

## **Sidedoor Season 3, Episode 3: The World's Deadliest Animal**

[INTRO MUSIC]

Tony Cohn: This is Sidedoor, a podcast from the Smithsonian with support from PRX. I'm Tony Cohn.

Yvonne Linton: In 1999, literally the crows started to fall out of the trees dead. And I remember coming here to USA and to going to a conference where they said that this was clearly an act of bioterrorism.

TC: That's Yvonne Linton. And just before Y2K -- if you remember all the panic around \*that\* -- her field was very worried about a new bug that appeared out of nowhere in the U.S.

YL: And imagine like all of a sudden you're in your garden and the birds are falling from the trees. And you're driving your kids to school and, and there's like dead birds on the pavement. I mean, this, it was super shocking and it was actually crows, which are kind of creepy anyway, you know. It's like an Alfred Hitchcock, you know. It's like, 'What is happening here?'

TC: Experts in her field really feared that this was a bioterrorist attack. They thought:

YL: Somebody had had put this virus on the shores of the eastern coast of USA and they were trying to kill the US people.

TC: They looked at the birds more closely. It turned out that they all shared a virus. But -- it was an African virus, which was weird.

YL: And we started to look more closely into it and see how this possibly could have got to the shores of USA and literally, um, there was a series of freak weather patterns and this put the birds that would normally migrate to northern Europe from Africa it flew them over to the east coast of the United States instead. So, West Nile virus is generally a bird virus.

TC: You've probably heard West Nile mentioned before. It's a virus that obviously kills birds... but it can harm people too.

YL: 130 people every year in USA die of West Nile virus. And this year is the biggest West Nile outbreak since that original outbreak.

TC: Since West Nile was first discovered in the U.S. there have been more than 46,000 reported cases, with over 2,000 dead. The reason we're having such a hard time stopping West Nile is that it's carried by birds. The virus spreads when the same mosquito that bites an infected bird bites us. And between Summer 2018's heat and rain, we've had a LOT of mosquitoes in the U.S.

YL: So anytime that that we have this combination, that's when we get tropical levels of mosquitoes, and that's what we have this year, certainly up the east coast of the United States.

TC: Linton is the research director for Walter Reed Biosystematics Unit -- a US army Unit housed within the Smithsonian that focuses on mosquitoes, and other insects that carry diseases dangerous to people -- she works alongside the U.S. Army to help determine risk of infection when sending troops abroad. And she says when there are more mosquitoes flying around, the odds of a disease outbreak increases too. In the United States, there are native mosquitoes. They're known to carry West Nile and other, more obscure viruses. Then, there are the invasive mosquitoes. Invasive just means that they didn't evolve here, but once they do get here, they thrive.

YL: Those are the mosquitoes that love to hitchhike, move around the world, and spread and establish. And those, unfortunately, are super good vectors of yellow fever, of dengue, Chikungunya, and Zika...so the big four viral diseases. They're also involved with the transmission of West Nile virus here as well.

TC: Those four diseases, plus malaria, and West Nile kill as many as seven hundred thousand people each year worldwide, with many more cases going undetected. And there's nothing to say that these illnesses couldn't pop up in the U.S. This summer we have the weather, we have the mosquitoes...we're just missing the viruses. So this time on Sidedoor, we visit Panama where we'll hunt for mosquitoes, the world's deadliest animals. Why Panama? Well, Panama and its famous canal, have been ground zero in the fight against invasive mosquitoes for over a century. It's a place where humans won an early battle in that war. And, we ask: how can we score a lasting victory in our fight against mosquitoes and the viruses they carry? Stay with us.

[BREAK]

TC: Earlier in the summer, we visited the Smithsonian Tropical Research Institute down in Panama. Panama is a narrow strip of land between two oceans. And its unique geography gives it unique opportunities, like controlling a major chokepoint of global shipping -- the Panama Canal. Now... you can't visit the country without seeing its famous canal. So obviously I did!

TC: I'm here at the Panama Canal, watching a huge ship pass through the 51 mile waterway that links the Atlantic and Pacific Oceans. From where I'm standing, the ship is about 100 feet away. From where I stand, it takes these vessels, on average, nearly 12 hours to pass through the Canal. I got to the canal about 20 minutes ago and so far, I haven't been bitten by a mosquito yet.

