Sidedoor Season 3, Episode 14:
The Silence of the Frogs

[INTRO MUSIC]

Haleema Shah: This is Sidedoor. A podcast from the Smithsonian with support from PRX. I'm Haleema Shah.

Brian Gratwicke: Frogs are really cool. They are the sound of the rainforest at night.

Haleema Shah: This is Brian Gratwicke. Gratwicke is a conservation biologist who studies frogs at the Smithsonian Tropical Research Institute in Panama. And he loves hiking deep into a pristine tropical rainforest to learn about them.

Brian Gratwicke: ...just an incredible chorus of sounds going through the night of all of these overlapping different species

Haleema Shah: Frogs live along warm tropical rivers deep in Panama's national parks.

Brian Gratwicke: They have all of these different calls, from high pitched chirps, to long trills, to gloops. You hear the glass frogs, then you can never find them, but you can hear them up there -- making a den, to right here by the stream, you have little dart frogs making a really big racket. And, some of these Panamanian rocket frogs have really trill call. It sounds like a little bird all along the streams.

Brian Gratwicke: And wherever you go looking for frogs, you tend to find them.

Haleema Shah: These soundscapes give Gratwicke hints that these dense tropical forests -- and his amphibian friends -- are happy. Healthy.

Brian Gratwicke: So, when you had the conditions just right, it was really… it was really magical and you get just a huge, huge chorus of song and sound and, and activity. All these frogs coming out. Trying to breed. Make their way in the world.

Haleema Shah: But his career has been shadowed by a growing threat: a nasty fungus called "chytrid."

Brian Gratwicke: Once the Chytrid fungus has come through, those go away. Tends to be silent.

Haleema Shah: Chytrid attacks frogs and other amphibians. And it's the stuff of horror films: It's invisible. It spreads easily. And it kills very fast: infected frogs seem fine one day; the next?

Dead[1]. And, like in a viral pandemic horror film -- think 28 Days Later -- it's an extremely effective killer. In the past decade, some frog populations have dropped by ninety percent. Around one hundred species of frogs have gone extinct.[2] And we have no way to stop it.

Haleema Shah: So, what does a conservation biologist like Gratwicke do when, like the hero in a virus pandemic movie -- he sees certain death coming for the frogs he loves? He hikes into parts of Panama that are not impacted by the fungus, and chooses the best individuals to rescue. Think of them as frog "Designated Survivors".

Brian Gratwicke: And so, the opportunity was to go to eastern Panama and collect populations of frogs before the chytrid fungus hit them, while they were still abundant and establish captive populations of those frogs.

Haleema Shah: And like a modern-day Noah with a passion for frogs, he builds an ark. A frog ark.

Haleema Shah: This time on Sidedoor, we'll hear how a global frog pandemic was discovered. And the long odds that a handful of Smithsonian biologists face trying to stop it, so that one day frogs may chirp, trill and gloop in the wild once again.

[BREAK]

Haleema Shah: Flash back with me to a more innocent time: The year is 1996. This is the time of dial-up internet, phones with cords, and if you wanted to know something you looked it up in a book. And, at this time, we knew nothing about this frog-killing fungus.

Haleema Shah: So, in September of '96 a blue poison dart frog died at the Smithsonian's National Zoo. Not long after? Another died. And then a week or two later, a third frog died. Here's Allan Pessier. He was a National Zoo veterinarian at the time.

Allan Pessier: Well, we started to get worried. So, you know, one or two deaths was not necessarily unusual in, you know a group of… a big breeding group of frogs like this. But when we started to lose the entire year's group of frogs all to the same thing, we started to definitely get concerned because it was having a big impact on the breeding program.

Haleema Shah: In just over a year, a total of thirty-one frogs[3] died. But the bigger problem? Pessier and his colleagues didn't know why. The zoo had a lot of experience with the small blue tropical frogs but when they kept dying, zoo vets were stumped. They investigated a short list of known frog-killers -- but this new problem didn't behave like anything they had seen before.

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[1] https://journals.sagepub.com/doi/10.1177/104063879901100219

[2] From chytrid, per our intvu Gratwicke. I've found sources independently say 200. It's possible the 200 number is "from all things" and G's number is from chytrid. Our intvu quote: There are "8,000 amphibian species in the world. We know that we've lost about a hundred of them to the Chytrid fungus."

