

Cicadology with Dr. Gene Kritsky

Ologies Podcast

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Oh heeey, it's your friend's older sister who taught you to swear in French, Alie Ward, back with an episode I have waited most of my life for. No exaggeration. When I first came up with *Ologies* as a concept, it was partly just to trick an expert into talking to me about cicadas. If this weren't the 13th month of a global pandemic, I would have recorded this in an Ohio backyard instead of over the internet. I would have hitchhiked there in a bug costume, holding a "Brood X or Bust" sign, and I would have meant it! This is the spring that bug lovers have waited 17 years for!

But before we cover ourselves in discarded exoskeletons, let's say some thanks to the backbone of the show, Patrons! Thank you so much. You can submit questions to the Ologists by joining [Patreon.com/Ologies](https://www.patreon.com/Ologies). It costs as little as 25 cents an episode, folks. One dollar a month. My heart is not expensive. You can also support the show just by texting links of episodes to your neighbors, friends, or enemies if you'd like, on your podcast app. Or you can leave a review, if you like. I have read every review ever left, including this one, this week by NeutralViking, who said:

I applied to a PhD program because of Ologies. I started listening to Ologies in 2019 during one of the lowest points in my life. I had never been one for science, but decided to give the podcast a shot after a friend recommended it to me. 'Maybe it will be a good distraction,' I thought. Half a dozen episodes later I realized how much I actually loved science, but had never had it presented in a way that I connected with. Because of Ologies I went back to school, and one day hope to study volcanoes on other planets.

NeutralViking, HELL yes, astrovolcanology! That episode is all yours! So, leave one and see if I read it next week. I dare you.

Okay, Let's get to Cicadology. *Cicada* in Latin means 'tree cricket', but your Appalachian friends may call them jar flies, I just found out. I have only seen a cicada in the wild maybe three times in my life, and each time I crowded around it and gasped and took pictures like an American at the Eiffel Tower. I have never even seen a periodical cicada – the ones that emerge in the trillions every 13 or 17 years in the US. But at their last emergence in 2004, I was so envious. So this year, we're getting ahead of their emergence. After the Forest Entomology episode last October, I asked KayDubs the Hiking Scientists, aka Dr. Kristen Wickert, for a cicada hookup and she started an email thread full of my secret internet science crushes, including Dan Mozgai, who runs CicadaMania.com (what's up Dan!), and this Ologist, who is the *authority* on periodical cicadas.

He hails from North Dakota. He got his Bachelor's in Biology from Indiana University, and his Master's and PhD in Entomology from the University of Illinois. He is now a professor and the Dean of Behavioral and Natural Sciences at Mount St Joseph University in Cincinnati, Ohio, and is the editor of *American Entomologist*. He has written multiple bug books and authored scores of papers on insects. He is *the* cicada guy.

He typically appears in the news, maybe you've seen him, in all-khaki field gear, and a tan sun hat, and he has a gentle silver beard with a tidy upturned mustache, like a friendly smile. We hopped on a call to record and I just screwed it up, like immediately. I dropped off the connection and could not log back in, and there all these tech hiccups. So I texted our wonderful assistant scheduler Noel Dilworth, I said, "I sent him a new link but he hasn't shown up and [*whispers hoarsely*] I hope he's not mad!" and then I got the reply, "I am not distressed." I had texted him that... instead of Noel!

So, between wanting to do this episode for 17 years, talking to the world expert in it, and texting him *about* him, my level of body sweat was clinically dangerous. Regardless, we figured it out, we got on the line to chat about life cycles, ghostly remains, cicada chasing, insect cuisine, the decibel levels of our springtime friends, what you should do if you see a cicada, the app Cicada Safari, their cultural and pop-cultural influence, and what they are doing underground for nearly two decades while we miss them, with icon, legend, and Cicadologist Dr. Gene Kritsky, who may or may not already be mad at me.

Alie Ward: [*laughing*] Oh my god. Are you mad at me?

Dr. Gene Kritsky: Why would I be mad?

Alie: I felt so bad! I was like, “Oh no, maybe he just left forever!” [*laughs*] I was mortified when that went to you, but... secret’s out, I’m a human being.

Gene: That’s all right. So am I!

Aside: Alright, down to business.

Gene: I’m Gene Kritsky and I use he/him.

Alie: You are, from what I can understand, a cicadologist. Do you ever call yourself that?

Gene: I consider myself an entomologist. Although I work with cicadas, I also do a lot of work with honeybees.

Aside: For more on his bee work, you can start with *The Tears of Re: Beekeeping in Ancient Egypt*. And while you’re buying his book, he has a new book! It came out this week, it’s called *Periodical Cicadas: The Brood X Edition*. It’s \$13 for the paperback, the link is in the show notes. Treat yourself. Get it. He literally wrote the book on these gorgeously loud, mysterious creatures.

Alie: Can you tell me a little bit about what we can expect this year from the cicada population in the United States?

Gene: Sure. This year we’re going to experience an emergence of Brood X. And when I say Brood X, that’s capital B with the Roman numeral for 10, which is an X. And so some people want to make it a little sexier than it really is, you know, Brood “X”, but it’s Brood 10.

We’re already beginning to see signs of it here in the Midwest. People are reporting lots of moles in their yards, mounds from where the moles have been feeding because the cicada nymphs are, right now, about four to six inches below the surface. We’ll start seeing our first sign of cicadas in late April after a big, heavy rain. Some of the cicadas, especially if the soil is a very heavy clay soil, they’ll actually extend their tunnels above ground. They’re called chimneys or turrets, similar to what a crayfish will sometimes do.

Aside: Uhh, newsflash to me that crawdads, aka crayfish, emerge sometimes out of tall, lumpy turrets they build. Also, I googled cicada tunnels and one image taken under a deck looked like a damn coral reef, or like big, tall stacks of dirty poker chips, or, like the tallest birthday cake ever, out of which a beautiful ghoulish pop up to say, “Happy 17-years-Day! Surprise!”

Gene: They’ll crawl all the way to the top of these things. They get as large as 12 inches high. As the water seeps down through the soil and gets out of the tunnel, they go back down, but you’ll see these little chimneys. That’ll be under things like people’s decks, or under the

large overhang of a roofline, for example, or an outbuilding of some kind. I've even seen them under pallets people have. Wooden pallets that are not solid wood but get nice and super wet, and you lift it up and they're filled with these little chimneys underneath. But that's the first sign that we'll see. That'll be usually late April. We could see... Especially in some of the southern states, in northern Georgia for example, we could see a few cicadas emerging around the 1st of May. They come out of the soil when the soil temperature reaches 64°F.

Alie: Very specific.

Gene: Very specific! Well, these are cicadas, you know. They've got things to do. They've got to come out in 17 years and keep track of numbers and what have you. Once you hit that temperature, 64°F, and then you have a really nice soaking rain that just sort of saturates everything, then they really pop. It's just amazing. The highest density I've ever seen was 356 per square yard.

Alie: Wow!

Gene: And that was over the course of about a two-week period they came up. They come up by the hundreds of thousands. Some of the things I've noticed... I remember the first time I experienced this. One evening, I thought I had to go in because it was starting to rain, and what it was, was cicadas falling from the trees above me and landing on the dry leaves. It just sounded like a heavy rainstorm. I remember seeing a yard where so many cicadas were crawling up blades of grass, the grass looked like it was in a heavy wind, just sort of like moving around. It's really quite amazing.

The weirdest one... I do a lot of work in cemeteries. And so I've been in cemeteries when these things start crawling out of the ground. It's almost like a scene from some B-rated '50s horror movie if you will, these things crawling out of the ground. [*clip from Tremors, Kevin Bacon: "Burt! They're under the ground, they are under the ground!"*] If they were much larger, you could probably have a really good sci-fi movie.

Alie: When they leave those exuviae behind, they look kind of like ghosts that have been frozen, to me.