TC: But that wouldn't have been the case in January of 1881, when workers for a French company started construction on the Panama Canal. They had a huge force of about 40,000 workers. Ninety percent of them were of African descent -- and the work was *hard*.

After eight years, the French effort to build the canal collapsed. They dug about 40 percent of

the canal's length, and spent all their money. Their vision of building essentially a 51-mile lazy river... it didn't really work. The canal was going to have to be a lot more complicated than they originally thought.

Tomas Mendizabal: The French effort to build a canal was huge, but it failed spectacularly and they just left millions of pounds of industrial machinery and, you know, rail track, locomotives, wagons, you name it. It was mostly iron remains of the French canal period.

TC: This is Tomas Mendizabal. He's an archaeologist who was hired by the Panama Canal Authority during the canal's excavation in 2010. That was when it dramatically increased its size and capacity. And a lot of this job was digging up the literal tons of stuff that the canal's builders left behind—usually, this meant wagons and old metal tools. But Tomas and his team also found entire cemeteries that had been swallowed by the forest.

TM: I've tried to do research on the deaths of canal workers precisely because during the expansion program we found cemeteries.

TC: Thousands of canal workers, from laborers to engineers were dropping dead from Yellow fever, and they had no idea how they were getting the disease. And... yellow fever is a really hard way to go. Now, just a heads up to our listeners: the next eight seconds are about to be pretty graphic. Canal workers infected with yellow fever bled from their mouths and noses. There was vomiting. Their skin turned yellow, and their livers and kidneys failed. They had seizures, and then death. More than 20,000 people died, many of them in this way. After the French canal-building companies went broke not once, but twice... France gave up. And the Americans were very interested in picking up the project. Around 1900, four U.S. Army disease researchers intentionally allowed themselves to be bitten by the same invasive mosquitoes. One of them died of yellow fever, and the rest lived. Thanks to Jesse William Lazear's sacrifice, they finally understood the source of the Canal Zone disease. But knowing the cause of an infection and stopping it are two different matters.

TM: So when the Americans took over the Canal, the first thing they started to do was like a military campaign to fight the mosquito.

TC: Yep. A war on mosquitoes.

TM: So there was this huge campaign of draining any swampy areas that held mosquitoes. They destroyed or filled in all the wells in Panama City. They built a sanitary aqueduct in the city to get rid of any stagnant water.

TC: Some of the improvements were fairly common sense: spraying for mosquitoes, better living conditions, plumbing. Others were a bit more heavy-handed.

TM: They forbade people from having wells in their houses...or just any jar with water, forbidden! They screened every window in the city and the canal zone, and it worked. They drove down the number of deaths exponentially downwards and they were able to build a canal.

TC: This top-down, military style approach to killing mosquitoes actually worked. The laborers lived long enough to finish building the canal just six years after the U.S. began construction. Around the world today, people are facing this issue all over again with Zika, Chikungunya, Dengue, and yes, Yellow fever, too. As global populations boom, controlling mosquitoes is as critical now as ever before. Sending in troops isn't an option. Over the past century, everything has changed. But in a way, we're exactly where we were in 1905, puzzling over how to get these mosquitoes under control. So... we visited one of Panama's top mosquito experts, Jose Loaiza, a Smithsonian mosquito researcher who also works for the Panamanian government.

Jose Loaiza: I collected 500 mosquitoes in less 10 minutes, literally from my skin.

TC: Yeah, you heard that right. Loaiza catches these deadly critters on his skin. We asked Jose to give us a quick intro to the mosquitoes giving Panama—and the rest of the world—so many problems. The mosquito that caused all that trouble at the Panama Canal is *Aedes aegypti*. *Aegypti* evolved in Africa, but beginning in the 1600s, they made their move, stowing away and laying eggs in water buckets and other human-made products on ships carrying enslaved people across the Atlantic to the Americas.

JL: There's a lot of speculation about when and where exactly the first batch of mosquito landed. People think it's Brazil—the first place where they colonized the Americas—other people think it's the Caribbean islands. And some people even think that Panama was the, Portobelo, was the first place where *Aegypti* landed into the Americas.

