have that same variant. And then, again, if we compare that to a group that doesn't have that trait and doesn't have that variant, that variant will be absent. So over time, that variant becomes fixed. And that simply means that everyone in the population has that same mutation.

Jamie 18:56
So, Katie, we have thousands of beekeepers listening to this podcast from all around the world. So they're listening to this, they're probably science nerds a lot like me, just completely salivating listening to you talk about all this stuff, and how amazing science is and how cool it is that we get to work with bees and have this really neat, natural history. So I want to boil it down right here at the end. What are some comments you'd like to share with beekeepers based on your research? What are some things that you think beekeepers should know, based on what you and your colleagues have found?

Guest 20:50
Yeah. So I think one of the most interesting things about looking at honey bee ancestry is that we can then look at the ancestry of the bees that we use, so the bees that we manage on a daily basis. What we've been able to discover by looking at the ancestral composition of colonies within North America is that they're actually a mix of three to four different lineages. So our honey bees in North America are primarily composed of ancestry from Eastern Europe. So this represents the C lineage. And it likely represents subspecies such as Apis mellifera ligustica and Apis mellifera carnica. We also see evidence of ancestry from the M lineage. So this is from Western Europe. We also see evidence for the O lineage, which is in Western Asia. And we also see evidence for African lineage from the A lineage. So it's a really interesting mix and mosaic of ancestry. So it isn't actually that we're working with pure honey bee subspecies, but this really interesting mix of different ancestries.

Jamie 22:05
I really love that concept. A lot of people in the US, if you look at the queen breeders, we've got this kind of Italian honey bee, we've got this kind of Carniolan, and in reality, if you do a genetic analysis, they're very mixed populations, right? We don't really have subspecies of honey bees in the US, probably. We mainly have stocks of bees just because of just what you say. It's just fascinating to me that the bees we keep, if you think about it, the bees we keep are a lot like the people here, right? They're mixtures from all over the world. I love it. What a great concept.

Guest 22:40
Yeah, it's very cool.

Amy 22:42
Yeah, I think you did a great job explaining that. Again, like what Jamie said, it's just kind of crazy, because we're just kind of a melting pot, right? And so same with honey bees. The honey bees are kind of a melting pot of different lineages of bees. So that's very cool.

Guest 22:57
Yeah, it's very interesting.

Amy 23:00
All right, Katie, was there anything else that you wanted to share with our listeners?

Guest 23:05
That's all for me. Unless you guys have any more questions?

Amy 23:08
Well, we're really excited to hopefully keep in touch with you and with our listeners, we'll be sure to link the video that we found you through so that they can also watch that as well. We'll be sure to go ahead and add that to our additional resources. If they have any questions for you, they can contact you and ask questions to you directly. But thank you so much for joining us today.

Guest 23:29
Thank you for having me. This is a lot of fun.

Amy 23:51
Well, Jamie, I was really happy to have Katie on. She was just on top of her game, as far as all the questions we had to ask her. She really knew her content.

Jamie 24:01
Yeah, we liked her presentation when we were watching that time during our learning lunch. We liked her topic. And then you and I were commenting before we came back on to rerecord this part, she really did a good job. I loved her research. She seems very knowledgeable about the topic. And as you know, this is a topic I'm interested in, just myself. We have a lot of data that needs to be analyzed that might shed some light on some additional questions related to it. So she did a good job. And I look forward to you and me talking about this a little bit more.

Amy 24:30
Yeah. I mean, I think, just from my perspective, I don't have a lot of experience with honey bee genetics and understanding lineages and subspecies and kind of what that all means and how they're all categorized. So let's just start from that. I mean, I know I asked her about the differences between a lineage and a subspecies, but can you kind of describe it a little bit more so that my brain can understand what that all means?

