Sparklebuttology with Dr. Sara Lewis
Ologies Podcast
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Oh heeey, it's that key that's under the mat that somehow nobody finds and uses to steal all your stuff, Alie Ward, back. I'm back. I'm just plain old home after a few weeks away, gettin' hitched, hanging out with family in Montana, being off my phone, eating too many fried cheese curds. I swam in a lake, I laughed with my aunties, and I was a wife for the first time in my life. But I'm back, we have fireflies for you. Or do we have lightning bugs? We're going to get into it!

These glowing friends, they're neither flies nor true bugs. Rather, beetles in the family Lampyridae. But as you will soon learn, this episode's name comes at an expert's behest. She is a Professor of Biology at Tufts University in Boston. She did a TED Talk on these beloved little critters. She's the author of the information-packed and entertaining book *Silent Sparks: The Wondrous World of Fireflies*. You may know her on Twitter under the handle @Silent _Sparks.

I was introduced to her through Eric Eaton, who was our wasp champion a few episodes back and I *jumped* at the chance to talk to her, crammed it in the schedule a day or two before my wedding earlier this month, and we will get to know her work in just a sec.

Super quick, thank you to everyone at Patreon.com/Ologies for making this show possible for the four years we've been around and for submitting great questions every week. Thank you to everyone for keeping *Ologies* in the #2 spot on Apple Podcasts Science with your ratings and reviews. I just read all that you left, and you know how to make a DadWard feel cool. Each week I pick a fresh one, and thanks Megahn Sur for writing the review:

> *For the first time since I was kid I am amazed by Science. Ologies unlocks life's mysteries and enables you to see all of its beauties.*

Happy to be your rusty key for that, Megahn, and thank you to everyone whose reviews I creepily read; literally all of them.

Onward. Sparklebuttology. You're going to learn the etymology in a minute. I'm not even going to go there in the intro. But you will also get hip to how these animals light up, why they light up our hearts, their luminous, sexy language, the best firefly photography accounts to follow, how to take your own pictures, dos and don'ts of firefly observation, is it actually okay to put them in jars on your nightstands, or are you a monster? Cobalt ghosts, pink glow-worms, femme fatales of the firefly world, how their populations are doing, if artificial lights affect them, how to join conservation efforts, and why western states need not suffer from sparklebutt envy any longer, with firefly scientist, evolutionary ecologist, researcher, conservation advocate, professor, author, and perhaps the world's first and only, self-proclaimed, Sparklebuttologist, Dr. Sara Lewis.

Dr. Sara Lewis: My name is Sara Lewis and I use she/her. Let us dive!

Alie Ward: Okay, great! Dr. Lewis, thank you so much for joining. Your ology, is it Lampyrology? Would that be what it is?

Dr. Lewis: You know, this is really, really a hard decision. I spent a lot of time in the last day thinking about this. So, I don't know. I don't like lampyr… I don't like that one at all. What about lightning bugology? Or, I don't know, like sparklebuttology?

Alie: [*laughs*]

Dr. Lewis: There's so many really great ones, you know? Why use the family scientific name? It just doesn't seem right!

Alie: Sparklebuttology it is.

Dr. Lewis: Okay. I like that one too. We're agreed.

Alie: You are one of the world's most well-known firefly experts, and scientists, and enthusiasts. Can you tell me a little bit about your relationship with bugs in general? Have you always been pro bug?

Dr. Lewis: So, yeah. You know, no I haven't. In fact, I don't like every single insect. I am completely, completely in love with fireflies, and I think that most people are. I know a lot of people who don't really like insects. In fact, they have, kind of, entomophobia. [*"So… What, we don't like bugs." "Honey, they don't like bugs."*] But I've really never met a single person who didn't like fireflies. So, they're kind of unique in that way, right? Even insect haters love fireflies. Of course, many people don't realize that fireflies are insects, so… huh.

Alie: Yeah, what do you think they think they are? Fairies?

Dr. Lewis: Magical fairies, yeah. Absolutely. I spend an inordinate amount of time trying to educate and advocate for fireflies on social media. One of the things I've noticed on Twitter is there's a lot of people who don't actually think that fireflies exist. They think they're, like, something that's in children's stories, it's kind of like a myth, and yeah, there really aren't any fireflies as far as they're concerned. They just don't believe it.

Alie: I mean, I felt that way about huckleberries and then I found out they were a real food. I was like, "A huckleberry exists??" So, I guess that's the first flimflam to debunk is that fireflies are non-existent. But they're not fiction, they're real.

Dr. Lewis: Yeah, there's so many really cool myths to debunk about fireflies. I just love it. It's so much fun.

Alie: What other myths do you feel like people come at you to ask about?

Dr. Lewis: First, they are real. That's cool. And yeah, the other thing is that a lot of people think, you know, you've seen one firefly and you've seen 'em all. But there's actually a lot of different kinds of fireflies. There's tremendous diversity in terms of their behavior, and their lifestyles, and the kinds of things that they like to do, the kinds of things they like to eat. So, that's really cool. There's not just one kind of firefly. If you believe that fireflies are real, you might think there's just one, but there's actually about… more than 2,000 different species of firefly. And! It turns out, we're discovering new ones all. the. time.

Alie: Ooh! That's cool. How big and how small do they get?

Dr. Lewis: They can be pretty tiny. You can still see them with your naked eye, so not *that* tiny. And they can also get really big. A couple of years ago, I was in Malaysia and I had a chance to see these… they're kind of giant, flightless, female fireflies. The females are like the size of your thumb. A big thumb, right? And they don't have any wings. They kind of look wormish, and they're pale, and they're big, and they're full of eggs, and they crawl around on the ground.

The genus is *Lamprigera*. They're actually really cool because the males look like regular little fireflies, but the females are giant, much, much bigger than the males, and they are putting all of their energy into reproduction. They don't bother flying around. Like, "Why bother? I'll just sit here and let the males come to me."