[3] https://journals.sagepub.com/doi/pdf/10.1177/104063879901100219

Allan Pessier: And, certainly anytime you're losing that many animals, there's that kind of, you know, “Oh crap” moment that, you know, this is something big and different and people want a solution. And that’s… I mean, that’s our job, so yeah, there was definitely a sense of urgency within the zoo.

Haleema Shah: Zoos can’t just have animals dying. You need answers. So veterinary pathologists like Pessier investigate. Luckily, this mysterious frog-killer left some clues. Most dead frogs had patches of thick rough skin on their bellies and legs, a bit like frog eczema. And when Pessier examined them under a microscope…

Allan Pessier: ...we certainly saw some structures. These things called kinetosome props and some other things that suggested fungi. But, we weren't… certainly, a zoo… a zoo pathologist is about as generalized as you can get. We're not experts in this. So, we started looking for people who might be experts in this field who could confirm what we sort of thought might be going on from these pictures that we took.

Haleema Shah: After further research the zoo determined that this might be a 300-million-year-old group of fungus called chytridiomycota. Chytrid for short. There are more than a thousand species[4] of chytrid, and in 1996, they weren’t very well researched. The fungus grows in muddy riverbanks, ditches and soils where rainfall is the sole source of moisture.[5]

Haleema Shah: There were only a handful of people who studied chytrid at the time. He found one in the U.S. named Joyce Longcore. And she agreed to take a look. She checked out the photos from the zoo’s microscope and said “Yeah, it could be chytrid. But I need a sample to know for sure.” So, the zoo snail-mailed her some infected frog legs. We tracked down Longcore. And here’s how she remembers what happened after she got them.

Joyce Longcore: I looked at it under the microscope, I could see some zoospores right under my microscope swimming around. And so, I knew that the organism was alive. And I said, “Okay, it's alive, maybe I can get it to grow.”

[MUSIC]

Haleema Shah: Longcore took the zoospore -- think of like a microscopic swimming fungus seed. And she put them in a petri dish. Then she waited. Pessier says that it was right around this time they learned they weren’t they only ones investigating frog deaths.

Allan Pessier: One of our reptile keepers brought us a copy of The New York Times and in The New York Times’ science section that day was a giant microscopic picture of the chytrid fungus.

[4] https://www.sciencedirect.com/topics/immunology-and-microbiology/chytridiomycota
[5] Zoo Chytrid Handbook

Haleema Shah: The picture looked exactly like what they'd been seeing on their frogs in the zoo.

Allan Pessier: ...and we're reading the story and it says this is a mysterious Protozoal organism that's been killing frogs in Central America and Australia and there's going to be a huge meeting next month to discuss this issue.

Haleema Shah: The National Zoo Team already knew this microscopic frog killer was not a protozoa. But what Pessier and his team did find out from the article was that this thing killed frogs around the world. Suddenly, the stakes were a lot higher.

Haleema Shah: Two weeks after The New York Times article ran, Longcore looked in her Petri dish and knew she had the answer to the question that the entire frog community was asking.

Joyce Longcore: I came into the lab, it was on October 13th, 1997. I remember the year, but particularly I remember the date because it was my birthday. And, I was alone -- it was on a weekend -- I was alone and I looked at that flask and it was opalescent and I said, "either there's bacteria growing in there or that fungus is growing."

Haleema Shah: It was a brand new type of chytrid fungus that attacks frogs. It was called: Batrachochytrium dendrobatitis.

Off Mic Person: dendrobetes…

Haleema Shah: Dendrobatidis!

Off Mic Person: Close!

Joyce Longcore: Batrachochytrium dendrobatidis.

Haleema Shah: Batrachochytrium dendrobatidis.

Joyce Longcore: ...and it's a good name because, "batratcho" means frog. And then the "chytrium" part means chytrid. So it says "frog chytrid."

[MUSIC]

Haleema Shah: And just for the record, scientists call this fungus B.D. for short, but we'll just keep calling it "chytrid."

Haleema Shah: So, just two weeks later, Longcore and Pessier went to this meeting on frog health. It was called the "International Symposium on Skin Infections and Die-Offs in Amphibians in Captivity and From Pristine Locales." This sounds really specific, but was also

really critical. It was the moment when frog researchers from all around the world got together and asked, “What the heck is this thing that’s killing all of our frogs?”