Jamie 24:59
I don't think I can explain it as well. But I will definitely give it my try. But I'm gonna start a little bit higher up. So everybody out there listening, if you've all gone through biology class in school, you know that we have this kind of taxonomic nomenclature system that's based on this idea of kingdom, phylum, class, order, family, genus, species. Well, within those classifications, scientists realize that some of

those aren't detailed enough. So they've stuck different levels of classification between those. For example, there's genus, but there are also subgenera, there are species, but there's also subspecies below that. So Katie said early on, there are 10 species of honey bees on planet Earth. That's true. So that's what our lab recognizes as well. That means there's 10 species of Apis. Apis is the genus. There's 10 species within that genus. So Katie was talking to us specifically about mellifera. So mellifera is the species name. So Apis is the genus, mellifera is the species. Okay, so it's normally good enough to say we're going to stop there. But as you know, even from the human perspective, homo sapien, homo, the genus, sapien, the species, even among humans, you'll recognize that there's a huge great diversity in humans. I mean, we've got companies built around telling you what your background diversity, your ancestral diversity is. Well, layer that on to the species mellifera. So the species, if you look at its distribution, and sample its population from everywhere it occurs, there appear to be different lineages. These lineages aren't species, it's not that high of a designation. They're not subspecies. It's above that. And so basically, it's saying there are subspecies of mellifera that are more related to one another than they are related to other subspecies of mellifera. When you look across the subspecies of mellifera, it's easy to group them, Katie said, into these seven groups, two in Europe, two in Asia, and three in Africa. So a lot of beekeepers have long known about the M, C, O lineages. Those are the lineages that most of our bees from the United States historically have been from. But that Y lineage is very fascinating. She talked about yemenitica, the one subspecies in that. The A lineage stands for Africa, right? But then the fact that there are two other lineages in Africa, the U and the L, the U being Madagascar, and the L being lamarckii, which is the Egyptian honey bee, is also fascinating. So some of these lineages only have one subspecies member, like that subspecies is so different from the rest of them it's its own lineage. But most of these lineages have multiple subspecies in them because they are more related to one another, as I said, than they are to the other subspecies from the other lineages.

Amy 25:40
So you said that there are 10 species of Apis. So you've mentioned subspecies, how many subspecies of Apis mellifera are there?

Jamie 28:24
Great question. That is super hotly debated. So this happens to be a topic that's near and dear to my heart. Some former postdocs and I have published the mitochondrial genome sequences of a number of subspecies of Apis mellifera, for that matter, a few species of Apis from around the world. In our publishing of these mitogenome sequences, we were asking that question ourselves because we wanted to reference that in some of our papers, and it's very clear that it's not clear at all. So there were some papers that we would read, some scientists who would suggest, that the number may be between 20 and 25. Some suggest it's between 25 and 30. We've seen some that suggest between 30 and 35. Usually, when people ask me, I say it's around 30, plus or minus a few. Some bees are screaming a subspecies, for example, Apis mellifera, the genus, species, ligustica. Ligustica is the subspecies name, it's the Italian honey bee. Everybody agrees that it is its own subspecies. But there are some subspecies out there that not everyone agrees is an independent subspecies, or if it should be grouped with another subspecies. So long story short, it's hotly debated. It probably ranges between 25 and 35,

but probably much closer, plus or minus a few, around 30. I get it all depends on whether you're a grouper or a splitter. Biology is full of groupers and biology is full of splitters. So it all depends on where you stand on that issue.

Amy 30:04
Yeah, I think it's also really interesting, especially from a queen breeder's perspective, just what kind of bee they're selling, what kind of queen they're selling, because there are Russian bees, right? Carniolan bees. So what does that look like and is there a certain percentage that it has to be to be identified as that?

Jamie 30:23
Well, I love what Katie said about this. She basically said without saying that there's really no subspecies, at least, in the United States. A lot of beekeepers will say, "I keep Italian bees," or, "I keep Carniolans," or whatever. But in reality, if you did a genetic analysis of them, they are composed of more than one lineage and certainly more than one subspecies. So really what we have in the US, and for that matter, anywhere in the world that Apis mellifera has been introduced, what we have are stocks or breeds, right? I think one of the coolest things, though, about this subspecies discussion, if you think about it, these, let's just say 30 to make the discussion easier, these 30 subspecies are distributed from Northern Europe to Southern Africa, through the Middle East. So I want you to think about the climatic variation, and the environmental variation that occurs from Northern Europe, all the way to the south of Africa, through tropics, temperate zones, dry zones, wet zones, cold zones, hot zones, zones that are arid and semi-arid zones that are tropical rain forests. Apis mellifera, has answered all of those environmental conundrums with a subspecies unique to and adapted for the environment in which they are found. That's the reason, in North America, we keep European subspecies because they are more temperate adapted. We have a more temperate climate in the northern, at least, in Canada and in the United States. When you're in Central America and South America, it benefits them to have more tropical or subtropical adapted bee, which, by the way, is the reason Apis mellifera scutelatta or the African honey bee has done so well there. So if you think about the huge genetic diversity and the remarkable ability of Apis mellifera as a species to occupy such vastly different environments, I mean, their ability to survive around the world is really only rivaled by that of Homo sapien, man. That's why I say over and over and over the answer to all of our beekeeping woes is tied up in the remarkable genetic diversity of Apis mellifera, from Northern Europe to Southern Africa through the Middle East.