TC: So these invasive mosquitoes do two things that makes them really good at infecting us. First up, they use us very well.

JL: They domesticated themselves. So, uh, oftentimes you go to a home and you don't find a dog, you don't find a cat, you find *Aedes*, for sure. So, if you think about it, human shelter, it's a shelter for mosquito as well.

TC: They're moochers! We build a house, and *Aedes aegypti* moves right in. In addition to being invisible roommates, they're really good at hitching free rides all around the world. They don't fly from one continent to the next. We ship them there.

JL: So the mosquito don't actually fly long distances to colonize new areas, but the eggs get laid in one of these containers. And they can withstand desiccation for long period of time.

TC: Desiccation means that the mosquito's eggs can totally dry out, but the mosquito embryo doesn't die.

JL: So the embryo remains viable for many months. And so when they lay eggs in a container, in a vessel, for example—like *Aedes aegypti* colonize the Americas when people were trading slave back in the 17th century—those containers got transported to the Americas and then the eggs hatched later on in these new grounds. And so that's how mosquitoes can colonize. Most mosquitoes cannot do that.

TC: So if it rains while a ship full of cargo is passing through the Panama Canal, those hitchhiking *Aedes* mosquito eggs can start to grow again. They're a bit like sea monkeys—just add water, and *poof!* They're back in business. They might fly off the ship in Panama. Or maybe they go to land when they stop in Miami. Or Italy. It's in this way that the *Aedes* mosquitoes have colonized six of the seven continents. Now, to make things worse, *Aedes aegypti* has another disease-carrying cousin from South Asia called *Aedes albopictus*. It's a more recent invader, but its methods are similar. But the point is, these two mosquitoes have the ability to survive in dry conditions and then hatch once water is available. They're also really good at spreading disease. Better than most mosquitoes.

JL: So *aegypti* can carry more pathogens that cause disease in humans than any other mosquitoes—Zika, Chikungunya, yellow fever, dengue, Mayaro and a bunch of other albo viruses can be transmitted by *Aedes aegypti* really efficiently.

TC: Since *Aedes aegypti* specializes in feeding on people, when they pick up a disease, it spreads very fast. They were the mosquito behind 2016's big Zika outbreak. Here's Yvonne Linton, the Smithsonian mosquito disease specialist talking about the virus spreading power of a female mosquito.

YL: So if she was to take a blood meal on somebody who had West Nile or dengue or Zika, um, she can actually pass that virus through her eggs.

TC: This is very important. Because it means that you might kill a mosquito, but if she has already laid eggs, you won't kill the disease.

YL: And so, really, when you're out in the garden and you're getting bitten, you know, sometimes it takes me four or five bites. 'I've had enough. I'm backing off. I'm going back inside.' In that time, I've actually provided blood meals, and if I was infected, I've just given rise to 600 infected mosquitoes just being out in the garden for a few minutes and getting bitten by five mosquitoes.

TC: That's very scary, and it's unique to these *Aedes* mosquitoes. So Linton says that from a public health perspective, infected people need to be responsible for keeping their friends and family disease-free.

YL: So that's really one of the critical things. When people are infected, they have to stay inside, they have to stay in air conditioning, which stops the mosquitoes coming indoors. Use screens on the doors, really be contained.

TC: With that fresh in mind, I joined Dr. Jose Loaiza's research team to hunt this animal that has evolved for millions of years to hunt me. Right after a quick break.

[BREAK]

TC: Before we go hunting mosquitoes in Panama with Jose Loaiza and his crew a quick recap: *Aedes aegypti* and *albopictus* are two of the deadliest and most widespread mosquitoes on the planet. They have two superpowers that let them travel around the world and spread disease so well. One, their eggs can totally dehydrate when they don't have enough water—and not die—and then start growing again once things get comfier. And two, they can pass disease from mother to egg. So even if you kill the parent, the disease will still survive. Part of Dr. Loaiza's job is to travel around Panama to collect mosquitoes, so the government can try to spot future viral outbreaks. He's also trying to gather scientific information about *Aedes* mosquitoes so that we can eradicate them. We went to the edge of Camino de Cruces National Park, a very natural area without much human impact outside of Panama City.