Aside: Some of these lady lightning bugs endemic to Asia would fill up your whole palm had you the chance to hold one. They are wingless, dense, pregnant, with a butt that blinks like a flickering neon sign. Kind of like the sexy Jabba the Hutt of fireflies with a real flashy ass. Much different than the airborne field fairies that folks in North America might be used to.

Alie: When did you first encounter them? Because I grew up in California, so I didn't see one until I was out of college when I went to New Jersey one summer. When did you first encounter fireflies?

Dr. Lewis: You know, it's funny. A lot of people have these, like, origin stories of first seeing fireflies when they were kids, and they just fell in love, and they've been in love with fireflies ever since. It's like a childhood nostalgia thing for many people. I grew up in Connecticut but I don't remember seeing fireflies until I was actually in school in North Carolina. And I was a marine biologist, and I was waiting to go to the field in Belize where I was studying coral reef ecology, and I was sitting out on my back porch with my dog, and it was, like, late afternoon and a thunderstorm was rolling in.

So, suddenly it got darker, and darker, and darker, and just before it started to rain I noticed that all around us in the grass there were these lights that were coming out of the grass and slowly rising up. And they were, like, these silent sparks like embers coming out of the grass and just filling the air all around me. It was like, "Whoa! What is going on here?" That is the first time, honestly, I remember seeing fireflies. It was like, "Huh? This is amazing!"

Alie: When did you turn your sail from the marine studies back to land?

Dr. Lewis: Well, you know, it's been a kind of evolution of interests. One of the great things about being in academia is that you have… like, you can kind of follow your curiosity. That night, actually, my curiosity got sparked and I started to wonder, like, "What the heck is going on here? Who is flying? What are they flashing about? Who are they talking to? What are they saying?"

So, in my copious free time I got to, sort of, investigate some of those questions and reach out to the firefly experts that I could find in the US and elsewhere and to start to put together, like, "What do we know about fireflies and what are the big missing pieces? What don't we know and where can I contribute to trying to answer some of these questions?" So after I got my PhD…

Aside: Dr. Lewis got her PhD in Coral Reef Ecology in 1984 from Duke University.

Dr. Lewis: … in North Carolina, I moved to Massachusetts and started working on fireflies. And I don't want to say that I worked continuously on fireflies, but a lot of the work that my students and I have done has been looking at the kind of intimate details of firefly sex lives, [*sexy guitar music*] and courtship. It's been really fascinating. We've been able to discover all this really, really cool stuff.

Alie: Would you say that's primarily why they're flashing their Morse code? Is that pretty much booty calls, like in a literal sense?

Dr. Lewis: Yep, yep. It is. It's subtle, and there's all kinds of innuendo in there. And if you're just looking at it from the gross point of view, it's like yeah, they're just flashing back and forth and trying to find mates. But really, they're actually trying to find *the best* mate. The females are really choosy, and the males are really competitive, and they're doing all this stuff… All of this information is being passed in this beautiful visual channel that people can actually see. So, a lot of insects communicate on other kinds of channels like smell, or sound, or ultrasound;

different kinds of things that are a little bit harder to eavesdrop on. But fireflies are a beautiful thing because all of this courtship exchange is going on in visual signals that are really, really easy for human beings to see, to record using electronic devices, and also to play back.

So, one of the things that my students and I have been able to do is to eavesdrop on the courtship conversations of these different kinds of fireflies, and then to be able to play back, just to tweak the signals that males are giving a little bit. Make them a little bit faster, make them a little bit louder, make them a little bit slower, and then play them back to female fireflies. One of the great things about… This isn't true for all fireflies, but a whole lot of the fireflies in the US engage in what we call a courtship dialogue. They talk back and forth. So, the males are flying around, they're advertising their availability with this pretty stereotyped signal, and the females respond to these male signals if they like the male. If they don't like the male, they shut off. [*"She ghosted you."*] They don't say anything at all.

So, you can actually find out what a firefly female is thinking about a signal by just asking her. It's kind of like conducting an opinion poll or going to the eye doctor. You know, they put those lens things on you and they say, "Is this better, or is this better? How about this? Is this better or is this better?" And you can do that to a female firefly and she will tell you, "Yeah, this is the signal that I like."

Alie: Wow. Are you doing that with little LED lights?

Dr. Lewis: Yes, exactly.

Alie: Really?

Dr. Lewis: Yeah. So, that's been kind of fun. And one of the things that we discovered is that female fireflies are really kind of choosy about who they respond to. If the female doesn't respond, of course, the male can't see her. It's dark, so he won't be able to find her and mate. But if she does respond, there's a whole frenzy. You know, if she responds to one male, a whole bunch of males might see her. It gets to be this very, very exciting, competitive dating scene.

So yeah, I guess a lot of my adult life has been spent following fireflies around at night and watching their courtship and mating. It's a little strange.

Alie: What kinds of questions and answers are they looking for? Are they looking for who has the shortest pulses, or the longest light, or is it species specific?

Dr. Lewis: Yeah, it differs with different species, but in general it seems to be that the females are looking for males that are a little bit more conspicuous within the parameters of their species-specific flash code, right? A little bit more conspicuous than other males. So in some of the species where the males are giving a single "bleep… bleep… bleep…." females will be looking for slightly longer "bleeeeeps." Not necessarily something that you could see with your eye or with the human brain, but the brain of a female firefly can make those distinctions and they choose to respond to males that have slightly longer durations of those single flashes.

One of the things that… We weren't actually looking for this, but one of the things that we discovered was that one of the reasons that female fireflies are so choosy is that males are giving a present to the females. It's called a nuptial gift. Totally, that's really the scientific term for it. It's one of the best non-jargon, scientific terms. Everybody understands, "Nuptial gift. Yeah, that's what it is."