Amy 32:52
Very cool. I feel like we'll just end there. I hope our listeners are able to take a look at our additional notes and are able to see her publication but, also, the recorded talk on YouTube. So we'll go ahead and link that to our additional show notes.

Stump The Chump 33:12
Everybody's favorite game show, Stump the Chump.

Amy 33:21

We are at the question and answer time. Jamie, the first question I have for you, they're asking about the pros and cons of slatted racks. I guess before we even go into pros and cons, can you talk about what slatted racks are?

Jamie 33:34
Yeah, so this is an interesting question that actually comes back from my past. I mean, you know that I was an undergraduate worker in the laboratory of Dr. Keith Delaplane at the University of Georgia. And while I was there as an undergraduate worker, years and years and years ago now, Dr. Delaplane did a research project on slatted racks. I had already known about them by that time, because as a beekeeper myself, I would always comb through the equipment catalogs I would get every year and just kind of marvel at all the beekeeping equipment that I couldn't afford or that I didn't know what it actually was. I always saw slatted racks and said, "I wonder what these things do." So, a slatted rack is not a common piece of equipment. In fact, I don't personally know any beekeepers who use them, although you can buy them in nearly every equipment catalog. What they are is they are a device that goes between the bottom board of a hive and the lowermost box of a hive. So basically, bees walk into the entrance of the hive, in the bottom board, have to go up through the slatted rack into the lowermost box or the brood chamber. And if you look at a slatted rack from above, the first quarter of it is a solid piece of wood, and then it alternates between gaps that are about two centimeters wide and then pieces of wood that are about two centimeters wide. So it's gap, wood, gap, wood, gap, wood, gap, wood, gap, wood. So as a beekeeper, you're listening to me, if you Google "slatted rack honey bee hive," you'll see what I mean. And the premise behind slatted racks, at least the original premise that I was taught, is that queens are reluctant to lay in the lower quadrant of the combs that are nearest the entrance of the hive because a lot of light comes in the entrance of the hive. So maybe the queen doesn't go and lay in that quadrate of comb nearest the entrance. So you're reducing her use and the amount of brood production that you could have of that area of comb, and principally, by adding a slatted rack, you recess that sunlight or that entrance a bit, so that sunlight doesn't flood in the entrance, like it would if you had a no slatted rack on a hive. And so the idea is, if you put these things on colonies, you get more brood. I've seen a lot of different things, airflow and all of these things. But the original reason that I saw these things being used was for increased brood production. So Dr. Delaplane did a study on this. In fact, I was involved. I was a technical laborer at the time and put these on and he measured things in colonies with and without them. Ultimately, he showed that you do, if I remember correctly, because I have not been able to find this study in a long time, it was published in the American Bee Journal, but I can't find PDFs of it online. But if I remember correctly, he did see an increased amount of brood production in that lower quadrant of the combs, like one would expect. But it didn't lead to an overall increase in the total amount of brood produced in a hive. So long story short, it seemed to do what it was saying it was going to do. The queens would lay more eggs in that lower quadrant near the entrance. But her laying there seemed to take away from her laying elsewhere. So at the end of the day, it all came out in the wash. My guess is that more work needs to be done on this to look at other benefits. But that's the only project I'm aware of where it's been looked at experimentally. That's what Dr. Delaplane found. So it was a really interesting study to me at the time. And like I said, you can still find them in equipment catalogs. And there you go.

Amy 33:49
Awesome. I'll have to Google it and see what they look like.

Jamie 37:28
My description wasn't perfect enough?

Amy 37:31
I'll have to listen to your description while I'm looking at a picture to see if your description is accurate.

Jamie 37:36
That's the total problem with podcasts, like when you're talking about something. Most of the time you can say something people, and they're like, oh, yeah. But a slatted rackets like, it's like, uhhh, it's alternating pieces of wood and gaps.

Amy 37:47
It sounds like a checkerboard.

