

Can we plant our way out of the pollinator crisis?  
A collaborative Research Approach  
July 23, 2016

**[0:17]** Great, we're going to get rolling. Thank you for spending part of your Saturday morning with us. We are running under about two hours on this, so about an hour and fifteen minutes just on the talk part but we'll hang out for the whole time to answer any questions you may have. First of all, I'll take any extra surveys if you have them completed. I guess you can give them to Nicole, back here. And first, I'd like to introduce our team: I'm Damon Hall, I'm assistant professor at St. Louis University in the Center for Sustainability; this is Gerardo Camillo, he's associate professor in Biology at St. Louis University; and we have graduate students with us who are – Paige Muniz, master student in biology; Molly Laycob, who is a master student in Sustainability; and Nicole Schaege, master student in sustainability. Um, what if we just go quickly around and just say your names, we can start with you on the end here, so we –

I knew there was a reason why I sat here. [Audience laughs].

Never sit in front.

My name is Ann High and I live over on the corner of Potomac and Sulpher.

Tom Nagel, I live on Arthur.

Christy Nagel, with him.

Dave Fernandes, we live by Chippewa and Macklind.

Donna, with him.

.....I live a couple doors up from Mom's Deli.

Okay.

I'm Deb Logan, I live on Maple.

[Audience laughs]

Bill Murray, a Lindenwood, a co-leader with Lindenwood Park Community Garden. We're on Smiley, or live on Mardell. My partner, Sharron.

Hey, I get to say that. [Audience laughs].

I'm Jenny, I live on Sunderland down from Mom's Deli.

Charlene, I live on Beck in the Tower Grove South neighborhood.

Great.

My name's Melody, I live on Humphrey.

Laura Hanneke, we're on the first long block of Arsenal.

...., I live across the street down about four houses.

My name's Mandi, I live at the corner of Bradley on Kimmel.

Great.

I'm Bill Wilson, I live on Arthur and this is Sophie, Sophia, she lives on...

I'm ... I live in the Holly Hills neighborhood and I missed the meeting yesterday but...

**[2:48]** No problem, welcome. Great, thank you.

I want to, as a way of asking why you're here I want to ask, was there some sort of 'ah ha' moment that you may have had about bees or about pollinators? Something that you heard or saw? What was your 'ah ha' moment?

When my tomato production went down.

Yes.

And other people agree with that?

Yeah.

I've noticed fewer bees this year. Like, especially in the spring some of the flowers that I had that they are normally on, I didn't see as many.

Wow. Yeah, I'm sorry –

Oh, I'm with them.

Oh, noticing, yeah –

I think it's just the accumulation of seeing stuff, news items about, about the problem and the hive collapse or whatever that hive problem. And you know, so you read it once and then you see it again and it just all of a sudden it's like 'oohhh.' But this might be something I could do something about compared to so much else.

Right, great.

And well that's really kind of my big reason for being here. I'd seen, you know at the Missouri Botanical Garden and in the news and so forth about the problems that the bees are facing but I always was kind of skeptical that in my little corner of the world I could do anything that would make it better. And so I've been trying to do some things. That's why I'm here, for more ideas.

**[4:18]** Great. We agree. There is something that can be done and we'll talk about that. Just get through the first ten minutes of gloom here. [Laughs]. There's a rainbow at the end of the storm. Uh, my 'ah ha' moment was when I was an undergraduate at Purdue University. As my full time job, I was a beekeeper and so my job was to manage one hundred and fifteen hives. I worked for a honeybee geneticist. And so part of my job in addition to managing these hives and checking for queens every week was to make sure that these hives overwinter successfully. And so I prepared the hives. I would make sure the enclosure was closed up so that no rodents could in and make sure the lids and everything were straight on it. And then we'd treat them in order to make sure they're healthy throughout the winter. And the first spring that I did that, I prepared all the hives, we had about ninety-seven percent of them came back and they were healthy and they made it through the winter. The following year, my second year on the job, I had to travel when we were to overwinter the hives and so my boss overwintered the hives, and prepared them. And then when I opened them up in the spring the following year, this was 1999, we had, or here's me, we had seventy percent loss. So, seventy percent of our hives died. [Audience thrills]. And so, you know,

a twenty-year-old, I thought well my boss has a PhD in genetics, maybe.... beekeeping. I should have done it. But that's really when we were just beginning to learn about colony collapse disorder, or the hive collapse disorder, and some of the other pests that were affecting bees and kind of the death by a thousand cuts affecting honeybees. Thirteen, fourteen years later I was at SLU and met Gerardo Camillo and it turned out Gerardo had done the exact same thing when he was an undergraduate student but at Texas A&M. Here's a file picture of him.

Oh wow.

**[6:23]** 1986. But what he found was that he never had that type of loss. Didn't experience the colony collapse like we were in the late nineties and early two-thousands. And so that was really an 'ah ha' moment. I since went on after beekeeping to study environmental policy and social sciences. Gerardo's still been studying entomology. And so, what we're going to talk with you about today is how we've been combining our most recent research to really try understand what's going on with pollinator populations in general. We can start. So you have heard kind of the, on the news the story of pollinator loses and of course we know the importance is really food security. One in every three bites of food we eat is from a plant, fruit, or vegetable that is pollinated by a bee. So there are a number of these images that show life with your breakfast with bees and your breakfast without bees. And then the value of U.S. crops that depend on these invisible services, or ecosystem services of bees, wild pollinators as well as honeybees, is 18.9 billion dollars. And this figure's a few years old actually. Here's another image, it shows your vegetable, fruit and vegetable choices, fruit choices without, with bees and then without bees. This is from Whole Foods. And then another stand here. With bees, without bees. And then this quote by Einstein, "If the bee disappears from the surface of the earth mankind would only, would have no more than four years to live," just emphasizing the importance of pollinators in our diet and our food security. In some places, pollinator populations have dropped so much that people are beginning to hand pollinate. And I know we've spoken with folks who are hand pollinating some of their fruits and vegetables because of the declines of pollinators but it's happening at a commercial scale. This is apples in China and then these are oranges in China. A lot of research has just recently been coming out about the extent of declines of wild bees and native bees. This just came out this year, the yellow shows the loses in declines and abundance, the amount of wild bees, and you can see where we are, kind of in between these large yellow areas. And if you know your agricultural geography, you know that this is why we have great produce in the winter and the fall. This is the central valley of California. Here are the apples as well as grapes. I know hops are up in here as well. Cotton, rice, and then the bread basket, and then I know there's lots of fruits and vegetables down in here as well.

Do you have the kind of a map for Mexico? Because I see a lot of our fruits and vegetables come from Mexico, at least during the winter.

Yeah, I –

Do you partnership with them? 'Cause that's a concern. That's where a lot of our stuff comes from.

We sadly, once you get to Mexico and Central America, the amount of research is very minimal. But I, from the anecdotal evidence I've heard is that they also have experience significant decline. And the United States, definitely Canada, Europe, so worldwide there's significant decline, yeah.

**[10:04]** So there are many causes of these loses of native pollinators. Number one is habitat loss. You have land that was once fields, that had flowers and now they've been transformed into some other land-use, if that makes sense. That's the largest cause. In that habitat loss as well, changes in agricultural practices. We've just become extremely effective at farming and extremely efficient to where now we

can, you think back to the family farm in the 1920s-, -teens, it looks very different than the farms of today, where there was a back forty acres and there was linear fence rows. Now, with the technologies we have we can farm right up to the fence rows in ways unlike before. Also, land use intensification, more acres can be put into production and so some of those areas that may have had say fence rows for milkweeds you know are no longer there, they're in production. Secondly, a large cause is the chemical industry advances. There's just been tremendous technological advances really within the past thirty, forty years that have allowed us to be more effectively, more effective at managing insects and pesticides as well as with herbicides. And they're always at our fingertips unlike any other time. And then the third are bee diseases and pests. And because there are species of bees that are treated like livestock, so honeybees and now even bumblebees and some others, leafcutter bees, because they get transferred around certain diseases and pests can be transferred as well. And that's just common with any domesticated animal really. And then fourth, there's a lack a flowers. Simply a lack of flowers is why there are declines in populations of bees. And then fifth, there are others both known and unknown and we've got many, many papers on just different causes that could be to where some folks have said, have called it 'the death by a thousand cuts.' So this is just an image to show habitat loss and some of the, just how recent this phenomenon is, the acres in grasslands, wetlands, shrub lands, that have been converted to crops by county. It was 2008-2011, so this is just a short period of time, very recent. And you can see in the bread basket kind of where we've had a lot of those loses, if you remember that earlier figure, I'll show it again. Um, these have been converted. And if you know something about that time period and if you're thinking about the grain belt of the country, anyone have an idea, like 2008, maybe 2005, 6, 7, you recall what was the hot issue in agriculture and energy?