Alie: Yeah! [*laughs*]

Dr. Lewis: So, during mating, male fireflies are giving females not just their gametes, not just their sperm, but also this package. And it's a really beautiful thing. It's this very elaborate structure. If you happen to look inside a male firefly, which, you know, probably most people never have a chance to do, but it's incredible what's inside. They don't really have a digestive tract or any of the other, you know, liver, spleen, stomach, all that stuff that we think of as internal organs. Their internal organs are basically reproductive glands that manufacture this elaborate package that is full of nutrients. And they transfer that internally to the female while they're mating. And the males that have the more desirable flashes also turn out, in many cases, to have the larger nuptial gifts.

And the nuptial gifts are a big deal for the females because they are full of protein, among other things, that the female then can use to provision her eggs. So, females that get more nuptial gifts actually are able to lay more eggs. So that's a cool thing. I mean, why not choose?

Alie: Yeah, I mean, if you kind of know through advertising, like, "Okay, longer pulse, bigger gift," then there you go. "Bigger sandwich he's going to bring me."

Dr. Lewis: Absolutely. We call it firefly bling.

Aside: Just a side note. Right before recording this a few weeks ago, I was cranky as hell and I could not figure out why. And then I realized that we had run out of coffee that morning. So Jarrett, then simply my fiancé, ran out to get my favorite latte as kind of a prenuptial gift, one might say. And my tiny brain was indeed impressed and I was very grateful to have those nutrients. I feel like it's important to note that he did not deliver this latte internally or during a copulatory act. I don't have *that* big of a coffee problem.

Alie: And what about you? Are you a night person? How much of your work involves these really long nights?

Dr. Lewis: Yeah, it's crazy. I don't know what… People who live in the tropics where firefly season is all year round, I don't know how they survive. Because you know, in the temperate zone, you have kind of a short firefly season. It might go from, I don't know, May until September, or maybe just June, July, August. And during the firefly season, my students and I, we work day and night. We get so strung out it's ridiculous. We can't even think straight, people hate us, our partners leave us, our dog walks out. It's really bad. You can do it for a few years and then you have to take a break.

But you know, we're usually out in the field at night, and then we are often doing lab experiments with fireflies that we've collected from the field and then put on a reverse light cycle so that they think it's nighttime when it's actually daytime. So, during the day we work in a dark room on fireflies that think it's night. You can get kind of strung out on that after a while. But you know, it's all worth it. It's fabulous to be able to bring some of the magic of these creatures to light and to let people know, you know, that they're real, and that they're really, really amazing. [*"They're real and they're spectacular."*]

Alie: You mentioned the tropics and the temperate zones. Does that mean that they don't inhabit arid climates as much? Why don't we have them in California?

Dr. Lewis: Yeah, so another myth that I am happy to be able to debunk is that a lot of people think that there aren't any fireflies in the western United States, and that's not true. So, happy! You should be happy! Because there are… There's at least three different kinds of fireflies. There's the daytime fireflies; they fly during the daytime. The adults don't light up even though the larvae do. They're still in the same firefly family. There's lots of those in California and in the West.

There are also glow-worm fireflies where the females typically… well, the females glow. Typically they are wormlike, as in they don't fly. And there's really, really cool glow-worm fireflies on the West Coast, including – you've got to google this – the California pink glow-worm. Oh my god, they're so beautiful! They are really beautiful and they're all over California. And I don't know why people don't recognize those as fireflies. The males don't light up, but the females do. They glow for hours to attract these flying, unlit males. They're really, really cool.

Aside: Okay, hold the phone. Boy howdy, hot damn! What?

Okay, so I'm a lifelong Californian, absolutely sniveling simp for bugs, and yet this is the first I'm hearing ever of the pink glow-worm, alias: the firefly beetle, *Microphotus angustus*.

Now, the ladies stay kind of babylike in a larva-ish form, and they just cruise the leaflitter, kind of like salmon-colored, segmented, tiny hotdogs. And then their soulmates are dude beetles who fly around, not glowing, but just looking out for butts.

I have spent my life jealous of New Jersey and ignoring all of these horny, babylike sparklebutts under my California nose. But as long as we're getting regional… I covered this ages ago in a minisode you probably never heard, but do you call them – you personally – fireflies or lightning bugs? Take a moment. Vote aloud while you're layering up a lasagna, or welding something, or brushing a chinchilla. [*assortment of voice effects, some say "lightning bugs" and others say "fireflies"*]

Okay, I hope one of you said peenie wallies, because a University of Cambridge linguistics professor by the name of Bert Vaux also needed to know, "Firefly or Lightning bug?" So he asked 10,000 Americans what they call sparklebutts. 40% of you go either way; firefly, lightning bug, you don't care. 30% of us are exclusively Team Firefly (Hello West Coast. Hi Massachusetts.) And about another 30% say "Yeah, no. It's lightning bug." (The South. Greetings to you.)

But to my delight and probably Professor Vaux's befuddlement, .02% of those people he polled called these glowing summer cuties peenie wallies. So that's two people in a study of 10,000. And if they are not already friends, oh I hope they find each other! I want them to hold hands and just stare into the summer dusk.

My point is, we need not be a nation divided on the topic of peenie wallies, especially now, because…

Dr. Lewis: *And* the other exciting news… and this is something that we're really just – this is really, really recent – that we have begun to realize that there are flashing fireflies in the Western United States. So there's a Western Firefly Project that's run out of the Natural History Museum of Utah, and they've been mapping flashing fireflies in Utah, Nevada, and nearby states since 2014. There is a new project called the New Mexico Firefly Project. There's flashing fireflies in New Mexico and Colorado. I heard a rumor that there might be flashing fireflies in Oregon.

A lot of this is very, very recent and a lot of it is based on citizen science, like community science observations. Just people going out into the night and looking for fireflies in different places where there are certain characteristics like moisture, like darkness, and food for the firefly larvae. So yeah, it's really exciting. There are Western fireflies. That's a myth that gives me great pleasure to be able to say, "No, not true. You do have them and they're really, really beautiful."

Aside: So if you've been asking fireflies, "Where have you been all my life?" The answer is: perhaps closer than you thought. Right here. Literally with a flashing butt. You just didn't notice. But where have *we* been all of *their* lives? How long do they spend in the inky evenings? What's up with their lifecycle?