Haleema Shah: And, the National Zoo team -- and their star fungus expert Joyce Longcore -- were able to say, “Hey everyone, we know what’s killing the frogs. It’s a type of chytrid fungus.”

[MUSIC]

Haleema Shah: Today the frog chytrid fungus is found on every continent where frogs live, which is all of them except Antarctica. And, it’s every bit the death sentence it was in 1996. Think of all of the great pandemics we’ve known in history: The Spanish Flu, the Bubonic Plague, the big cholera outbreaks. Chytrid is every bit as devastating as those outbreaks. And, in some populations, one hundred percent of infected frogs die.

Haleema Shah: The chytrid fungus works this way: Once a frog encounters it, usually in the environment or on other frogs, it sticks to a frog’s skin. And this is problematic for frogs, because their skin is a fine-tuned organ. They use it to breathe and drink. And in many species, it’s also a poison-oozing defense tool. Here’s Brian Gratwicke again.

Brian Gratwicke: And, ultimately that leads to an electrolyte imbalance resulting in cardiac arrest.

Haleema Shah: That’s science-talk for “chytrid causes frogs to have a Kermit-sized heart failure.”

Haleema Shah: Researchers say that this type of chytrid evolved at some point in the 20th Century, probably on the Korean peninsula. The frogs in this part of the world appear to have an immunity to the fungal infections. But, the problem with this is that they become carriers rather than victims.

Haleema Shah: And this is important because when those frogs are moved to a different part of the world -- they bring chytrid with them.

Brian Gratwicke: And so, just like old world pathogens that were brought to the New World. The same sort of thing has happened with amphibians where the spread of Amphibians for food or pets or research animals has resulted in the inadvertent spread of this new pathogen.

Haleema Shah: If chytrid carriers encounter healthy frogs or environments that can host the fungus, it takes root there too.

Brian Gratwicke: So, when a place becomes Chytrid positive, it stays there. It doesn't ever go away.

Haleema Shah: At some point in the 1980s, chytrid arrived in Central America. Scientists have called the ensuing chytrid pandemic, “the most spectacular loss of vertebrate biodiversity due to disease in recorded history.”[6]

Haleema Shah: Gratwicke has tried everything to keep frogs alive since he started working in Panama in 2008. He transplanted bacteria from other frog species, hoping it would produce an anti-fungal layer on vulnerable frogs’ skin, but no luck. Chytrid kept spreading. So, that’s when Gratwicke decided to build his ARC.

Haleema Shah (on tape): I want to make sure I understand the idea of the ARC correctly: The idea is you basically pluck enough frogs out of the wild, and then you breed them inside the ark until basically Chytrid is over? And then… is that… is that basically the game plan?

Brian Gratwicke: Exactly. Yeah.

[MUSIC]

Haleema Shah: The fact that biologists basically have, “save what you can and hope for the best” as the survival strategy for many frogs -- feels a little bleak. But, that’s basically where we are with chytrid.

Haleema Shah: So, coming up after a quick break, we’ll visit the Smithsonian’s Frog ARC in Panama, to get a sense of what survival looks like for these frogs in a world dominated by a killer fungus.

[BREAK]

Haleema Shah: So, here’s where we are with frog chytrid: It’s nearly everywhere. It kills frogs around the world. And there’s no cure. But, thanks to the Panamanian Amphibian Rescue and Conservation project -- that’s A-R-C -- “ARC,” a dozen types of frogs are still around, when they might not be otherwise

Haleema Shah: And last summer -- before I worked here -- the ‘Sidedoor’ team went on a reporting trip to Panama -- without me -- to get a firsthand look at the Smithsonian Tropical Research Institute’s Frog “ARC”.

Haleema Shah: So, I wanted to bring back an old friend whose laugh you may remember, former Sidedoor host, Tony Cohn.

Haleema Shah (on tape): Tony, hi!

Tony Cohn (in studio): Hi! Haleema!

[6] https://link.springer.com/article/10.1007/s10393-007-0093-5

Haleema Shah (on tape): It’s so nice to see you again!

Tony Cohn (in studio): Thank you! It’s so nice to hear you too.

Haleema Shah (on tape): So, I’ve done some research about your trip and this is what I’ve learned: The ARC is located about twenty miles from central Panama City and most of that drive tracks alongside the Panama Canal. And, this is important because the frog ARC is made from shipping containers?

