

Ask A Biologist Vol 060 (Guest: Marlene Zuk)

**Strange Cricket Silence**

The evening cricket chorus has gone silent on the island of Kauai. Behind the mystery is a parasite fly that is using male crickets as a factory and incubator for future flies. More gruesome than a science fiction movie, this is real. Dr. Biology talks with biologist Marlene Zuk about how Nature has come to the rescue of male crickets so they can mate and also live to see another day.

**Transcript**

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**Dr. Biology:** This is Ask A Biologist. A program about the living world and I'm Dr. Biology. Imagine a warm summer night. You're out walking with friends or family and you're listening to the chorus of crickets singing.

[cricket songs in the background]

It's the song of summer. It's heard while walking in the park, camping in the mountains, or maybe just in your backyard. It's as much a part of our lives as birds singing at sunrise. So now you have that chorus of crickets going and suddenly it stops.

[sounds stop]

Now what might seem a small loss to humans and for some of my friends they would think great, they might even applaud, it's much more of a problem for a male cricket in the Hawaiian Island of Kauai. Without their song, which is used to attract females, these crickets are unlikely to find a mate.

Now if they do sing...

[buzzing flies in the background]

... well, a clever fly, a parasite might find them and turn them into a factory to make new flies.

[single fly lands]

The whole story is a big gruesome. It has a sad end for the male cricket, but nature is also clever and the male crickets have changed their mating habits and in a very short time.

My guest today is Marlene Zuk, professor of Biology at the University of California, Riverside. She, along with researches in her laboratory, discovered a strange cricket silence and they're unlocking the mystery behind the story. Welcome to the show Marlene Zuk and I really thank you for visiting with me today.

**Marlene Zuk:** Well, thanks for having me.

**Dr. Biology:** Let's start off with the short story. What's up with these poor crickets?

**Marlene:** So, the first thing to know is that from a cricket's perspective singing is his whole life or at least from a male cricket's perspective. That's just what he does and he does it not because it's pretty or he wants to torment you in your bedroom, but because that's the way he's going to get a female cricket and have babies.

That's the only way he's going to get a female cricket and have babies because they're outside at night, it's dark, and they can't see each other, so he has to get her to come over to him by singing to her.

**Dr. Biology:** Makes sense to me.

**Marlene:** The problem is that if he can be heard by a female, he can also be heard by somebody he wasn't really intending to call to and in this case, that's that fly that you mentioned. So the fly hears the same song that you hear, and that a female cricket hears. When the fly hears it, the fly comes over and she doesn't mate with the cricket because she's not a cricket.

Instead, she puts her babies on the cricket and around the cricket and those babies burrow inside the body of the cricket while the cricket is still alive.

**Dr. Biology:** You know, I saw a picture that you had on your website and it actually made me think of the movie Alien, only this isn't one alien is it?

**Marlene:** It's not and also it's real. This isn't an alien that somebody made up in a book. This happens all the time and it happens practically under your nose it's just that you don't know where to look for it - maybe. So the cricket ends up with this maggot inside of him and he's just going about his business.

So he's still alive, but the maggot is crawling around inside the cricket's body and at first it just eats little bits of fat tissue and things that are maybe not so necessary and, I don't know, maybe people think it would be kind of a nice idea to have a maggot inside them to keep them from getting too fat.

In the long run it's not a very good idea because eventually it runs out of fat to eat and it starts eating the cricket tissue and after about a week it eats the organs, and it eats the guts, and the insides, and eventually the cricket is just like this shell with this big, pulsating, white larvae in it.

Then finally, and this is where the alien part comes in, the cricket shell bursts open, the larvae comes oozing out, and so much for the cricket.

**Dr. Biology:** You actually said they can live quite a long time. You said it walks like a cricket, talks like a cricket, but you open it up and it's mostly filled with these maggots.

**Marlene:** Yep. That's exactly right and so it looks like a maggot from the outside but appearances can be deceiving.

**Dr. Biology:** Wow. OK, I'm a cricket. I'm a male cricket and unfortunately I'm one of these male crickets on the island of Kauai and I like to sing and if I like to sing I'm going to be in trouble because I'm going to get this fly. What do I do?

**Marlene:** Well, you can do some different things, so for example, you might be able to do some kind of minor like not sing during the time when the flies are the most active or maybe change the notes that are a part of the song. But that's not going to get you very far because it turns out that everything you do to avoid the fly finding you also makes it harder for the female to find you and that's the whole point of singing so really you're stuck.

**Dr. Biology:** So, this is the dilemma. I can't sing and if I can't sing, I can't get a mate. When you would go to the islands for your research, you would always hear this chorus of males out there singing, but something changed right?