Gene: It does. It's a hollow shell reminder of what was. There was an article I remember reading from the early 19th century talking about – they called them locusts at the time – “The cicadas have left, and all we see are their ghostly reminders.”

Alie: Oooh, that's beautiful. I was going to ask this, if it ever gets your goat that they're called locusts, because a locust is a type of grasshopper morph, right?

Gene: Cicadas are insects that belong to the – sorry to get technical [*"We love it"*] – the insect order Hemiptera, which are sucking insects, like bed bugs, stink bugs, leafhoppers, and aphids, and so on. They belong to the suborder that includes the treehoppers, and leafhoppers, and what have you. They have sucking mouthparts, and in the case of the periodical cicadas, red eyes, orange veined wings, black body as adults. Whereas locusts on the other hand are, essentially, a form of grasshopper. It's really interesting, the very first time they were seen in our history goes back to 1634.

Alie: Oh! Dang!

Gene: That's when William Bradford, the governor of Plymouth colony reported them in his history of the colony. And he actually may have gotten the date wrong. At the top of the page he wrote 1633. Then what he wrote, which is kind of neat:

[audio effect: scratchy record old-timey harpsichord music with an echoey voice]

In the spring before, especially all the month of May, there was such a quantity of a great sort of flies like for bigness to wasps or bumblebees, which came out of holes in the ground and replenished all the woods, and ate green things, and made such a constant yelling noise as made all the woods ring of them, and ready to deaf the hearers. They have not, by the English, been heard or seen before or since.

[end music]

The reason I say he got the date wrong, as it turns out 1633, there is not a brood of cicadas that would emerge if you go back in time from 1633 to today.

Alie: So you had to kind of backtrack and figure out, “Okay, minus 17... minus 13.”?

Gene: Yep. But it concurs that there were cicadas that should have emerged the following year in 1634. And it turns out he didn’t write that passage in that same year; he did it a few years later. So he might’ve gotten the notes mixed up or what have you. And so, I think he probably got the date wrong. But they called them flies until the early 18th century.

Alie: Well, you know, that was going to be one of my questions because they’re in Hemiptera, but are there a lot of Hemiptera bugs that have the kind of robust wings that they do?

Gene: Well, there are a lot. A lot of cicadas do. And then there are the lanternflies. They have large wings as well. So there are some.

Aside: I was trying so hard to impress him by knowing what a Hemiptera is. It means half-wing, and I did not realize cicadas were among them.

Gene: ... and there are some strong fliers. Not as strong as dragonflies per se, but some of the Reduviidae are strong fliers as well. Some others are bumbling along. But periodical cicadas, if you’ve seen them, they don’t look like they’re savvy insects. I mean, they’re sort of tumbling around, and I’ve seen them get picked off by birds, you know? They just seem very clumsy at times.

Alie: What’s the difference between a periodical cicada that might come out every 17 years, like Brood X, or 13 years, and annual cicadas?

Gene: They belong to different genera. If you look at them, you’ll find that the annual cicadas – sometimes called dog day cicadas because they come up in the dog days of summer – they’re much larger, their head is more flat. Their eyes are black, sometimes green. Many of them are black with brown markings or black with green markings, more camouflaged. And as I say, they’re about a half-inch to an inch larger than the periodicals.

Aside: So the annual ones come out in the heat of summer every year, and although they are more chonk, you won’t see their camouflaged bods as readily. And you will not witness anything *near* the numbers of periodical cicadas. The annual ones are, all in all, more low-key.

Gene: Behaviorally, they’re much more cryptic. They look like little camouflage insects. If you stand under a tree, let’s say in late August, and you hear the annual cicadas singing away. You can stare at them in that tree, and you can’t see them because their whole survival strategy is totally different. It’s to be cryptic. When the male starts singing, of course, he then is very vulnerable to a bird, if the bird can find it. But he’s up in the shadows of the tree.

A couple of years ago, my wife and I were in Greece, and we heard cicadas in the trees. We must have looked for 25 minutes to find a couple of them. We were less than three feet away, but it was really hard to pick them out. On the other hand, the periodical cicada, they're in your face. It's not so much that you need to look for them. It's like, "Where can you look that they're not present?" They come out in big numbers.

Alie: Is that part of their evolutionary strategy, just a ton of them at once? How does that work?

Gene: It works well for them. It's called predator satiation, what we think is happening. They come out in these large numbers, and some of the birds are major predators of them, but their little crops can't hold many more cicadas. And the analogy I like to use is, imagine walking outside, and all of a sudden you see the whole world is inundated with flying Hershey's Kisses. I'm fond of Hershey's Kisses. You would tend to eat, and eat, and eat, and eat, and eat, but eventually you will get tired of them.

In 1991 in Brood XIV emergence, I was over at Mariemont, a little suburb of Cincinnati. It was really kind of cool to watch. I saw this dog the first day they were coming out, snapping at 'em, all over the yard, just going at 'em. Five days later, I go back to see how the emergence is going at some of my test sites. And that dog is just lying on the porch, paws folded, and cicadas walking all around him.

Alie: [*laughing*] Does not care! He's over it! Over these things!

Gene: That's why a lot of people like to collect cicadas in cicada years, but not to use as fish bait this year, but to use for next year. They'll freeze them. I've seen people collect, you know, ten 5-gallon containers of these things and freeze them for the course of a decade.

Aside: So, periodical cicadas are in the genus *Magicicada*, and they make a splash. They are smaller than the annual cicadas but they have such style in the form of blood-red eyes, and there's billions, maybe trillions, of them. In fact, their genus *looks* like 'magic cicada', but *magi* actually comes from the Latin for 'many', or just a staggering ass-load. Not from the word 'magic'.

Okay, but you *will* have a magic spring and summer if you live in Delaware, Illinois, Georgia, Indiana, New York, Kentucky, Maryland North Carolina, New Jersey, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, Michigan, as well as Washington DC, and can witness the party. If you miss it, you're going to have to set your calendars for 2038 to see these hordes of beauties.

Now, Brood X is the largest group of 17-year cicadas. They emerge this year. But there are over a dozen 17-year broods and a small handful of 13-year broods. I'm going to link on my website to a US map to see which broods might be in your area.

Elsewhere in the world, you can always gaze at an annual cicada if you have them. You can tell it you love it if you can find it. But if you have periodicals in your area, they're hard to miss because they blanket everything.

Alie: How old were you when you saw your first emergence?

Gene: Well, I was pretty old. I was born in a cicada year. I'm from North Dakota, so we don't have periodical cicadas there.

Alie: You were born in a cicada year! That's auspicious.

Gene: A Brood X year. It was 1953, and then in 1970 I was living in northern Illinois, and of course, they have Brood XIII there, not Brood X, so I missed that one. Then, finally in 1987, I was

able to witness my first Brood X emergence. However, I did a lot of fieldwork in 1976 with Brood XXIII, a 13-year cicada that emerged in eastern Illinois.

Alie: Had you already been studying them previously or was this, kind of like, a chance fieldwork assignment and *then* you started getting into them?

Gene: Well, I became an entomologist in part because of periodical cicadas. My undergraduate professor at Indiana University, Frank Young, wonderful guy; he's deceased now. In that second week of that course, he starts talking about these things and I thought, "Whoa! This is just wild." And he was a cicada specialist for Indiana, so I knew within two weeks of listening to this man: my life is in bugs. [*Alie laughs*]

So, I went to the University of Illinois, where I didn't work on cicadas as my major PhD. work, but my advisor was Illinois's cicada specialist, Lewis Stannard; another wonderful guy. Between Lou and Frank, these guys loved life.

My dad, he loved life but he sold insurance. But these guys just loved coming to the office every day, and I found that infectious.

Aside: Gene told me about being in college and taking on a mapping project in researching old letters from 1863 to track down where in the county the brood may emerge.

