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SPEAKERS

Amy, Stump The Chump, Jamie, Guest, 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. Hello, everyone, and welcome to another segment of Two Bees in a Podcast. Amy, I'm not even really sure how to introduce today's segment because our guest is going to be talking to us about so many different things. So normally we say, hey, today we're talking about bee nutrition, today we're talking about disease and pests, but today, we're actually talking about a lot of things and I'm really excited to have our guests with us. Our guest is Etienne Tardiff who is a hobbyist beekeeper in the Yukon in Canada so this is sub-Arctic beekeeping.

Amy 01:20
We can't relate at all.

Jamie 01:22
No, not at all. No, we're like sub-sun beekeeping, it's like crazy here. But very different beekeeping. Etienne, you reached out to us some months and months and months ago with some issues that you were saying, and we struck up a collaboration through one of my PhD students, Dr. Marley Iredale, and since then, Etienne, we've had some really cool interactions and conversations. So thank you so much for joining us here on Two Bees in a Podcast.

Guest 01:49
It's my pleasure. It's an honor and hopefully, we can help folks understand what sub-Arctic beekeeping is and share some knowledge.

Jamie 02:01
Well, we have you on. We've got some notes down and we know we're talking about kind of three broad things, your involvement in the Western Apiculture Society, some sub-arctic beekeeping tips and strategies that you have to do where you are as well as your fascination of citizen science. But before we get into any of that, Etienne what I would really love for you to be able to do is introduce yourself to our listeners. How did you get into beekeeping? What's your background, and how did you find yourself where you are now?

Guest 02:31
Sure. So my name is Etienne Tardiff. So I live up in the Yukon. I got my start in beekeeping through my work. I'm actually a mechanical engineer. I help put together maintenance programs and manage large mining fleets and processing plants. But now, I mostly do leadership training and coaching and mentoring and trying to make engineers more practical. So, I'd say, about 15 years ago, a geologist friend approached me at the mine site, he says, "Do you want to do beekeeping?" And I said, "I'd never thought about beekeeping. It was never in my psyche." So I said yes. So as part of a reclamation project and a sentinel-type project, so the geologist wanted to use it to do some exploration with pollen samples and different things so basically, I got my start through the mine, and I guess beekeeping for dummies was our guide because we both had no experience. We had no mentors, and there was no other beekeeper in the area. So this was in Northwestern Ontario so just off the edge of some Arctic climate, but cold winters and warm summers.

Amy 04:05
So how many colonies are you running these days?

Guest 04:09
I run anywhere from four to about 10 in three different locations. The thing with sub-Arctic climates is we're very forage-limited and very isolated so there are no other beekeepers in the area. So if I do 10 colonies in one area, I get zero honey. If I do two to three colonies in one area, then I get, say, 100 to 150 pounds split on a good season. But the challenge up here is the weather. We haven't had 30 frost-free days this summer. I did get 40 pounds of honey. And it's great honey, but I guess it is what it is. And I love challenges. So that's why I keep bees up here.

Amy 05:09
I'm just thinking about the weather. And we're going to get to the cold management next. And I have so many questions for you, but before we get into that, I do want to discuss your involvement with the Western Apicultural Society. And so can you discuss what the Western Apicultural Society is? What do you guys call yourself WAS? I don't know. So tell us what that is, and then the purpose that it serves and your role with the society.

Guest 05:39
So a few years back, I had Dr. Bromenshenk, he reached out to me to be the Yukon representative or director for WAS, and I said yes. And I guess I stuck around for two years. And then there was a new election, Dr. Bromenshenk was stepping down, and I was going to be supporting a president, either as

a vice president or another director, but again, things fell through. And we were without a president so I put my hand up. And now, I guess, I'm president of WAS. WAS is a nonprofit. It's mostly focused on education for western North America, so all the way down the West Coast of the US, all the way up to the Yukon and Alaska and central to Saskatchewan westwards. And the focus is mostly smallish beekeepers from, say, zero hives to probably 100 colonies. We do have some large commercial beekeepers. We have a board, our board is mostly filled. And I guess that's our focus. It's small beekeepers. But we've been putting on, during COVID times, monthly mini-conferences where we bring two speakers with a related topic. And we've been running them through Zoom on bee nutrition, management, queens, drones, diseases, and pests. And usually, we have a decent panel, like Randy Oliver, I've invited Ian Steppler, and we've got Dr. Dewey Caron, and a few more, Dr. Medhat, Medhat Nasr. So basically, we can have discussions afterward so it's fun. And I guess just to put a plug in, our next talk is at the end of the month, and it's going to be Dr. Porrini from Argentina talking about Nosema and Dara Scott from Hive Alive talking about additives and Hive Alive and some of the research that's been done on that product, and Dr. Tarpy, next month, with Mike Palmer talking about queens and different types of stuff. So we try to put on a nice, I guess, schedule of speakers over the year just to provide our membership with some education opportunities.