**Marlene:** That's right. We were going and collecting crickets and using them for a whole bunch of different things, but then on Kauai in particular, there were fewer and fewer crickets and I thought well the flies were just going to knock them all out and that was just going to be it. I took fewer and fewer and I thought OK you know the next time there just won't be any and I'm just going to have to work some place else, but we went one more time and I didn't hear anything, so OK I thought that was it.

But then when we were walking to the place where we usually work it was dark of course because you only work on crickets when it's dark because that's the only time they're active.

I suddenly started seeing in my headlamp all these crickets but they weren't making a sound. So you have to understand if you're a cricket and you you're not calling then it's like you're betraying your crickethood. You are not being a proper cricket because crickets call. That's what they do, but here were all these crickets and they weren't calling.

I picked some up and I looked at them to make sure they were the right kind of cricket and they were the right kind of cricket, they just weren't calling.

**Dr. Biology:** Right, because not all crickets are the same, right? There are different species of crickets.

**Marlene:** There are lots of different species of crickets and you can tell them apart by their songs. So some chirp really fast, some chirp slow, there are hundreds and hundreds of kinds of crickets all over the world, but these crickets have their own song and I've gotten really used to it because I've been studying it for a long time. Yet there I was standing there in the dark, in the field, holding a cricket, looking at other crickets and none of them were making a sound.

**Dr. Biology:** So all cricket songs are not the same and that's how you can tell different crickets?

**Marlene:** It's like their signature and they've got different songs for every different kind of cricket or just like you can tell a cardinal from a blue jay by the song, well you don't even have to look at it to know what kind of animal it is. It's the same thing with crickets. You don't have to look at them to know what kind of cricket it is because their songs are different.

**Dr. Biology:** And also it's only the males who are doing the singing?

**Marlene:** That's right, because the males are calling to get the females to come over to them to mate.

**Dr. Biology:** So that lonely cricket in your house that's driving you nuts at midnight is a male?

**Marlene:** Always.

**Dr. Biology:** [laughs] . So you don't have to say he or she or not know if it's a he or a she, you will know it's a he when you're tracking him down and you'll actually might have a little bit of pity because you'll know what he's doing. He's not trying to keep you up.

Now, we should talk a little bit about how crickets make their sounds because we have a larynx and we actually have vocal chords and so we make a sound using that apparatus and birds have a similar process, they're called syringes. Crickets don't do the same thing do they?

**Marlene:** No. Crickets make really different songs and so do grasshoppers by the way. Crickets make songs by rubbing the backs of their wings together and so you can think of it like what happens if you were going to rub your thumbnail against the teeth of a comb. It would make kind of a raspy noise and if you were able to do it really fast, it would make kind of a (thrrp) noise. Well, that's exactly the noise that crickets make when they close their wings.

It makes a little (thrrp) noise and we call it a pulse.

They can close their wings really fast because they have muscles and nerves that are able to be very well controlled so they close and those groups of little pulses, make what you hear as your chirp.

And it goes faster when the weather's warmer, and slower when the weather's colder and so some of you may have heard that you can actually tell the temperature by how many chirps, per second or per minute, you hear.

And with some species of crickets that's true. You can actually calculate how cold it is in degrees by using a formula by adding, and subtracting, and multiplying some numbers and if anybody is interested we can tell them where to go to find out that information.

Anyway, so you can find out how cold it is by listening to how fast crickets chirp, but these crickets have their own song that they make, but even though they were there and I saw them and they look like crickets, they still weren't making it.

**Dr. Biology:** They still weren't making it. So does that mean that the crickets were no longer beating their wings or rubbing them together?

**Marlene:** No, it turns out they still rub their wings together, but nothing happens. It's as if you open your mouth and move your lips, but you're not making any noise with your larynx. It's not because they wanted to but couldn't or you know wanted to but didn't or had some other reason for not doing it, it's that they were physically unable to make a sound. The structures on their wings, like your thumbnail and the comb, were completely missing.

**Dr. Biology:** Wow.

**Marlene:** They could just rub their wings together but it would make the same amount of noise as if, you rubbed your palms together. It just wouldn't do anything.

**Dr. Biology:** OK, so they used to have the structure on their wings that behaved like this comb structure to make the sound. They no longer have it. How quick of a change are we talking about?

**Marlene:** What happened was, of course, like all the other structures on a cricket's body and for that matter your body, there are genes that control what you look like. So there's a gene that's responsible for making these structures on the wing, so you have to have the right DNA that produces your wing structures.

These crickets had a change in their DNA; a change that we usually think of as taking a really long time, but in this case happened in what we think is less than 20 generations. That's incredibly fast to get a genetic change happening in a population.

**Dr. Biology:** Well, with humans, 20 generations that could be a long time, but for crickets what are we talking about?