Dr. Lewis: Yes! So, one of the things that people who believe that fireflies are real, and maybe have even seen fireflies, many people don't realize that what we're looking at when we see these ethereal adults flying around in the night, we're just looking at the very, very tip of the firefly lifecycle. It's the tip of the iceberg.

Fireflies spend up to two years living their lives in a completely different environment. So, fireflies are beetles, and like other beetles they go through complete metamorphosis. The adult firefly, the female, lays her eggs. The eggs hatch out into little, tiny firefly larvae.

Aside: There are a few thousand species of fireflies, and as adults they're between 5 and 25 millimeters long, just an inch long at the biggest. But in their larval forms, they're little and they're hungry.

Dr. Lewis: And it's the larval stage where they're eating and they're actually… They're predators. They're voracious predators. They're really, kind of, fearsome, voracious predators. They live underground, sometimes in rotting wood, sometimes in leaf litter, and they're burrowing around and they're looking for soft-bodied things like earthworms, slugs, snails, and that's what they eat. And even though they're tiny, they have the ability to bite and paralyze prey that's many, many, *many* times bigger than themselves. So, a couple of firefly larvae can take out a really big earthworm, paralyze it so that it basically can't move. It's still alive. Can't move; still alive. And then they will… Yeah, they'll just feast on that earthworm for days, and days, and days, and days.

Alie: Do they hunt in packs?? [*"Clever girl."*] Are they hunting in packs like wolves??

Dr. Lewis: [*laughs*] You know, we don't actually know what they do in the field, but there are many observations of… And I've seen it myself. In the lab, firefly larvae will gather together in groups to take down an earthworm. And you see them… Oh man, it's just kind of gory. I've walked in at night, like you're just walking by and you have this little container where you have firefly larvae, right? Everybody has this in their house.

Aside: Oh the delight it brought me to think of a firefly expert tossing their mail onto a kitchen counter next to a deli cup of thriving larvae! Sara just has these things in her casual possession, of course. Man, if I had a container of firefly larvae for every container of firefly larvae I had in my house… Ah!

Dr. Lewis: … and a couple of earthworms. And you see that there's all this glowing, and they're all lined up along the earthworm, and all the firefly larvae are glowing, and they're all… They just have their jaws sunk into the earthworm, and the earthworm isn't moving at all. They're lined up kind of like suckling pigs. Just all lined up sucking earthworm like an earthworm smoothie. It's a little alarming and slightly disgusting.

But anyways, that's the backstory of those ethereal adults, is that they are larvae for up to two years, depending on the latitude, and during that time they're just… They're just eating and growing, eating, and growing. And then when they get big enough, they pupate kind of like a butterfly. They metamorphose into an adult.

The adult fireflies only live a couple of weeks. Very, very short-lived. And all they're doing is reproducing. Most adult fireflies don't eat anything at all once they reach that stage. So,

they're spending down the capital that they have accumulated, all the resources that they've managed to accumulate as larvae is getting spent down in all their reproductive activity; their flying around, their nuptial gifts. The nuptial gifts are kind of a big thing in the firefly economics, right? Because they're expensive for males to produce. They're spending down their capital with every nuptial gift that they're making, and they're really valuable for females because she doesn't have any other income. It's just the nuptial gift.

Alie: Wow!

Aside: Just revisit this drama with me, if you will. Come on this journey.

So, let's say you're a baby. You're a human baby, a small, chubby baby who must grow. So you post up with other babies around a giant, paralyzed worm. Like a beached whale. And you and all these babies just devour this whale-like carcass until it's gone, and you do this for years. Imagine if humans spent most of our lifespans in focused bloodlust, eating raw meat, and then in the very twilight of life, like when we're 80, we finally go through puberty.

And for the equivalent of, like, the last year of our human lives, out comes a different-looking person with a glowing disco ass that makes people so horny . And the world *loves* us! We're so beautiful, people assume we're not even real! And then all that flesh we ate all of our lives as babies? We use that fuel to pay baby mammas so the kids we'll never meet can survive and follow in our sparkly footsteps. I mean, firefly lifecycles: what a party!

Alie: Do scientists know why they glow certain colors, and where is that bioluminescence coming from? I'm sure your background as a marine biologist, a lot of glowing stuff in the sea where it's dark, but not a lot of glowing stuff up here, so it seems. So what's it made out of?

Dr. Lewis: A lot of creatures have independently evolved this amazing, fantastic ability to produce their own light. It's really fabulous. So, among terrestrial animals and plants, there's not that many that can produce their own light, even though it's really common in the sea.

In the sea, a lot of marine creatures use their light as a defense, or as a way of hiding, camouflage, or as a way to attract prey. And fireflies use their light in many of the same ways. So, every single juvenile firefly, those baby fireflies I was talking about that live underground or in leaflitter, they actually… every single juvenile firefly can light up, even when the adults can't. So, we think that the ability, this light-producing talent of fireflies, first evolved in the juvenile stage and that it first evolved as a warning signal.

Firefly larvae and a lot of adult fireflies taste really nasty. They manufacture toxins that they carry inside their body that are distasteful to many insect-eating predators. So, you know, if you live in the dark and there's no reflected light, it doesn't really help to be brightly colored like a monarch butterfly.

Aside: Or, say, brightly colored poison dart frogs, or skunk stripes. So this "Yo, you do not want this" type of coloration has a name and it's 'aposematism', taken from the Greek words for 'away sign'. And aposematism was coined by a British zoologist who had a mustache like a snow-white feather boa, Sir Edward Bagnall Poulton, in 1890. Because one of the pleasures of being an animal scientist is that you can make up words when you identify the need for them, like Sparklebuttology.