Back in the 1800s, scientists had to dispatch grad students on horseback. But in the late-1970s, Gene just cracked open a window and let the wind through his hair, following his bliss to mud-tunnels and still-wet wings.

Alie: Did you get into a Chevy Nova and just ramble around the country looking for different emergences?

Gene: You could say that. Although, it wasn't a Chevy Nova. It was a Chevette. [*laughs*]

Alie: [*laughs*] Close! Can you tell me a little bit about what one of the world's, if not *the* world's, biggest authorities on periodical cicadas, what is your job like? When people ask you, "Oh, nice to meet you, Gene. What do you do?" What do you tell them?

Gene: Well actually, cicadas usually won't pay the bills [*laughs*] I'm the Dean of Behavioral and Natural Sciences at Mount St. Joseph's University. I'm the longest-serving faculty member there. But I am an entomologist who works on... I am a frustrated historian. [*Alie laughs*]

While I was in Illinois, I was able to use the fantastic library resources at Illinois. I think it's now the largest state university library in the US. I was able to find mimeographed, stapled papers that had all the USDA records on them. To me, every time there's an emergence, you make observations, you come up with hypotheses. But with cicadas, it's not like looking and checking every year. You've got 17 years between these emergences.

So, I decided to start looking through newspapers, any kind of publication I could find for old historic records of cicadas. I gathered about 7-8,000 by the time I was done. And then – this is getting back now to the '80s – I found a computer program, for the Macintosh at the time, that was primarily used for demographic marketing of where to put golf courses. But it had a great mapping program!

So, I literally took all 8,000 of these things and put in the FIPS code, which is coding based on the alphabetical order of the state and then the alphabetical order of the county in that state. Then from there I could map out these cicada broods 17 years apart and see how the patterns change, and how our knowledge built up, and were there areas where the emergence records go back to the beginning, and so on.

Alie: Do golf courses... By the way, side note: Do golf courses see a lot of emergence as well?

Gene: Some do, yes. I've been at several golf courses where there's a decent cicada emergence. Especially the ones that are near other areas where cicadas are heavy and they've just planted some new trees at the ends of the fairways and along the rough.

Alie: You know, this is one thing, I think, that still mystifies us. Can you describe a little bit of the life cycle? What are they doing that whole time?

Gene: Let's start when the adults emerge from the ground. That's going to happen... Here in Cincinnati, somewhere in early May. I have a formula that I developed a few years ago which will allow you to predict when in May they should come out within a plus-or-minus 48-hour period, but we need to have all the April temperatures to do that. So, around the 25th of April, I take the long-range forecasts and I calculate when the cicadas should come out. So, that'll be here around the 12th or the 15th of May. You might see them a week earlier in Georgia because of being further south.

But what will happen, as I mentioned, the soil will be 64°F, a nice soaking rain, and that causes the nymph cicadas to come out of the ground. They start wandering around trying to find a vertical surface to crawl up because their whole purpose now is to shed their nymphal skin and transform to the adult. I have seen them crawl up trees, brick walls, fence walls, tombstones, blades of grass, whatever. [*“Going Up!”*]

They climb up that surface, and they lock their little legs into the tree trunk – let's say it's a tree – with their tarsal claws, getting a nice solid purchase. Then all of the sudden, the back of the thorax splits open. Like somebody wearing a black coat with a white shirt underneath it, and it's just too small, and they split the seam. [*Alie laughs*]

You can see this thing open up, and then it goes up and cracks the head capsule. And then slowly the adult cicada wriggles its way out and pulls itself out to the point where it's hanging upside down, being held in place just by the tension of the old nymphal skin holding on to the abdomen. And you see these white string-like things coming out. Those are the breathing tubes.

Aside: I looked up the time-lapse of this, and yes, those tracheal tubes are like little white threads, kind of like the final ripcord that detaches from its old self.

Also, as I watched the wings inflate in this one video, I 100% started to cry at how beautiful an emerging cicada is. Crying. So pretty!

Gene: The trachea that the cicada breathes by, those are also made of chitin as well. So, when it transforms, it's literally pulling its tracheal tubes... The old ones are being pulled out because it made new ones on the inside.

Alie: Oh, wow.

Gene: If you thought puberty was rough, just think what this is like!

Alie: Yeah, seriously! [*laughs*]

Gene: So it's hanging there by a few minutes, and then eventually it'll start doing what I like to call a cicada sit-up. It starts trying to sit forward but just can't make it. Then it finally can grab a hold of the old nymphal skin and it wriggles its little abdomen free. By this time, it's out, it's clear. It's white in color, it's got red eyes, two black patches behind the head, but the wings are all shriveled. The next thing it has to do is expand its wings, so it starts pumping fluid through the wings. They slowly expand to where they look like a typical cicada, with the

wings held tent-like over the abdomen, but they're still creamy white because their exoskeleton hasn't hardened yet.

Now, this has taken about 90 minutes, depending on air temperature. Now they have to start hardening their exoskeleton, and they'll slowly start turning dark over the next 90 minutes again. Then they'll eventually look like the typical adult cicada with the red eyes, and the black body, and the membranous wings with the orange color on the major wing at the base.

The thing they want to do now is, basically, climb to the tops of the trees. Even though it's dark, it's not completely hard. It's going to take a couple more days; two, to three, four or five days, somewhere in there, before they complete this process of hardening. But they want to get farther up so they're hidden from some of the major predators. Then they start flying. That's when you'll see the birds really attune to them. I've seen this many times, a cicada flying from one tree to another and a blue jay grabs it right out of the air.

Alie: Oh, I bet.

Gene: They're not strong flyers, per se. And at this time, more males emerge the first couple of days than females. That vanguard there is going to give their lives so others can live. Then eventually the numbers start to equal out, and then more females come out in greater numbers towards the end.

That emergence process is going to take about two weeks. They all don't come out in one night. It's not like this massive thing that happens. It's about a two-week rolling period. If you have some cool days in there, it might slow down, it can be a little longer. But on the average, it's about two weeks.

Aside: So, the early male gets... the ax. Just first on the scene, horned up, lookin' for ladies. They are delicious. They're like the first French fry you eat out of the drive-thru. Just... the least likely to survive. Males and females will sprout out over the next couple of weeks all looking for springtime summer lovin'.

Gene: After about five days or so after they've emerged, the males can start singing.

Alie: Yes! So many questions about this. When you say 'singing', what would you say that it sounds like? [*cicada song begins in the background*]

Gene: It's beautiful!

Alie: Yeah!

Gene: You gotta remember: these things got me tenure. [*laughs*]

Alie: [*laughs*] I love it. I think it sounds kind of otherworldly to me. This really, kind of, high-pitched buzzing.

Gene: Yes, it's very much so. There are three species. The calls are different for the three species. The large one, *septendecim*, has a sort of, like, "FAAAIR-oh." [*clip of cicada song: high tone held long, drops low at the end*] When you hear a whole chorus of these things, it sounds like some 1950s science fiction movie that's the sound of the flying saucers flying in.

Alie: [*laughs*] Yeah!

Gene: Then the smaller species, *cassinii*, which is very common in some of the areas that have been turned into suburbs here in Cincinnati, is more of a constant "SHHHHH." [*clip of cicada song: one high-pitch note held long, like radio static*] It doesn't stay all constant in sound and

levels. It will get louder and then drop off. Louder, drop off. The highest I've measured is 96 decibels.

Alie: Oh my gosh! That's about as loud as a rock band playing, right?

Aside: "As a rock band"? I've never been more like your old uncle. But yes, different calls – like the ones on the wonderful, incredible website CicadaMania.com, run by Dan Mozgai – hit different decibel levels, and some are said to approach 120 decibels. I looked it up, and that is the volume of an ambulance siren. So, man bugs, screaming for love.

Gene: Mount St. Joseph's is on the flight path to Cincinnati International Airport, and the cicadas will drown out the jets. If you get the chance to go into a major cicada area, when you're done, after about half an hour of collecting, recording, taking measurements, whatever, you get in the car, the windows are up, and you *feel* like you've been to a concert. [*"Damn you, tinnitus! You're a cruel mistress!"*] It just keeps ringing.