Tony Cohn (in studio): Exactly. So, the shipping containers are lined with shelves holding dozens of mini frog habitats. Think of like, small aquarium tanks, with a half dozen tiny tropical frogs in each of them.

Haleema Shah (on tape): Yeah, and I’ve seen some photos of the frogs and they’re really, really colorful. Anyways, I assume you didn’t just wander around alone. Who did you meet there?

Tony Cohn (in studio): Blake Klocke is a PhD student who works under Brian Gratwicke at the ARC. Blake showed me a baby one, and this is when I learned about a key challenge to raising poison dart frogs in captivity.

Blake Klocke: Here's, here's one that's a little tiny baby poison dart frog that just metamorphed.

Tony Cohn (on tape): So, if I were to hold this, would it be poisonous?

Blake Klocke: No. So, in captivity, these poisoned dart frogs, they don't have the toxins because toxins are derived from what they eat in the wild. For example, more like ants and termites and some beetles are thought to be where they get the alkaloids to make the toxins.

Haleema Shah (on tape): And I know there’s some audio of you actually holding one of these non-poisonous frogs, right?

Tony Cohn (in studio): Well, before the physical feeling, emotionally it was terrifying because these are some of the most endangered frogs in the world. So, you’re holding them in between your fingers, and the entire time I’m just thinking, “Don’t squish this incredibly adorable, amazing, precious thing…

Haleema Shah (on tape): That’s a lot of pressure.

Tony Cohn (in studio): It was a lot of pressure, but trying to do it with very little pressure between my fingers (laughs).

Haleema Shah (on tape): Mmmm. Mmmhmm, mmhmm, mmhmm.

Blake Klocke: So, these frogs are almost extinct in the wild, so, please try to… try to be gentle with them. You can grab them right by the back legs like this and just very gently hold her.

Tony Cohn (on tape): She won't bite?

Blake Klocke: She won't bite. She won't do anything and here you go, just very gently.

Tony Cohn (on tape): Hi Little Buddy. You're so pretty. I want you to be in the wild forever! Okay. She's trying… she's like, "Oh, get away from me!"

Blake Klocke: (Laughing) Don't eat me!

Tony Cohn (on tape): Oh my God. So, I'm holding a orange frog with black spots that's the size of my thumb. And this frog's almost extinct in the wild?

Blake Klocke: Yeah.

Haleema Shah (on tape): So, Tony, it sounds like you got to hang out with Blake and the frogs for a while that day. What were the biggest takeaways?

Tony Cohn (in studio): So, one thing is that a lot of tropical frogs are really important to their ecosystem. They eat algae and mosquitoes and just things that you don't really want too much of in one place. In spots where the frogs have been wiped out, the rivers become overrun with algae. And that's bad for a lot of other critters.

Tony Cohn (in studio): Also, Blake Klocke and the rest of the ARC team are working really hard on releasing these frogs back into the wild.

Haleema Shah (on tape): So, hopefully their work comes to fruition and these frogs get to survive and thrive in the wild.

Tony Cohn (in studio): And be little, happy hoppers!

Haleema Shah (on tape): Aw! Thank you so much.

Tony Cohn (in studio): (Laughing) Thank you guys. This has been such a blast, and I miss you guys!

Haleema Shah (on tape): We miss you, too!

[BREAK]

Haleema Shah: At the time of this recording, the frog ARC has about three thousand frogs of twelve different species, but only so much space to care for them. And, frogs reproduce pretty

fast. So, this gives Brian Gratwicke, Blake Klocke, and the rest of the frog ark team a huge opportunity. They actually take those surplus frogs and put them back into the wild. Which, if your entire career is focused on saving species of frogs -- that has to feel pretty great. Just over a year ago, Blake and his fellow field researchers released a batch of five hundred Variable Harlequin frogs back into the forest. Here's how they do it:

Blake Klocke: So, we pack up all these frogs, and we put them in bags, little little tiny bags. Each frog gets a bag and then we hike them over the ridge and, just, try not to fall when you're carrying them.

Haleema Shah: They hike to a site specifically chosen for the release. Blake says that they often pick places where their release frog was once found -- it's a good hint that those frogs will be able to survive there. The researchers also attach little radio transmitters to some of the frogs -- think of them as tiny froggy backpacks -- so they can check on them later.

