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SPEAKERS

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

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. In this episode of Two Bees in a Podcast, we are joined by Dr. Ashley Mortenson from Plant and Food Research in New Zealand. She will be with us talking about drone congregation areas. We will follow that segment with a segment on queen bee production in Europe by interviewing Dr. Raffaele Dall'Olio who's an independent honey bee research and extension specialist in Italy. And of course, we will end today's episode with a segment of Stump The Chump where you ask your questions and I do my best to answer them. Alright listeners, welcome to Two Bees in a Podcast. We have a very special segment for you today because our guest is going to be familiar to many of you who've been in Florida during her years here at the University of Florida. But she is Dr. Ashley Mortensen, who's a senior scientist in the Productive Biodiversity and Pollination Science Group, the Bee Biology and Productivity Team for the New Zealand Institute for Plant and Food Research. Ashley is going to be here talking to us about drone congregation areas. But you might be familiar with her because we had the privilege of having her here for her Master's and PhD degree. So Ashley, thank you for joining us on Two Bees in a Podcast.

Guest 02:02
Thanks so much for having me here. It's really nice to get to have a little bit of familiarity and nostalgia back with the University of Florida Bee Lab.

Amy 02:11
I was about to say, Jamie, I hear Ashley has some stories about you sitting maybe next to like raccoons or rain or I don't know.

Jamie 02:19
When we start talking about DCA, there's a lot we can talk about. But Ashley, when did you start here at the University of Florida? I forget.

Guest 02:26
I was there for six years total. That ended in 2017. So does that put us at 2011?

Jamie 02:32
Let's just say yes for the sake of the podcast. But yeah, that's pretty cool. All right. So it's neat that you have been able to join us. I've been willing to have you on because I know that you're able to teach the beekeepers a lot. And we're talking about a topic that's near and dear to you, and even me when your time here, that's drone congregation areas. But before we get there, Ashley, we always like to have our guests to a little bit about themselves, how they found themselves in the bee world, and how they ended up where they are. So could you do that for us? Could you tell us about yourself, how you got started with bees, and how you ended up where you are now?

Guest 03:02
Yeah, so I mean, I have a tendency to be long-winded anyway, but this really isn't a short story. So I'm going to keep it as concise as possible. But I really did go on quite a journey to get into the world of bees. I always was interested in animals and animal behavior, and that actually took the form of a livestock undergraduate degree. And I went from there to work in zookeeping and actually worked with big cats and primates for a couple years as a zookeeper. And then, through the process of moving around, I left my zookeeper job because I had to move out of state and started working as a vet tech and was just missing this wildlife connection. So I started doing wildlife rehabilitation on my own. And through that, I met someone who had just started keeping bees. I'm a bit of a serial hobbyist so I always have some new hobby that I'm learning or getting involved into. And I decided I was going to start keeping bees because that was a cool hobby to get into. So that was while I was living in South Carolina. And I actually signed up to take an Introduction to Beekeeping Course that was offered through the Pickens County Beekeepers Association that was in association with their master beekeeper program there in South Carolina. And that was like a 12-week course that you went once a week to a lecture. And at the end, there was the test that was that apprentice level master beekeeper written test that you took. The two people that scored the highest in the course got a free colony. So I won the colony, so that was a package of bees and then the whole deep box and super.

Amy 04:30
That's awesome. We should do that, Jamie.

Jamie 04:31
What a great idea. Anyway, keep going, Ashley.

Guest 04:37

So I won that colony, and then I brought it home. Actually, I got the box and equipment before I got the package so you could get it all set up. In the time that I had all that equipment sitting out in my driveway, then a swarm actually landed in my squirrel cage that I had for my outdoor wildlife.

Jamie 04:53
I want to ask why you had a squirrel cage in the first place, but let's keep going.

Guest 04:58
It was my outdoor, it was my pre-release outdoor cage for my squirrels for my wildlife rehabilitation side gig. Yeah, so I caught that swarm, and then a week later, got another package and automatically had two hives of bees, or two colonies of bees out in hives in my backyard. And it was probably six or eight months later that my partner at the time got a job at the University of Florida. So we were moving to Florida, and I had been to the South Carolina Annual Beekeepers Meeting. And actually, Jamie was presenting there. I talked to Jamie about the fact that I was about to be moving to Florida and needed to get bees across state lines, and what on earth was I doing to make that happen? And I think, maybe, it was Dave Westervelt's email that you gave me. It was someone with the Florida Department of Ag. So I got my bees transferred down to Florida and started working in a research lab that was actually using cats to study cough and swallow and decided I really liked research and that I really liked bees. I was thinking about doing a graduate degree for years, but I just hadn't picked a topic. All the sudden, all of the things aligned that was I like bees, I do really, really like doing research where I want to have a little bit more independence in what's happening than just being a research tech doing what I'm told to do on someone else's project. And I met Jamie and started talking to him about starting a master's degree there. I wanted to go straight into a PhD, but since I had had such a convoluted path into the world of entomology, the department was like, "Yeah, we're not taking a PhD student who's been out of school for six years and did animal science as their undergraduate. So how about you do a master's and if you really actually like it--"

Jamie 06:25
That actually benefits us, though. We got twice as much work out of you.

Guest 06:28
Yeah, it was great.

Amy 06:31
That's awesome. So you did your masters and your PhD work under Jamie at the lab?

Guest 06:36
Yeah. And then there actually ended up being two really, really different topics at first. The PhD was going to be somewhat of a lead-on from work that was started in the masters. But then a year into PhD, Jamie and I, it was probably a car ride back from Bee College because that's where all of the great conversations happen is in the two hours from St. Augustine or five hours from Fort Lauderdale drive back up. Jamie said that he really wanted someone to be carrying on with doing the artificial rearing work in the lab. And I was like, "Yeah, I'm pretty keen on that. I just don't want to do hardcore

toxicological work. I would like to do behavior and biology." We were like, "Well, yeah, let's make that work," and then just changed everything that I was gonna do.

Jamie 07:17
Yeah, then you ended up in New Zealand after that, that's really neat. Like you left here with your PhD and went straight there. So you didn't have to take that intermediate postdoc step.

Guest 07:26
Yeah, it was really, really an intense semester. So it was in June or July that you had sent around the general call that had kind of been spread around through networks about there was a position available here. I almost didn't apply for it. I ended up submitting my application probably two hours before it was due after hemming and hawing that I maybe wasn't, then I was like, "Oh, I'm definitely not gonna get this job. Like who gets the job straight out of their PhD, right? I'm definitely not going straight into a permanent role, right? Like I'm probably going to end up going into a postdoc somewhere." I interviewed, and really thought that it was just going to be a preliminary interview because it was an online Zoom interview, and that there would be some sort of second round where people were brought over to New Zealand to do an in-person interview, and then all of a sudden, I got a phone call that's like you've been offered the job.