Ethanol.

Yes, absolutely. Biofuels. Ethanol. Putting a great percentage of ethanol. That was a federal policy that allowed, I think it went from five percent to fifteen percent and then that encouraged different subsidies which just changes the way that we use land and that's just what happens when you have different types of policies. A second, so that's habitat loss, secondly, the neonicotinoids, there has been, since about 1992 there's been a brand new, entire class of insecticides that were never before on the market. Now they're on the market. They're nicotine-based chemicals, introduced in the nineties, systemic insecticides. So if they're systemic, meaning they go throughout the system, the entire system of the plant. And it can be coated on the seed and what happens is, is the insecticide is in the roots, it's in the vegetation structures, in the leaves, it's in the flowers, and it's in the pollen and it's in the nectar. And it's highly effective, it works very well. If there's a pest, it bites the leaf, bites it and then it dies. But what we've also found is that the insecticide is persistent in the nectar and the pollen, so when the bees collect the pollen, take they nectar, they are not killed outright but they are weakened. They're immune systems are weakened. And recent papers have come out that have said there is an addictive quality to this neonicotinoids and so they keep returning to it. As you imagine with a nicotine-based - So, 1990 no one had heard of it but now one-third of all global pesticide use, insecticide use, is one of these classes of neonicotinoids. So we went from zero to one hundred very quickly. This is from a paper from Dave Goulson, "Wild bees and specifically solitary bees may be more, much more strongly affected than domesticated honeybees," so that's something of concern for wild and native bee populations. In fact this chemical was banded by the European Union in 2013, even though the world's two largest producers are European companies. So Syngenta which is Switzerland and then Bayer from Germany. They still banded it. So you can see the increase this figure, this graph here shows the increase in use on different type of crops. So really, 1992-1993 nothing. Then 1994, vegetables and fruit, uh but then you can see that it started in cotton, then orchards, all of these are bee dependent with the exception of corn and grapes. But, pastures and hay as well, very important. This is from the US Geological survey, 2016, they monitor all the pesticide use for

water quality. Their concern, their focus is on water quality. If you look at this, how widespread this usage of these new class of insecticide are, I think these maps kind of tell the story. So this is 1993, you know nothing, 1994, it started with the apples right, some of the cotton and rice, it's the same down there. Here's where we are and then here's where Perdue is so you can kind of see what was happening in the world of 1999 and 2000. Then 1995, a lot of folks began, this is the Central Valley right. '98, '99, 2000, 2005, we skip a few years, 2010, and then this is 2013 data, the most recent data they have. And so you can see that. If we put back the image of again the bread basket, central valley, apples, if you put back this image with this and kind of talk back and forth, you can begin to see you know maybe there is some correlation here. We have high use of these brand new chemicals, that probably weren't tested on honeybees and bees, and we see some declines with that. So, that's a part of the issue of the declines of wild bees. There was a map generated by the same authors of this paper that took the most wild bee-dependent crops and they mapped them with declines and then they identified counties most at risk of losing their bee populations. And so those are in the darker red. But you can see, these are the, whatever products are coming, agricultural products are coming out of these areas, these are at risk because of the loss of wild bees. And so we are kind of in a unique position and I think that's really the hopeful part of what we're talking about in our research and what we're doing. So how does this affect you at home? Prices of food will rise and they have been on the rise slowly. So here are almond prices and you've probably noticed this in buying almonds, just a steady increase. Almonds are pollinator-dependent, in this case wild bee dependent but also honeybee dependent and their prices are raising. But this is not just for fruits and vegetables, it's also for meat. So in feed of alfalfa, so the alfalfa bee is the dominant pollinator of alfalfa throughout the country and if you go out through upper western, like in Montana, you'll see these bee houses, they've got for alfalfa bees. But that price as well has been steadily increasing over time and so this affects the price of meat as well, so oh boy. It's become an issue, it's been getting national and international attention. Time magazine has a cover story in 2013, the inter-governmental platform on biodiversity and ecosystem services which is a bunch of governments coming together with their lead scientists trying to figure out large-scale problems. The first report they put out just a few months ago was about pollinators, pollinator declines, so that's what they prioritized. There's been a national strategy. June 2014, the White House got together all the land management agencies that could do something about this problem, so the Department of Transportation, U.S. Department of Agriculture, Environmental Protection Agency, the Department of Interior which has national parks, and land management, got them all together and said we've got to figure out what we can do. Strategy was released in 2015 and then just last month they put out an action plan. So we see our work as informing that and being informed by this as well. So, really what our question is and the basis of our research is, can we plant our way out of this pollinator health crisis? We know it's a problem, what can we do about it? And what roles can cities play? And this may seem like a funny question but this will become clearer when Gerardo talks. How can we develop communities in ways that add bee habitat? Is there a way that we can develop housing projects or even neighborhoods in a way that's strategic for bee habitat, that increases the flowers? And this project seeks to test all of this at a very neighborhood small scale. And so, with that, here's the outline of the workshop. I just introduced the question of what we're going to talk about. Gerardo will talk about the research, bees of St. Louis, as well as bee biology 101. Then Paige will walk us through that card, the bee identification card, and talk about bee identification. And then I'll finish up and we'll talk about this study itself and what we think can be done to address this crisis.

**[21:01]** So, uh, so I don't know if you've seen me in Lindenwood Park or Pernod, I'm the grown-up man with the little...[Laughs].

Is not a fishing net either.

No, it's very, very thin mesh. And so, I, as Damon said, I've been working with insects for a long, long time. To the point that my mom is hoping I outgrow that phase....So, myself and my students, we've been collecting insects and now specifically bees all over the city. We've collected in city parks, we have collected, you know we have start then switch a very specific emphasis to community gardens in 2013 when we realized that, that's where the action was. And also been looking at urban farms, so these are larger, so these are much more intense. And the purpose of these of course is to sell produce at you know farmer's market. We've also been looking prairie pockets, and these areas that have been freely established with native wildflowers. And now more recently, this year we're also looking at the role that vacant lots have, specifically in the north side of the city but also in the central corridor. So, how do we go around doing this stuff? So I have literally an army of undergrad students during the summer. We get in the lab, we have to organize you know which teams will go to which place. Each team will hit anywhere between two or three different locations each day. When you hear 'busy as a bee,' that's a big lie. Bees keep bankers' hours, okay. A bee, a bee doesn't really come out until ten in the morning. That's like ten fifteen. By 3:00 they're done...if it is cloudy, I'm not going out today. And there are many reasons for that but that allows us to follow them very, very efficiently. So we go out, you go out with the nets. So this is EarthDance farms out in Ferguson and you know, you see that even though this is a working urban farm, they have many areas where just like weeds and plants grow wild. We will sample many, you can see total urban setting. We get in one location, we spend anywhere from half hour if a small community garden to two hours, out in Ferguson. We collect the bees. They come into these nets, they are very, very fine mesh because some of them are really, really tiny so they cannot escape. And then we put them in a kill jar that has a chemical that kills the bees and it's part of the reason why I am part of the collapse. [Laughs]. No, at any one time we only collect anywhere between twenty and one hundred bees depending on the size, it's not that many. But you can see there are all these various urban settings that you really do not suspect should have a large diversity of bees and large abundance of bees, especially when you consider traditional agricultural areas. So you come back into the lab, we then have to sort the bees and pin them and identify them and put them into appropriate trays. Then, we spend a significant amount of time looking at the bees under a microscope and identifying them, measuring them, so on and so forth; all the good stuff that we scientist like to do. And at the end of the day you end up with essentially, you know something like this in which, for example, these are bumblebees. Every single bumblebee that you see in this try is just one species of bumblebee. So I know which bumblebee came from which garden, when. And we've been doing this now for, going on our fourth year. And you start looking at these numbers, you start looking at this species list, and you start realizing, oh St. Louis has a lot of bees. Much more so than the surrounding suburbs and much more so than the surrounding agricultural areas.

That seems backwards.

