

**TRANSCRIPT**

**INTERVIEWEE: Paul Crump**

**INTERVIEWER: David Todd**

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**David Todd** [00:00:01] So my name is David Todd. It is December 6, 2000 19. I'm in Columbus, Texas, with Paul Crump, who is a biologist for Texas Parks and Wildlife.

**Paul Crump** [00:00:14] Good morning, David. I'm fine, thank you.

**David Todd** [00:00:18] So, Paul, I gave you a very brief introduction.

**David Todd** [00:00:21] Could you tell me what your full and formal title and affiliation.

**Paul Crump** [00:00:27] So, yeah. So right now I work for Texas Parks and Wildlife. I work in the long tail. So I'll get ready. I work in the wildlife division in the non game and Rare Species program as the herpetologist.

**David Todd** [00:00:40] I see.

**Paul Crump** [00:00:42] So there's a lot of infrastructure at TPWD. And that's how I fit into the broad range of things there.

**David Todd** [00:00:48] Can you give some examples of the animals that are under your work?

**Paul Crump** [00:00:52] Yeah. So as a herpetologist, I deal with all of the other kind of conservation research issues surrounding the reptiles and amphibians in Texas.

**Paul Crump** [00:01:00] So, you know, frogs, salamanders, snakes, lizards and and turtles primarily, what I work on. I tend to focus more. We have sea turtles in Texas, like four or five species of sea turtles in Texas. And I have abdicated all responsibility on those to our coastal fisheries division. They work primarily on those.

**Paul Crump** [00:01:18] We don't get tangled too much in them. Fortunately or unfortunately.

**David Todd** [00:01:24] And so tell me how you came to this position. What was your training and early career like?

**Paul Crump** [00:01:29] So. So I grew up in the UK originally, and the UK is not known for its reptile and amphibian diversity there. You know, we had like three species, a frog and toad, and I think we're three species of lizard. I don't think there are any native turtles. So I wasn't exposed to the reptiles or amphibians at an early age, although I had a affinity for for wildlife. And so I went to university, in Southern Wales, Cardiff, and studied genetics. And it was in my I think it was like the end of my second or third year, I did a internship at the Cincinnati Zoo in Ohio. I've got a kind of wild hare and took off for the summer and ended up working in the

reptile department at the Cincinnati Zoo kind of serendipitously. I didn't you know, I didn't really have a focus on a particular group of animals, but some somehow I chose reptiles and the amphibians as the the sort of areas I would work in for the summer. And I completely fell in love with them both in every way possible. Just the aesthetics of them, the fascinating biology, the you know, the conservation need, just everything about them. Really, really kind of flipped my switch. And then I went back to the U.K., came back to Houston a year later to do another internship at the Houston Zoo in the herpetology department there. And that internship kind of evolved into a professional training year, kind like a sandwich year for my degree. Where I did a kind of bigger project and got credit through school for the project. And then that turned into a job eventually where where I was a zookeeper for five years. And then during that, those five years as a zookeeper, you know, I very rapidly got involved with kind of offgrounds conservation issues. I took a big trip to Panama in December of 2003 as my first trip to the tropics. And then there there's a lot of kind of conservation work going on in Panama at the time to do with cichtrid fungus was was threatening the amphibian communities down there. So I was really interested in kind of understanding and working on some of the responses to buy it.

**Paul Crump** [00:03:38] And and I think that was right around 2006, we got connected with Texas Parks and Wildlife and Fish and Wildlife Service to start working on Houston toad conservation work.

**Paul Crump** [00:03:48] And then around 2000, I think it's mid 2000, I transferred out of that kind of zookeeper a side event at the husbandry side into that kind of program management conservation side of it. I got to focus on 100 percent on the zoo's amphibian conservation programs.