Amy 08:17
That's awesome.

Guest 08:18
Yeah. And it was a big leap of faith. And some people were like, "I can't believe you're just going to go full in on that and commit on going after having not been there." But it was a bit of a leap of faith for them too. They'd only met me via Zoom and hadn't had a full couple of days with me in-person as well. And then I went and sat down in Jamie's office and was like, "So I've got this job. We're actually going to really get my dissertation done this semester, because we were hemming and hawing as to whether we might just drag it out for another semester and give us all a lot of time to work through it at, probably, what would be a more reasonable pace than what we did in that last semester."

Jamie 08:54
Yeah, it seems like students are always wanting to finish quickly at the end so it worked out. But now, you're in New Zealand and doing well, and we've got you on as a interviewee here on Two Bees in a Podcast. So, Amy, don't you want to find out what a DCA is?

Amy 09:10
I do. Before this before we started recording, I was telling Ashley, I was like, " I've actually heard you speak before at Bee College and that was like three years ago." So I felt like kind of creepy, but kind of fangirl-ish. It was kind of weird. But I do remember you speaking --

Jamie 09:24
It's not just kinda weird. It's straight up weird.

Guest 09:29
It happens all the time, though. I'll meet somebody and I'm like, "Oh, I know your work. I don't want to talk to you about that. Because then it makes me look real weird."

Amy 09:37
Okay, exactly. Well, I'm gonna be that weird person. And I remember you specifically talking about DCAs. I was teaching beekeeping in Orange County in Orlando. And I used what you told me during Bee College as some examples of what a drone congregation area was. So, when I was explaining DCAs to people, I would use what you would tell people at Bee College. So will you tell our audience, what is a DCA? And how do you find them?

Guest 10:05
So, DCA stands for drone congregation area. And since this is a beekeeping audience, you probably don't need to explain that a drone is a male honey bee but I'll do it just in case because frequently you get this, "Are we talking about drones, like with a radio remote controller?" Definitely not that. Male honey bees. And so these are the mating sites that honey bees attend, where drones mate with the virgin queens that are coming out from the colonies on their mating flights. What is crazy cool about drone congregation areas is that, as humans we don't 100% understand what causes a place to be a good place for a drone congregation area, but the bees definitely do. So these areas, these sites, these drone congregation areas aren't transient and moving through the landscape. They're actually these consistent locations that occur for years along the line. So the work that I did in Florida was only over one season, but I was able to go back to the same drone congregation areas each time that I went down to sample from there. But Niko and Gudrun Koeniger would actually spend quite a bit of time at the University while I was getting that project set up and running. And the drone congregation areas that they've been doing research at in Germany have been persistent for 20 to 30 years. So there's something consistent about that landscape that these male bees are honing in on that takes them to these drone congregation areas. And what's really cool is if a new colony is brought into an area, within 24 hours, those drones are at the local DCA, so they almost immediately know where it is.

Amy 11:41
So how did you find them? Like how do you go out searching for DCAs?

Guest 11:45
Yeah, so this was something that was a big sticking point for my master's degree there at the University and almost caused us to kibosh the project, finding the drone congregation areas. The published literature was talking about drone flight times are from 10 o'clock to two o'clock, maybe starting as early as 11 o'clock. But this middle of the day, kind of when you think of in terms of prime foraging time as well, so you're supposed to go out during the drone flight time, and essentially wander around with a queen pheromone lure elevated in the air at about 10 to 15 meters. So the way that we were doing that was with a large one-meter weather balloon up in the air with, five meters below that, the queen pheromone lure suspended. You also can use a kite if you have skills at flying a kite, which I do not, and also have an environment that's conducive to keep flying. So the weather balloon is just a lot easier

to be able to fill up. It does mean that I was driving around with pickup trucks full of helium tanks and a bunch of weather balloons. But we were wandering around and wandering around and wandering around out in these fields that were basically areas that looked like drone congregation areas might occur there, which, in Florida, is also a little bit tricky because most of the work is done in these really hilly areas. So a large amount of the work of what we know about the honey bee mating system has been done by these European researchers in areas that actually have mountains and valleys. So the drones typically fly downward on the horizon towards a valley and a mountainous area, and then also, if there's a lot of a bush, like a big tree stand, and then there's an open field where they can fly down towards the horizon across an open space, and then some sort of vertical relief, like a tree line. The DCA is usually in and around that space. So we were looking at GIS, Google Earth images and finding areas that had kind of trees and bush around and then would have an empty field. But it's Florida, it's pretty much all flat.

Amy 13:53
I'm from Kansas, so I completely understand flat land.

Jamie 14:00
It's funny because up until that point, like Ashley said, a lot of the research had been done in mountainous regions. And so they would work towards these depletions on the horizon, or the word they use, basically, where mountains come together, these trends in topography or something.

Guest 14:12
We were like, "Great." So Florida is one point in the middle, kind of, that sticks up out of the water, right? So we were just wandering around and wandering around. And it was myself and a couple of the different research associates that were there in the lab at the time, really struggling to do that. And then finally, at one point, when we were like, "We might just have to trash this whole project and come up with something else to do because we're running out of time in the season." It was probably you, Jamie, and it was probably the 10th time that you'd said it. We're like, "Yeah, how about you just stay out there longer. Just go in the morning and don't leave until the night. Just set it up for a really long time." And then it was like four or five o'clock, someone just turned a switch on and drones --

Amy 15:02
AM? PM?

Guest 15:03
PM. So yeah.

Jamie 15:07
I actually wouldn't get up that early.

Guest 15:08
I'm certainly not driving two hours away to be up by that time.

Jamie 15:14
Exactly. She spent the night in a tent to do this DCA work.