Jamie 05:48
Alright Etienne, thank you so much for sharing about your participation with WAS. I love beekeeping organizations. They are so fundamental in the education of sustainability of beekeeping and beekeepers. It's really great that you are able to be involved in that capacity in such a large, impactful organization. So now I want to shift gears just a little bit and go back to the fact that you keep bees in such a difficult place to keep bees. Here in Florida, it's warm all the time. We think something's happening when we get two or three nights in a row that are below freezing and that we have to adjust a lot. Gosh, you experience this all the time. So it's going to be really difficult because there are so many things you could talk about. But could you tell me just a little bit about some of the obstacles you encounter in keeping bees in the cold? One of the things we know about you because we know you from behind the scenes, you use a lot of temperature sensors and you measure a lot of things that maybe the average beekeeper wouldn't use. So what are some issues you face, some management that you believe is unique to beekeeping in the cold, and some of the strategies that you employ that you would like to share with other beekeepers?

Guest 09:45
Sounds good. So I guess our season is fairly short. It goes from May, usually May to early September. Fall actually starts in August here. So in my journey up here, it was figuring out the pollen cycles, the nectar cycles, the bees' annual cycle. So when the queen, the laying cycle of the queen, and the ramp up and ramp down the mites cycles, what's available for forage and all that type of stuff. So I'd say that was the biggest challenge because there's not much. There are beekeepers in Alaska. Most of them are on the coast, in the coastal area, which is probably four or five USDA hardiness zones warmer than here. So we're zone one to two, where the coast is three to four. Fairbanks, for example, because just to put things in perspective, in the Yukon, there are only 40,000 people. And it's the size, I think, of Spain. And Alaska has close to a million people, so a lot more people, so a lot more beekeepers, but they tend to kill bees seasonally, and then start over in the next season. I don't want to kill my bees. So

my goal was to keep my bees alive, keep them healthy, keep them going. Hence, I follow a lot of the commercial beekeeper approaches. So using pollen patties to lengthen my queen cycle, get her laying longer, get her laying while there's still snow on the ground when there's no natural pollen. So I've had to use my hive monitoring. So temperature, for example, one temperature sensor in the center of your colony can tell you what the annual bee cycle is. So it'll tell you when the queen starts laying in the spring, and then when she stops laying in the fall so I've used that, especially in the first couple of years, I didn't use pollen patties, and I had issues with weak colonies in spring. So to put things in perspective, my winter bees are anywhere from 200 to 275 days old. So to figure that out, if you feed pollen patties into August, into early September, and then I started feeding pollen patties in March, I can basically make my 1ueen lay earlier and later but also, I make my winter bees younger. So that was one of my key findings was to focus on that. I guess, because we get a lot of frost, just to throw another challenge out there, the plants get stressed out a lot. And we get a lot of rust spores, fungal spores on our plants here and the bees collect it like pollen. And from the studies I've read, it's poor nutrition. And we can get into microscopy, but I noticed a lot of my bees have gut fulls of rust spores, and they're dead in front of the colony. So I have a feeling it's a stressor. They can't get the full nutrition. So one thing with adding pollen patties in August, it helps reduce rust spore consumption. So these are based on observations. I haven't done any trials. But if you read my stuff, I do quite a few observations, I take lots of notes, I collect lots of data. So my engineering background, that's what I do, I collect data.

Amy 13:48
So I'm interested to hear, during that time, you said that your season is between around May to September, so what is the average temperature during that time? I'm just trying to think about the bees foraging and what that looks like on a day-to-day.

Guest 14:04
So warm here, like a typical summer, would be around 20 degrees Celsius, so I'd say that's in the low 70s. And in my location, it's the evening so the evenings dropped to maybe five degrees Celsius, so 40 F. So I use polystyrene hives. Understanding thermodynamics and all that type of stuff, So by having my polystyrene hives, it manages the five degrees. So just to put things in perspective, in polystyrene hives, bees don't really start clustering until the outside temperature is like minus 10, minus 15. So there's plenty of wiggle room there for the bees not to get stressed out by the cold mornings, or even the occasional frosty morning. So this year we had frost in mid-July, early July, and late July. So luckily, a lot of our plants here are frost-hardy and drought-hardy. So they've adapted to it so it doesn't take them long to recover and start producing nectar again and pollen. So one thing with the sub-Arctic here is they're not big nectar producers, but they're quite hardy and they recover fairly quick.

Amy 15:31
Do you also feed with sugar water?

Guest 15:34
I tend to only feed sugar water in fall and then I bulk up. So for example, this year, the colonies are, without any feeding, they were in a 75 to 100 pound range. And because of my extra installation, a

colony here consumes maybe 50 pounds. A double brood box colony will consume about 50 pounds in my winter. And so I bulk up in the fall. And then in spring, they don't need any feeding, because there's still 50 pounds of honey in the colony. So technically, I feed maybe 20 pounds of sugar syrup water per colony. And sometimes I don't even have to feed much. It's more to backfill the brood nest as the queen stops laying and to keep them busy until the snow falls.