**[26:07]** Totally, because that's not what I learned when I was taking ecology as undergrad, you know, thirty-five years ago. So you're like scratching your head, what the hell is going on? And then I start talking to other colleagues that are doing similar work, you know, in California, Frankie, my current post-doc now Rebecca Tonietto in Chicago. Colleagues you know in New York, San Francisco, Phoenix, and then we start expanding and realize that Europe is in the same boat. Literally, all of England is in the same boat. A large...in their cities, not in agricultural areas. We've seen the same thing in Australia, in Latin America, in Canada. So we're like literally itching, scratching our heads, what the hell is going on? Cities

then are becoming a refuge for bees. So much so that now we're thinking that if we start changing you know, as we start putting bees a higher priority, cities may serve then as a source for recolonizing agricultural areas. So in order to get a little bit further, you know how come we have all these bees, one of the things we have to do is figure out what is a bee and what's role? Okay. So bees, you have heard that bees are pollinators. Okay, well what the heck is pollination? Pollination, no ifs, ands, or buts, is the way that plants have sex. It's nothing else than that. And you are trying to move the male cells which are called the pollen to the female part which are the stamens, so basically moving in the eggs, moving the pollen from one to the other. The easiest, the simplest way to do it is by wind. So you get the male flowers who use hordes and hordes of pollen, and this pollen is very, very thin and ... and you put lots of pollen to here and some of it by chance will hit a female flower. Oak is the classical wind pollinator. You know back in April, you can come out to the car and you'll see that car yellow sheen all over it, that's oak pollen. It's a classic. But that is tremendously inefficient because you end up with a lot of your pollen on people's cars. [Laughs]. It's not going to do any good there. So, there is something that is called directed pollination which you take a ... of a species and you take that species ... from this flower to this flower. You don't need to produce as much pollen and you ensure that that pollen gets there. And that's what we call animal pollination and there's a whole host of ways of animals that do that so that plants provide a reward which is nectar and the animals ... as a vector moving the pollen from one flower to the other. And we have classical pollinators being butterflies. Regular flies are pollinators. Birds, bats, and of course bees. And when you look through the, through nature, you see that you have flowers that are you know very specific for bats, you have flowers that are more specific for birds, they're called syndromes, and you have many flowers that are specific for bees. The bulk of everything we eat that requires a pollinator, is a bee pollinated flower. Very, very few things that we eat that are not bee pollinated. And of all these critters, bees are the only one that will intentionally and delicately collect pollen. Everybody else is just happenstance, it's just chance. Bats are a classic example. I work with pollinating bats in the tropics, this bat you can see has a very long tongue to lick the nectar. But when they go in there .... You get a face full of pollen and you can see that bat is like 'ahhh,' I mean who wants to go there? It's like me taking a big pile of flour or something and just blowing it in your face, I mean that's not fun. You get it in your face and then the bat is like scraping it. And then it comes over here and it moves it to this flower and then the same thing happens and you exchange the pollen. So it's not fun for the bat and it works more or less okay. Alternatively, these critters are the only ones that intentionally collect pollen and move it to another flower. Therefore, the bulk of pollination in nature and more specifically in agriculture is done by these critters. And of the bees, only the females are the ones that collect pollen and you know why? You can see this leg has all these hairs over here, the whole purpose of all those hairs is to gather the pollen there. You can see much better. So this one is from St. Louis, this is called a Sunflower bee. You can see also in there; you can see that that is just solid. There are probably tens of thousands pollen grains there. Bumblebees have a slight variation of that in which they gather the pollen through these little pockets, other ones will do it all over the place but bees are the only ones that can do it, and only the females.

**[32:29]** So, one of the big questions I come around all the time is, well how do bees know where to go and how do they see? Well, most bee pollinated flowers, when you put them under a UV light source, it looks like a aircraft carrier in the middle of the night. They have these landing patterns, these landing bands, that say, 'ah this is where we go' and they go straight into that flower. And it's because it reflects that UV light. Therefore, flies, I mean bees, they see in UV light. They don't see in regular light. So like in this room, this room would literally look completely dark to them because there is no UV light, not much UV light here. That's why they don't come out until the sun is high enough in the sky so you get the reflectance. And by the same token, they use, many bees use the sun, the angle of the sun in the sky to fly around, to orient themselves. And that's a good one. Uh, alternatively most bees will spend the bulk of

their life in an area about the size of this room. In fact, many of them, they are really teeny, tiny ones, they have a nest on the ground next to the plant that they like and the fly from the nest to the plant and that's it. So they'll spend their life in an area this big. Some bees, uh, the bulk of their life, they spend it in the shape of the larvae or pupa, and then they emerge as an adult. Some live as short as a week. Some may live as long as four or five weeks, as an adult. There are some of the time, there are larvae or pupae in the ground or in the nest. What are, so this something that you'll notice, many of your tomatoes were not emerging. You would see that by this time a lot of your tomato flowers don't look yellow and bright anymore, they kind of look cream color and they start to look shriveled like these. Or your pumpkin flowers, they go like that, you know and they start getting, they call senescence, ageing and getting old flower. The flower goes like this and starts drooping. No its not, people think 'oh, I'm not watering enough.' No, you're watering plenty it's just that your flower is not being pollinated. And that is something that as you'll notice with the tomato, other people have noticed with the pumpkins around the city. But this is a very serious issue because as these things start decreasing in abundance their prices of course increase as a matter of supply and demand.

**[35:36]** Okay, I have a question on the frequently asked questions. Can you talk about the effectiveness of pollination, like native bees –

Oh yes, thank you.

I was just thinking the same thing.

So, so, so one bumblebee, and again going back to the fact that bees are lazy critters, a honeybee is the ultimate jack of all trades. The honeybee is like an average sized bee, is an average pollinator, but it can pollinate hundreds of different kinds of pollinators. Alternatively, when it comes to tomatoes one bumblebee is the equivalent of forty honeybees. A honeybee, a bumblebee can actually come into the flower, it will buzz it, and when it buzzes it the flower where the anthers were, where the pollen is, those anthers just burst, so in a fraction of the time. So many times you may not see bees in your tomatoes but you're getting tons of tomatoes, it's just that a bumblebee is just coming 'bzzz, bzzz.'

Yeah, I've noticed in our community garden bumblebees are the pollinator of the tomato plants. You just walk around and look at everybody's tomato plants, that's what's working it, it's not the honeybees.

We have a neighbor down the alley who has three hives I think, or four, how far do those bees go?

So honeybees can go potentially up to two miles. Most of the time they are within half a mile to a mile. Now, it all depends if there is plenty of resources nearby, they'll stay close. If you don't have too many resources they really go far out. One of the issues we have in the city is that you might have a neighbor that has three or four hives and then somebody two blocks away doesn't know they have a neighbor that has three or four hives and they also put two or three hives. And basically there's not enough food in that area in-between. They're competing against each other.

Is there a way to collect that information? Or to help people?

The best thing is to attend the St. Louis Beekeepers' Association. They keep track of where the hives are and how many because that becomes a very serious problem.

This is a Mennonite couple and it could be where they worship down in Frederick town maybe, that people talk down there too.

Yeah, there's a bee hive right outside the window.

Oh yeah, yes. Just outside, I've seen them.

I have another question. This is more for the nerds in the room. Why do, could you talk about the nutritional value of pollen and why bees collect it and how they use it?

Okay, so, so, especially Paige will talk a little about generalists versus specialists. But when it comes to honeybees, honeybees are like us, we are omnivores. Not only are we omnivores, we need to have a very wide range. I mean you need to eat your fruits and veggies and you need to eat your meats and dairies and grains, and so we have this very broad range of nutritional requirements. And honeybees are very much like that. Honeybees require pollen and nectar from different kinds of plants because some pollen will provide some vitamins but other pollen will provide different kinds of proteins and then some nectar will provide some Vitamin C or whatever. So they need to have this broad range of different kinds of pollen in order to have, to be healthy. And one of the things will happen when you only plant corn for thousands and thousands and thousands of acres the only pollen they have is corn pollen and corn doesn't provide any nectar. So, you know, when you're eating – there was a great experiment back in the nineteen-teens in Mississippi in which they told prisoners that if they joined this experiment they will get their sentences cut in half. All they had to do is eat corn for breakfast, lunch, and dinner for thirty days. By the middle of the experiment, I mean something like 150 of them signed up, by the middle of the experience most of them have dropped out. Only two inmates made it to the end of the experiment and within a week one had died.

I was going to say, how sick were they?

Horribly sick.

Malnutrition.

Malnutrition. Malnutrition. So the same thing happens, when a bee is eating only one source of pollen, one source of nectar, the same happens, their health drops tremendously. So that's why we need lots of different kinds of flowers. Okay, I'm going to let Paige take over because this is definitely her expertise is much greater than mine.

Now the fun begins folks.