JL: So yes, this is tropical jungle, right? Tropical rainforest. And this is, I would say, that this is the habitat that harbors the most diverse fauna of mosquitoes in Panama. And this forest provides a lot of different niches, like little different habitats for different species of mosquitoes to develop. Epiphyte plants, plants that harbor water, tree holes, little creeks. So all these types of habitats harbor a distinct portion of a community of mosquitoes, and it's quite interesting.

TC: So inside this forest, Jose Loaiza fills me in on the way that they catch mosquitoes. He calls it, "human landing catch."

JL: Some people call it "human bait." Yeah, so you guys put deodorant on this morning? That's probably not a good idea. No, no, just joking. (laughs) But it'll take a few minutes for the mosquitoes to actually realize that we are here and then they'll come around. Hopefully, we'll find something.

TC: Now we just wait.

TC: Loaiza warned me to be careful about being the bait. He got Zika when he was in the field back in 2016.

Kelly Bennett: It's coming in for the kill.

TC: Joining us in this mosquito-collecting mission is Kelly Bennett, who is a post-doctoral fellow doing research in Loaiza's lab.

TC: Oh, my gosh.

KB: I think there's more than one. There's a few flying around here. There's one there.

TC: Oh, my god. That was so good!

KB: This is not an *Aedes* mosquito.

TC: A mosquito just landed on me, and Kelly took this gigantic straw, and like sucked it from my sleeve, and into this mesh little enclosure where we trapped it.

TC: It's a bit hard to imagine, but while I stood as still as possible, Kelly waited next to me until a mosquito got close. Then she sucked them up into this 3-foot-long clear plastic pipe that ends in a thick straw that would be great for slurping up a milkshake.

JL: Yeah, it's a mosquito that belongs to the genus *Mansonia*. These are tropical species, right? And so, their ranges are quite big. They go from Mexico all the way down to Brazil. They're tropical.

TC: So our first catch was a mosquito that could be considered native, which is a good sign. But then the very second mosquito we caught in the forest...

KB: ...it's an *Aedes* mosquito. I'm just trying to wait for it to stay still so I can see which type. And it's *albopictus*. *Aedes albopictus*.

TC: So on our first location of the day we already caught an invasive mosquito. But next, we wanted to see the inside of a home. Which, at least in theory, is a good environment to find *Aedes aegypti*. So Loaiza found a generous volunteer to let him set up mosquito traps in their home for our little experiment.

Laura, Homeowner: Come on, Monkey!

TC: That's Laura and her dog, Monkey. They live in a quiet suburban neighborhood on the edge of Panama City. And one critical detail makes it a good place to trap mosquitoes, and for mosquitoes to bite people—the small suburban home has an interior courtyard. And on one wall of this courtyard is an 8-foot-tall fountain, the kind that you have to plug in for the water to run. But this fountain looks like it hasn't been run in a while. And even before we get to the mosquito traps, Kelly Bennett sticks her face inches from the fountain's still-green water.

TC: So, Kelly, what do you see?

KB: I can see, wiggling around, is some larvae of *Aedes* mosquitoes.

TC: How can you tell?

KB: I can tell, um, from the shape of them and from the way that they're swimming. They have quite a distinctive look.

TC: And it looks like you're holding a turkey baster and uh...

KB: This is a turkey baster.

TC: So, what are you going to do?

KB: I'm going to suck up the mosquitoes from the water and I'm going to put them into this tray. I'm going to collect all the ones up I can find. And then I'm going to pull them into a well pack bag, and then you can transport the larvae to the lab.

TC: Okay, do your thing.

KB: Okay. So, usually if you tap they'll start wiggling, and then you can see them. Okay, so we have the larvae of an Aedes here.

TC: Can you see...okay...they look like quick little tadpoles.

KB: Yeah. In this area I would guess it's Aedes albopictus because this area is, although it's residential, it's very green. And, uh, Aedes albopictus tend to like more rural areas where there's a lot of vegetation around the houses. So, I would guess that's Aedes albopictus. Yeah.

TC: Jose Loaiza couldn't pass up the opportunity to turn this into a teachable moment for the homeowner.