Jamie 16:41
Let me ask a quick question. You're talking about all this and I'm overlaying it in my mind with typical beekeeper management elsewhere around the world. I want to ask the big question, which is Varroa. Is Varroa a problem where you live given the environment and the truncated season and if so, how do you deal with it?

Guest 16:59
Varroa is always a problem. So I've experimented. I've let them go unmanaged, and it usually takes three years for a colony to go from very low mite counts to PMS, so parasitic mite syndrome where there's a collapse and the bees are all beat up. So what I do is I try to split my colonies every spring to recover my number. So like I mentioned, I'm fully isolated. So I try not to bring bees in to ensure I don't bring any new mites into my apiaries and to manage diseases. So I do use OAV, so oxalic acid vaporization. And typically, one or two treatments are enough. And I use open-screen bottom boards in the winter. But in the summer, I have the tray in and I use OAV, actually, to help me with my mite counts. So the post-treatment drop, I count because when I do alcohol washes, I typically get like zero to one mite on a normal colony, but if I do an OAV, I'll get an actual post-treatment drop. In extreme cases, I'll use Formic Pro to really beat those mites up. But I'd say, like everywhere, if you do nothing, eventually it comes back and bites you. So I do have a few colonies that don't have mites, and they just seem to be able to manage it but there are always a few colonies that have high mite counts and if I do nothing, then it'll be a poor spring for them. They'll survive the winter. Again, the insulation and the no top entrance and the way I manage my colonies is very low stress, low metabolic rate, most of the heating inside the colony is done through resting metabolism versus active metabolism so the bees are less stressed and they age less quickly. So I'm thinking and, Jamie, you can kind of maybe help me think this through but with the queen slowing down production, her egg-laying during the winter, doesn't that kind of give us a little bit of a brood break as far as Varroa and mite monitoring and how many mites there could be in a colony? So that was part of my strategy, initially, to use brood breaks to manage Varroa but we've got one of the longest brood breaks up here and it has minimal impact. So I have a feeling, because previously, a few years back, we thought that mites were phoretic, they just hang on to the bees all winter. But they actually do feed during the winter. So it's not like they're not feeding. And I found that a bad, say, a medium infestation level one year, so the next spring, the mites will be at higher numbers. And because of my hot approach to running my colonies in winter, they don't freeze. The average temperature in the box is about 15 degrees Celsius, and that's just using passive heat. So the mites are there and I've got to do something. So either through genetics, which is hard up here, or via treatment, so I don't rely on brood breaks for thermal control.

Amy 20:47

So something else that you had just mentioned was about the different gut microbiomes and that you did microscopy work. I know that you've worked a little bit with Nosema and amoeba and so can you tell us just a little bit about that?

Guest 21:03
Yeah, so probably back in 2017, I had my first winter losses after four years of beekeeping having a 100% success rate in my winter, I had my first winter losses where I lost four colonies, and they all had dysentery. They all had massive bee mortality out front of the colonies during winter, so during cold events, there would be thousands of dead bees up front. The one thing in common, they all had honeydew honey so I discovered what honeydew honey was, dark honey. And just on that honeydew honey, the one I had, I had it tested, and a typical honey has 70 grams to 75 grams of glucose fructose. This one had 50 grams. Okay, so you can do the math. So glucose or fructose is their simple sugars. It's what the bees use to generate energy. So it was actually a very poor fuel for the winter. So they had to consume more. And at the same time, I started learning about Nosema and how Nosema is an energy-robbing disease. So it's all these spores in their guts, it's feeding on their gut contents, so it's actually stealing energy from them. So it means that they have to eat more to get the same amount of energy output. They've got honeydew, which is less energy, more stuff. So they call it ash content, so things they can digest. So their guts get full of stuff, and then they pooped everywhere inside the hive during the winter. Bees like to be clean. So basically, my theory is they were trying to clean it and I had a mass infection of Nosema. So during that winter, I think I read some of Randy Oliver's material on Nosema and I bought myself a microscope with a digital camera. And then I started monitoring the dead bees out front to look for Nosema. And at the time, I didn't recognize there were these little globes in my pictures, but I didn't know what they were. Okay, people were saying, "Oh, they're yeast, they're different things." So I started connecting Nosema with the mortality in front of the colony, so a colony that had low mortality. And literally, I have pictures of piles of dead bees in front of a colony and the colony right next to it had, say, five dead bees. So I knew there was a connection there. So the power of observation, looking, and asking questions is key for any beekeeper. And so the first year, bunches have died, I cleaned my equipment up, I used vinegar and scraping and threw a lot of frames out. Then, the following year, I had four colonies again, and I only lost one colony. Again, same symptoms, a bunch of dead bees so I cleaned the bees off, the next month, a bunch of dead bees. Some dysentery up at the front but now I knew how to manage honeydew honey. If I see it, I feed more, I pull some frames. So again, seeing Nosema, seeing these globes, and then the following year it had happened again, same symptoms. So that's where I said, "Okay, I'm going to figure this out." And that's where I reached out to you, Dr. Ellis, and then you put me in touch with Dr. Iredale. And then at that point, I taught myself how to dissect bee guts. And I knew about these globes because somebody had put me on to, I can't pronounce it, amoeba disease. And I knew about malpighian tubules. So it's like the bees kidneys. So I was able to extract some of those, and then I could see all these cysts, these globes in it. I was like, "Oh, it's amoeba disease," and that's where I sample fixed in 100% ethanol to Dr. Iredale. And then she did some work on that and we were able to finally confirm that it was amoeba disease. And because it's the kidney and it helps the bees manage their internal water, which is critical for winter here. So basically, it was probably the missing link because sometimes bees have Nosema, even high loads, but there's no mortality and the bees do fine in the spring, they make it through. So in my case, anytime I noticed those globes, those cysts, along with Nosema, would spell a high mortality during