Guest 15:19
Yeah, so all of a sudden, it was just like a switch was flipped. And clearly, the drone flight time in Florida, in the area that we were at, was much different than the other areas where it had been recorded before in the past. And at the same time as staying out to the later time is when we also then developed a method that didn't require multiple people, kind of for all the same reasons. So the original method was one person wanders around with this thing, and the other person's following behind them with binoculars looking to see if drones end up flying towards that lure. By the time you keep going and going and going, and you aren't finding any DCAs, research assistants lose interest in going with you. So we got it sorted to where it can just be one person out there. And that was actually the true innovation of tying that balloon to a cinderblock. And then we set up five or six of those cinder blocks out in a fielded area. And then I was just able to drive one of the research trucks between all those balloons to see which ones were starting to see any drone activity, and then continue to kind of reorient and orient them until we found the maximum activity that we would have, actually, in one of the drone congregation areas. What's really cool about the drone congregation areas is if the drones aren't in the DCA, they aren't as attracted, in some cases, not at all attracted, to the queen mandibular pheromone, that sex pheromone that they have there. So if you're just outside the boundary of the DCA, you might not collect any drones. But if you move 15 meters into the DCA, then you will be collecting drones.

Jamie 17:00
So Amy, you mentioned early on about there being a raccoon story in me. So here's where I come into the story. So as a supervisor, I didn't get to go out in the field a lot with students, but the one time I talked Ashley into taking me out into the field, we went in the same truck. And so all the all of her sites were far, not far, but far enough from one another. So she leaves.

Guest 17:24
15 minutes or so.

Jamie 17:25
Yeah, so she leaves me out in this field with a cooler and a weather balloon and one tree.

Amy 17:32
She left you with the tree.

Jamie 17:34
Yeah, she left me. She took the truck away. So, a thunderstorm rolls in and it's lightning like berserk.

Guest 17:41
It's 4 or 5 in the afternoon.

Jamie 17:43

So, I'm like, "What am I supposed to do? I can't sit here and hold this weather balloon. Benjamin Franklin discovered electricity this way." So I was like, "I have to go do something else." So I took the cooler under the tree. I didn't know what I was supposed to do, and I sat on the cooler, and I look to my right, and there was this sun-dried raccoon on the ground. It was probably the last thing that went under that tree the last time a thunderstorm had come.

Amy 18:06
Did you make a hat out of it?

Jamie 18:09
I was utterly terrified. And I was like, "Ashley is sure taking a long time to get back and save me. She sure is taking a little time to get back and save me." And so that was the last time I went to the field with her. So, thanks, Ashley. I know my place was back in my office. All right, Ashley. So with that background, okay, you can find DCAs, you tell us what they are, you told us how to find them. Why are they important to understand? Why would you want to be looking for them in the first place?

Guest 18:34
Yeah, so, the reason that I was looking for them there for that project and would be a primary reason why people are looking at drone congregation areas is that it's a really cool way to sample the reproductive population in a region. For the most part, most drones fly half a kilometer or less to a drone congregation area. About two, two and a half kilometers are reaching out towards the maximum recorded flights that drones have made out to the drone congregation areas. So they typically don't fly very far at all. And part of that being that they have to go back and forth between the colony and the drone congregation area constantly. They're not flying out to drone congregation area and then sitting there all day waiting for a queen to show up. They have about 30 minutes they can be away from the colony, and then they fly back to be fed and get more resources and catch their breath and then go back out to a DCA. So if they were traveling a far distance to DCAs, they would spend all their time in transit rather than actually being there having a chance of mating. So with that in mind, you then can find a DCA and then draw kind of a half kilometer radius around there and have a pretty good idea that you're sampling colonies that occur within that area. And so if you're just thinking about managed colonies, sure, you probably could go around in that area and find most of those managed colonies because they're pretty obvious. They're big white boxes or pink boxes or some other colored box that's sitting out there. But if you're actually interested in the total population and that total reproductive population, you will then have all of the feral colonies in that area to contend with as well. And those are really cryptic and really hard to find at times. So the DCA allows you to have this one sample point where you can collect hundreds of drones really quickly from one side, and then take them back to the lab and process them for months like I did.

Amy 20:33
So what were you actually processing? Can you tell us a little bit about that side of the DCA research?

Guest 20:39

Yeah, so the project that I was doing actually had the drone congregation areas identified in three areas that were directly associated with managed European honey bee apiaries, and those apiaries had about 100 European-managed colonies in them. And then I had three DCAS that were further away in an area that didn't have any managed colonies around it. And so this was a site that had restricted access. So we knew that there were not other managed colonies in the area. So we were out in a space that was truly only feral colonies that we were sampling from the DCAs out there in those spaces. And the main thing that we were looking at is, does the management of European honey bees modify the number, the amount of African-derived honey bee colonies that you have in that specific region right there? Yeah, so with the idea being that European honey bee colonies are from a climate where you come out in the spring or you wake up more so in the spring, and you are really, really busy and active, you're collecting a lot of nectar and pollen, as much as you can from whatever's available. And then once it becomes autumn, again, you just hunker down and eat the resources that you've stored until you pass through the winter, and then start back over in the spring. So, on top of that, we've had years of beekeepers selecting for colonies that aren't absconding and are just staying put and dealing with whatever resources they have. Whereas African honey bees don't have the same history of management. They're from a climate where they're actually able to say, "There's not a whole lot of resources available to me here. I'm just going to abscond and move to a place that has more resources available." So the idea being that if you can almost saturate an environment and the resource competition becomes more high because you have so many European honey bees in the colony and the environment, do then African honey bee colonies say, "We're gonna swarm or abscond and go over here and find a different place that's easier to collect a whole bunch of resources." So can European honey bee management be used as a way to minimize the influence of those African-derived honey bees in Central Florida, central South Florida?

Jamie 23:02
So Ashley, all this is really neat. Finding DCAs is obviously a scientific endeavor for you. It's been one for me, right? And a lot of our colleagues who do the same thing, they're asking a lot of biological questions that are relevant. You mentioned your project where you were looking at the influence of African honey bee drones at these DCAs. So with all of this kind of in mind, ultimately, why should beekeepers care about DCAs? I mean, I know they're interested in the story of finding them. But why are drone congregation areas important to beekeepers?

Guest 23:32
Yeah. So, drones in general aren't always regarded as important to beekeepers, right? Like we put all this worker comb foundation in there, all the burr comb, that's drone comb that exists in our colonies, we cut out. Drones are seen as just such a waste and a drain in the colony. But the drones actually represent half of the reproductive potential and reproductive capability of a colony. So biologically, they're a really important part of the colony. And that's why the colony is so keen to produce all the drones that it feels like it should be, even when we're not providing the space for that. Anytime you leave a frame out, all that burr comb they draw in is typically drone comb because they're like, "Yes, we finally have enough space to make all these drones." And for beekeepers, if you have a colony that swarms and creates a virgin queen, or if they're superseding their old queen because you accidentally squished it while you were in there, or it's just a failing queen that's not doing great, that queen is going

to go out and it's going to mate with the drones that are present at the local drone congregation areas. So actually having an understanding of what that mating system looks like can help you in your management strategies of I guess just knowing that your queens will be mated knowing if you're in an area that, potentially, especially as Floridians, would have African genetics at those drone congregation areas. That's certainly a good thing to know. And another cool thing that we found from those drones that we had collected in Florida, which we don't really know the implications of that yet, was actually that we had collected Varroa mites off of those drones that we had at the drone congregation areas. So drones carrying Varroa and interacting with other drones at DCAs and interacting with queens that they're meeting with at DCAS, we don't know the implications of what that looks like. But there is actually evidence that there is at least pests and disease present there at DCAs.