JL: (Spanish being spoken off-mic). So, she's saying that that's sort of a decorative fountain and usually the water runs out. It doesn't stay stagnant. She's actually turning it on right now. You can see it's bubbling on the top. But she said that it's been awhile since they cleaned that up last time and so you got to make sure that you check for larvae, empty the water, replace the water, clean up the premises of the container. A lot of people don't really know that they're creating opportunities for mosquitoes to develop in their own houses and so that's part of the education campaign that we need to do.

TC: Another part of Loaiza's job is public outreach. He wants to teach people that stagnant water is bad, and screens on doors and windows are good. He says that if you give mosquitoes the smallest opening—a bottle cap with a tablespoon of rainwater—they'll take advantage of it. Now, the third stop on Tony's Invasive Mosquito Tour Through Panama City is the University of Panama. It's a downtown campus that has over 70,000 students.

JL: Now we're passing the Faculty of Medicine. And this is a public hospital right here.

TC: And once Jose Loaiza found a place he could park... his team collected the mosquito traps they had set on of the University of Panama's hilly campus.

TC: So this is the sample from the University of Panama?



KB: That's right, we've got an ovitrap here. So, we were looking for mosquito eggs. But this time we have an incredible amount.

TC: Wow. I bet there's, like, 25 at least.

KB: I would say on this stick alone, yeah, there's about 50. And then on this one, another 50 again. So maybe even maybe up to 100 eggs on here.

TC: Because the university has so many students, that means that there are lots of mosquitoes. And more mosquitoes and a lot of people means a lot more potential for disease.

KB: Because of the urban nature of this environment and the fact that there's a high number of people walking around here at the university, there's a bunch of people on campus here, so I would guess that it's going to be *Aedes aegypti*. So it's concerning that there's such a high abundance of them around here.

TC: And that's a prime example of what Loaiza, and really, all of us, face. In a world that's increasingly built up—more homes, more trade, more people—it's a world that's only more comfortable for these invasive, disease-carrying mosquitoes.

JL: We are 8 billion people on earth and growing. And so mosquitoes will never lack resources, blood resources, so humans provide all their requirements. And so, it makes it really hard to battle this mosquito problem, especially these two species *Aedes aegypti* and *Aedes albopictus*. There isn't one, um, silver bullet that you can use with these mosquitoes.

TC: There might not be one silver bullet, but there are a lot of pretty simple steps we can take to noticeably reduce the number of mosquitoes in your life. Here's what I learned while I was reporting this story: first, take a good look at your yard.

YL: Anything that you see in your garden can act as a mosquito reservoir. You need to clean your gutters out in your houses, you know, make sure that water isn't collecting there.

TC: If there's any trash or human-made debris, get rid of it. If water collects and sits somewhere—whether that be on your roof, or in your driveway—drain it.

YL: And if we all did a small piece, just, just that, we would reduce the number of mosquitoes. Hugely.

TC: Yvonne Linton says that stopping the spread of the world's deadliest animal—and their diseases—doesn't take heroic deeds. Just diligence, and a little bit of teamwork.

YL: You have to take responsibility for yourself, for your family, for your environment, and also educate your neighbors on the same. The government, you know, and the spraying campaigns

that are going on at county and state level, um, are fabulous. But, but ultimately all of us have in our own gardens, mosquito breeding sites and we don't do anything about it.

TC: Okay, I don't know about you. But I'm heading home, throwing on some bug spray, tipping over that bird bath... and enjoying the rest of my summer, mosquito-free.

TC: You've been listening to Sidedoor, a podcast from the Smithsonian with support from PRX. Sidedoor is made possible by funding from the Secretary of the Smithsonian, as well as the Smithsonian National Board. It's also supported, in part, by the Alfred P. Sloan Foundation, enhancing public understanding of science, technology, and economic performance. More information at Sloan DOT org. And thanks as well to listeners like you, who support the Smithsonian and all its amazing work. And if you've been enjoying Sidedoor, leave us a review on Apple Podcasts! It helps people find us and scratch their Smithsonian itch even if they can't come to our museums. Our podcast team is Justin O'Neill, Haleema Shah, Jason Orfanon, Jess Sadeq, Greg Fisk, and Elisabeth Pilger. 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. If you'd like to sponsor our show, please email sponsorship at PRX DOT org. I'm your host Tony Cohn. Thanks for listening.

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