winter. Fewer bees mean more energy output per remaining bee, which means more consumption, more stress, more aging, and all that. And then in the spring, there's a rapid dwindle. So I've tried to requeen, I've tried to add frames from stronger colonies, but they always eventually fail. And I've tested a queen the one time and yeah, she was infected too. It was my aha moment. And I've taken my box knife and scraped off feces off the frames, and I put them in a little vial, added some hot water, mixed it up, ran it through my little centrifuge, and it's full of Nosema and amoeba spores, or amoeba cysts. So now the question is, is that a transmission? Are those contagious? Can they create a new infection? And I guess those are future questions and things that we can figure out.

Jamie 27:05
There's so much follow-up that I wanted to do, Etienne because there's so much to talk about here. But I'm just going to stick to the script, and thank you for that overview of the things that you have to battle in your particular place. I'm going to change a little bit of the story now to your passion for citizen science. So could you share with us a few of the projects that you've led or what you've participated in, and ultimately, what draws you to citizen science?

Guest 27:31
So I'll call it group science because when I first started, we had maybe one or two, old-time beekeepers in the Yukon that had been keeping bees forever. And most of them got beat up once mites arrived and overwintering became really difficult. So the first point of my project was to get our beekeepers together and to share ideas or successes or failures and that type of stuff. Then we got into education. So I brought up a master beekeeper to run the course. And I created a Facebook group for sub-Arctic beekeepers up here in Alaska, Northwest Territories, and a few Northern Europeans. I did start a small beekeeping club where we do have some hive monitoring equipment, that technically could be shared out, but, I guess, data, not everybody has the right background to get the most out of hive monitoring equipment. So you can get your basic cycles or nectar flows and all that, but basically, it was more about sharing ideas and projects that I've been doing looking at different hive configurations during winter. So asking what other people do, and then sort of connecting the data on successes to understand the whys and understanding heat loss and natural ventilation. So if you don't use the top entrance, natural ventilation becomes your critical factor. So how can you maximize natural ventilation without not ventilating too much? And just using a bottom entrance or an open-screen bottom board, how to manage moisture. So just to put things in perspective, in cold climates or even in winter down south, even if the RH, relative humidity, is close to 100%, so 80 to 100%, there's very little moisture in that air. Anytime the temperatures in the minus 15 or minus 20, the air loses a lot of moisture or water-carrying capacity. So from my numbers and my crunching, most of the water, so 80 to 100% of the water inside a colony in winter is from the metabolic processes. So the bee's consuming honey, and then perspiring or sweating out the moisture into the colony. So by reducing consumption, you reduce the amount of moisture in the colony. By over-ventilating and creating more heat loss, there's a balance there. And in some places, the cluster is a great mechanism for keeping the bees alive. In my area, that cluster would die without extra protection, so installation. So it's finding that balance. Sometimes, it's cluster-driven overwintering versus hive enclosure driven, wintering. So it's a balance of both.

Amy 31:06

So I'm amazed. We've talked about so much today. We heard your story, we talked about the Western Apicultural Society, and we talked about your experience with microscopy and citizen science. It seems like the hive monitoring equipment that in and of itself is just amazing. And I have a million more questions about it. With beekeepers, I think it's always fun for beekeepers to help beekeepers and beekeepers to mentor other beekeepers. What recommendations would you have for other backyard beekeepers or commercial beekeepers interested in just being part of honey bee science, citizen science? Should they go out and get a microscope? What are your recommendations for these beekeepers?