**[41:17]** So I'm just going to go over a little bit of identification, some fun facts about the, our Missouri native bees and wild bees, and how to identify a bee, what's a bee compared to a fly, bee, wasp. So bees and flies, as you can see here, this fly actually mimics a bee. One thing to look for, is the wings. So flies have two wings where bees have four. And sometimes you think, 'oh how on a flower how am I going to notice?' But you can kind of see how they stick up, they stick I guess just straight up from the body kind of on a fly. They just kind of go out like this. Where bees tend to have them like this or up like this. And flies will do this. So that's one thing when they're around, if you're watching them on a flower that's one thing to look for. Also, the noise they make, they make, flies make a very high pitch buzzing sound, 'bzzzzzz,' where bees are more like, 'bzzzzz,' so that's one thing. Also, the antennae. Bees have these really elongated antennae whereas flies don't, they have these little short nubs on their head. And flies, the term bug-eyed I'm pretty sure comes from flies 'cause their eyes are just huge. And bees you can see are more slender and more to the sides of their heads. Again, bees collected pollen intentionally so they're going to, so the females will use it to go to the pollen where flies, they may have a couple of pollen grains but you wouldn't even be able to see that if you're just watching them on a flower. Now wasps, wasp are little, I'd say a lot, you definitely can tell wasp from a bee I would say. Wasp are very slender, they have this little waist here, this thin little waistline. That's one key sign of a wasp. Where bees are more round

and robust. Again, wasps do not collect pollen so they are very, pretty much hairless all around. They may have a few hairs on their body but up here, on this part of their body here, but nothing on their hind legs. Where a bee would have a ton of pollen and a ton of hairs there, so. So this was, this is a representative of my 'ah ha' moment of being interested in bees, was just looking at the diversity that's out there. There are a ton of different bees, they come in different colors, shapes, sizes, they're fascinating. Here I'm sure some of you have bee blocks for the orchard bee, this is what the orchard bee looks like, not this big unfortunately. [Laughs]. So, in the United States we have, or North America, we have roughly 4400 different types of bees. The honeybee is just one species, it's just one type. Everything else is a different kind of bee. And that's a, so when you say honeybee, so the Africanized honeybee, the European honeybee, that's there, they're essentially listed as the same, well and they haven't go to Missouri yet. Missouri, we have a 450 different types of bees and in St. Louis, a round of applause for St. Louis, we have 150 of those species and we're still counting. So that's pretty amazing. So when I was talking about the different colors, shapes, and sizes, this is just a fun photo of the largest bee in North America and the smallest. This bee here is the Carpenter bee. So it's this size. So that tiny little bee up there just fits, right there. We don't get that little one here, that's found in southwestern United States but it's just a pretty neat picture. So, bee basics. When a lot of people think about bees, they tend to think about these big colonies and honeybees and bumblebees and the queen and worker system, but our bees are actually, 99% of our bee species are solitary bees. So what that means, is that it's one female to the nest and she lays her eggs, eggs develop into adults, they fly off, the newly emerged adults fly off, so they don't stay. Where the social bees, like the honeybees or the bumblebees, the queen will go out forage, lay her eggs, they emerge as adults, then they do the work and they come back so that's the worker-queen system. Also, they don't live in hives. 70% of our, so the solitary bees don't live in hives and most of them live in the ground, so you just have these little holes in the ground. And further down in the presentation you'll see different slides of, different images of the, what their nest look like. But in the springtime you can kind of see them out in your yard and going in and out of the grass and you think they're just little flies but if you get down you can see that they're little bees.

**[46:32]** So again the lifecycle of a solitary bee. Overall, from the egg to the adult stage it's about a yearlong so you'll have bees that will overwinter as either larva or as adults and then they'll emerge the next year and start foraging. So the female leaves the nest, she starts foraging, and the main thing about why they're collecting pollen is because they feed that pollen, that's what their larva eat, is the pollen so that's why it's extremely important to have pollen resources for the bees because they have the bees for the next gener- or the pollen for the next generation. And that's solitary, so for all bees. So the adults will leave the nest and they'll find their own next and kind of do the same cycle. And on average they're out for about four weeks as adults throughout the year. And solitary bees especially, you'll see some groups of bees will be out earlier in the year and some different types of bees earlier in the year and later in the year so it's extremely important to have – when you plant a garden you want to plant for early spring and then late fall flowering plants to provide all those resources. So, here's some examples of solitary nests. They nest in a variety of ways. Some are more like, like an apartment building. They all have the same entrance and then they kind of go off into their own little cells. Others will have more like a little neighborhood, or they call it an aggregation, so each has their – they all live together in the same area but they have their own entrances.

Is that the picture from Mallinckrodt?

No, no, yeah. They all have their own little houses there. And this one is just one female, right there. Then you also have the cavity nesters. So this is where the orchard bee would live, carpenter bees, everyone's favorite, and another type of carpenter bee, the smaller carpenter bee, they also because they're smaller

but they also dig out the pit of the plants. So the lifecycle of a social bee. Social bee, as in bumblebees, honeybees are just so unique they are not like anything else, but other social bees, bumblebees. So the female will emerge in the spring and she'll emerge, she starts collecting pollen. So it's really important to have pollen resources for her. She's already been mated, emerged, collect pollen, find a hole in the ground or even above ground at the top of a tall grass area, lay her eggs, and put her pollen baskets there, and then once her eggs emerge as adults, they fly off and they start doing the work and they keep reproducing, or producing the next generation after generation. And then at the end of the year, the queen, the new queen will go underground and a lot of times they will overwinter in old rodents' nest, so yeah. And she'll wait there until the spring and come out, so. And their lifespan, you'll see bumblebees out all year-round but there are different types of bumblebees that will be out at different times of the year. And a queen could last a full summer, so. And here is an example of a nest of social bees. So here, honeybees, this is just a cavity in a tree. So here's an example of an old rodent nest. Grasses or in the ground. If you, at the end of the, when the leaves start falling off the tree it would be a good thing to leave, just a little portion, just a little area of those leaves in part of your yard if you can. Or maybe get one of the neighbors to allot part of their yard for that because a lot of times you'll get them nesting in the leaf piles. And then here is a bee that nested in a bird house at my parents' house. So also if you, my dad used to always like to take the nest, the old nest out of there after the bird was done, but now he doesn't because we realized the bees will actually nest in there. And this is Beatrice, we named her Beatrice. So again bumblebees, are social bees. These are, can be very confused with Carpenter bees because they're roughly the same size, they're black and yellow, and big. But the key thing to look for is the abdomen. On a Carpenter bee, it's super shiny 'cause they don't have a bunch of hairs there. A bumblebee is, looks a matte coloration because they have a lot of hairs on their abdomen. And the abdomen is this part here above their butt you could say. So that's one thing to look for. One thing to do, I know some people aren't big fans of dandelions, but especially the early queen springs, they love dandelions so that's a good nectar and pollen source for them. Oh, what else? Oh and menara, so bee balm, they love that. That's early spring. And penstemon, so beardtongue, they like that. Carpenter bees, again these are the big ones and we have the small one, this ..... here, the small carpenter bee. These ones will next in your deck and a lot of times people are really scared. They're like, 'oh my gosh, they're like termites.' But again they're solitary, so they don't live in big colonies and their nest, the hole is probably about this big, eh more like that big, and it's I don't know, roughly that deep I'd see. She lays about three eggs in there, so maybe about that small. So it doesn't go very far. A lot of times the next generation will reuse the nest or a different nest, so they're not drilling a bunch of holes and going through the deck like termites would. This, the little carpenter bee, that's about the size of my pinky fingernail, so it's a lot different size than the carpenter bee. So those, if you have a blackberry bush I recommend cutting it back at the end of the year if you already don't because they will, they tend to overwinter there and then they make their nests in those type of bushes throughout the year, in twigs. And also, the carpenter bees can come off as being aggressive and very scary if they're out on your deck. Especially I've noticed in early spring, the males, you can tell a male from a female because the males have this yellow patch on their face and I don't know if you can see it now but we have a ton you can look after. But the males kind of have this little, they come out and they do this, and they kind of get in your face if you're out on your deck. They're just looking for a female. And it's kind of funny 'cause you'll watch them do that and then you'll see a bird fly by and they'll just go after the bird, they don't know the difference. You can take a pebble and toss it up and kind of play catch them. And males don't sting. So, yeah, exactly. They seem scary and aggressive when they're doing that but you could catch it as long as it has the yellow on their face. So these are a fun group, leafcutter bees. These collect pollen on the underside of their abdomens here, so instead of having the hair on their hind legs they have these hairs on their abdomen here. They will, as the name suggest, cut portions of the leaves out. So if you see anything like this on the sides, you know a leafcutter bee has

been there. And they don't do, again they're solitary so there's not a huge colony of thousands of them coming and chewing up your plants, you know. But that's also one thing to think about. So they cut these leaf portions out to line their cells with. So a lot of them are cavity nesters, so in twigs and well, and you can see her taking in that leaf in there because she uses it, she kinds of chews it up and plasters it on there. And so that's one thing to consider when you're using, when you're spraying chemicals on your plants is, you know it could potentially have an effect on those nests. And this one is a wool carder bee. If you have, and this is, she collects these little hairs off of the, if you all have lamb's ear the little fuzzy plants or any type of fuzzy plant she collects those hairs there and you can see a line, and she does the same thing, lines the nests. So and that's just to keep out different fungus and different types of pests. Yeah, and then you can tell if they've been there because they'll have these little tracts on the leaves of just bare hair, little thin lines. And also the male of this species does the same type of thing that the Carpenter bee does. He'll stand around those lamb's ear and he'll knock off other bees that are there and go after them, so.