Jamie 25:25
Yeah, I think there's just so much to know. The whole story of finding them is really cool. What I want to do, Amy, is make sure that we link all of Ashley's papers that she's published related to DCAs, all of her DCA-based research, including that method on how to find them that Ashley was talking about pioneering a little bit earlier. We also have an article that I had written before on mating biology, the honey bee that explains a little bit about the biology of DCAs, as well. And so we'll make sure to link all of those in the show notes. And Ashley, the benefit is that people will be able to check them out and maybe ask you some questions directly about them.

Guest 25:55
Yeah, that's cool. I can also make sure to send -- I can find some pictures of us out in the field with the drone balloons in the clouds and stuff.

Amy 26:02
Jamie in a raccoon hat.

Jamie 26:03
I was going to say, me with the raccoon.

Guest 26:05
I need to deliver that picture because by the time I got over there with the truck, it was like throwing everything in and going. There was no picture-taking happening.

Jamie 26:15
What's funny is that I spent the rest of the ride home googling what you're supposed to do if you're caught in a field in a thunderstorm. What I found out is actually pretty amazing. But we won't go there.

Guest 26:27
The context of it was I left Jamie at one side and I had gone over to another site that was like 15-20 minutes away. And I actually had six balloons set up at my site. And the thunderstorm came in from the side of the town that Jamie was in. So he's messaging like, "Oh, there's a thunderstorm coming." And

I'm like, "Oh my gosh," so I'm like packing down six balloons, and then trying to drive out there as quick as possible. I felt so bad.

Jamie 26:50
And I'm dodging thunder lightning bolts. It was crazy, amazing athleticism on my part.

Amy 26:56
Maybe a little dramatic, Jamie.

Jamie 26:58
There was one I had to catch and redirect. It was pretty intense.

Guest 27:01
What he did was open up 100 bee colonies without a smoker or a bee suit and then create a dome of bees I extracted him from when I showed up.

Amy 27:10
Oh my goodness.

Jamie 27:12
Well, Ashley, thank you so much for joining us. I'm sure our listeners are gonna find this very interesting, and they're gonna want to know more. So thank you for joining us on this episode.

Guest 27:19
Yeah, thanks so much for having me. It was really fun.

Jamie 27:21
Absolutely. Everybody, that was Dr. Ashley Mortensen, a senior scientist at the Productive Biodiversity and Pollination Science Group, the Bee Biology and Productivity team for the New Zealand Institute for Plant and Food Research.

Honey Bee 27:36
Have questions or comments? Don't forget to like and follow us on Facebook, Instagram, and Twitter @UFHoneyBeeLab.

Jamie 27:46
Everyone, welcome back to this segment of Two Bees in a Podcast. Amy, I don't know if you've noticed, but we have had a lot of questions and podcast segments on honey bee queens. Have you noticed that?

Amy 27:57
I guess I have noticed that. Yeah.

Jamie 27:59
So I think one of the reasons this has been happening is because this really illustrates how important this topic is to beekeepers. We talk a lot about Varroa, we talk a lot about feeding and nutrition and other things, but beekeepers just regularly have queens on their mind. They're always thinking about them, they're always having to manage around it, and we're actually privileged to be able to be joined today by Dr. Raffaele Dall'Olio who is from Bologna, Italy. He has his own company called Bee Sources where he is an independent bee research and extension consulting specialist. And he's joining us on Zoom today from Italy to talk about the queen breeding program in Europe. This will be a very interesting thing to think about because we, of course, you and I know a lot about the queen breeding system here in the US, but Dr. Dall'Olio will be joining us from Italy to talk about it specifically in Europe.

Amy 28:56
Dr. Raffaele was supposed to come and teach a honey sensory class for us in March, which was the beginning of COVID. He was packed up and ready to go to the airport when we had to postpone his trip. So he was supposed to be here in-person, and we should have had him in-person, but because of COVID messing everything up, it was unfortunate. But we're gonna definitely have them coming next year.

Jamie 29:21
Of all the things that we've been offering with our various Bee Colleges, this honey sensory analysis thing was really -- it sold out like instantly. It was very heartbreaking, Raffaele, to not be able to have you. So first, let me welcome you, Raffaele to Two Bees in a Podcast. So thank you for joining me.

Guest 29:40
Thank you, Jamie. Thank you, Amy, for hosting me and for having me.

Jamie 29:44
Well, we promise to do the honey sensory thing in the near future as soon as COVID allows us to ease restrictions. We know that what you're going to offer is going to be a big hit for beekeepers here. But for this particular segment, we want to ask you a lot of questions related queen breeding because we know that you have an expertise in that. So thanks for joining us. So let's just kind of start, Raffaele, from the beginning. If you could tell us just briefly about yourself, how you got into beekeeping and bee research, and then we're going to launch straight into giving us an overall picture of the queen breeding situation in Europe. So, first, tell us about yourself, Raffaele.

Guest 30:22
Oh, yes, sure. I'm a biologist. I had my study here in Bologna. Then I had a PhD in animal biology with molecular diagnostic and the masters in bee pathogens later at the University of Pisa. It was pretty fun to get engaged with bees, because I was working in other animals system like Sweetwater fish and frogs, working in reproduction and phylogeny of those animals. Then, I had an interview to become a CSI agent with a friend of mine that was having a PhD all together with me. And since he was working with bees, and I was aiming to get his seat, I said, "Look, if you're going to win the contest to became a CSI agent, I would be willing to take over your job with the Bee Institute." And finally, I didn't want the

interview, but my friend did. And so I got in touch with bees. That was in 2003. Then I had 12-13 years of experience as a researcher at CREA in Bologna, which is the former National Institute of beekeeping. And then after a couple of commercial experience in New Zealand, and then California as well, I decided to quit, let's say, a full time research position, and to start being much more in touch with beekeepers and to become, let's say, what in the US, you call extension. So trying to transfer research to the field and to companies.