Dr. Lewis: All of those usual warning colors don't really work. But if you can make a flash of light, that turns out to be a very, very memorable kind of warning signal that flashes out in the darkness. "I'm toxic. Do not even think about eating me." So, the first fireflies, by reconstructing their evolutionary history, scientists have figured out that the very first

fireflies, the adults didn't light up at all. And it wasn't until many million years later that some adult fireflies managed to co-opt that larval bioluminescence and turn it into the quick bright flashes that the flashing fireflies now use to find their mates. So, fireflies started out as a warning signal, and then later on turned it to courtship. It's kind of romantic, right?

Aside: Imagine a dating app that's like, "Oh my god, you're toxic? I'm toxic!" And then you just can't stop sending texts with your butts. That's the firefly life.

This week, Dr. Sara Lewis would like her *Ologies* donation to keep these lovers alive via the Xerces Society, which is a wonderful nonprofit that has so many resources for conservation, including guides on native plants to help out our favorite critters, light pollution effects and guidelines, which we're going to talk about later, and so much outreach and education. So learn more at Xerces.org. That donation we made in her name was possible by some Ward-approved sponsors of the show, who you may hear about now.

[*Ad Break*]

Okay, you were in the dark with some firefly facts and Sara had illuminating answers. Let's hear 'em.

Alie: I have so many questions from listeners. Meagan Walker wants to know: If you clap or make noise, do they flash? My dad told me that as a kid and it mostly seems to work, but I'm also skeptical that it's just coincidence.

Dr. Lewis: Yeah, so fireflies respond to a threat by… often respond to a threat by making light because it is a warning signal. So, if you have a firefly and it's just, kind of, hanging out in a container and you vibrate that container, or knock on it, or slap the side of the container, a firefly will often flash. So, it's possible that clapping might be perceived as a disturbance and they would light up as a way of saying, "Hey, don't eat me. I'm here. I'm toxic." [*"Can you not do that?"*]

Alie: Got it. Okay. So many people wanted to know about catching them, and if you catch them and put them in a jar with grass, how bad is it for them and will they die immediately?

Dr. Lewis: No, I think it's actually… You know, I love that people catch fireflies and then release them. I think it's a beautiful thing. I think the more people that can appreciate these miraculous, luminous beings, the better. And what better way to do it than to get up close and personal with them?

So, I think that as long as people realize that, you know, if you catch a firefly, catch it with a net, handle it really gently, coax it into a jar, as you say, with some grass, maybe a little bit damp… not sopping wet but damp paper towel, even a tiny piece of apple. They'll really, really like the moisture from the apple and the sugars that are in the apple. And you know, watch them overnight. Make sure they have a lot of moisture in the jar, and then let them go into the same habitat where you collected them the next day.

So, I'm all in favor of catch and release for fireflies. There's one caution that I have to mention, which is that… This happened to my nephew many years ago. [*magical fairytale land music plays in the background*] He was visiting from California. He was visiting in Vermont and he was really excited to see fireflies. [*music changes to ominous*] And he went out, caught a whole bunch, and he put them in a jar, and he put them on the night table next to his bed. [*music continues to get spookier*] And during the night he woke up and he actually saw a very, very gory scene, which is pretty common. Some of the fireflies were eating some of the other fireflies. [*spooky music climaxes and fades out*]

So, I haven't really mentioned this, but there's a particular group of fireflies just in North America (Yeah, we're proud!), and they are predators of other fireflies. And what was going on in Nate's jar was that he had accidentally caught some of the prey fireflies and a couple of the predator fireflies, and the predator fireflies were, like, so excited and they were feasting on the other fireflies. He was… Like, he screamed in the middle of the night. We had to get up and go running into his room. He was fine. The fireflies were not. And then we had to explain the whole predation thing. And yeah… So, be careful to only include the little guys and none of the big predatory ones.

Alie: Oh no!

Aside: Yes, *Photuris*. These predatory females whom Sara has called the femme fatales of lightning bugs are great at doing impressions of other species, but they're not great at making their own lucibufagins – lucibufagins? Sure. – which are steroid compounds that make them less tasty to birds, and spiders, and such. So, catfishing and preying on other glowing beetles gives them more defense against predators. So for those who wish that there were raves that were also gladiatorial matches, congratulations, sickos. Your time has arrived.

Alie: Davis Born, Anne Hardtke, Kevin Glover, and Lisa Ma want to know: Why do they smell that way? Do they smell?

Dr. Lewis: Oh! Yes, that's so interesting. What great questions! Thank you, all.

So, when you handle fireflies, they do give off a particular odor, and that odor is part of their, sort of… we call it a multimodal defense mechanism, but they have the light that they're using as a warning. They have a volatile smell that they release that warns potential predators that they are going to taste bad. And then if you were to taste a firefly, which I don't recommend, you would… or even, you know, gently bite into a firefly, which I don't recommend. Fireflies release a tiny droplet of blood, and the blood that circulates inside their bodies contains a toxin that is very, very deadly to many vertebrate predators.

So yeah, that smell is something that a lot of people don't even notice. It's really, really noticeable if you hold a firefly in your hand, just hold it up to your nose. They get disturbed if you're capturing them, and then they have that particular odor. And yeah, that's cool. It's part of their defense against getting eaten.

Aside: Sidenote. I have never sniffed a peenie wallie, but the internet told me that they smell like the following adjective: musky, cucumber-esque, and buggy. Ah yes, buggy. That's very helpful.

Either way, the taste and those aforementioned lucibufagin steroids can make a frog or a bird think twice and maybe barf it right up. Although plenty of folks report seeing fireflies illuminating the stomachs of their predators, which is kind of like being eaten by an alligator, yet continuing to swipe on Tinder from its murky, disgusting belly. But yes, the sparklebuttology smell is the sweet odor of love and warnings.

Alie: Ah ha! So, sniff a firefly.

Dr. Lewis: Sniff a firefly today. Or tomorrow. Or tonight.

Alie: Yeah. Nutella wants to know: Why do fireflies like overgrown grass more than cut grass, and what can people with yards do to encourage more fireflies?

Dr. Lewis: Absolutely! So, one of the things about fireflies is that they need the same kinds of things that all of us need, right? So, they need food, they need shelter, they need moisture. So, if you can provide those things, you can usually encourage fireflies, if they're around in your area, to move into your yard.