**[55:45]** I have a question and you may have said it and I didn't catch it, but the leafcutter bees, is there a particular leaf that they go after?

Not that I know of, now. I mean, yeah, nothing in particular. I know in Turkey they have certain flowers that they particularly like to use on their nest cells, but here no. so here are the digger or mining bees and as you can probably imagine the digger bees generally nest in the ground. One thing to do for these bees are that they usually come out very early in the spring so plant apple trees, or any type of flowering trees, early flowering trees. They did at Mallinckrodt this year after we told them and we already found I think three, we added three new species to their list this year just because, and they just had these little trees there that are flowering. And one way to identify these, a lot of times they look like honeybees, but one way to identify them on the flower is that they have these hairs that stick up and they're usually dusted with pollen. Where the honeybees and the bumblebees they have that wax-like structure there, it looks more like a ball of wax. And also they make this C-formation on the plant when they're foraging and honeybees kind of just go out straight where these make more of a c-shape.

So like redbuds and Bradford's pears, and those are all good ones?

So these ones are really robust, fuzzy bees. I love this group because they have these, a lady yesterday described them as saddlebags on the side, and they're these huge, fuzzy hind legs. This is the sunflower bees, a lot of these, most of these are specialists on sunflowers. So what that means is that they'll collect pollen only from flowers that are like the sunflowers. Where the honeybee and most bumblebees are generalist, they'll go to any type of flower to collect the pollen. And one way to identify these is by those really robust hind legs. And the males, they're called longhorn bees because they have these super elongated antennae. Also, males of all bees tend to just buzz around really quickly. They'll just go like this around the flowers, you can barely see them, and then they'll stop on one for a minute and that's when you can just the long horns, but after that they're just buzzing around. And these tend to be a little bit larger too. Squash bees, this is fun. They're called squash bees because they only collect pollen from squash plants. And if you have squash plants, you'll notice that the flowers kind of close like this. Well, even today when you get home, if you have them, go in and open them up. A lot of times you'll find the bees inside and generally the males because the males will sleep in there and they'll sleep in there at night and during the day they'll stay there and wait for a female to come in.

**[58:53]** I have a question. Like specifically about these and the sunflower bees. I don't know, it's just not making sense to me. So, they need it at all different times. But around here, sunflowers are only going to start blooming like now, what have they been doing for? Are they somewhere else?

So they're not out yet. They're still underground.

Oh, so there not even – okay.

They're not out yet. Yeah, so that's why it's important to have a variety of flowers throughout the year. Like the early spring bees, they're, some of them are only for two weeks in early spring and –

Oh, so they each have their own time period too. Okay, that's what wasn't making sense to me.

Yeah, exactly. Where bumblebees are out and honeybees are out all year around, and carpenter bees, but a lot of the specialist bees are only out when their host plant is out.

**[59:44]** So we just planted some sunflowers today and this week so they'll be ready in mid-September so they'll be a fall-winter food supply for them.

That will be perfect. And you should probably see the squash bee, a lot of the long-horned bees there, bumblebees for sure. So yeah, check in your squash plants to find these. And again, I didn't mention this but the males of all, other than the honeybees because honeybees are just weird, but the males of all other bees they don't go back to the nest. So it's important to provide an area, like flowers for example, because they'll either sleep inside the flower or if you have a coneflower for example, they kind of go like this, they sleep underneath. Or if you have tall grasses it good because they use their mandibles and they latch on and that's where they sleep at night. And also the tall grass is good because don't really know when a random rain storm is going to come. So it's good, I love the prairie dropseed because it's a pretty grass and it provides a nice little umbrella. I've seen especially bumblebees and I say especially bumblebees just 'cause they're really obvious to see going in, but they'll go in there during a little rain storm to hide or underneath the coneflower to use it as an umbrella.

What's the name of that? Dropseed?

Prairie dropseed.

**[1:01:11]** So it looks like with bees, the primary method sensor if, are their eyes. I mean you say they have antennae but do that use them in any manner to sense?

Yeah, so if you – it's hard to see. I've not that –

They don't have smell do they?

They use their antennae.

They smell with their antennae.

Yeah. And so if you– and for feeling. They use their antennae for a number of things. But if you ever see the bee, if you could see them in slow motion. If you have a camera, you know just snap some pictures as they're approaching the flower because the first that's going out are their antennae. They're sensing, you know smelling what's there, feeling how close it is, so. And also they have their eyes on the side of their head and they also have these three little eyes, they call them little eyes, here and that's for sensing the light.

Okay, so they're getting a depth perception with their eye vision to the target they're going to?

No. [Laughs].

With their, with their–

They cannot perceive that. Think about it like if it was like a string.

Two-dimensional.

So that's why you want to plant a patch of flowers because a big patch can reflect a lot of UV light.

So they're doing the UV light reflection.

UV light reflection and that brings them to— so you say 'Ah! We have flowers here!' And then they can see the landing pattern but the question is where to land. That's the antennae. 'Cause if the flower has been pollinated it gives a different smell than when the flower is ready.

So how much UV radiation is getting reflected from the flower? Does it depend on what the source is?

On what the source is and how cloudy or clear and how high the sun is.

You've just given some students a project. [Laughs].

**[1:03:04]** There you go. So these bees here are called the masked bees and the polyester bees. Polyester bees, these are the ones in the early spring that you can see if you just take a lawn chair out on your front yard, sit down or sit on the ground, and you'll see all these little things going in and out of the ground; in and out in and out. And you'll think flies, but if you could get close to it they're actually these little bees going in and out; they nest in the ground. And they also use a lining. They have a secretion that they use to line the nest cells, that's why they are called polyester bees. These masked bees here, these ones love dill. I've seen them, I feel like that's one of their go to plants is dill. These ones look more like wasps. They're super small. They're probably— yeah this is a good, yeah you can see that. They're that big. By super small, I mean super small.

Holy cow. Oh my gosh. That's like a tick!

Yeah, tiny. But you probably wouldn't be able to see it anyways, but they don't have pollen collecting hairs. They just actually collect the pollen in their crop like a bird would store their food. But one way to notice them they have these really distinct masks on their face. This is a female, she has two little lines and the male would have this center portion, like the carpenter bee, covered. Sweat bees, these you'll find all year round, they love all different types of plants, generalists in this area. They are solitary and can be social. Super small, again this is actually a sweat bee but you do get the metallic green sweat bees which are beautiful. We have some over there. This is a picture of a male. The females are actually all metallic green. And, again you'll see these on a number of different flowers. And a lot of people think, you know in the summer they're, 'Oh I don't want to go in the yard and sweat too much or I'm going to get stung.' The only reason why you get stung is if they land on you and you hit them. You know if they're— they're going to sting you if you hit them because you're squishing them, right? But this is actually a photo of my husband, and he has— this was taken a couple months ago at Tower Grove Park and he's— a little sweat bee came and lapping up some sweat and then she went on her way. So just let them sit there and it's kind of fun to watch them. They're actually really, really cute if you can see them up close. [Laughs].

You can tell she loves bees.

Yeah, I do.