**Marlene:** Five years.

**Dr. Biology:** Five years? Wow. So when you say that we have this rapid change over five years, we're not suggesting that these singing males somehow have modified their wings? They just basically caught on to the fact that these flies come in and so they just rip off the parts that make them sing. We're talking about something different.

**Marlene:** That's right! Because of course an individual cricket only lives maybe two or three weeks at most. So, if we're saying change that happened over five years, that means generations of crickets. So it means that the crickets that happened to have a trait that made them survive and made them not get nailed by the fly, they had more babies that then also had that trait and then that spread more and more and more.

**Dr. Biology:** Right. And so we end up with a whole lot of non-singing crickets and just a few of the singing ones.

**Marlene:** Exactly!

**Dr. Biology:** Hypothetically, what would happen if there were no singing crickets?

**Marlene:** I think if all the singers went away then eventually the population would really go extinct. And there's no guarantee, it might happen like that. I just don't know. I mean, it's one of the things that makes going back to see what the population's doing so exciting.

**Dr. Biology:** OK. So now I'm going to use the e-word and yes, that means evolution. And the reason I want to bring it up is, many people are curious about evolution. They are curious about it because they often don't think they can see it. Scientists talk about it and we talk about evolution over long periods of time. And so, often people say, "Well, if I can't see it, if it doesn't happen in my lifetime it's a little hard to believe it." Now we're talking about something that is happening within five years. So let's talk a little bit about the crickets and this evolution that occurred.

**Marlene:** So, we think this is one of the fastest cases of evolution that's happened in the wild. There are some other ones that people have known about for a long time. There are some birds that have evolved very quickly, there's fish that have evolved very quickly, there are other insects that have evolved quickly. But partly I think it's really cool because it was what I was studying but also, five years is really fast!

**Dr. Biology:** Right, that's incredibly fast. And you also mentioned in the wild and I think that's an important point. This isn't something that a scientist changed in the laboratory, this is nature at work, right? So, here we are, it's going on, it happened in five years. So, we had crickets that could sing by rubbing their wings together. Five years later they can rub their wings together but they're not singing. Now, the ones that can't sing, do you ever find any parasites inside them?

**Marlene:** No, we've actually checked and if you cut them open they just don't attract the fly!

**Dr. Biology:** So, it's been very effective?

**Marlene:** Very effective!

**Dr. Biology:** OK, so we've taken care of the flies. Well, now we have another problem, don't we?

**Marlene:** Well, yeah! Because of course, the whole point of singing to begin with is so that the male can attract a female!

**Dr. Biology:** Yeah. So, how are you going to do that if you can't sing?

**Marlene:** It's a big problem and that was what we were really interested in when we first found out that this evolution had happened so fast. Because of course, the crickets had just changed! The first clue we had that they were still managing was that there were still just a few callers that were out there. So you could still hear just a few crickets even though most of them showed this genetic change, there were still a few that still had the regular wing shape and all the regular wing structures.

So, then we thought, well, OK. The females are still going to be attracted to the males that are calling. Well, if I'm a male that can't call but the females are still going to the males that can call, maybe if I just hang around the males that are calling, I could find a female that way.

**Dr. Biology:** How does that all work? Because it seems like sooner or later, wouldn't we run out of crickets that could call?

**Marlene:** Well, we might expect, remember, the females, they'll mate with a male that can't call if they run into him and if they haven't mated it in a long time and if some other things were true. But all else being equal, they'd still way rather mate with a male that can call. So, the few that are calling have this big advantage over all those silent ones.

**Dr. Biology:** Oh, OK, I get it. So, there are still some of them that are still going to survive, at least passing on their genetic material so that we could still have these calling crickets. And then we have the others that are basically getting the benefit. There's got to be more to the story though because I have a feeling that you're still, it's a work in progress.

**Marlene:** Well, it is because we're seeing evolution in action! It's like we're seeing it happening right now in front of us! And every time I go back I never know what I'm going to find!

**Dr. Biology:** All right, we're talking about evolution and I know there are people out there, I hate to say skeptics, but people that just don't really believe and don't think that evolution is really occurring, it has been occurring. But there are some really cool sites out there and I think you were talking about one earlier.

**Marlene:** There's a great website that the University of California Berkley sponsors, called Understanding Evolution. And they have a great cartoon of our research that shows actually the sad plight of the male that can't attract a female and what happens when the flies come in and all kinds of other stuff. So, that's a great place to check for lots of examples of evolution in action.

**Dr. Biology:** Oh, it's perfect! And the logs for this and in the transcript, we'll add that in there. So, if you want to find that website we'll have the link on the Ask A Biologist website, it will send you right to the one at Berkley. It would be a great way to learn about evolution and I love cartoons! I'm going to look it up myself.