Guest 31:53
So first, beekeepers need to learn to ask questions, especially the question why. So why something happened, and then learn to hypothesize. So you have to do some reading. But it's critical that a beekeeper learns to ask the question why. Why did this happen? And then come up with, say, two or three reasons why they think it happened. And the key with networking and working together in a group is then you can start bouncing ideas off each other. The thing about a microscope, so for most people, I would say, especially if they're part of a club but the club has some extra funds, buy a microscope for the club that can be loaned out. Because I'm self-taught, the last time I used the microscope, I think, was in high school. And I had to teach myself how to use it, watch lots of YouTube videos, but again, it's questions. So typically, you do need a leader. So I have these vials and I pass out those vials, and I say, "If you see this, collect the bees, put them in a Ziploc bag, put them in your freezer, and I'll analyze the bees for you." Because the more we talk to each other, the more we share the good and the bad, and the more we ask questions because yes, I have winter but beekeeping is beekeeping, and then there are just the regional differences. But, in general, beekeeping is beekeeping, regardless of where you are in the world, especially in the temperate world. So if you're in Hawaii, and you've got a nectar flow year-round, that's one thing. But over here, when you do have a winter and a pause, it is what it is. But I'd say on microscopy and hive monitoring, the more you work together, the more you compare data, I'd say the better it is versus trying to do things on your own. It's always better as a team because you'll get a broader sense of what's really going on.

Amy 34:05
Absolutely. I feel like I need to make a plan to visit in 2023 because I want to see how beekeeping works, and I could use some cold air.

Guest 34:15
Yeah, we get that in summer too.

Jamie 34:19
Gosh, that's just amazing information that you shared with us. First of all, I can't imagine keeping bees where you live, but your involvement in WAS as well as your attention to detail, how focused you are as a beekeeper, and your involvement in citizen science and education of other beekeepers. I really think, Etienne, it's just really nice to see. And I really appreciate you coming on to our podcast and sharing that with our listeners. Thank you so much.

Guest 34:46
It was my pleasure. And I guess the key thing is beekeepers, have fun and learn from your failures because we all fail.

Jamie 34:54
Good words. Thank you so much for joining us.

Amy 35:14
Okay, Jamie. So listeners, this is a follow-up from our interview that we just had. And now, I have to tell everyone what I've just done because it's going to be so obvious. Amy over here was trying to speak into the mic and Jamie kept telling me that I sounded like I was so far away from the microphone. And so now, apparently, I sound better. Is that right, Jamie?

Jamie 35:40
You do. When you were doing the interview --

Amy 35:43
Now I sound like I'm yelling at you.

Jamie 35:44
Now you sound crisp and clear, the Amy I know.

Amy 35:47
That's great. And the reason was because my microphone was backwards when I was podcasting.

Jamie 35:54
The behind-the-scenes story is you and I kind of were taking pauses between the interview to try to troubleshoot. I'm like, "Amy, have you got the right microphone selected?" I even took a picture of my little monitor box just to see if I can come over to your office to see if the settings are right. And then I looked at your microphone and it was turned sideways. I was like, "Well, that's probably it." And now, you sound so crisp and clear. You know what? This is what people get for a low-production podcast. That's right.

Amy 36:20
Okay, everyone?

Jamie 36:20
You get what you pay for, folks.

Amy 36:22
That's right. I am no podcasting expert. But my microphone is now turned towards the right side. All right.

Jamie 36:30
You're speaking into the mic, rather than past the mic now, good job.

Amy 36:33
Now I can't even get with the outro. Honestly, I mean, at the end of the interview, we Google mapped where Etienne was and it was so far north. And it seems so cold and it looked so beautiful. And it seemed super remote. And I'm just completely super impressed with the fact that he's beekeeping in sub-Arctic temperatures, right? Like that's crazy to think about.

Jamie 37:01
Yeah, it's crazy. Indeed. Right? I've only ever grown up and lived in warm climates. It's really difficult for me to fathom the condition that the bees have to go through in order to survive those temperatures. But in their native range, Apis mellifera does occur in Northern Europe, naturally, and they would have had to survive some pretty harsh temperatures. So as long as the conditions are right for them, as Etiene was showing, it's very possible for them to survive in the conditions that I sometimes wonder why people live in.

Amy 37:32
Right, I know.

Jamie 37:34
But it's amazing to me, the story was amazing, and all of his involvement. Everything was really cool.

Amy 37:39
I mean, I think something else that he had mentioned just about beekeepers constantly asking questions, I feel like that's why a lot of us get into beekeeping. We like the problem-solving, we like to figure out what's going on in our colony, the whys, right? The whys and why do we think that this or this, or this has happened? And so I think just his involvement with the society and the involvement with citizen science, he's just my type of beekeeper. He wants to share his information, he wants to see what's going on, and then you kind of use that to move forward with a little mini project or activity that you have in your own apiary.

Jamie 38:16
I think one of the ways to think about this is that we interview a lot of commercial beekeepers, we interview a lot of scientists, we interview industry folks, we interview hobbyist beekeepers, and what I would say is it takes all of this to move the beekeeping industry and beekeeping in general forward, right? Etienne is doing this as a hobby but brings his data-hungry engineering background to the table to teach us all something about managing bees. So new knowledge doesn't always need to come from scientists. It comes from commercial beekeepers, hobbyist beekeepers, sideline beekeepers, and all the players, and I just really love listening to him talk about what he said. He wasn't just saying stuff to say it. It didn't sound very anecdotal. He was matching it with the data that he was collecting from the colonies. And I really liked that. It's really powerful.