Alie: How are they making that loud of a sound?

Gene: The sound is made by a tymbal. There are two tymbals on the first abdominal segment of the male, and then the male's abdomen is mostly hollow, so that acts almost like a resonator to get it a little louder.

Aside: Think of the belly of a stringed instrument. There's a reason a violin or acoustic guitar is hollow. It's probably also horny.

Gene: And you put 10 or 20 thousand of these in one tree... It's going to add up. And the sound... if you've ever taken a bendy straw, you know the ones that...

Alie: Yeah.

Gene: And you pull it out, and you hear that little snapping sound? Do that about 150 or 200 times in a second, and that's your call for that male. And amplified with the abdomen being hollow, and then multiply that by 20,000, and you might have a good example of a chorus.

Alie: Yeah! Oh my gosh. Ah!

Aside: I know that there is an aside here about hollow males being the loudest, but I'm just gonna let you write that one in your head. I prefer to think of cicadas as just crooning for love; a symphony of sexual desperation giving us outdoor ambiance as the weather, and maybe our love lives, heat up. But also maybe not.

Alie: So it's a chorus. Just a huge chorus.

Gene: We actually refer to them as chorusing centers. Large numbers of males will gather in a tree; the ecological term used is a 'lek.' That's where large aggregations of males occur, and then the females fly in. There are three types of calls that the large species, *decim*, makes. The first is that "FAAIR-oh." Then there's a gap. Just as it gets to the "oh," downturn, the female will flick her wings. She does not have tymbals, so she cannot make a call like the male does. So she'll flick her wings at that moment.

If the male notices that, he'll turn and walk towards her and sing again. If she flicks her wings, he'll walk closer. Then he'll go into a second call that doesn't have that space, that quiet phase, but just keeps going "fair-oh, fair-oh," that type of thing. Then he'll actually start tapping her with his foreleg, and uh, well, they do the nasty. [*"Ohhh yeahhh."*]

Now, if you're a male that's nearby and you hear this female that flicks her wings at the right time, you could steal her by capturing her attention.

Alie: WHAT?!

Gene: When the first male makes the first “faaaair-oh,” when he gets to that “oh” portion, another male might start singing before he gets there so she doesn’t hear the end of the call to flick her wings.

Alie: [*amused laughter*]

Aside: What a dick! Also, apparently, if you are hosting a boy cicada on your hand and you want to prompt it to perform, try snapping your fingers at it. It will mistake the sound [*pompous voice*] for a lady, and then try to impress you. By screaming.

Gene: It’s like a gigantic cicada singles bar with a lot of competition.

Alie: [*laughs*] Someone might literally swoop in and steal your girl.

Gene: Yup. When the sound gets loud and then drops off in intensity, that’s because if a male has been unsuccessful, he will probably fly to another branch or even another tree. Maybe the luck is better over there. That’s why you can hear this very loud, up to 96 decibels, then it drops down to 75 or 80 decibels depending on the number of cicadas there. If you watch the trees, you’ll see this flight going from branch to branch between trees when that happens.

Alie: That’s got to be so great just to pull up a lawn chair, crack a beer, and just watch ‘em jumping around.

Gene: Oh, it is. Last year, when Brood IX emerged, my wife Jessee and I went out to check on the cicadas, and we didn’t realize that we were there just as Tropical Storm Bertha was coming in. We had a good cicada experience, but we didn’t have that *magical* experience where you’re in it and your ears are just ringing with them. So we went back in for another two days. It was COVID time, so we had arranged to go to hotels that had COVID cleaning regimens, and we took our own food with us. We went in there and we had a great cicada fix that we needed to get.

As we were driving back to Cincinnati, we stopped at a rest stop in West Virginia and made our dinner, and they had just started emerging at the rest stop. It was just so pleasant to be there, as a sort of “Sayonara! Glad you came!” to end that trip.

Aside: Should I drive to the Midwest? Should I rent a van and just eff off, and drive through the Midwest, and let these things crawl on my face? I want to, so bad! As we started recording this, Jarrett was like, “Let’s go see them!” and I’m in the sound booth in the closet and I started to cry. It might happen.

Alie: What happens when she is gravid, or preggers, or gets as knocked up as a cicada can get?

Gene: Well, then she’s got to find a place to lay her eggs. She will lay her eggs in the new growth of trees, that’s the terminal ends of the branches of new leaves. There are over 200 species of woody plants that cicadas have been shown to oviposit, or lay their eggs, in. She has a structure called an ovipositor, which she pulls out of a slit at the tip of her abdomen. It has a central rod, and on each side are two structures that are serrated. These structures move opposite each other [*slides hands rapidly against each other*] and literally cut into the wood.

Alie: [*whispers*] Wow.

Gene: A colleague of mine at Kent State University Stark Campus, Matt Lehnert, and his students examined the chemical composition of cicada ovipositors. It turns out that they are also... Like what we see with ichneumonid wasps that lay their eggs in bark, the structures are also

reinforced with metals, and these metals are increased along the side of the serrations. So, they're armored cicadas!

Alie: Oh, wow. That's amazing.

Aside: I'm just gonna restate that for all of us. Cicada ladies' ovipositors are serrated, like knives, and reinforced with metal, also like a knife. Imagine: your crotch is a knife, and you wait 17 years to pierce tree bark with this, a baby shank.

Gene: She'll lay ten to twenty eggs in each little egg nest, which is about a quarter of an inch long. She'll walk another quarter inch down, puncture the tree twig again, lay more eggs, and so on. She keeps doing that until she either runs out of a branch and has to fly to another one, and eventually runs out of eggs. I had a student, Kayla Stallworth, who decided for her research project to find out exactly how many cicada eggs a female has. We sampled females from four different broods, and she counted 16,000 eggs.

Alie: Whoa! So many babies!

Gene: They averaged 506. But that was a range. It could be between 400 and 600, but it was right around 500 eggs. Then you start realizing... Think of all the cicadas you see. How many are reproducing? How many are in the trees laying eggs? Multiply that by 500!

Alie: Oh, that's SO MANY! But they still have quite a trek to make, right?

Gene: They do. After she lays her eggs, she dies.

Alie: Aww.

Gene: The male is dead, and the female drops dead, and that's it. It takes six to eight weeks after the eggs are laid for them to start hatching. That's usually at the end of July or the first of August. Again, talk about sitting in your lawn chair with a beer, watching this! If you're in the right place at the right time, when the eggs are hatching and the nymphs crawl out of the egg nests, and the sun is at the right angle, you can actually see these things drop like little flecks to the ground. That's when they're extremely vulnerable. Spiders, ants, and ground beetles go after these things like crazy. As soon as they hit the ground, they have to find a crack in the soil, usually along a blade of grass, and they get underground as fast as they can.

Aside: So yes, eggs are laid in slits in tree twigs, and then they emerge. Once on the ground, they start looking for 13- or 17-year real estate.

Gene: Not all make it, but that's why they're laying 500 eggs [*laughs*]. They feed on grass roots for the first few weeks, and by New Year's Day, they're 10-12 inches below the surface, latched onto a tree root, sucking. I know it because on New Year's Day, I went out and dug up cicadas.

Alie: Really! So they've already latched on there? Do they spend those cold winters just sucking up sugars from the tree roots?

Gene: Yes, although they're feeding on the xylem tissue. As you remember from biology, xylem is the water-conducting tissue that brings water and minerals from the soil up to the leaves. The phloem has the sugars coming down. So they're feeding on this nutrient-poor fluid for the next 17 years, and not moving more than a yard or a meter in any direction during that time.