**Paul Crump** [00:04:01] So it was around 2008. We kicked off the Houston type always 2008. I think 2007 was when the entire program kicked off in a major way at the zoo and then went from there. So I know I left the zoo around 2013 to go back to school to pursue a PhD in Canada the university in New Brunswick, where I studied amphibian ecology, kind of wetland community ecology and spent a lot of time doing kind of figuring out how to survey for amphibians effectively using kind of automated approaches, using the automated recorders and then trying to drone on too long here. And in 2016 came back to Texas and it took a start, a postdoc position at Texas State University working on the Dunes Sagebrush Lizard, which is another know rare species, has been petitioned for listing multiple times. It's been a lot of fascinating kind of a political and kind of biological conflicts surrounding that species and then in mid or early 2018, I started working at Texas Parks and Wildlife.

**Paul Crump** [00:05:08] Here I am today.

**David Todd** [00:05:11] That brings us up to the present.

**Paul Crump** [00:05:12] Yeah, yeah. Is that.

**David Todd** [00:05:14] I'm curious. You said that for I think five years you were a zookeeper. Yes. What were your duties?

**Paul Crump** [00:05:19] So I started out kind of as a general, you know, kind of taking care of a bunch of the animals that nobody else wanted to take care of. You know, when you're the low man on the totem pole at the zoo, you get you get the stuff that people are people on. The other older, more senior keepers aren't as excited about it.

**Paul Crump** [00:05:35] So I spent my time taking care of like some confiscated geckos we had. And, you know, I think a couple of big snakes that eat you name that were part of a breeding program.

**Paul Crump** [00:05:46] Dumerl's grand boas. They were big Madagascar boas, has a bad temperament and eats and poops a lot. So there's a lot to clean and whatnot. It's part of a breeding program that the zoo had probably 20 years before where they were super rare and exciting. But then they bred. They figured out how to breed than they breed at all. Every zoo had one and then kind of people got bored of them. Then they realized they weren't as rare in the wild as they thought they were. It's stuff like that.

**Paul Crump** [00:06:07] But eventually I kind of I finagled my way into being the primary amphibian keeper and was able to work primarily with different frogs and toads and salamanders that we had in the collection and which included things like, you know, we had these Mandarin newts, are a particularly cool example. There are bright orange species of newt from southern China. I think they have these really cool kind of glands on the side of their bodies that when they're when they're attacked by a predator, they slip that they can have control over their ribs and they flex up their ribs to kind of push the push the poison glands kind of up and out so that the first thing, you know, any potential predator gets is that a mouthful of poison from the glands on the side of the body. Pretty cool.

**Paul Crump** [00:06:53] We actually had an accident one time where I think a volunteer closed the door on one of the arms of one of these newts, that kind of causing damage. And the newts kind of arm degraded a little bit. But over the next year, the thing grew back completely into a fully formed and functional arm. Pretty amazing that salamanders have the ability to regenerate limbs. So yeah, lots and lots of really cool animals, lots of tree frogs and poison dart frogs to care for.

**David Todd** [00:07:30] We're going to resume and we're talking about some of your duties at the Houston Zoo and with reptiles of various shapes and sizes. And I was hoping that you might be able to tell us a little bit about the shift from being a zookeeper to working in the field.

**Paul Crump** [00:07:48] Yeah. So, yeah, it came on a couple of different fronts that there were a couple of major projects that we were working on.

**Paul Crump** [00:07:56] I think really it came at the time it came down to, you know, I was involved with a large port in Panama where we were we were trying to develop kind of access to or captive captive facilities for the breeding of rare and threatened amphibians in Panama. And we were we were sort of just the Panamanians knew exactly what they needed to do. They just lacked the kind of resources and the and the facilities to do it. So we were providing funds and kind of logistical support to develop facilities and country. Then that was eating up a lot of my time. Was a big project that receives a lot of attention from the kind of zoo conservation community, but also pretty popular media and stuff at the time, just because it was a pretty novel project. Pretty ambitious in terms of the scale of things. It was coming at the time when chytrid fungus was sweeping through the Panamanian highlands and causing lots of mortality. Kind of extirpations of all these different populations, including some extinctions that already occurred in Costa Rica. So there's a lot of concern about that. So we're doing that project and the Houston toad project, which started again in 2007. That was another kind of captive program. And I would say while I was at the zoo, my primary goal, at