Jamie 32:04
That's amazing. And I think all of that experience that you've had, of course, in Europe, as well as California and New Zealand, really has probably given you a really good perspective of the queen breeding situation and helps you understand and work with queen breeders in Europe. So could you tell us a little bit about the overall situation for queen breeding in Europe? When's the breeding season? How big is the market for queens? Some of the leading countries that produce queens and the various breeds of bees that you guys target for the production of over there?

Guest 32:32
Yes, it's not easy to have those kinds of information because, as you might know already, I mean, most of the queens are sold unofficially. They are off the records. But anyway, the general situation is that we have queen issues. I mean, all of the beekeepers are complaining about performances, they are complaining about the lifespan of the queen, so they have to requeen more and more often. So we have a queen issue. And this is creating, of course, some market opportunities. And also, the queen producers are realizing that the biological quality is not anymore enough. I mean, they also have to perform breeding, and they have to produce queens with specific and fixed traits in order to satisfy the market. So we have a very long tradition in queen rearing, especially in Italy, already at the end of the 19th century, in a city nearby where I live close to Bologna, a single beekeeper was able to ship 25-30,000 Italian queens abroad. So that was the end of 19th century. So they went by boat, long journeys, not in small cages, but with whole colonies or banks. So it was completely different logistic. With respect to breeding, I would say that, maybe, Central Europe has the most structured system, especially Germany. They have a very long tradition. And they now have a very well-known system in breeding that maybe we can describe in detail later. But actually, you can find most of the outcome in a database online that's called the BeeBreed.eu. And it has a German origin. Also, the host is German but currently, you can find information about different subspecies of queens. You might know that Europe is a hotspot for diversity in bees so we have several subspecies. All of the traits, performance traits are referred to a single subspecies. Nowadays, I would say that, officially, we have a market, which is close to 2 million queens per year where Italy, Poland, and France maybe share the leadership of the market. But honestly, I believe this market is way larger, I would say 10 times larger than those official figures. Because there are also, of course, the internal market to every country, and also what we call off the records rates.

Amy 35:20
So this website that you're talking about, Dr. Raffaele, so that's open to anyone who wants to look for different types of queens?

Guest 35:29
Sure this is open source. And as a customer, you can search within the database, you can search according to the traits you're looking for, being honey production, production, gentleness, or maybe hygienic behavior, and whatever. You can look back at the pedigree of the queens, so looking at their parents, if it was naturally mated or artificially inseminated, and so on. And finally, once you have found the queen you would like to purchase, you get the contacts of the beekeepers. So if you look at the other website, you will see most of the website, most of the records are referred to the Carniolan bees, because this is what is bred in Germany, mostly, but also the section of Italian bees. And now, there are more sections with a little amount of records being updated. This is because most of the other subspecies have a much more recent history in breeding. So some of them have recently started breeding in these kinds of populations.

Amy 36:39
And they get shipped across the world.

Guest 36:41
Yes, then it's a contact between privates. So it's up to the private if they want to ship it or not. Some of the breeders are really, really concerned about their effort. And so they don't want to ship queens for long distances. They prefer the customer to go and pick up because they know the value of those queens. So you might have read, I mean, this is a study from Canada. And then with US queens shipping between US and Canada, how shipping can affect the queen quality.

Jamie 37:12
I mean, make sure that we get that link and have it in the show notes so that people can visit. We'd obviously be unable to import the queens into the US, but certainly other places. The beekeepers here might be at least interested in going to the website to learn more.

Guest 37:26
Or maybe just have a look, have a look at the structure and the information you can find.

Amy 37:31
I want to say that, through our podcasts, we've been talking a lot about queens. And that's been my number one question on where do we find these queens? Where do we find more information about these queens? So it's really good to know. And we'll definitely add that to the show notes after this. So I want to kind of switch out of the marketing and out of how to sell some of these queens and how they're being produced and talk about some of the research projects that's on breeding. So we all know, after discussing queen breeding, what are the main research projects? What are researchers looking for when they are going through and breeding queens?

Guest 38:08
Well, in Europe, we have several research projects ongoing. Some of them, most of them, are local or national. And a few of them are, let's say, funded by the European Union and those kinds of projects. They allow a large scale assessment or collaboration among countries. These allow, also, to enlarge

the size of the breeding population and also to do performance testing on different subspecies. So one of the most recent ones was called smart bees. That was an FP7 framework project funded by the European Union. And the consortium was led by Caspar Benefield, in Germany. This project ended in October 2019, it was a four-year project. Of course, when we say research project, there is some contradiction between the research project and breeding because normally, breeding is a long-term effort. While research is something, which is like two years, three years, four or five years in the best case scenario duration. So it's something that you can perform a little bit of breeding during these efforts. Anyway, during smart bees, during this four-year project, there was a lot of effort put in training in different countries. So I think something like 14 or 15 European countries were involved. Some of them didn't have any tradition in breeding. So a lot of effort was put in building a team and training the future trainers for a starting breeding effort in those countries. In other countries, we had already an established breeding system so we could take advantage of that and do a little bit more of experiments. During this, the main goal of this project actually was preservation through utilization. So the idea was to facilitate sustainable breeding of endangered honey bees. So not only in Italian ligustica and Carniolan bees, but also the so-called neglected subspecies, like siciliana, or macedonica, or adami, those kinds of bees that nobody knows about. This is another difference, maybe, between us because here, we also have to pay attention a little bit to conservation because of the diversity of bees. So during smart bees, more than 2000 colonies were assessed, lots of samples were taken. And according to the performance rate, especially on resistant traits like hygienic behavior, one of the main outcomes of the project was a cheaper of 2500 snips that includes race characterization for nine subspecies, sex alleles, and hygienic markers. And this kit is now commercially available in the Eurofins, which is a laboratory, I think, present worldwide. And another successful outcome of the project is that it is still leaving after the end. Because actually, the group of people that was trained was so interested in the topic, they pushed it to establishing a new association, which is called the International Honey Bee Breeding Network, IHBBM, which is now aiming to become a kind of federation of breeders or breeding association to share the vision of sustainable breeding all around the world. Another project that is still ongoing, it is a tender project, a pilot project led by Ralph Buechler. It's called your best. This is a three-year project. And the main goal is to evaluate the current status of commercially available resistant stock. So several queens were distributed across five different countries. Something like 4500 colonies were assessed for performance traits, not only on a production or commercially interesting trait, but also for resistance to mites, which is still the main thread for bees. Those colonies were assessed at the commercial level by beekeepers through a comparison with their local stock or their normal stock they have in the company. At the institute, let's say, with some more sophisticated protocols, and a very interesting part of this project was also evaluating the economic gain and cost of upgrading or performance testing everything which is related to selection, let's say. A few more projects ongoing. While we are recording this this segment, I just came off an RNSBB workshop or the task force of college network about bee breeding. And there are a lot of efforts ongoing to assess VSH trait or SMR recapping trait in European population to make a comparison, also, to the previous assessment you had from the US. Actually, there is also a recently published paper on a large-scale assessment by Fanny Mondet and co-authors on insects about the trait SMR and recapping European population.