Amy 39:10
Yeah, and I'm just going to put a shameless plug in for our programs. But with our master beekeeper program at the University of Florida, we do teach a segment about research. We teach about science communication, and education is very important to us and conducting research and understanding how that process works is part of our master beekeeper program. So I encourage anyone who's interested in the research side of things and conducting their own projects to go through our program because I think it is very helpful.

Jamie 39:40
That's a perfect comment. Amy, one of the ways that I see scientists, a lot of times people come to us, "Well, you're not full-time beekeepers, you can't know what you're talking about." What scientists are really good at is asking the right questions and knowing how to answer them. And I think like what you mentioned with our master beekeeper program, the research module that we have is just that. Hey, you don't always need scientists to answer your questions for you. You can come up with questions, answer them for your own, and change your management practices based on what you find. And sometimes, you just need a little help knowing how best to do that. And that's certainly a service that we can offer from the academic side of things. And then you see someone like Etienne who's employing that technique in his own operation and is finding ways to keep his bees alive in the sub-Arctic temperatures throughout a year. That's just really great. And that's the way that it's supposed to work.

Stump The Chump 40:39
It's everybody's favorite game show, Stump the Chump.

Amy 40:49
Welcome back to the question and answer segment today. Jamie, today, I wanted to talk a little bit about artificial intelligence. I guess we're going to talk about technology and what that looks like in the honey bee world. So I feel like this is an exciting new topic that, especially, the University of Florida is excited about. All three questions are related to this. And the first question I have is what is artificial intelligence? And how does that even apply to honey bees?

Jamie 41:19
Okay. Well, alright, so I'm going to begin answering this question by saying this is not my research field. So I'm giving a very cursory kind of 30,000-foot view of this. The reason it's pertinent to us here is that we've done a little bit of work on it, some colleagues of mine around the country have done a little bit of work, around the world have done a little bit of work, the University of Florida is investing heavily in artificial intelligence. In fact, they claim to be the leaders, in the US, at least, for artificial intelligence research. And of course, we're in a school of agriculture so how to use AI in agricultural settings. And let's just face it, folks. If you're listening to me out there, there will be an exponential explosion of research in the AI realm, especially with honey bees, since this is our world, over the next decade. And what is artificial intelligence? Well, I can't describe it well since it's not my field, but it's essentially computer technologies that allow computers to solve problems and develop problem-solving strategies in ways that currently take humans a lot of thinking power and time. So let me give you an example of

how AI is currently used in the honey bee world or how artificial intelligence is. There's a project, for example, I'm aware of, where some folks are taking pictures of wings from the different subspecies of Apis mellifera, they're telling the computer that these wings come from Ligustica, these wings come from carnica, these wings come from caucasica, these wings come from capensis, these wings from scutellata, these wings from adansonii, or whatever subspecies that you want. You're saying, "Hey, computer, these wings are from these subspecies. Now, you figure out what the differences are in these wings," such that someday we can take a picture of a wing of a honey bee with an app and then the app tells us what subspecies you were looking at. Right? And there are these applications already out there. My wife loves to sit on our front porch, put the bird sound application to use where it picks up the sound of the birds in our yard and then it identifies all the birds. Well, that's an application, currently, dealing with birds. They do it in the plant world where you take a picture of a plant leaf and it tells you what species of plant you're working with. Well, very soon in the bee world, I say very soon, maybe tongue in cheek, you can take pictures of wings and it tells you what bee you have. My lab, we developed the ability to take pictures of a bee's wing, a honey bee's wing, and tell what species of Apis, not subspecies of Apis mellifera, but what species of Apis. It's called Apis ID. If you go online and find Apis ID, you can upload an image of your honey bee wing, click on 19 points, press enter, and it will tell you if you have mellifera, dorsata, laboriosa, cerana, koschevnikovi, nuluensis, etc. So the species level work was kind of easy. The subspecies work is more difficult because a computer needs to find differences that we don't think of and that's just identifying honey bees. What if you could point your phone at a frame and take a picture and it determine your Varroa loads, which some people claimed have already done? You can look it up online. You can take pictures of bees and it count Varroa or take a picture of a frame and it tells you if you have brood diseases. Or take a picture of your frame and it tells you if you have bee diseases or brood diseases, and what steps you should take next. Or, to upscale it even further, if technology could, around the country, say, "Hey, there was better rainfall in the southeastern United States this year or in Western Europe this year or in northern Africa this year," and it was able to predict the nectar flow based on rainfall, heat, and temperature and say, "Hey, this year, your area's not going to be a good place for honey production. If you move them 50 kilometers to the west, it will be much better," because a computer crunched all the numbers, looked at the weather data, looked at the warm hours and the rainfall and was able to predict that your nectar flows would be better over here this year than over there. So artificial intelligence, basically, among other things, is a way to look at problems and solve those problems that we would otherwise struggle on our own to do quickly. It might predict when you need to requeen, it might predict like I said, nectar flow or disease and pest loads, it might predict pollination events. There are all kinds of ways that we can see, moving forward, how artificial intelligence is going to make beekeeping easier. I've even seen one thing, and I'll slow down so that you can ask me the next question, but I've even seen one company out there create a completely robotic hive as it were, this machine that is the casing of the hive, and it takes frames out of this hive, takes images, knows what to do in response to the images that it receives, if it needs control, and it administers treatments and does all these things to a colony. And as you might guess, new technologies in the AI world are going to cost a lot. But we think about it as fringe technologies now. But by the time I retire, I believe AI will be integral to keeping and managing bees. And so I'm kind of just touching the tip of the iceberg as I discuss this here.