Aside: In all my bug lust, I realized that I forgot to ask: Does this hurt the trees? Most arborists say: Not really. The main peril is in younger trees, whose slim little twigs are the bulk of their branches, so it's recommended not to plant young trees a couple years before a

cicada brood emerges. For everyone in Brood X territory who just spent their quarantine gardening, I'm so sorry. But just think, you will have a lot of tiny friends to hang out with for the next 17 years in the backyard.

Gene: It's thought that the long lifecycle might be a response to them evolving and adapting to the ice ages.

Alie: Really? Tell me a little bit about these long life cycles and how they know when to come out.

Gene: There are two life cycles: 17 years and 13 years. The idea is that the 13-year cicadas evolved south of the glaciers, and if you look at 13-year cicada distribution, they're mostly in the southern part of the eastern United States. They don't get into Florida, but they're in Georgia, Mississippi, Alabama, what have you. They come up the Mississippi River Valley into Illinois and Missouri, and they get up into South Carolina and parts of North Carolina on the east.

The 17-year cicadas are generally more north than that, although there are some in eastern Oklahoma that get a little farther south. But in general, it's thought that the ancestor of the periodical cicadas split into two species.

Aside: Gene explained that cicadas are creatures of climate, evolving and separating into different species, and broods, and groups relatively recently in the last ice ages, adapting to ice sheets and going further south, and then advancing north again when they receded. The 13- and 17-year periodical cicadas separated over the last 300,000 years which, geologically speaking, is pretty recently. They then further split into the three 13-year broods and twelve 17-year broods, and Brood X is about to have its moment.

Alie: How do you handle it when people say Brood "ex"? Do you correct them?

Gene: Oh yeah, I have to. I'm a teacher. *[both laugh]* There's a phrase attributed in part to Confucius: The first step toward wisdom is calling things by the correct names.

Alie: *[laughs]* That makes me feel better. I called it Brood "ex" forever, because I thought it was like Generation X. I thought it was even named after Generation X.

Gene: Well, that's what Generation X would like. *[laughs]*

Alie: I know! *[laughs]* Can I ask you questions from listeners?

Gene: Certainly.

Alie: They know you're coming on and they're very excited.

Aside: But before we do, a quick note about sponsors of the show. Because of them, we can toss a cicada-load of money at a worthy cause each week. This week, Dr. Kritsky requested it to go to the Mount St Joseph's University in Cincinnati School of Behavioral and Natural Sciences in Cincinnati. Gene said, "You can designate it for cicada research. Our VP will be shocked." So let's do that! If you feel like tossing a few bucks that way, there will be a link in the show notes. Thank you to the following sponsors for allowing this podcast to donate.

[Ad Break]

Okay, your questions.

Alie: If there's anyone on planet Earth who can answer these questions, it's going to be you. Miranda Hulse-Vincent, first-time question-asker, wants to know: Why are their eyes so big and why are they the best bug ever? *[DJ airhorn]*

Gene: Well, the whole subgroup that cicadas and their relatives belong to is called the Auchenorrhyncha because the eyes are quite noticeable, because of that red pigmentation. But they are a visual insect in the sense that they need to see their mate and look where they're going. Also, they'll feed on fluids under tree bark, and sometimes they'll spray it at potential predators. I've been under Bradford pears, for example, and I thought it was raining because these cicadas were shootin' honeydew at me. *[laughs]* So, they need to know what's going on, and they can aim these things pretty well. I don't know how accurate they could be, but they were hitting me, though I'm a pretty big target compared to a cicada.

Aside: PS: I looked up this sprinkling and there's a page on CicadaMania.com that explains, reassuringly, "You may have been under a cicada-filled tree on a sunny day and felt a sprinkle or two. Don't worry, it is just watery tree sap (xylem) passed through a cicada." Under this, Dan has embedded a video of cicadas doing this, and y'all, it looks like a Super Soaker fight in the suburbs in the heat of August. It is just juicy watersports from a bug rump. Pretend it's a blessing, wipe it off, move on. You're going to be fine.

Alie: Ryan G., Carter Hildebrand, and first-time question-asker Ashley Burdett all had this question, in Ashley's words: I would love to know what they do underground. Do they hibernate until the next instar or is there a whole little cicada world underground? Megan Dawe, Colten Dewitt, a bunch of people had the same question.

Gene: They're not hibernating. They're down there feeding; they're below the frost line. If anyone's ever gone into a cave, like Mammoth Cave, once you get in there, it's about 56°F. Even though it's cold here and it's been cold for the last couple of weeks, it's going to be in the 50s if you go down a foot. So, it's not going to be that bitter cold and solid. I was out digging up cicadas back in November when we had a few cold days, and I was surprised that some of the cicadas that I expected to see 4-6 inches below the surface were already 8-10 inches down. So they're down there, sucking on a tree root, making a tunnel. They're not scootin' around very fast. They're ectothermic animals, so they're going to be moving slowly, but they're not hibernating per se.

And they grow at different rates. One of the differences between 13- and 17-year cicadas is that the 13-year cicadas molt an extra time within that first five years of life, and that triggers their coming out four years early. But I've dug up cicadas seven years into their life cycle and I've found third-, fourth-, and fifth-instar cicadas. By the time the 17-year cicadas reach 13 years, almost all of them are in their last instar. Usually by the 14th year they are. Then they don't grow or molt anymore. They just hang around down there, feeding and getting ready for the magical 17.

Alie: It's bananas that when you see periodical cicadas, at least in Brood X, that they are old enough to drive a car, technically.

Gene: That is true. I've never thought of it quite that way, but yeah.

Alie: It's nuts.

Aside: Many patrons, such as Katie Timothy, Luke, Earl of Greymalkin, Alora Smith, Angela Scarduzio, Zwelf Juniper, Brooke, Nikki DeMarco, Mardee Goodwin, and first-time question-askers Molly Cousins and Alex Bauman, wanted to know: How are they better at time management than people? How do they know when to come out? Is there a stage manager underground? What's happening?

Alie: Do scientists know if there's something chemical that triggers their emergence? How do they sense it?

Gene: Oh there's some experimental work going on now that I'm involved in with my colleagues. We're trying to determine what's the trigger. We know that they can determine year passages by the changes in fluid flow in the xylem. When the tree goes dormant, there seems to be some way they can detect that. Leaf sets and flower sets can trigger that because you'll see more fluid flow.

But what we don't know is how they remember what year it is. We did have an event happen here in Cincinnati in 2006. We had a December that reached 70 degrees and it continued into January, and the maple tree in my backyard leafed out. I was just amazed, this was *January*. And then we had a hard freeze in February; all the leaves fell off. Come late March, early April, the trees started leafing out again. And in parts of Cincinnati where brood XIV was expected to come out the following year, they came out. So, those cicadas thought 17 years had passed, even though they had two leaf sets that occurred in one year.

Alie: [*whispered*] Wow.

Aside: For more on how leaves come and go, by the way, check out the Phenology episodes. Also, heads up Hannah Nuest, I'm about to pronounce your name wrong, and I am sorry.

Alie: And so, this dovetails into a question from several listeners, a first-time question-asker David Orndorff, first-timer Hunter Elliot, Hannah Nuest, and Earl of Greymalkin all wanted to know, in Earl's words: Not to be depressing, but to be depressing, how is climate change affecting cicadas? And Hunter wanted to know: Could their hibernation cycles be altered because of it?

Gene: That's one of the things we're looking into, and it seems possible. As I mentioned, they are climate insects, if you will. They emerge when the soil temperature reaches 64°F, and prior to 1950, the average for Cincinnati was May 28/29th. Since 1950, and in the last few years, they're now coming out between the 13th and the 16th of May. So, spring is out two weeks warmer than it was back in the first half of the 20th century. And that's not surprising.

Anybody that goes to a garden store sees these growing season charts, and they'll notice that the planting zones are moving northward. What that could do, for example, if you had what happened in 2006 to 2007, where it seemed to the cicada nymphs that two years had passed, because of the trees, they might molt in that first five years, which would trigger a four-year early acceleration of emerging, off-cycle.