Amy 43:58

Sure, so I was gonna let Jamie ask a question, but because you're already on the topic of resistance to Varroa, what is SMR? I actually don't know what that stands for.

Guest 44:08
SMR stands for a suppression of mite production. Actually, it's pretty similar to VSH. You might be more familiar about. But normally, we can say that a VSH is the trait and SMR is the outcome. We're still not sure but you might understand VSH is one of the components of SMR. So SMR might be an outcome of different behavior and different mechanism that are ongoing in the colony. So we are also trying to disentangle those kinds of mechanisms. VSH might be one of them.

Amy 44:48
We always have so many acronyms in beekeeping and outside of beekeeping. So I always just want to make sure our audience knows because sometimes I'm like, "What does that stand for again? I forget."

Jamie 44:58
Raffaele, I really liked the way that you explained that. VSH is the trait, Varroa sensitive hygiene is the trait but SMR, suppressed mite reproduction is the outcome. We were able to interview a scientist from Mississippi State University, Dr. Jeff Harris, who obviously is a world expert on this particular trait. You're probably familiar with him. I don't even know if that episode has come out yet. But if it hasn't come out, it's coming out for our listeners soon, and they'll be able to hear a lot about that. He talked a lot about that European effort that you just mentioned, this beginning to look at that trait in honey bees across Europe. Amy, I guess, kind of expanding your question to Raffaele, what what efforts to breed for resistance to Varroa, beyond SMR and VSH, is actually happening in Europe?

Guest 45:46
Still, we have a lot of effort on hygienic behavior. So hygienic behavior is still a very important trait. And also I have to say, hygienic behavior is now also popular among beekeepers, not only from from Institute and on research project, but a lot of associations or independent companies are adding one of the hygienic behavior traits to their breeding system. So I think this will stay for a long time as an important trait to add. And actually, there are also efforts ongoing to make the pin test or hygienic behavior screen way easier. I think a couple of research groups, one is in France, and another is a kind of collaboration between Israel and all of Rupa lab. They are exploring the possibility of using olfactory clues, like spray, in order to trigger the hygienic behavior and not to give any mechanical stress, let's say, like pinning the cap or freezing the combs, which is kind of a different clue. So they are trying to wash out some olfactory clues from infested brood, from viruses or other stressors, and use those kinds of spray to make the hygienic test much easier and sometimes more informative as well. So I think this will stay. And then there is also a joint program ongoing in Germany on SMR, which is not only looking at the other trait in the field, they are also breeding the population using artificial insemination, trying to keep a comparison between the natural limited population and the artificially made population. They also use single-drawn insemination in order to maximize the heritability of the trait in some generation. And this is another effort which is ongoing still on SMR. And another very interesting trait where we are looking at is recapping. Once the Varroa enter the cells and the worker bees cap the larvae, they cap the cells, that cap can be opened from workers, not only once, but even several times through some

images and putting some individual ID on the bees, some researchers were able to detect that in a single brood cycle the same cell was open and then closed up to nine times, something like that. So in a very short period, and this trait is related to the ability of the mite to reproduce. So we are trying to understand what is triggering recapping and also we are investigating the so-called targeted recapping. So what is the share of the cells that really are infested or they really need to be open? Is just a behavior that all the bees goes crazy and you start to open the cell because of certain reason? Or they can do it based on some clues that we still don't know much about? So those are I think promising, promising traits.

Jamie 49:14
So Raffaele, let me tell you a little bit of a perspective here. So obviously, I'm based in the US, and in the US, we have a very different thought process about producing bees because as you've mentioned already multiple times, honey bees are not native to North America. So a lot of the efforts here are breeding for specific traits, etc. with no, I would say, effort to preserve a type of bee. Now, with that said, there are definitely some smaller groups around the US that are interested in things like the Buckfast bee or Russian bees, etc. But we don't have a native honey bee here. So there's no efforts to maintain this native bee. However, when I'm in Europe, and I'm fortunate to be able to get to Europe two to four times a year, Europeans take a very different perspective about breeding honey bees, because just like what you've said, you guys have a number of subspecies of Apis mellifera distributed across Europe, all the way from Ireland and the UK, all the way east to the eastern-most European countries. And you guys have all of these ranges of subspecies. And I know when I'm in the UK, for example, there's a lot of breeding efforts to maintain that local black bee, they call it, or when I'm in Germany, the bee that they're wanting to take care of in Italy, the bees that you guys take care of. So, collectively, Europe seems to think very differently about bee breeding and conservation than we do here in the States and then other places around the world. So I'm curious if you could spend a little bit of time talking about breeding and conservation efforts in Europe from that perspective, not just to produce bees that are resistant to Varroa, or through all of these other great programs, like you have smart bees and your best and these others, but talk about it more from the breeding for conservation purposes. Because I think that will be really interesting for our listeners around the world to hear, given your unique perspective in Europe,

Guest 51:09
You're right and also, it's really challenging because breeding normally means selection, while conservation means try to keep everything as possible to preserve most of the diversity. So actually, this is a very delicate balance to find between breeding and conservation. And of course, I have the perspective of the biologist with a greater consciousness on the importance of diversity. But at the same time, I also work in touch with companies, so I understand their needs, I understand their willingness to try different stocks, to try something new, maybe exotic, just for the sake of curiosity. So it is a delicate balance. It's also not topic, as you said, here in Europe, so there is no consensus on that. Most people, they say, "Oh, look, I have to have an income from my business. So I cannot rely on local breeding efforts because we don't have many breeders around here," so I can understand that. But I also think that we have the knowledge and the possibility to allow breeding livestock,, while also preserving and conserving our current genetic diversity. So we have to avoid the overlapping of, let's