These are called cuckoo bees or cleptoparasitic bees. So these don't even look like bees, these definitely look like wasp and that's because they actually don't collect pollen. So the name clepto kind of gives it away; they steal pollen from other females so these are very, very opportunistic bees. They hang around

outside of the nests of other bees and they'll kind of wait for the female go. Watch her all day, working hard, going in and out with pollen loads and then once she goes out again, this female will sneak in there, lay her egg and either kill the egg of the other female or when her eggs develop into larva they will kill the egg and then eat the larva, or eat the pollen load. So very opportunistic bees, but they look like wasps as you can see and they fly really low to the ground. And unlike, a wasps or flies, they kind of go like this. Just 'bzzzzz,' just buzz around 'cause they're kind of controlling the area. I described it yesterday as like watching a kid play with a remote control helicopter low to the ground or something, but yeah. They're also very beautiful, their different colors. Yeah, so stinging bees. We're out in the field five days a week. We use a net and when I say we use a net— I did this the other day, there was a big group of, I think a big group mint and basil and all sorts of other herbs and tons of bees flying around on a super hot day. So I just took the net and went like this, just to collect as many as I could, and I probably had at least thirty bees in the net and none of them— you would think if you're swatting like that you'd just get swarmed and get attacked. They, they're only out to collect pollen and to get nectar and find a mate. They don't care about, they're, you know it wastes so much energy for them to come sting you and it wastes time out of the day. The only time, I've been doing this for three years now and I've got stung twice this year. I think I'm just getting to comfortable with it but it was because I had one in the net and I didn't see it and I went like this and she got me. And another time I just caught with my hand. I just wanted to see what kind it was. It was a female. [Laughs]. Yeah, so only females have stingers, males don't. And there was actually a study done in 1997 that looked at the emergency room visits for bee stings and they found actually that 90% of the bee sting visits were actually due to wasps and other things, so not bees. Anyone have questions? Yes.

**[1:08:20]** Okay, I'm allergic to all of them. I've been tested from getting stung and having hives years ago. Luckily, it didn't hit my wind pipe. And I haven't been stung since. I garden all the time and I knew that about them coming out late because once I see them coming by my— but they never bother me but then I go it. But my question is, the wasps, is it okay to kill those? [Laughs].

I mean you could.

Now, they scare me. You know, I'll get my husband to get— I think there's a nest somewhere, find it and get rid of it because for some reason they seem more random to me.

Yeah, they are more aggressive. Especially if you have them, like right about your— a lot of times I know they like to make their nests right above your front door. Very convenient for both parties. But yeah, and I've seen them down and people see them because you're right there, you know. So if you're allergic I'd probably suggest it.

So what is the purpose of wasps? What do wasps do?

Wasps are actually beneficial insects. They're considered beneficial insects like bees because in the garden they'll just eat a bunch of pests.

Oh, okay.

So it's like a whole, yeah, it's a whole system in one little garden.

So they're kind of like hawks.

Yeah, exactly.

Oh, that's a good way to say, yeah.

A couple of years ago there was this beautiful sweat bee that I was about to swipe but this giant wasp just came up and went [mimics wasps noise]. I'm like looking at the little, tiny, beautiful bee and this giant, it was a hornet but it just came down and just grabbed it and kept on flying.

Yeah, is that the kind of wasp? But that's actually what I'm— There were five things. There were three kinds of hornets and maybe two kinds of bees that sting, that I was when they tested me. But maybe I'm not allergic anymore. I don't want to find out.

Hornets, hornets are of the entire group, hornets are the most aggressive.

And other ones when you're mowing your lawn, and you know people are like 'oh I got swarmed by bees,' it's not. It's cause, bees that—

So do I have hornets in my yard too? I don't even know what a hornet is actually.

I mean they're real big wasps.

It is a wasp that is very stout.

Yeah, it's like a robust—

And a paper nest. It basically looks like a basketball in a tree.

Yeah, exactly that's it.

**[1:10;44]** I might have missed this but when the bees collect the pollen and they go back to their nests and they're going to store it for the eggs that are going to hatch later, how do they get it off of them?

So, it's pretty fun to watch them. You can watch them on the plants, do this. Because whenever they're like with any other insect that collects nectar or drinks nectar, they get pollen on their face and on their arms. And they actually have on their legs, they have little areas like this, they're kind of cut out and they're antennae cleaners. So they go like this with their antennae and then they kind of, and that gets stuck on one part of their body. And then they use their, they have three sets of legs. So then they use their second sets of legs and they do this little dance and they move it down like this. So they just shimmy it off kind of. And when they're in the nests I would imagine it's probably a similar motion. Yeah, they do it.

So I have a question, since a lot of these live in the ground, some of the like weed killers and stuff that we're putting on our yard is that affecting them?

I would imagine it wouldn't be the best. I mean I can't say 100% that it's—

Well it's not the weed killer as much as the, whatchamacallit, the sod wet worm.

The what?

The sod wet worm pesticide and the grub, when we put stuff for the grubs. But usually you get that problem with grubs and sod wet worms when you have like only one type of grass. I mean, especially you get it with Bermuda grass or Zoysia or you know, you only have one kind of grass that is solid, then sod wet worm and Japanese beetle grubs, they will do a number on your lawn and then you put that kind of pesticide down.

And that will hurt the bees.

And that hurts the bees.

But the regular like fertilizers and weed killers?

I wouldn't.

Keep it to a minimum. I mean, I really don't have an issue with any of that as long as you're using the proper recommended dosage. There was a lady, at Pernod, across from Mallinckrodt. They, she has all these flowers. It's just like half a block down from, if not the house. And roses are very susceptible to fungal damage.

Right.

I mean it doesn't damage, it doesn't kill the plant, it just makes the flowers—

Look not so pretty.

And there's a fungicide that you can use when the bud is about to emerge and you just squirt, a little squirt on the bud, on each bud, that's it. And she was just spraying the whole plant. Up and down, up and down. So she was applying probably 100 times the recommended dosage. And I mean you can smell the smell of the pest—, of the fungicide.

Right.

So that's the problem because I mean, we need to use pesticides responsibly, in the recommended dosage. And many times, they you know, you get this concentrate that says well you have to do it, this solution, and I've seen it a lot of times it comes in metric and not English system and people are not used to millimeters versus you know.

Right, right.

So we need to learn to take your time and learn how to apply it.

Yes.

What is the relationship between bees and bats? I'd like to have a bat house but if I have bees that are interested in living in it, I don't want them to attack the bats.

I don't think you'd have a problem with that at all.

They coexist?

Yes.

And I don't even know if the bees would make a nest there, if the bats were there, so.

And all the bats we have here are insectivores, so they eat insects. And—

So I'm killing—

Well they're good for mosquitos. They love mosquitos.

Yeah, because bees are active during the day and bats are active during the night. So they don't even know they exist with each other.

So they could live together just fine.

I guess what I'm seeing here is, I thought I'm going to help the bees and get a hive but in fact I should just be planting more flowers.

Yep.

Oh and leave bare ground.

The hive really isn't the issue, it's the flowers.

So this is a perfect Segway for Damon to explain exactly what is. Excellent question.

**[1:15:36]** Yeah, that's exactly. Now you're armed with a little bit of bee biology, natural history. For the natural problem solvers in the room, you can begin to put things together. We as humans, our food, we need a diversity of different bee species in order to pollinate the plants and foods that we eat. Bees themselves, the wild bees, they need a diversity of plants, a diversity of flowers, a diversity of early spring to late fall. And they also, knowing that they live in small areas, like an area this size of the room, an area the size of this table means there's something that we can do. What the research is showing— Oh wait, did you have a question?

Well yeah, because if we're going to plant more flowers so we have more bees in the size of this room, how is that going to help the map you showed in the beginning which is where all the farmers and the farm land is lacking the bees, how is that helping those outer areas.

So we'll get there, we'll get there.

Yeah, we'll get there later. Question? You guys are too fast. You're good. The consistent driver of pollinator health, this is what all the studies are showing again and again, is that it's floral resources. It's the presence of flowers for forage. It makes sense, these populations need food. This is the consistent driver. So, that is really, that piece of information and a lot of what we've told you is really the driving force behind the questions that we're asking in this research project that's funded by the Missouri Department of Conservation. We have one year to have these meetings with folks and talk about our research and talk about bee conservation. And that is essentially because we know city-wide bee diversity, we have thirty sites now throughout the city, can we target areas with education like these bee conservation workshops, talk about our work, talk about bees, to where people would voluntarily change their lawn care practices or some aspect of their lawn care practices, plant some flowers that increases floral diversity which would then increase these target sites' bee diversity. So this is essentially the question that we're asking with this project that we're only doing in Ward 23 and only doing in Holly Hills. So here's where we are now in our first intervention site. We collected— we decided to go with two intervention sites that had consistently the lowest number of unique bee species. So the lowest bee species diversity of all of our thirty sites is actually this site right here and then second lowest in Holly Hills. So we're not 100% sure why, that's part of what we're trying to figure out. We also have control sites where we're not talking to people, we're not encouraging people in anything, we're not having any contact with them. Although anyone can come to these workshops of course. So here in Ward 23, we have been sampling the Mallinckrodt Elementary School site for the past four years now, so we have long term data and we know the number of species, different types of bees in this area. And what we're really interested in are folks who are in a 500 meter and a 1000 meter radius of that site because that's about the average body size of a bee, the average size that they forage. As Gerardo said, honeybees will go up to two miles to find food but for most of the other bees, small areas. Our second area is Holly Hills and that is at the Bates and Arendes site. There, there is a community garden there, that's the place where we're really focusing our efforts. But of course if you're out here somewhere, what you're planting could have an

impact, it could help bring some of the other species to these areas. So here is just kind of the photos of different species of bees that have been found here from Mallinckrodt. 15 versus 24. This is just from last year, these are last year's data. And in other sites, far more, in the forties, some a little be higher. So, what we're asking folks to do is to plant flowers with high food value for bees. And as Paige talked about, particularly for the social bees, like bumblebees, that really depend on early season flowers, but all those that are emerging early in the spring that need that early season flowers for forage and also important are species that bloom in the fall. But, really it's the diversity of plants, it's the diversity of flowers, it's the diversity of flower sizes because different bees, different sized bees are attracted to different sized flowers. So large flowers bigger bees; smaller flowers, smaller bees and so if you want to target a certain type of bees you can begin thinking on that level as well.