So, one really important thing for all the life stages of the firefly is moisture. Longer grass holds moisture better. It holds moisture in the soil better and it will be more conducive for females to lay their eggs at the base of the grass and for the larvae to develop in that habitat. Longer grass is better for all the soil organisms like the earthworms and all those things that the baby fireflies are eating as prey.

I guess the biggest thing if you want to promote fireflies in your yard is to leave your grass long, or better yet, make it into a wildflower meadow. Fireflies also need darkness, so a lot of the work that we are currently doing in my lab at Tufts focuses on light pollution and how light pollution impacts fireflies. And it turns out that lights, even pretty dim lights, can really, really disrupt the courtship dialogue of fireflies. So, if you have layers of shrubs and trees… If you happen to have streetlights around or other lights that are shining into your yard, having a lot of layers of vegetation will help make dark places where the fireflies can court.

Aside: So you're not letting your lawn go to shit. You're making a romantic environment where sparklebutt beetles can get nasty.

What else do you need to do to set the mood and help them thrive?

Dr. Lewis: Fireflies need darkness. They need moisture, and they also… Fireflies are insects, so you definitely do not want to be treating your yard or your garden with any kind of broad-spectrum insecticides, because anything that you… Remember, the baby fireflies spend months to years living underground. So if you're treating your yard or if you happen to have a lawn, and you're treating it for Japanese beetle grubs, you're going to be killing the firefly larvae that live in the lawn too. So, be really, really thoughtful about using insecticides only where and when you need them. Try to target them to specific pests.

And then also, in addition to shading your yard, if you have a place where there's fireflies and you can control the light in that firefly habitat, just turn your lights off during the firefly mating season. Give them a little privacy. Let them do their thing. And then, you know, in the wintertime you can have your lights back on as much as you want. But if you can shield your lights, or dim them, or put them on timers so that they're off during the firefly mating season, that's a great way to attract fireflies to your yard.

Alie: Great. Alexis Culley, first-time question-asker, wants to know if any fireflies flash different colors?

Dr. Lewis: Yeah, so there are slightly different colors. There are tiny, tiny differences in the shape of the enzyme, luciferase, that's inside the firefly lantern and that is one of the players that produces the… actually, it's the catalyst for the bioluminescence. So, tiny differences in the shape of that enzyme actually create different colors. So, in North America we have fireflies that range from yellow… So, a lot of the fireflies that are flashing in the early evening have sort of a lime green or yellow color bioluminescence. There's other groups of fireflies that have a more amber colored bioluminescence. And then there's some late-night fireflies that flash with a very green bioluminescence. So, they do have different colors.

Alie: Oh, okay. Do any change their colors like an LED light, at all?

Dr. Lewis: Ooh! That would be cool. Not yet, but I think they're working on it. We're looking for mutations right now.

Alie: Amazing. So many great questions. Casey Handmer wrote in and said: I think Luciferase is an amazing name for a child but my wife says No. What the fuck? Help me out?

Dr. Lewis: Anybody! Yes! Luciferase! I love it. You know… "Hey, Ace." Yeah, it's great.

Alie: That is great. And it means 'light', right? *lucifera* means light, right?

Dr. Lewis: Right. Luciferase means 'light bearer'. It's a beautiful name for a kid.

Aside: Also, how Satan biblically became Lucifer may have just been the result of a translation snafu involving the Hebrew word for 'howl'. So, Casey, Christine, name that next Luciferase. You have our blessing.

And patron Nathan Ahlgrim wrote in to say that they saw their first blue ghosts this summer and it was "trippy in the best way possible." And I'm glad for Nathan that this experience wasn't trippy in the worst way possible, which would've been an encounter with Hallucifer himself. But yes, you were not alone when it came to wondering about blue ghost fireflies and why they are such low-flying marvels.

Alie: Mila Cuda wants to know: What's the deal with blue ghost fireflies?

Dr. Lewis: Mm-hmm. The deal with blue ghost fireflies; they are magic! Totally magic. This is a firefly that's found throughout the Southeastern United States and the southern Appalachian Mountains. And they're really, really cool because they're a glow-worm firefly. The females are tiny, tiny, tiny. They don't have any wings. They cannot fly. They are totally earthbound. Which is sad, but they're also really beautiful.

They're like these beautiful little jewels that are hidden in the leaflitter in the forest. The males light up in this case and they fly around with a very, very long… like, minutes-long glow. And, for reasons that remain a bit elusive but have something to do with the physics of light, their light looks blue. But if you record the light with a spectrograph, it actually turns out to be green.

So, they're called blue ghosts because they look kind of blueish when it's reflected off the vegetation, but they're really glowing green. And one of the things about the blue ghost fireflies that's quite remarkable is they've gotten to be a pretty big tourist attraction in the past few years. And fireflies in many places are actually, kind of, flickering out. In most cases, it's because their habitat is being lost. In some cases, it's because their local population is being threatened by either light pollution or even tourism. So the blue ghost fireflies are particularly susceptible to too much attention from tourists.

When the season begins, the females are down in the leaflitter and on the forest floor. So if there's a lot of people who are walking through their habitat, they're often looking at the males that are flying around and not realizing that they could be accidentally trampling these tiny females, and also the larvae, and also the eggs, and also the pupae. And it's the females that are carrying the next generation of fireflies. So when people are going to see blue ghost fireflies, I do highly recommend going to see them, but stay on the trail. Don't walk off into the forest because you might be trampling on those beautiful little females.

Alie: Yeah, which is probably the last thing people want to be doing without realizing that they're doing it.

Dr. Lewis: Yeah, how would you ever know?