Amy 46:56

Yeah, absolutely. I'm kind of transitioning into the next question that we have for today, but it's based on remote monitoring of colonies. And so, we've discussed with beekeepers before the different types of remote monitoring they have. Of course, I actually saw a video recently, it was on Facebook, and it was this farmer who was at his house but driving a tractor and just could see it in real-time. There's basically a camera on the tractor, and they weren't actually out there in the field, but they could see what they were doing. So I'm just imagining that being part of the honey bee world and what that could look like in the future. But as far as remote monitoring of colonies, what is it? Is it helpful? Is it useful? Have you seen this? What information and data are beekeepers supposed to be looking for?

Jamie 47:48
I think your preamble to that question is really good. Before I answer your question, I really think it shows what's possible out there. So beekeeping tends to lag behind the rest of agriculture. But you're right, farmers can sit in their living room and their combine can go do all the work. And even beyond that, there can be moisture sensors in the soil at different depths and at different spots in the field. Heck, Amy, there are even nitrogen sensors at different spots in the field. And so with these moisture and nitrogen sensors, they can control irrigation and fertilization release and give different amounts of nitrogen to different spots of the field, different amounts of water to different spots of the fields.

Amy 48:31
From their cell phone.

Jamie 48:32
Exactly. And so, essentially, you get really smart control and delivery of water and fertilizer and just all kinds of stuff in agriculture. Okay. So in the bee world, what's that going to look like? So I think people started getting introduced to technology in the honey bee world, mostly through this concept of remote monitoring, which is what you're asking specifically about. And so what is remote monitoring? That's basically, like the term says, the ability to monitor your colonies remotely. And almost every company that I've seen try to get into the remote monitoring world has done it through, "I want to weigh your colonies, I want to tell you what your temperature is inside your hive, and I also want to tell you what the humidity is inside your hive." It's weight, temperature, humidity, weight, temperature, humidity, weight, temperature, humidity. So there are a lot of folks putting these weight, temperature, and humidity sensors in their colonies. And all of this is good, but the ability to measure these things has outpaced the ability to know what they mean. So for example, I know if a colony is getting heavier, that's okay. But I don't know if a colony is warmer or colder by a degree, what does that mean? What do I need to do with it? So, unfortunately, the remote monitoring technology, the monitoring part has outpaced the, what do we do with this information part.

Amy 50:05
Right.

Jamie 50:06
And so from the perspective of remote monitoring, beekeepers need to know what these things that we can measure actually predict so that we can turn it into an action. So when I've got this weight, this

humidity, this temperature, this sound, this whatever, that I can monitor remotely, it's telling me I need to come do this to my colony. That's where we kind of bogged down. We can measure all of these other things, but it stopped short of saying, "Okay, so what do we need to do with this information?" I know that there's one laboratory, for example, in the US, that for a while has been trying to correlate the sound that colonies make with Varroa infestation levels or small hive beetle infestation levels. So that's great. In that case, colonies might make a certain sound when they've got high Varroa infestations, in which case, this sound equals, "I need to go treat my bees," or this sound equals, "I've got a lot of beetles." So those are actionable monitoring data points. But a lot of the data points that I see being collected in colonies, at the moment, aren't actionable. That's it, Amy, that's where artificial intelligence steps in. We measure all of these parameters and colonies, we give it to a computer and say, "Computer, here's the data point. Number one, here are the data points. Number two, here's the colony condition that we measure." Now, if you do that over thousands of colonies, collecting all these data points from the remote monitoring, and you feed in the colony had a queen, it produced lots of bees and had a little bit of brood, it had a lot of pollen, a little bit of pollen and so forth. You put all that information into a machine, the artificial intelligence can say, "Hey, when these things are being picked up on your sensors, this is what's happening in your colony." And that's the future beauty of remote monitoring. But we need artificial intelligence to decipher all that information to make the data that we are gathering actionable. And that's kind of where we are in that field right now.