And that's actually happened! In 1991, my students in my ecology and evolution classes, which was an alternating course I taught at the time, we'd go out to the orchard at the university and we'd dig up cicada nymphs, to sort of drive home the scientific method. I gave this wonderful paper written by Monte Lloyd and JoAnne White, that talked about the difference between 13-year cicadas and 17-year cicadas. And it said what stage of growth they should be at each year.

I said, "Okay, these cicadas laid their eggs. They hatch in 1987, this is 1991. What stage should they be at if they're Brood X cicadas?" And to drive the point home, I had them write it on a card, they put the card in an envelope, they sealed the envelope, they signed the seal.

Alie: [*laughs in anticipation*]

Gene: And then we got shovels and we dug up cicadas [*drumroll*] And the cicadas were bigger than they should have been.

Alie: [*amazed exhale*]

Gene: So what that meant to me was they were going to come out four years early.

Aside: So in 1999, the year before they were supposed to emerge early, Dr. Kritsky presents a paper like the Nostradamus of cicada wizards. So much is on the line, he's making a *huge* prediction. Y2K rolls around. Cicadas should pop out early, according to his forecast. Were they right? Did they come out?

Gene: And they came out.

Alie: Oh man.

Gene: And in massive numbers. It was mind-boggling! At that time we didn't have an app to help us map these things. The wife and I used to help. I used an answering machine and one woman called and said, "Why are all the cicadas in my front yard?" And so my students and I went out to look for them, and sure enough, her yard was *packed* with these things. But what was exciting was they were singing. Usually, when cicadas emerge off-cycle like that, they all get eaten by predators because they don't come out in large enough numbers. They were singing, they were mating, they were laying eggs!

Alie: What's going to happen to that one? Is it going to get off cycle now, or is it going to step in line with the rest?

Gene: That's what we wanted to know. Of course, that's the problem with working with cicadas – this is the year 2000. So I went back in 2013; my wife and I went to the study site. And by the way, this is one of five places in Cincinnati where this happened in 2000. And they started coming out, they were coming out and we found shells all over the place. Hundreds of them came out. We'd go back the next day, and we couldn't find a single adult cicada. Those cicadas did not survive predation to reproduce in 2013.

Alie: Wow.

Gene: Wait four more years... Now you remember, this is now 17 years later. If I worked on fruit flies, I'd have this done in two months. But no.

Alie: [laughs]

Aside: This last early emergence happened in 2017. Adult cicadas who were just little baby eggs in that early 2000 emergence mated all around Cincinnati, and their babies were on time, 17 years later. Not in one backyard, but at 33 different locations. So what happens to all these early-bird cicadas? Things are all out of sync!

Gene: What we've seen now is the origin of a new population of Brood VI.

Alie: Oh wow!

Gene: And we thought that would be what's happening, because if you look at certain places here in Cincinnati, we have Brood XIV adjacent to Brood X, four years apart. Now, VI is there. In the Eastern States, we got Brood IX adjacent to Brood V adjacent to Brood I. Some kind of genetic switch that triggers a four-year cycle may be coming into play. We see these patterns that correspond. So I feel like the cicadas revealed one of their secrets.

Alie: And you can start to tease out the mechanisms of that chronobiology?

Gene: Yeah, and get a sense of what's really happening. It's just so cool. And it's neat that people realize evolution is happening in your very backyard.

Alie: Mm-hmm. Would you say that you're a patient person, overall? Do you think that's what enables you to deal with these long stretches?

Gene: Well yeah, I am patient. I also have other things I like to talk about and work on. *[laughs]*

Alie: Okay, you're a multitasker.

Aside: So yes, Gene has many professional obligations, publishing deadlines, and pet projects. Oh, speaking of pets...

Alie: Listeners Redtoque, first-time question-asker Miranda Hulse-Vincent (who was very excited about this episode), Rachel Casha, first-timers Gracie Vandiver and Victoria Boatwright, a lot of them wanted to know about cicadas as pets. Miranda asked: Can you keep them as pets? Do they make good pets or not at all?

Gene: Well, if you don't mind a pet that you don't have to play with because it's underground. You can't dig them up, and play with them, and put them back. That's not going to work.

Alie: *[laughs]*

Gene: So yes, I have a lot of cicada pets in the woods behind my house here, but they're not like a dog. It's like, what's the difference between dogs and cats? Dogs need lots of attention, they demand a lot, and some cats do as well. But cats are like having an older uncle or aunt hanging around.

Alie: That's nice. It's mellow.

Gene: But with cicadas, you can certainly have them as pets when they come out as adults, but you've got to be prepared for early disappointment because they will die in about a month.

Alie: And maybe if they're boys, they might be just singing their heads off.

Gene: Yup.

Alie: Okay.

Aside: On the topic of heads, let's talk about mouth holes. And yours. And putting cicadas into them. So many listeners on Patreon including Laurent Duverglas, Rachel Casha, Mitch Hughes, Crystal, Jess Swann, Monica Rasmussen, Val Lucas, Meghan McLean, Heather Densmore, Kathleen Sachs, Daniel Zalana, Zoe Jane, Emily Z, Hollis, Erin Magleic, Katie Timothy, Meredith Loy's cicada-loving partner, Devon Robertson, Samantha Mitts, Alyson Ewald, Shelagh Leutwiler, first-time question-askers GG (who once accidentally ate one while playing volleyball), Gavin, Eve Ross, Paul Smith, Tim Dodge, shellfish-allergic Kevin Beamer, and Leah Darpel, who wrote in: Are they safe to eat? I ask because I once watched a friend's dad smear a live one with peanut butter and pop it in his mouth.

Alie: Some people wanted to know why their dogs like to eat them and others were curious if you have ever eaten cicadas.

Gene: I think dogs like to eat a lot of things. They're general eaters. Actually, my cat Budno was maybe the only cat in history to have fresh, live periodical cicadas for five consecutive years. Jesse and I would drive around to all the broods coming out. And with that cycle, when you get to Brood I, there's a cicada brood almost every year for the next 10 years. So I made it a point to bring him home come cicadas to play with and eat.

To answer the other question, yes I have eaten cicadas. I don't make a habit of it because one of the things I'm really actively concerned about this year is: Are cicadas under threat? But getting into the culinary experience, I've had them deep fat fried, I've had them sauteed, I've had them in salads and stir-fries. If you feel like you need to eat cicadas, you want to collect a right as they're emerging from their shells because they're nice and white and soft.

If you should eat them when they're all dark, it's like eating the tail end of the shrimp, the part you hold to dip the shrimp into the cocktail sauce. You can't eat that sort of papery, parchment-like stuff, it's just too solid. That's what it's like eating an adult cicada that's mature. You also want to eat females because they're filled with eggs, whereas the males are mostly hollow, so you get more nutrition from the female.

Alie: Oh! Eve Ross, a first-time question-asker, says that they know some entomologists who shake the trees and have cicada-eating contests. Have you witnessed this ever??

Gene: No.

Alie: Okay. [laughs] I was like... you've really just got to gorge yourself on that.

Aside: Every year that periodical cicada broods emerge, there are people eating them. So make no mistake, there's even a cookbook called *Cicada Licious*. And some folks say they taste like lobster popcorn, shrimp, or nutty and buttery. And for more on eating insects, check out the episode we did Entomophagy Anthropology in January 2019 and I'll link it on my website.

But different Indigenous groups have varying relationships to the cicada in diet. It can represent eternal life or even hardship, as the Onondaga Nation, located in what is now Upstate New York, relied on them for sustenance after their people were attacked and crops were torched by colonists. So, the bugs can be symbolic now of resilience and sacrifices made by their ancestors.

Patron David Orndorff asks: Are we looking at dwindling populations? I experienced the last Brood X emergence in Baltimore where I grew up, and it was a wild experience! And Hunter Elliott says: I need there to be as many cicadas as possible in my life. They are the beautiful bug-eyed screaming monsters that sparked my interest in insects as a child. So what kind of headcount are we talking?