say, unwanted genes, where we have some conservation issues, some like locally endangered population, some very narrow population. For instance, some islands like Malta or Sicily, they have a very narrow population size. So we cannot allow any breeder to breed different breeds if we want to preserve the honey bees in Malta, for instance. But at the same time, we might be able to allow the exchange of different stocks in the market. Personally, I am for sustainable breeding. What I mean with sustainable breeding, you need to get some improvement without losing anything. So you need to preserve. I also believe that the honey bee genome, because of the peculiar mating system of the honey bees and their behavior, their mating behavior, mostly in every population, they harbor most of the diversity of the species. So, that kind of diversity is shaped by local adaptation through many generation. This was really evident in an experiment, large-scale experiment, so-called GEI, genotype environment interaction experiment by Buechler and colleagues in 2014. They prove the importance of local adaptation with no doubt. So local bees were living longer, surviving the stress much more than others. Of course, you can say, "But this kind of experiment was under unmanaged conditions. So you are not controlling Varroa mite while we do as beekeepers." But anyway, this is for me, the base, the fundamentals, to see that in every local population, there is a potential and this potential is given by local adaptation. So in order to enhance the use of those neglected population, I think we have a lot of effort to do in training breeders in every country. For instance, if you live in Spain and you want to conserve Apis mellifera iberiensis, but then you want to buy selected stock of iberiensis, it is very difficult. There is not much of breeding tradition over there. So if you want to have a selected stock for your company, you are mostly almost forced to go abroad and to buy queens. So the first step is to establish a breeding system in every country using local genotypes. So that's the best way to do it. When you improve the local structure, then conservation is naturally coming with the utilization of the same stocks because they have the same performance as others.

Amy 55:26
Jamie and I have discussed this before, I feel like the more I hear about all the research and everything happening around the world, I feel like the less I know about honey bees. Everything that you're saying to me right now, I'm like --

Guest 55:38
You're not alone in this.

Amy 55:40
I know, there's so much that goes into it, every which way possible that we're thinking of. And so now my brain just kind of hurts.

Guest 55:49
My feeling on this is we also need to make a little step back sometimes. Sometimes, our scientific progress are making us a little bit more blind. So for instance, when we had the hype of genomics, proteomics, all of the omics power, then we forgot to look under the microscope. And the recent discovery of Samuel Ramsey on Varroa feeding on dead bodies is a clear example of that. You have to look at the performance, you have to look at the phenotype, you have to look at what you see. Of course, all of the omics and other techniques are powerful. But we don't have to forget to look at things,

real things. And the same principle is also happening in breeding. I mean, most of our students' studies are focusing on breeding the livestocks because we want to improve the management of honey bees, but we are overlooking the behavior of the wild animals. So we are forgetting to observe the free-living honey bees. And I think, also, with respect to breeding and the behavior of bees, we have much to learn from observation of the free-living colonies.

Amy 56:59
Yeah, absolutely. So we've discussed with you marketing, the industry, some of the research projects, what we're looking for, what you all are looking for with breeding, and then, what other projects and how you all are breeding, while taking conservation into consideration. Generally speaking, with the queen breeding that's happening in Europe, what would you say are some of the future perspectives that you have on what this industry will do?

Guest 57:29
Well, sure, we have a lot of challenges in front of us. First of all, the one I just said, to start breeding systems in several countries. That would help conservation. I would say that, now, breeding is largely based on phenotypes measurement and their performance. Probably in the near future, we hope to be able to rely on genomic selection so markers assisted selection. This would allow us to minimize the field labor, and also to forecast the performance of a queen based on maybe the genome of an egg, for instance. We don't have to wait for the full colony development and for a whole season. So, we might have more possibility to use this kind of genomic selection. Personally, I'm hopeful on that, but at the same time, a little bit skeptical since I believe both differential gene expression and also epigenetic mechanism play an important role in a complex super organism such as a honey bee colony. Another challenge that we have to face, and we are already facing, maybe, there are growing efforts on investigating resilience to climate changes. So it's not only the southern states of US like California, but also in Europe, we are experiencing very hot summer, a lot of drought, and so there are already efforts ongoing to investigate how bees can respond to those extreme climates, how quick are they to react to blomings or to different environments, because that will be a challenge in the near future. What we observe right now, there is not any more usual sync between the blooming and readiness of the colonies to harvest. So that missing synchronization is sometimes causing the bees to starve, not only damaging lack of harvest, but damaging to the colonies for the remainder of the season. And in the near future, I also think that there will be a growing importance of virology in breeding. So, again, Varroa is still the main pest altogether and the main threat altogether with pesticide and insecticide for bees. But we are learning more and more how Varroa and viruses is a kind of unique complex, three species system or three way system. So also adding some trait of resistance to viruses in our breeding effort will be a challenge for the near future. There is a very nice paper published recently on Nature, a scientific report by Reinier De Graaff in the culture about a new trait, so-called suppressive invivo virus infection, which looks promising or looks interesting, at least, to have a deeper look and try to insert in some breeding effort. So basically, I think this is a challenge. And finally, cryopreservation of semen is already a reality. And so we have established the semen bank, although we are still lacking, let's say, we're not sure about the vitality of the semen on the long-term. So the technique is relatively recent. So we already have data on a five-year storage, about the vitality after five years of storage, but we don't know much long-term. Another evolution of the cryopreservation would be on the female line. So

cryopreservation of all sides, there, I think some Institute in Germany are already working on that. That would be, of course, important for breeding because it's not only about preserving the semen, but if we can preserve also the female line, it could be another tool to use, both for improving the livestock, but also very important for conservation of diversity. So Raffaele, you have really done a great job giving us an overview of all the things going on related to queen breeding and conservation in Europe. It's actually fascinating. You taught me a lot of things I had not already heard. I'll tell you every time I go to Europe and listen to bee scientists or extension specialists speak about the things that they're doing, it's really inspiring to me to see the work that you guys are doing. I mean, I'm kind of blanketing Europe as a whole. But I just want to thank you so much for joining us on this segment of the podcast. I think everything you said is going to be really interesting to listeners and we're gonna make sure and provide links in our show notes to all of these different topics, all of these different efforts that you've mentioned. So thank you so much for joining us, Raffaele. Thank you again for having me. It was my pleasure, and I really hope that your audience will like to have these kinds of exotic information from Europe.

Jamie 1:02:35
I have no doubt they will, Raffaele. One of the funny things is, though, we're finding that we're being listened to by people from dozens and dozens and dozens of countries all around the world. So I think it's going to be a really, really good perspective for our beekeeper colleagues worldwide. Everybody, you've been listening to Dr. Raffaele Dall'Olio, who runs his own bee research and extension consulting business from Bologna, Italy. That business is called Bee Sources. Again, Raffaele, thank you so much for joining us on Two Bees in a Podcast.