**[1:20:33]** So we're asking people to plant in large clumps as Gerardo talked about because that's how bees can find that area. A diversity of flowers and we're asking folks as well, well natives are important as far as less management, those are the seeds that we have for you are native mixtures. We're asking folks to be patient too, sometimes it takes, it does take time to establish these gardens. And, kind of a bigger picture, because of the importance of food security and the role of pollinators we're kind of seeing if we can change the way that we think about our lawns just in general, and our yards in general, because again small areas can have an impact. One person could have an impact on planting. We're asking people to think about their lawns, to whatever degree they're comfortable, a little bit differently. Something from this to something that may look like this. Or like this, that could be planted from a group of neighbors who could get together on an area that really doesn't have, that's just grass. Or you could find dead space in your lawn that's really not usable to you. We're just supplementing kinds of traditional iris beds with some natives. This is in front of Schlafly Bottleworks, this was a year ago and so if you've been there recently you know it's grown up quite a bit. So this is the biggest, this is kind of the spacing they planted in the quarts. And they put a sign there for people to know, hey we're planting for pollinators it may look a little wonky right now but a little bit of patience. We also have signs available for folks. If you want a sign to take, to put in your yard if you're going to do major changes we're happy to give you one. Just give us your name and address so we know kind of where they all are so we can map them out later. But yeah, you can have them and keep them forever.

**[1:22:34]** The second thing that we're asking folks to do are to manage their lawns differently. Grass has a lot of, most of our lawns, particularly older lawns have a lot of valuable flowers and species that are very valuable to bees. Even though we've called them weeds for many years they still have flowers that are valuable. Paige mentioned the importance of early spring dandelions. If you're nervous about them, get them right before they go to see. Well, you know. The buckthorn as well. The buckthorn, the narrow leaf plantain. Those get a lot of bees, I've seen a lot of bees on those, the smaller ones. Of course the white clover. Yellow wood sorrel; we just saw some out in front of the church this morning, on this. Many of these species are valuable.

Isn't that first big one, the one you get every spring that's everywhere?

Yeah, yeah, creeping Charlie. Yeah, you'll see it in farm fields.

Yeah.

And we're asking folks to slow their mow too. Mow at great increments of time because lawns have this valuable forage. So there was a study done in 2014 from the University of Massachusetts in Amherst. At Springfield, Massachusetts they worked with a bunch of homeowners. They had homeowners in three groups. The control group would mow their lawns once a week. The second group would mow their lawn once every two weeks. And the third group would mow their lawn once every three weeks. And they had

researchers come out and sample the bees in-between each of the mowing. So for those that mowed once every one week, that was the control group, but those who mowed once every two weeks, they saw a 60% increase in the number of unique bee species just from mowing less. And for those that mowed once every three weeks, in addition to possible upsetting their neighbors, they found a 300% increase in the number of unique bee species just from mowing less. Of course they had signs out upfront that they were participating in this study. So if you don't like mowing the lawn [laughs], take up this study. You may want to communicate with your neighbors, you may want to communicate with your alderpersons to say hey, I'm participating in this bee study. Yeah, question?

Does that matter if you have, or is it more beneficial if you have a ton of weeds in your lawn or even if you have a rather nice lawn?

It's going to be better with weeds. [Laughs]. It's going to be better with weeds rather than just straight sod. And what's nice about the homes in your neighborhood as well as in Holly Hills, is because of the way that they planted the grasses. There was a mixture of grasses planted in the '30s, '40s, '50s, all the way in the '80s, where they had mixtures of white clover in it and that kept the lawn green throughout the year as well as fixed nitrogen to feed the rest of the grasses. So that mixture of a diversity of plants in the lawn is beneficial, and particularly for these older neighborhoods.

So no more killing the clover. [Laughs].

I'm not saying it has to be like this. Yeah.

Back up. What about the nitrogen, is it okay to be putting that kind of thing on your lawn then? For our bees that go into the ground?

Yeah.

So, it's okay to do some fertilizing, especially if you're applying it usually later in the spring but most of the regimes that they recommend, you know like fertilize four or five times year, that's ridiculous and most of that nitrogen ends up in the Mississippi and then down to the Gulf.

Well I think you're point with clover, clover has nitrogen fixing system in its roots.

Correct. Exactly.

So with that diversity you won't need to—

Basically air is 80% nitrogen, so it's taking the nitrogen out of the air and putting it into the roots.

No but, if you have a diverse mixture of grasses and a few forbs in there, your lawn will stay greener just naturally.

**[1:27:05]** So when we consider it could look something like this, just reimagining your lawn could have an impact. Third, we're asking folks to avoid the neonicotinoids. Right now that's going to be difficult because they're everywhere it seems. Again, they're very effective, it's great technology, and we have tremendous access to them. So just taking a look at a photo of a big box store shelf, the red Xs are the imidacloprids, the yellows are acetamiprids and so you can see what's kind of leftover when you strike those out. They will be labeled on these chemical containers. Yes?

I noticed the sunflowers we planted this morning were from France and the mixed flowers were from Holland. So I'm wondering if you said that the Europeans have outlawed it and they're going there for their source of seeds to sell in the stores.

Yeah, I think that would increase your odds. Yeah, it's coming out of Europe.

And one thing I too, I know a lot of people love to go to Home Depot and Lowe's for plants for your garden but I would suggest not because they do now at Home Depot is starting to label what plants are treated with neonicotinoids but when I bought one there it's like hidden inside the container, so you don't really know when you first buy it. And also there's a nursery, in particular there's one Bowood Farms in the Central West End and they have one section devoted to native plants, Missouri native plants, so they're all grown here in Missouri, locally sourced, and they're obviously beneficial for bees and other insects. And they're actually, I mean you'd think native plant is going to be more expensive. They're actually quite cheap, like five or six dollars for coneflowers or blazing star and even they have the dropseed and grasses and everything there.

What's the name of that again please?

Bowood Farms.

Could you spell it?

Yes, B-O-W-O-O-D. And it's on Washington Avenue, it's like hidden in the back of Central West end kind of but it's a really neat place.

On Olive I think.

Oh yeah, maybe it's Olive.

I guess where Olive becomes Lindell.

Oh right it splits, yeah, yeah.

As well, many of the plants you buy, the live plants, are treated with neonicotinoids as Paige said. You have to, some places have tags but they're not required to tag them. There's a brand called Monrovia that is distributed widely and they do not treat with neonicotinoids. Now, big box stores have agreed to phase out all these plants, so Ace, Home Depot, Lowe's, but that's in 2019, 2020, and 2021. So until those years you have to be vigilant about what you buy and where you buy. Yeah, go ahead.

You mentioned native plants. You know, a lot of people are using those. If you use a cultivar of a native plant are they as beneficial to the bees?

So, there, the thing is some cultivars have been selected for like very large or showy flowers are not as good at producing nectar. You know, so you have to be careful with some of those.

One thing to do, if you go up to, I know Home Depot has a section, I was just there this weekend so I know, but they have a section that says pollinator plants which I looked at them and I don't think half of these are really good for pollinators. But I know at like Bowood they have a huge open area and you can walk through. And one thing to do is, especially if you go during the day, is to look at the plants and you'll see tons of bees flying around. So if the bees are going to them there, they're going to go to them in your garden so that's one of the, that's a key thing to do.

And the one over in Webster's good for that too.

Or that place in Richmond Heights, apparently Operation Brightside recommended. I thought milkweed was that stuff on our fence where it opens up and you can— I didn't know it was pinky, orangy, who knew!