Gene: It's interesting. In the 1890s entomologists at the USDA were getting kind of worried with all the deforestation for agriculture, thinking that would have an impact on cicadas. And that's mentioned in the USDA works by Marlatt in the 1890s. In 1919, headlines and newspapers around the country talked about Brood X emerging, saying it's probably on its way out, there's concern that it's going extinct. As crazy as that sounds, it's happened. Brood XI, which emerged in massive numbers in 1699, just outside of Boston went extinct in 1954.

Alie: [gasp] Wow.

Gene: Brood XII, which occurs in upstate New York, is only found in two counties. That's probably going to be next. It's on protected land, so maybe that'll help. But one of the things that my undergraduate advisor Frank was really concerned about and talked about this in the 1950s, and then he and I worked on it in 1987 was, are we seeing signs of periodical cicada Brood X decline? And we are. ["Noooooo!"]

Brood X was known to occur in every county in the state of Indiana, and now it's... In the upper third of the state, it's highly fragmented. You have to sometimes drive miles between emergence zones. There are parts of the southern part of the state that have massive numbers that are still there, but that's been going on. Here in Ohio, in northwest Ohio, several counties that reported cicadas in the late 19th century, early 20th century, no longer have cicadas. So, one of the things I'm hoping that we do with people helping us with the Cicada Safari app is to really give us a good picture of the status of Brood X.

Aside: Before everyone had cameras, and omniscience, and global connectivity in their pockets, folks sent out letters. In 1902, scientists sent out 15,000 letters to schools, and postmasters, and railroad conductors asking, “Hey, if you see or hear this beautiful shrieking bug, just give us a heads up.” But these days, with the Cicada Safari app that they made, Gene’s team was able to capture nearly 8,000 recorded sightings of an early emergence of Brood IX, something they could never have done with grad students on horseback, or dusty letters handed out across the nation.

So if you’re underwhelmed with dating app options, just go on an insect safari in a local park and upload some horny bugs. Maybe wear an *Ologies* shirt and you’ll find your soulmate also looking for horny bugs, and I will officiate your wedding. Maybe. Just saying.

Alie: And so, now people can download Cicada Safari, and... They take a picture and let you know where they took it? Like, geotag it?

Gene: Yeah. We want to do two things. We want to help people have more enjoyment with the cicadas. So after you download the app – and it’s free! It costs no money. We don’t collect the data to sell to people, none of that. The Center for IT Engagement develops apps to engage a user, to provide the research data I need so that I can map out cicadas.

And so we encourage people to go on their own cicada Safari. And if they see one, they take a photograph and submit it. I’ve got a group of colleagues who are volunteering and working to help us identify and examine every photograph. And we are expecting 50,000 photographs.

Alie: [*excited squeal*] That’s great.

Gene: We’re hoping for that. I’ve been told to expect maybe 65,000, so we’re not sure how this is going to go, but we’re looking forward to being overwhelmed.

Alie: Great!

Aside: US Ologites: Do. Your. Thing. Cicada Safari app!

Gene: So each photo is a voucher specimen that, what they’re looking at is a real periodical cicada. That’s important. We want to verify that the observations are accurate. If they are, they’re put on our live map. And so users of the app can follow the emergence when it starts in Northern Georgia and slowly see it move north as spring moves northward in April and May and June. With the new version that we put out last year, we can also receive 11-second videos. And from the videos, we can hear the calls. And when you hear the calls, you get to identify the species.

Aside: [*satisfied whisper*] Nice!

Alie: So everyone in the US where there are cicadas: get your cameras, get your phones ready.

Gene: The cicadas are unique to the eastern United States. They don’t occur any further west than eastern Kansas and Nebraska. Our friends in Philadelphia, our friends in Washington, Baltimore, Indianapolis, Louisville, Nashville, those metropolitan areas – that’s important. Get Cicada Safari and help us find out what’s really going on with this massive brood.

Alie: That’s great. A few more questions from listeners. Zoe wanted to know: How do people’s feelings and associations about cicadas vary in different cultures and places? And also, a lot of listeners are... Personally, if I see one, I want to hug it. I get so excited. But some listeners are scared of them. So how do feelings differ? And what’s the best way to embrace cicadas in your heart?

Gene: Well, let's do the cultural first... Cicadas are amazing animals as we've been talking about, but there are some really interesting cultural differences. In China, during the Han dynasty, you'd find cicada amulets – pieces of jade carved in the shape of the adult cicada – placed on the tongue of the deceased as a means of ensuring resurrection or rebirth. When I visited the Jade Buddha temple in Shanghai when I was lecturing in China in 1986, they had a little store right next door to the temple that sold religious artifacts. It's much like we see here in Cincinnati, some of the Catholic churches have little shops to sell crosses, and amulets, and what have you. And they had these large, wooden, carved cicadas. It turns out that when a Cicada nymph crawls out of the ground up the tree, out of the dirt and everything else, and sheds its skin, that's symbolic of the Buddha reaching the next level of understanding.

Alie: Oh, wow! That's beautiful!

Aside: Who doesn't love a makeover, especially spiritually? Those ghostly shells that they leave behind are called exuviae and, truth be told, I almost named my company Exuvia because I love them so much! It's just such a cool reminder that you can chill, and get ready, and then boom! Blast out and be like "I'm fabulous!" and then hopefully no one puts peanut butter on you and eats you and talks about it for 17 years.

Gene: And we have found now sketches by Van Gogh of cicadas. We've got a couple of DaVinci cicadas. They're not very big, they're on rebuses. In Japan, there are wonderful examples of cicadas in those scroll paintings and watercolors, just gorgeous. And here in the United States, Kokopelli for example is thought by many to be a cicada. You know, the flute player. So that flute is the proboscis of the insect. It has a big hump behind the eyes, so it's got the humpback, it's bent over, and it sings.

I'm trying to think of other cool examples. In 1970, Bob Dylan got an honorary degree from Princeton University, and while he was there receiving his degree, the cicadas are screaming in the distance. What does he do? He goes home and writes the song about "the locusts sang for me."

Alie: Oh, beautiful! That's a beautiful thing. Did any get stuck in his hair?

Gene: No. Allegedly, the story goes that he went there with David Crosby, who sat in the front row with the dignitaries. And he made small talk with Coretta Scott King, who also received an honorary doctorate that year. He got his cap and gown. He didn't address the group. He just got his honorary doctorate and walked off stage, took off his cap and gown, gave it to somebody, and drove away. So you wonder then, how closely did he listen? Because he was actually really tuning in to the cicadas.

[clip from "Day of the Locusts" by Bob Dylan: "Oh, the locusts sang off in the distance/Yeah, the locusts sang and they were singin' for me."]

Aside: So, to Patron Umair Khakoo who asked: Is there any music that was inspired by cicadas singing in the summer? There's at least one. And Cicada Mania also has a whole page devoted to cicada-themed songs. And again, there are Indigenous nations who are said to have paid homage to them in their drum rhythms. So when you hear them, just think of them serenading you because they are so happy to see you after all this time! And unless you are a tree, they do not want to bite you. So, all the patrons such as Rainbow Warrior, Emma Parks, Amy Miller, first-time question-askers Taylor Noel, and Stirling Mackie, and Kate Rumpy, who would like to be assured that they are not a baby, would like to know: How not be I scared?

Alie: What's a way to get over your fear of them? They don't bite us, do they?

Gene: No. Some people, if you grab them... If you're afraid of them, you're not going to be grabbing them per se. They're lovely little animals and you should always face your fear. So go out there and really get yourself involved with the cicadas. Watch the slow-motion dance they do as they shed their skin and turn into adults. Listen to the chorus. When Gideon Smith, this individual from the 1840s, wrote in 1851, he was talking about Brood X. And he said (I'm paraphrasing here): "While some people find this a sad song, I enjoy hearing it, but I was melancholy as I heard it because I wondered if I'd live to hear it again." He died one year before Brood X emerged the next time in 1868. He died in 1867, a year before.