Not that I have any love for these flies, especially after looking at these wonderful pictures. How are they doing if their main meal has changed and they can't find it anymore?

**Marlene:** Good question! The short answer is, we don't know. The long answer is, well, there are still flies there, I mean, we know that. So, we can go out and if you play a recorded cricket song flies will come in and wander around on your speaker. But what are they living on? Because they have to reproduce inside of a cricket, it's not like they can just go ahead and put their offspring into an orange or a jellybean or something. They have to reproduce in a cricket, it's what they do.

We think they may be finding just the few crickets that are remaining and getting very good at that. But that doesn't explain that all the flies that could be persisting because that has to mean that they're killing the cricket when they develop. So, that's one of those things we're still going to be going back to find out.

**Dr. Biology:** Ah, young scientists out there, you got a job. You mentioned you're working in Hawaii, or I mentioned you're working in Hawaii and wow, it sounds like a great place to do your work!

**Marlene:** [laughs] It is and we do really like it but I always tell people that remember, the crickets are animals that do all their stuff at night and these crickets are mostly in the lawns and the grass outside of buildings. And so, don't be too jealous because I'm not on the beach watching the beautiful waves or even up in the mountains looking at the exotic birds. I'm pretty much on my hands and knees in the grass in the dark and really, you could be anywhere.

**Dr. Biology:** And then during the day, are you sleeping because you were up at night?

**Marlene:** [laughs] Some of it, although I won't deny that occasionally that beach or that mountain comes into the picture too.

**Dr. Biology:** Let me ask you three questions that my scientists can never leave without answering. The first one, you might have come across this before. When did you first know that you wanted to be a biologist? Was there a spark, I call it, an aha moment?

**Marlene:** Not really, I always liked insects even when I was a little girl but I think I didn't really realize that being interested in animals meant that you might like biology. I kind of thought biology was something that people did maybe somewhere in a lab or doing something really far away. And also, I liked lots of other things too, so it actually took me a long time until I decided that, oh, being interested in animals and what they did meant that I was interested in biology.

And then I found out that you could actually do this for a living, which was pretty exciting too!

**Dr. Biology:** Right, I think it's exciting! And as we know, you get to travel! OK! You are a biologist, I'm going to take it all away. You're also at a university so I know you probably love teaching. But if I take it all away from you and I let you really go beyond your usual boundaries, what would you be or what would you do?

**Marlene:** I don't know, that's a hard one. I like writing a lot, I do that a lot of the time. I have to admit I don't necessarily like writing fiction because I have trouble coming up with a plot. The great thing about writing non-fiction and writing about animals or nature and what they do is that the plot is there for you.

**Dr. Biology:** With your crickets it's actually better than, as you said, the movie "Aliens" and it's got all the gory parts too. So, I'll let you be a writer, that's great. So, you're going to do non-fiction. For those that do want to be a scientist or a biologist, and I usually say young scientists, but there are also people out there that have had other careers and they think, "You know, I've always wanted to be a biologist." What advice do you have for them?

**Marlene:** I don't know, I guess being a scientist to me is about two things. It's about being really curious about the world and wanting to find out answers. And it's about thinking that rational thought and logic and that we are going to be able to understand this, that you don't have to say, "Oh, this occurred and then magic happened and the leprechauns came in and that's why the crickets can't sing."

But the great thing to me about science is that we're going to be able to find out the answers. And it doesn't even matter what kind of a person you are or whether you're a rich person or a poor person or anything.

One of the most exciting things to me about science is that it's a big equalizer. You can do it, yeah, you need some tools but it doesn't matter what kind of a person you are. Anybody can find out the answers to questions by thinking and using the tools.

**Dr. Biology:** Right. Well, Marlene Zuk, thank you for visiting with me today. It's been wonderful!

**Marlene:** Thanks so much!

**Dr. Biology:** You've been listening to Ask A Biologist and my guest has been Marlene Zuk, a professor of Biology at the University of California Riverside. She is currently hard at work on



the islands of Hawaii, even if it is at night in the dark on her hands and knees looking for crickets, whether they're singing or not singing.

And what they're doing, they're unlocking the mystery behind the cricket silence and how they've evolved to evade a parasitic fly and still live to mate another day.

The Ask A Biologist podcast is produced on the campus of Arizona State University and is recorded in the Grassroots Studio, housed in the School of Life Sciences which is a division of the College of the Liberal Arts and Sciences.

And remember, even though our program is not broadcast live, you can still send us your questions about biology, using our companion website. The address is, [askabiologist.asu.edu](http://askabiologist.asu.edu) or you can just Google the words "Ask A Biologist". I'm Dr. Biology.