There are a lot of varieties.

And our neighbor went to the Operation Brightside program and they told them to go to, whatever it's called there on Big Bend and Richmond Heights.

Garden Heights.

Garden Heights, yeah, and they had all kinds of .... What's the Latin name? It starts with an A?

Aster?

Asclepias?

Asclepias, yeah.

That's milkweed.

Milkweed, yeah, yeah. I always heard they could see it from a mile up and I thought, how do they see this white flaky, well, duh.

What about Bayer's Garden Shop? I know they have a lot of Monrovia; do they have the other?

Yeah, you'd have to check but if they're carrying Monrovia I think that--

They have a lot of-- so like our vegetable plants, I mean I try to buy as many heirloom plants as possible but a lot of our plants that we buy are cultivated, are those?

Well the interesting thing about cultivated plants is that we select for the fruit, not the flower. So the, it's meant to attract the, you know, the native-- they attract bees. And I mean tomatoes are native believe it or not, peppers are native.

But those are still good for the bees though? There's nothing?

Yeah, yeah.

Okay.

Before you get off the insecticides, we planted a milkweed last year specifically for the butterflies and the bees you know. It did okay last year but at the end of the season it got these little yellow bugs which I heard are, you know, aphids. So this year, it has come out beautiful--

After a rabbit ate it all to nothing.

Yeah. But then we found it comes out from the ground in the spring so we were okay. But now it's covered in them again. So what do we use?

Soapy water.

So can you make your own? My grandma use to tell us that.

Dawn is the best.

While we're here, why is Europe so far ahead of us with banning these things? Where have we been?

There ahead of us on everything.

That's a policy question, they work on the precautionary principle whereas they are more precautionary.

Yeah, we're reactionary.

Whereas we're a little more reactionary. We let the market flourish a little bit and then we find out, whoops.

But it's just like food. They're beginning to change the stuff in food because people aren't buying it and they're losing money. That's the only thing that's going to change it.

Yeah, exactly. The market.

The market will eventually.

**[1:34:04]** We have like five more slides here. Next thing we want you to do is leave some bare ground because most are ground nesters. Leaving bare ground, not mulching every square inch, particularly around the plants that you want pollinated would be important. They'll use these spaces, you can see. This one here is from Mallinckrodt, this is a hibiscus bee.

So I don't have to feel guilty that I didn't get my mulching done.

That's right.

Will the burrow in the ground in a shady area verses an all-sun area? Or?

They prefer all sun. They like sunny spots usually.

And how big of an area?

That spot there where that picture was taken, it was probably, it was quite patchy but I'd say the majority of the area where the nests were was just this big. Then there were smaller patches about like this size just throughout the front yard of the school. About this size and you could see a couple of nests there.

But you need that to be bare like that the whole year round?

Yes and don't disturb it. Don't dig it.

So don't put your leaves on top of it.

Should we pull weeds of it and make it really bare first?

Oh, yeah that'd be a good idea.

You could keep a bare spot and if you have a little bird bath, that's good because they like clay soil and so they have to use water to moisten the soil to actually dig the nest in.

And also in the fall, leave a pile of leaves in the corner. Some bees will go there.

Well yeah, because earlier she said that. So we need both.

Another thing we're asking is make some bee condos or buy some. These are easily made; you can drill holes into firewood. There's all kinds of instructional videos on YouTube, we have one linked on our site. And it may take a couple years, one, two, three years before it gets inhabited. But just be patient. Keep it in a dry area. South facing, keep it in the sunlight. Make sure no water can run into it as well.

That lady yesterday had one with Mason bees for the last couple years.

So it does take a while?

Yes it will take a while for them to.

[1:36:22] So, to summarize the research we're doing in your communities. We've been sampling these areas across the city. We are documenting to some degree the backyards of basic yard management. We're encouraging you all to plant, reduce mowing, leave some bare ground, leave leaves. We will continuously sample, we're sampling at least this year as well as next year. We will continue to monitor these populations in the future. This is our goal as a larger research lab, we're going to keep this long term pending funding. And then what we hope to do is be able to suggest management practices that have worked in certain areas. Particularly if we can see an increase in the amount of bee species in the two target areas. We are, as Gerardo had mentioned, we are working with an international group of about 30 to 40 different researchers that are doing urban bee research in different cities throughout the world; Singapore, Australia, all throughout the UK, Europe, all throughout the United States, and Costa Rica. So what we're doing here in working with you is unique. People have similar amounts of collections, very few, just one actually. This lab is highly productive in terms of sampling these bees and then this step of moving it forward and trying to work with communities to experiment can we actually increase the population of diverse bees is very unique. So what happens here is being watched from other folks worldwide. Yeah.

I was thinking though, like Lindenwood Park Neighborhood Association has a garden contest every year. Which I'm still bitter about because I didn't get considered, I didn't have a water feature. I mean I had a fountain but I didn't have a water feature. But I'm thinking, maybe, and I'd be glad to talk to them, but maybe they could have a category for those of us that have a more random looking. But I'm realizing some of my laziness has actually been good. I mean, I just stepped in and then— and it's a real, real old garden. The house is almost 100 years old. Next year it will be but we're only the third people that have owned it.

We'd love to talk with the organizers and put in touch with me.

But I think that'd be a great idea because what they put their seal on, which is natural but you know it's what people do, is the beautiful, manicured looking, which—

That is a good idea.

What about Tilles Park?

Oh yeah, this will go exactly to the heart of what you're talking about.

Yeah, and we'll talk about Tilles Park. But before you leave though, if you have to leave early, we do have an exit survey we want folks to fill out, it has two questions on it, but that is important to us. We will talk about Tilles. Want to show you just a tale of two gardens here. One is Lindenwood Park Community Garden, the other one is Tower Grove East. You can kind of see similar areas, maybe this one here is closer to the park. Four bee species found in Lindenwood Park and 20 species found in the other. And just kind of looking at the difference, and these are— Lindenwood Park you can see kind of has a large amount of concrete around here so maybe that's not. Whereas there are multiple yards here, spaces for the bees. You can look at kind of the neighborhood composition. Looks relatively similar but looking on the ground you see some clover here but it's managed well whereas this one here is kind of wild looking.

It's being corrected. [Laughs].

It's still going to be managed but we're going to have a lot of beds with flowers.

There's a lot more stuff this year and there's milkweed isn't there over by the compost I think?

[1:40:32] So, and this is a number of ways of just managing differently but also trying to change the way that we think what the aesthetic of neat looking yard, or a highly productive garden may look like. I imagine with the tomatoes in here, just with a number of species, maybe the produce would look differently. I don't know if we could even start taking pictures of one place and another but I'm glad you guys are working on it. And then finally, additional steps, we'd love for you guys to sign up through our website.

Is that information on these papers?

It is, on a card we have— we have a postcard, we'll show it to you again, it will be on the next slide as well in a larger font. So sign up, we'll keep you in touch with what we're doing and how the research is moving forward and what we're finding particularly at the, probably in the winter because we have thousands and thousands of bees to count, so after we find out the numbers. And if you're in the study area and you're managing for pollinators or you plan on doing something differently with your lawn or your garden or a space you manage at work or you have access to, take a sign. I mean, let us know, we want to document who has the signs, but take a sign. We have poles as well and hardware. We'd love to have you advertise and let your neighbors know.

And then people start talking about it.

Fourth, talk to your neighbors about this study. Take any extra materials you need. Take extra seeds. We will have this video posted, probably in mid-August. Give us about two or three weeks, we're going to clean up some things but we'll have the video posted for folks that couldn't make this meeting, folks who can't get out to this meeting as well.

Are there things that you can share on Facebook for example that I could get the word out?

We would love for you to start it. To share it.

By sharing the link?

Yeah, absolutely. Share the link.

What's your Instagram?

We have bees on the block. [Bees\\_on\\_the\\_block](#) is the Instagram and we have a twitter as well that Andrea— We don't know the handle right now.

Instagram would be perfect for pictures.

It should be on the website too, so.

And that's what we would love. If you have pictures of your yard as you have changed it over time, we would love to see any types of photos of that just so other people can see what types of options they can do as well.

And one thing too, now that you guys know you can save so much and you don't have to manage your yards as much, instead of mulching, or mowing, or spraying, just take a chair out where you have a flower bed, next to your flowers have a seat, bring your camera out, and just watch the bees. Spend 30 minutes or an hour, however long you want. Watch the bees because they're fascinating and they have lots of different ways that they collect the pollen; some go like this and others go like that.

Bring your bee guide.

Yeah, exactly. And take a couple of pictures.