Alie: Wow.

Aside: I could have sworn that Earl of Greymalkin wasn't the only one who asked this, but:

Alie: A few people wanted to know: If Mothman exists, is there a Cicadaman somewhere?

Gene: Not officially, but although this sounds self-serving, there was a headline in 1987 that referred to me as "Cicadaman," in Cincinnati.

Alie: [laughs] Oh, that's amazing!

Gene: I've been called a lot of things in my life, but that was a first.

Alie: What about... The last few questions I always ask: Worst thing about cicadas – don't worry, I'll ask the best – but the thing about your job that is the most annoying, or difficult, or irksome. Does anything really stick in your craw?

Gene: Well, irksome is a good way... it's not that it angers me by any means, but I don't like it when people want to just step on them willy-nilly. That bothers me.

Aside: [clip from *Lucas*, distressed female voice: "Oh my god, it looks like a huge M&M!"] Anyone see the 1986 Corey Haim vehicle, *Lucas*? Gene didn't, but if you did you might remember a young Winona Ryder and Charlie Sheen and a subplot of emerging locusts, which for some reason they did not call cicadas. Either way, my sisters and I can quote entire scenes of that movie. Lotta great bug shots, just gotta say. But what else irks Gene?

Gene: I do get a lot of questions about eating them, and that's understandable because the whole reason they were called locusts, in part, was related to people looking at these insects and trying to interpret what these things were using the King James Version of the Bible. And John the Baptist ate locusts. We knew that the Indigenous people of New England ate locusts. When they came out in 1715, the report from a reverend in Philadelphia said the English split them open and ate them because they said that they were the locusts eaten by John the Baptist. I can't eat... Right now, if indeed the cicadas are in decline, then I really don't like killing them per se, because I want them to be around for many centuries.

Alie: That makes tons of sense. Every 13 or 17 years, hopefully someone will write in a journal about their experience, you know?

Gene: Oh yeah. You'd be surprised by the number of letters I'm informed about. If I hear of somebody that's got a letter archive, I'll give them dates and what to look for and see if there's any mention of cicadas or locusts, depending on the time period.

Alie: That's great that you can say, "Look in spring-ish and this year."

Gene: And one thing people could do if they want to have the fun themselves: The Library of Congress has a wonderful website called *Chronicling America*, and they've been digitizing newspapers from the late 1700s to 1963. If you're in a cicada area – you could find this out in my book, *Periodical Cicadas: Brood X Edition* – you can look up what year. If you've got

cicadas in your area based on the distribution maps, you can look at what brood they are, or what year they came out, and then go back into *Chronicling America* for May through June and look for stories on locusts, if it's early, or cicadas. Do both because a lot of times, even in the 1760s, they were talking about, "These things aren't locusts, they're cicadas!"

Alie: Oh, that's so cool. There's going to be so many people going back in time into history!

Gene: And they should talk to their grandparents, if they're lucky to have their grandparents around, if they were around for cicadas and what they remember about them. And they may remember what *their* grandparents told them about the cicadas. So, it's a multi-generational insect. That's for sure.

Alie: I know that there's so much that you love about them, but is there something that is your *favorite* thing about cicadas?

Gene: Oh, wow. There is something about when they first start coming out. I will go out with my tripod, my iPhone, and my flashlight and I'll set this thing up and I'll sit there for hours, photographing a cicada. I've got probably 20,000 pictures of this now, but it never gets old. It never gets old. And that's almost like a Zen moment when that happens. And then to the opposite extreme, but still fun, is when the numbers are really big and they're screaming. It's just fun. It's just great.

[whispery cicada "shhhhs" fades in]

So, ask world-renowned experts basic questions, even if you have to wait 17 years to do so and you screw it up for the first couple of minutes. At the link in the show notes you will find Gene's fresh, newly emerged, soft and squishy book, *Periodical Cicadas: The Brood X Edition*. It's 13 bucks in paperback, and it's available in e-reader too, and it'll make your whole year. You can get the app Cicada Safari and help Gene's lab track these suckers.

Gene's wife Jessee is a silversmith and fellow bug nerd and sells her gorgeous entomological creations via SilverSpotStudio.com which I'll link in the show notes as well. Cool stuff! You can learn more about cicadas from Dan Mozgai's website, CicadaMania.com, which is wonderful, and he has an [Instagram](https://www.instagram.com/CicadaMania), @CicadaMania. I highly recommend following them.

I am @AlieWard on [Twitter](https://twitter.com/AlieWard) and [Instagram](https://www.instagram.com/AlieWard), and the show is @Ologies on [Twitter](https://twitter.com/Ologies) and [Instagram](https://www.instagram.com/Ologies). Thank you to Erin Talbert who admins the incredible Ologies Podcast Facebook group. Thank you to cicada-obsessed Shannon and Boni of the podcast *You Are That*, who manage Ologies merch at OlogiesMerch.com. Thank you to all the Patrons at [Patreon.com/Ologies](https://www.patreon.com/Ologies). Hello *Ologies* Subredditors, also! Thank you to Noel Dilworth for scheduling this, including when I got locked out and you had to send a new link.

Thank you to Emily White and all the transcribers for making transcripts available and free, those are on my website and they're linked in the show notes. Thank you to Caleb Patton for bleeping them. Bleeped versions – safe for kids – are also on my website and the link's in the show notes.

Thank you to assistant editor but show producer, Jarrett Sleeper, who took the first crack at this week's edit for me because I have had a *bananas* few weeks with *Innovation Nation* shoots. Jarrett, you are the wind beneath my wrinkly and soggy cicada wings. And of course, thanks to editor and Magic Cicada, Steven Ray Morris, who hosts the *Purrrrcast*, *See Jurassic Right* and *Everything but the Movie: A Star Wars Book Club* podcasts. Nick Thorburn wrote and performed the theme music.

If you stick around until the end of the episode I tell you a secret, and this week the secret is that *[laughing]* I've recorded a secret, like, 15 times but I keep losing my train of thought or I change the secret. One of the secrets I recorded for this was, like, "You know what's really good instead of iced coffee is just putting hot espresso over ice because then it's not too watery!" And then I was like, "That's not a good secret!" And then I recorded a secret about how this is coming out later on a Tuesday because Grem spent Sunday projectile vomiting on clean bedding, and it turned out we had to take her to the emergency vet and she got X-rays. She had just eaten some rocks because she was like, "Woohoo, rocks!" She's gonna be fine.

Also, I have to be downtown on a shoot, camera-ready, in *29 minutes*, and I am in my pajamas. My pajamas are pulled up WELL past my navel. And this morning the garage door fell off its hinges, there was an owl hooting, and a garbage truck... Anyway, I'm having a real *[singing]* MONDAY of a Tuesday! But we're here and I wanna see cicadas this year. Okay. Berbye!

Transcribed by:

Scott Metzinger

Elinor Austin

Madison Campbell

Your neighbour with a 'u' up North, Aska Djikia. With the emphatic, deafening SCREE of a cicada: Aska, out!

Florence Yuan, your friendly local family medicine resident physician who is happy to chat about anything from contraception to constipation.

More links you may find of interest:

A donation was made to [Mount Saint Joseph's](#) cicada research in the School of Behavioral and Natural Sciences

[United States periodical cicadas: where's your closet brood?](#)

[Entomophagy Anthropology: Eating bugs!](#)

[How loud are different noises?](#)

[Cooking cicadas?](#)

[Gardening and cicadas](#)

[Cicada drinking and peeing!](#)

[Cicada pee via CicadaMania.com](#)

[Annual cicada \(green grocer\) emerging from its pupal case](#)

[Onondag Nation's relationship with cicadas](#)

[Songs about cicadas via CicadaMania.com](#)

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