Jamie 37:51
Okay, sure. There's slats. Imagine another way, like if you're looking at a solid piece of wood where the first quarter of it is solid, and then the rest of it is just gaps have been cut into it. Right? And so you'll have to Google it to see it. Everybody who's listening to this episode needs to run and Google it and see what I mean.

Amy 38:09
Sounds good. Okay. So the second question we have is, if a queen is parasitized by a mite, can a disease be transmitted vertically to the egg from the queen, resulting in a mass infection to the colony? I think that's a great question.

Jamie 38:25
Yeah, it's a really good question. And I will tell you, a queen does not have to be parasitized by a mite for this to happen. So this is actually an active area of research, which is the research associated with how are honey bee viruses spread among other workers. For example, there was a really good paper that came out recently on how deformed wing virus was spread. Of course, we knew that Varroa could spread it, but they were able to demonstrate that, if a bee has deformed wing virus, a Varroa can get it from the bee and spread it to another bee. That's been kind of shown conclusively. Varroa to Varroa transfer, bee to bee transfer, they were looking at all these transmission routes. So one of the routes that other folks have looked at for viruses, in general, is this route from queens to eggs. If queens have the virus, can they transmit it to their own offspring by virtue of laying an egg that has the virus, and research has shown that this is the case. Now, they haven't shown it yet for every virus that honey bees are known to have. But it's definitely been shown for a few key viruses. My suspicion is that this is a reasonably common route, and we call it vertical transmission. Horizontal transmission is from worker adult to worker adult. Vertical transmission would be from up to down, from the queen who is up, to

down, to her offspring. It is reasonably believed and there's a reasonable amount of data to support that queens are able to transmit viruses to their eggs, which then go on to infect the offspring. There's still more work to be done on whether or not the virus is in the egg or on the egg. Obviously, if an egg is being laid by something that has a virus, the virus could end up on the coating of the egg. But there's ample evidence to show that for some viruses, it's on the egg or in the egg. I really think this is a growing field that people are going to talk about more and more.

Amy 40:26
Yeah, I mean, surely they've done other research on different types of animals that lay eggs and viral transmission, right?

Jamie 40:32
Sure, sure. Yeah, absolutely. It's a commonly studied mechanism among virus transfer for all types of organisms. Even humans, right? If the mother is sick, can she pass something on to her offspring? So, it's similar. It's a similar question with honey bee queens and their eggs.

Amy 40:50
Okay, so for number three, this person is asking if a colony can produce different honey from another colony that are side-by-side. So this person's colonies are right next to each other, they've extracted honey, they both basically were started at the same time. But one colony was started as a package and then the other as a nuc. Their honey is totally different in taste and color. Is that possible? Why would that happen?

Jamie 41:18
Yeah, so it's entirely possible is the short answer. Let me explain why that's the case. So I would say that more often than not, if colonies are maintained in the same apiary, they're going to be producing honeys of similar color, taste, and quality because they're foraging on the same flowers available in their area. So that's kind of the easy overgeneralization that most of the time is going to happen because they're sharing a forage base. But it is very conceivably possible that the colonies within the same space are foraging on different foodstuffs. Imagine, for example, and I'm oversimplifying here, but imagine, for example, you've got two colonies in an area. Both colonies' workers are capable of foraging three to five miles, that's up to eight kilometers. They can go even further than that, but a standard foraging range is three to five miles, which I believe is five to eight kilometers. Alright, so if colony A is foraging north, and colony B is foraging principally south, there could be two very different things blooming in those two directions from the colonies. So no doubt, both colonies would be exploiting both resources, they just may be exploiting both of those resources at different intensities. So colony A tends to be getting more from whatever species of plant that's further up, colony B from further down. You can end up getting two different colors, two different tastes of honey. There are other possibilities as well. Maybe there was stored honey leftover from the previous season that one colony exhausted but the other colony did not, so you're getting residues of that honey from one colony that are no longer present in the other colony. Maybe a feral colony of bees existed in a tree somewhere, and it died and colony B found it and robbed out that honey from that colony, but colony A didn't. So

there are lots of reasons that could lead to these two different types of honey. So that's what I'll say. In general, it's going to be very, very similar because they're foraging on similar resources. But in practice, it can be different depending on where they're getting the most of their nectar from and what plants they're visiting the most.

Amy 41:23
All right, very cool. So there are lots of questions that we've been receiving. If you have questions for our Q&A segment, feel free to send us an email or send us a message on our social media pages.

Serra Sowers 43:55
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.