Blake Klocke: And, when we do that, the radio transmitter emits a signal every two seconds. So, you walk around with this big lunky receiver and an antenna in the rain forest and you listen for the radio transmitter to give its beeping signal. So, you're playing a hot… game of hot-and-cold with this frog that's, you know, as big as a half dollar in the middle of the rainforest and it could be anywhere. So, it's really important to use radio tracking for what we're doing because otherwise we have no idea where they go.

Haleema Shah: But these ARC frogs were born in captivity -- they're not poisonous, despite how millions of years of evolution teaches them to behave. And, they've never encountered predators before. Blake tells the story of what happened after a frog release, when he checked on the frogs he had just put in the wild.

Blake Klocke: It was about 6:45 at night. That's when it starts getting about… getting dark in the rainforest. And, this is the last frog of the day. We were excited to go eat dinner. Put on clean, warm clothes. And, I see her cute little nose sticking out from the leaf. I'm like, "Alright. We found her." I flip over the leaf and there was a fishing spider attached to her. And, she had been killed by this fishing spider within probably the past 20 minutes. She looked like she was freshly killed. And the spider was about the size of my palm. So, if you can imagine, I flipped this leaf over and I screamed.

[MUSIC]

Haleema Shah: Brian Gratwicke knows this story too, and others like it. The radio transmitter that leads to a fattened snake, a flash flood that roars through a recent release area, and the dozens of frogs that just wander off quietly into the jungle never to be heard from again.

Haleema Shah: Gratwicke is realistic about the chances of survival for these individual frogs. He often wonders…

Brian Gratwicke: ...if you take a frog from captivity and put it back in a wild situation, is it going to just be a walking McDonald's sign for a raccoon or a snake or, you know, what are the other threats that we're going to have to run into that are not Chytrid-related?

Haleema Shah: Gratwicke says in the grand scheme, it's hard to measure the impact of frog releases. But, we've already come a long way in our understanding of chytrid, how these frogs live, and how they die.

Brian Gratwicke: We know we're doing the release trials without a cure. So, we know that those animals are likely going to get a Chytrid infection and probably die. But, this is an opportunity we get to study that in a field situation.

Haleema Shah: Science conservation work takes a lot of trial-and-error, and years to get right. But, the way Gratwicke sees it, his only choice is to remain devoted to the ARC frogs, persistently send their surplus frogs into the forest, and hope the newly released frogs might chirp, trill, and gloop into the night. And maybe get a call back from long lost relatives they didn't know they had. And, over time breed a more Chytrid-resistant future. Maybe they can help make Panama's forest as loud, and magical, as it once was.

Brian Gratwicke: I think the world is just a, a better, richer place when you have, you know, a tiny little glass frog dad brooding his eggs hanging over a stream in the rainforest waiting for… for the offspring to fall into the stream and go and develop and continue their lives like they have for hundreds-of-millions-of-years. That's really what it's about.

[BREAK]

Haleema Shah: You've been listening to Sidedoor, a podcast from the Smithsonian with support from PRX.

Haleema Shah: We wanted to thank the Smithsonian Tropical Research Institute's team for their hospitality and showing us around Panama. Especially Matt Larsen, Linette Duttari, and Beth King. And, thanks Tony Cohn for coming back and visiting us at Sidedoor to tell us about his experience there.

Haleema Shah: If you want to see a frog wearing a tiny radio collar fanny-pack, or see the colorful frogs inside the frog ARC, check out our newsletter. You can subscribe at si.edu/sidedoor.

Haleema Shah: Sidedoor is made possible by funding from the Secretary of the Smithsonian, as well as the Smithsonian's National Board. And thanks to listeners like you. Your generous support helps make all the amazing work you hear about at the Smithsonian possible.

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Haleema Shah: And if you've been enjoying Sidedoor, leave us a review in Apple Podcasts! Or give us a low-tech recommendation by telling someone about Sidedoor I-R-L.

Haleema Shah: Our podcast team is Justin O'Neill, Jason Orfanon, Lizzie Peabody, Laura Krantz, Jess Sadeq, Greg Fisk, and Lara Koch. Extra support comes from John Barth, and Genevieve Sponsler. Our show is mixed by Tarek Fouda. Our theme song and other episode music are by Breakmaster Cylinder.

Haleema Shah: And if you want to sponsor our show, please email sponsorship!prx.org.

Haleema Shah: I'm your host Haleema Shah. Thanks for listening.

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