Amy 52:12
Well, you've kind of already answered this, but I'll ask you anyway, what do you think the future is as far as technology and honey bees?

Jamie 52:19
Oh, Amy, I absolutely believe that someday there will be sensors in our colonies that do a lot of the work that a colony inspection is necessary for at the moment. So for example, I've had colleagues here at the University of Florida say that they can develop monitoring devices that will look for certain levels of very specific classes of pesticides, maybe like neonicotinoids or organophosphates. So when that pesticide comes through the entrance of the hive, that sensor will be able to point it out to you and you'd get told. So I'm absolutely convinced that someday there will be these chips, there'll be these sensors in colonies that monitor things that we can't even think about now. Right now, we're thinking about sound, temperature, humidity, maybe pesticide exposure, maybe queen presence, things like that. But I think, someday, maybe unfortunately, not in my lifetime, but I think someday in the next few decades, maybe, as fast as technology moves, maybe in my lifetime, there will be sensors that take away the need to physically work colonies to identify what the issues are. For example, they'd be able to count bees coming into a hive, they'd be able to measure pollen loads coming in, they'd be able to measure, by weight gain, nectar coming into the hive, and all of this information be assimilated and processed through these artificial intelligence machine learning technologies that are being developed to where beekeepers are sitting at a control board saying, "Oh gosh, five colonies in apiary A need to be addressed. It looks like there's a feeding situation that's necessary." So it still may require beekeepers to engage in the action necessary to fix the problem. I do feel like the diagnosis of the problem through sensing technologies is, quote, right around the corner. Now, some companies would say the fixing of the problem is right around the corner because there are these, we talked about

earlier, these robotic structures that you keep multiple colonies in and they don't only just sense the problem, they fix the problem. Maybe beekeeping, someday, will be sitting in your living room watching TV while occasionally checking the app on your phone. But I really feel, with the technologies, I mean, it's technology right? So the first iPhones were very expensive. Well, now, these days they're still expensive but lots of people have them, but the technology is there and everywhere. Well, I really feel like we're going to get there with bees, where there are these monitoring technologies in every hive, it's standard practice in every hive. Heck, if you can make self-driving cars you can make self-driving forklifts that will fork up the pallets of bees, put them on the back of the truck, and move them to almond pollination without you needing to do it. And before people are laughing that this is happening, I'm telling you, there's no end in this world to what science and technology can do. So whereas we may not see it in our lifetime, I definitely believe that, in the future, beekeeping will be a lot of remote managing of colonies. I just definitely believe that's going to happen.

Amy 55:20
Yeah, I kind of just laugh because this past summer, I was working with some commercial beekeepers harvesting honey, I've told this story before, it was so hot, and the boxes were so heavy. And I just remember being so sweaty in my car driving away, and of course, they have a relationship with a landowner there that, usually the farmer, they've got row crops, etc. And I just remember driving out so hot and sweaty and exhausted, and I look over and this farmer is just sitting in his air-conditioned tractor driving past me down the road. And I'm just like, I wonder when things are going to change as far as management practice with the beekeeping industry, and it's just so interesting, because what would it take for the next step to be able to make that happen for beekeepers, again, like you said, to sit in their living room or in AC somehow or have a self-driving forklift to be able to help with some of that stuff. So it's always kind of fun to think about.

Jamie 56:16
I tell you, it's so important. Beekeeping is incredibly labor-intensive. Incredibly labor-intensive,. You physically have to move colonies at ridiculous times of the day at night, you physically have to go into hives to diagnose what issues are so that you can treat whole apiaries or feed whole apiaries. And our industry is small so technology creep into our industry is slow. But a lot of these other agricultural industries, you keep mentioning farmers driving tractors, they are laying the groundwork for what will someday be an explosion of technology in our industry, that will unquestionably revolutionize the bee world. I'll give you one final example and I'll quit yapping about it. But 20 years ago, maybe 15 years ago, I was at a blueberry processing facility where the blueberry grower had this machine that would drop blueberries through a large tube, and on its way down the tube sensors in the tube could tell if the blueberries are ripe or not, if they were blue or green or red. And as those berries were falling, they would shoot jets of air to punch the unripe blueberries out of the system as it fell. And oh, by the way, as it fell, they were freezing the rest of the blueberries so that by the time they get to the bottom of the chute, all of the unripe blueberries had been shot out by air jets and the blueberries that hit the bottom were frozen.

Amy 58:04
That's amazing.

Jamie 58:05
Yeah, this was 15 or 20 years ago. Now, imagine jets of air knocking Varroa off of bees and hives. And I know people listening are going to giggle. But a lot of other ag is way ahead of us in this and our day is coming. So be ready.

Amy 58:22
All right, well, that was a fun conversation. I'm excited for some of the AI junkies to have input in this conversation as well. So if you have any questions or if you have any articles or whatever you want to share with us, feel free to do so by sending us an email or sending us a message on any of our social media pages.

Serra Sowers 58:43
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.