Aside: Patrons Ally Gibson, first-time question-asker Ivelisse Sanchez, Chris Moore, Alli Barg, Rose Moon Yards, Kent Durvin, and…

Alie: So many people, Claire Weldon, Tegan Mortimer, first-time question-asker Anthony, Katie Courtright, and Alex Stahl wanted to know about the numbers of fireflies. Anthony says: Why is it some years we have tons and tons and other years almost none? And Claire says: I've heard a lot the last few years about major declines in firefly populations. Alex Stahl says: Growing up, I remember seeing fireflies all the time but it's been ages since I saw any. How are they doing and what can we do to help?

Dr. Lewis: Great questions. Yes, thank you. So, you know, like other insects, fireflies have good years and bad years. So, in a really, really dry year there's a lot of mortality, especially of the larvae, so there won't be as many adult fireflies emerging the following spring and summer. Sometimes in a wet year, there's lots of prey, the larvae are surviving really well, there will be a lot of fireflies that year. So, they do have good years and bad years.

But in general, it's a really, really common perception, and it's something that a lot of firefly experts and, you know, people on the street have noticed that there just aren't as many fireflies as there used to be. And this holds across the board around the world. It's not just something that happens in the United States. So, there are three major things that are responsible for declining firefly populations.

The first one is the loss of suitable habitat. Some fireflies are really, really tuned in to a very particular habitat, like one particular kind of wetland, and that's the only place that they can survive. That's where their larvae live, that's where they can pupate, where they can complete their whole life cycle. If you wipe out that wetland, those fireflies can't just get up and move somewhere else. There are other fireflies that are habitat generalists. They can live in all kinds of places. They're doing fine. The habitat specialists are not doing so well.

Aside: So yes, some sparklebutts do well sauntering between various habitats, but other, tender, glowy babies have evolved to thrive in only one specific ecological niche.

Dr. Lewis: So the loss and degradation of appropriate habitat is a really, really big problem for many species of firefly, including a bunch of US fireflies that are specialists in wetland habitats.

The second thing that is really bad for fireflies, we've already talked about it a little bit, they need dark nights. Light pollution is a big threat to fireflies around the world. So you can turn off your lights. That's an easy thing to do. Light pollution is totally reversible! Just turn that switch. And then insecticides is a third major threat to fireflies. So, pesticides that are applied to the soil or to plants that then get into the soil and will kill firefly larvae.

So, one of the things that we've been doing… I work with a group called Fireflyers International, and one of the things that we have been doing is trying to educate people about the different life stages of fireflies, the things that they need, and to advocate for their protection. We've been working with the Xerces Society in the US, and you can go to the Xerces Society website. Just google 'Xerces fireflies' and there's a whole lot of information, free PDFs that you can download about conversing fireflies and what you can do to… And we have fact sheets about fireflies and light pollution, so firefly-friendly lighting guidelines. You can get all of that stuff at the Xerces website.

Aside: Listen. I get it. You're listening to this while paddling a gondola or herding penguins, and you're like, "*You're* my internet dad. Look it up for me."

So, Xerces recommends using motion detectors or timers to limit the amount of time lights shine; shielding lights so that they only illuminate the intended areas, like a pathway; switching out bright outdoor lighting for red bulbs or covering existing bulbs with red filters; and closing curtains at night to reduce the amount of indoor lights that spill outdoors.

More info is up at Xerces.org, and also get Dr. Sara Lewis's book, *Silent Spark*, which is linked in the show notes. It will delight and inform you.

Also, I just realized that when I said "herding penguins" it sounded like "hurting penguins," but I meant, like, there's a herd of penguins that you're… I don't want to make it sound like you're just out there hurting penguins.

Anyway, what else can you do?

Alie: Are there any community science projects that people can help out with?

Dr. Lewis: Yeah, there's so much we don't know about fireflies. As I mentioned, there's especially a lot we don't know about fireflies in the Western US. So, I highly recommend the Western Firefly Project. Just google it. They are, right now, collecting observations from people all over the west of flashing fireflies, and that's really exciting. There's a New Mexico firefly project that just started this year, and that's really exciting. People are discovering all-new fireflies we never even knew were in some of these places. So, there's a lot of really… It's a very exciting time to be a community scientist for fireflies. Fireflies are out for a short time each night and also a short season each year, so we really need many eyes in many places.

So, those are two things, the Western Firefly Project and the New Mexico Firefly Project. And then also, across all of the US, there is Firefly Watch, which is run by the Massachusetts Audubon Society. And you can find out more about that community science project on their website.

Alie: Ooh! And what about photography? Any hints on capturing good firefly photos?

Dr. Lewis: Yes. So, I would like to say that, personally, I am in awe of the many, many firefly photographers out there who capture these beautiful, long-exposure images of fireflies. And in these images, you can often see the flash pattern of the firefly. You can almost identify, like, what species of firefly it is from the photograph. But, I have no idea how they do that. [*Price is Right loser horns*]

Aside: It's okay. I looked up some tips for us. Basically, get a tripod, slow down the shutter speed, open your lens up wide, and crank up your camera's sensitivity to light, its ISO. If you don't have a fancy camera that is also not a phone, then there are apps like ProCam 8 that have presets like low light and light trails. And you can also do a slow shutter mode, which stacks a bunch of images on top of each other to create a longer exposure effect. But, patience, and experimentation, maybe a late-night energy drink, all help. Or you know what? Just leave it to the pros.

Dr. Lewis: Actually, I'll just put a shout out here to one of the firefly photographers we worked with very closely on our conservation efforts has a website. It's called Firefly Experience. His name is Radim Schreiber, and he takes pictures of fireflies using just their light. Never any flash, never any extraneous light. And his photographs, they're amazing and they really capture the personality of each of the different kinds of fireflies. So, I highly recommend FireflyExperience.org.

Alie: That's amazing. Cool. Last listener question. Sara Hoover, Cameron Brown, and RJ Doidge all asked if you have thoughts on the song "Fireflies" by Owl City, if it ever gets stuck in your head? Have you heard of this?

Dr. Lewis: [*laughs*] That's so funny. Yes, I don't really like that song because, you know… I don't know, that 10,000 hug stuff.