Guest 1:03:04
Thank you and congratulations for your podcast.

Stump The Chump 1:03:09
It's everybody's favorite game show, Stump The Chump.

Amy 1:03:20
It is that question answer time. And I have a couple of questions for you, Jamie. And I've actually responded to some of these people, and they just didn't like my response. So I'm going to let you respond.

Jamie 1:03:30
Uh, oh. Pressure is on.

Amy 1:03:31
So the first question I have is from Russ. Russ emailed me and he asked, so let me tell you, all of the people who went to our Bee College, they received a logo sticker. And on our logo, if you've been to our website, we've got three hexagons as just part of the logo. So he wanted to know what the significance of the three honeycomb patterns are on our logo and what it meant.

Jamie 1:03:53

Yeah, so those of you listening out there, we have a brand new bee lab. At least, it's brand new to me. It's about two years old now in 2018. We're recording here in 2020. So in 2018, we built a new bee lab at the University of Florida. On the front of the building are three sets of hexagons. It's not just three hexagons, but three sets of hexagons and they're in different patterns. And I think some of our followers are beginning to wonder if there's a secret code that's been encoded into those sets of hexagons. And the answer is, drumroll, Amy --

Amy 1:04:27
Beep beep beep beep.

Jamie 1:04:28
That's not a drumroll, that's a van or a vehicle backing up. Anyway, so there is no pattern to the patterns.

Amy 1:04:39
There's no story.

Jamie 1:04:40
The architect who designed this building, he was coming at it from an artistic perspective. He thought that it would look cool to have some hexagons on the front of the building. It does. It does look cool in all three sets. They're different colors. There's one orangey and one yellow and one yellow-orangey, and I'm colorblind, so that's the best I can tell you about it. But the colors are just, they're just what what were in his brain. I happen to like it. I know this is going to make all of you go to our website UFhoneybee.com to check out the face of our building. It's what we're beginning to be known by. But in fact, we've incorporated that pattern into our logo. I wish I could tell you we were all part of some secret society, but we're not. It's just what was-- It's well, the again, the answer is there's nothing sacred about it. It's just an artistic rendition that ultimately won the day and found itself on the face of our building. There we go. Sorry, Russ. Alright, so the second question we had was, why don't we hear more about essential oils to assist with diseases or Varroa or small hive beetle? Goodness. Well, Amy, sometimes --

Amy 1:05:49
Have you read a label on oils?

Jamie 1:05:51
Yeah, sometimes my answers just get me in trouble. But the short answer is the reason you don't hear more about essential oils is because they don't do very much for bees. And I think I just shattered some thought processes for a lot of people. The only conclusive evidence that I have ever seen about the benefits of essential oil to bees has been through some of the impact of essential oils on Varroa. These have been formulated into some products, Apiguard, as an example, ApiLife Var is an older one. These particular products are based on thymol. I think Apiguard might have a few other things. Sorry, no, ApiLife Var might have a few other things in it. But these these products and other products that have been created on essential oils to be used against Varroa, they have documented efficacy in these

cases. But I've seen a zillion and one studies on essential oils on Nosema and essential oils on this and that the other and most of these, you're really stretching it to find any effect at all. And I know a lot of beekeepers who will mix essential oils into their pollen patties. But honestly, the data are just lacking to support a lot of their anecdotal comments. So the reason you don't hear a lot about them is because even though they've been studied 1001 different ways, there's just really no conclusive data that they're beneficial beyond these two or three or four things that have come out and that are registered for use in bee colonies. That's the short answer.

Amy 1:07:16
I feel like this Q&A is just like a womp womp.

Jamie 1:07:19
I know, I feel like we're gonna get some hate mail because some people are absolutely married to the idea that essential oils are a cure all in honey bee colonies. Incidentally, I'm not trying to knock them. One of my hobbies is I love growing herbs and spices in mine and my wife's garden. So I fully appreciate the aura associated with these things. But in the bee world, it's more of a, "I like it. So now I'm going to try to come up with a reason to put it in colonies." Unfortunately, a lot of the reasons haven't been substantiated with data.

Amy 1:07:49
Sure. Except it smells good.

Jamie 1:07:51
Smells good. But there are a few products that are based on essential oils and those products have been tested and actually shown to be beneficial. But a lot of these other things are just home remedies that really are better for the beekeeper than they are for the bees.

Amy 1:08:06
Yeah, so the last question we have is from Stephen Cuts, and it's really funny. He left me this super long voicemail, and he was just talking about himself pondering and thinking about life and bees. And so he was wondering if drones have the ability to produce wax, just in general. I mean, do they have wax glands? Can they produce wax?

Jamie 1:08:29
Yeah. Honestly, Amy, that is the first time I've ever been asked that question. That's awesome. So I have read and read and read and read about bees and workers and wax production. In fact, my late PhD supervisor Randall Hepburn from Rhodes University in Grahamstown, South Africa, he wrote a book on a wax production and honey bees. And I have never read anywhere that drones are capable of producing wax. The catch-22, Amy, is the absence of data, does it imply absence of possibility? So I would say drones do not produce wax. Never in my reading have I read that drones are capable of producing wax or have wax glands. However, if you're a listener out there, and you know this to be false, feel free to email us with the manuscript that shows that this is the case. But until then, Stephen, I'm going to say, to my knowledge, there's no evidence that drones produce wax. It's a funny question,

though, because just the other day I was thinking about the old debate on why do male humans have have nipples? Right? I know, I'm not graphic. This is actually a biological question. We know why female humans have that because they have the ability to produce milk and can feed their offspring. But why did male humans continue to have them? So this kind of seems to me to be the same kind of question with drones. So I'm not aware of drones having wax glands. But let's just pretend for a second that someone demonstrates to me that they do. So we're going to have that old argument, "Well, why do they have wax glands if they don't produce wax?" So interesting question, Stephen. And I'm curious if our listeners out there have more insight on this. Tough Q&A, Amy. I'm not sure I want ever do this again. I think we need to stop doing the Q&A.

Amy 1:10:20
Sure. That's so funny. At first, I was just kind of thinking of questions that people might have. And now that people are actually asking questions, I'm like, "Alright, this is this is easy for me because I just have to read them."

Jamie 1:10:41
Maybe we should uninvite the questions.

Amy 1:10:47
All right. Well, that was fun. Send some more pondering questions while you all have them. Don't send any more questions.

Jamie 1:10:51
Thank you guys out there for stumping the chump. I appreciate it.

Amy 1:10:53
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 1:11:16
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!