[*clip from "Fireflies": … 'Cause I'd get a thousand hugs… From ten thousand lightning bugs*]

Yeah, it's not my favorite firefly song. There's a really cool… There's a glow-worm song that was popular, I guess, in the 1950s. My mother used to sing it to me when I was little. Hey, maybe that's why I study fireflies! I'm not sure. Anyways, Mills Brothers "The Glow-Worm" song, I like that one a whole lot better.

[*clip from "The Glow-Worm": This night could use a little brightnin'… Light up you little ol' bug of lightnin'… When you gotta glow, you gotta glow… Glow little glow-worm, glow.*]

Aside: Did we just discover why Sara Lewis is a firefly scientist? Did that just happen? I don't know. I guess, either way, sing to your loved ones, ask smart people weird but well-intentioned questions because you never know what's underneath some rocks.

On the topic of "Meh…" [*verbal shrug*]

Alie: Last questions I always ask everyone. Your least favorite thing about being a sparklebuttologist, or least favorite thing about fireflies? Is there anything that's just an annoyance or you wish was different?

Dr. Lewis: Absolutely. It's undoubtedly mosquitos.

Alie: Ah! [*laughs*]

Dr. Lewis: So, there's a really high correlation between… You know, fireflies like places where there's a lot of moisture, and so do mosquitos, and it's nighttime, and so… Yeah, I think the hardest thing for a lot of my students and for myself working on fireflies is just, like… not necessarily, like, the mosquitos are going to bite you because usually you're covered up completely; long sleeves, sometimes we wear rubber gloves and we have anti-mosquito gear on. But it's the sound of the mosquitos. That little "*neeeee,*" that whine. It just, like… Sometimes I would go to sleep, finally, after a really long night, and I'd still, like in my dreams I would hear that whine of the mosquitos just buzzing around my head. Yeah, that was really kind of traumatic for a couple of years there.

Alie: And lastly, difficult to answer, but your favorite thing about fireflies or being a firefly scientist?

Dr. Lewis: Wow, yeah…

Alie: Hee-hee!

Dr. Lewis: So, this is easy because… The thing that I really, really appreciate… I just feel so fortunate to be able to have devoted so much of my scientific career to studying such a wondrous animal. Like, every single season, I do my science, and write all the notes, and take all the measurements and stuff. But every single season I always spend at least one night that I just dedicate to wonder. I just put everything else out of my mind and I just go out and gawk at the fireflies and just drink in the wonder. Man, it's a really incredible thing. And it's not just… You know, they don't just bring that wonder to me, but to everybody who sees them. They are some of the best ambassadors for Earth's natural magic. So, I feel so lucky to be, like, you

know, representing them, and telling people about them, and learning more about them. I just feel super, super, super grateful to the fireflies, lucky to have found this niche.

Alie: Well, I think they're lucky to have a spokesperson as knowledgeable and enthusiastic as you. For sure.

Dr. Lewis: You're very kind. Thank you.

Alie: Thank you so much for doing this! This is just a joy. I love this.

Dr. Lewis: It's been really, really fun. Thank you so much for inviting me!

So yes, get Sara Lewis's book, *Silent Sparks*. It's linked in the show notes below. You can follow her on Twitter @Silent_Sparks. Her website is SilentSparks.com. Also check out Xerces.org.

We are @Ologies on Twitter and Instagram. I'm @AlieWard on both. Come say hi. There are more links up at AlieWard.com/Ologies/Sparklebuttology, 'cuz that's what Dr. Lewis said and I love it. Thank you, Erin Talbert, for adminning the *Ologies* Podcast Facebook group. Thank you, Shannon Feltus and this week's birthday lady Boni Dutch [*makes airhorns with mouth*], of the podcast *You Are That* for helping handle merch. Emily White of The Wordary makes professional transcripts very well, and Caleb Patton bleeps episodes. Those are downloadable and free at AlieWard.com/Ologies-Extras, that's where the transcripts are too.

Noel Dilworth and Susan Hale make sure the trains run on time and help with quizzes, and Merch Mondays, and Fan Art Fridays on the *Ologies* Instagram. Late-night post-honeymoon trip editing by *husband* and hunk Jarrett Sleeper of Mindjam Media. And Zeke Rodrigues Thomas edits down the *Smologies* episodes that are coming out now every other Thursday. And long-time editor, of course, is Steven Ray Morris of the podcasts *See Jurassic Right* and *The Purrrcast*. Nick Thorburn wrote the theme music. Happy birthday to my sister Celeste Altus, herself a glowing being in the night.

And if you stick around until the end of the episode, I tell you a secret. This week we did a lot of driving through Montana, in which gambling is legal in that state. And whenever I see a casino billboard that advertises loose slots, I always think of just terrible food poisoning. Just like eating bad shrimp from the buffet and having *loose slots* all weekend. Just, chained to the jackpot, if you will.

Anyway, it's gross. I can't remember if I've told you that before, but now you know. Sorry.

Berbye.

Transcribed by Emily White at TheWordary.com

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A donation went to: Xerces.org

Dr. Sara Lewis's book

Dr. Lewis's lab at Tufts University

Dr. Sara Lewis's work on ResearchGate

Her TED2014 Talk

Great pic of firefly butts

Predatory firefly GORGING on a littler one

Relaxing firefly footage with harp music

Firefly Experience

Warning colors aka Aposematism

Sir EB Poulton's mus-taaaache

Follow this man's firefly photos!

Glow-Worm by the Mills Brothers

Not-delicious steroids

Cold light of the firefly

Here's How to Help Protect Fireflies

Booklet (with great photos)

Brochure

Firefly-friendly Lighting Practices

Fireflyers International Network is an international group of firefly scientists, artists, and other enthusiasts dedicated to firefly research, education, advocacy, and conservation

Friends of Fireflyers International

News story about their 2020 work on global threats to fireflies

A field guide to fireflies of the western US (pdf)

The Western Firefly Project

New Mexico Firefly Project

Pink Glowworms in California!

Xerces.org info on pink glowworm