least initially, was to integrate these captive programs. So a captive breeding had starting all the things that you think of zoos do traditionally in with the field programs that it was less of a sort of a barrier between the two. And so for the Houston toad program started by us collecting some eggs from the Griffith League ranch and Bastrop State Park in 2007, 2008, where we bring the eggs back to the zoo or partial eggs, but partial, partial like strands, rather like sort of 50 to 60 percent of the extra. And we would harvest the wild, bring it back and raising captivity. And then when that we had toadlets or, you know, kind of inch long individuals, we would take them back and then release them again. And the goal, of course, was to bypass these high mortality life stages that occur very early on. Most of the available data say only around 5 percent. The eggs that are laid actually make it to even metamorphosis, and then probably only about one in a thousand to one in every ten thousand eggs makes it, completes the lifecycle and makes it back to to adulthood. In most toads, in a lot of amphibians. So there's very low survivorship. We have this idea that while we can sort of kind of like hijack that a little bit and increase that survivorship, maybe we can turn that into more toads in the wild. In the end. So that was the focus of the program for the first couple of years. So that kicked off Panama and Houston toads were kind of kicking off while I was making that transition from being a zookeeper to be in it to focusing more on the conservation side of things. And of course, once you start working on the the call to conservation of captive conservation stuff, en situ being the stuff that was in the field, to be in the stuff that happens in the field and and. Yeah. So as I start working on these two things, it became apparent to me that there was a huge need for additional labor in the field, whether I was doing Houston toad surveys or working with landowners on, you know, different things, getting people interested in outreach and whatnot. So, yeah, I started sort of splitting my time between, you know, taking care of the toads at the zoo and trying to build resources and capacity at the zoo and then doing fieldwork as well at the same time.

**David Todd** [00:11:36] You mentioned when you were down in Panama that part of the reason you were there was to study the chytrid virus was about fungus, fungus and of some sort. Can you explain a little bit about the fungus and where it came from and what its impact was and, you know, if there are any kind of remedies?

**Paul Crump** [00:11:56] Yeah. So it's a particularly nasty fungus. I mean, at the time when I was working on this, the sort of prevailing theories were that it was originally a fungus that occurred naturally on amphibians from southern Africa and that there was a frog called the African clawed frog. It's a fully aquatic kind of weird looking frog that just, you know, doesn't have a terrestrial life stage or anything, just totally aquatic. It was used in the, pardon me, in the 30s and 40s. And I think even a fatal bit after that as a pregnancy test where people would doctors would inject the urine of a human female into this frog. And if the frog laid eggs because of hormones are so similar to our internal chemistry, so similar to Vivian's, the the lady was pregnant. And if the frog didn't lay eggs, she was not pregnant. So these these frogs were shipped across the world and especially to developed countries like the United States, Europe, Australia. During that time frame. But at the same time, though, the fungus went with it. So inevitably, these frogs escaped and kind of did that. They got places they couldn't survive because they were well outside of their conditions. But occasionally the fungus would jump from the frog. That naturally occurred only to some of these newly encountered species. And eventually over time it spread and kind of made its way around and would cause cause in some circumstances. That is basically kind of an environment where the fungus does really well and there are some species that seem to be particularly susceptible to it. And where that kind of interaction occurs, it's devastating to amphibian populations. And the tropics are a really good example of this sort of cloud forest conditions, which are high enough elevation to have these kind of cool conditions, but very moist.

**Paul Crump** [00:14:02] And there's locations in Australia and the western United States and then in Central and South America where it's been particularly problematic.

**Paul Crump** [00:14:14] And it's I'm not as up to speed on it as I as I used to be.

**Paul Crump** [00:14:19] And there's been a lot of genetics research done in the last sort of five, 10 years. And they keep I think everybody keeps kind of arguing about exactly where it originated from. The original I think the original South Africa hypothesis maybe isn't as strong as it used to be and that maybe there are endemic strains of kindred that occur in different places and that it's the the courts kind of co occurrence of different strains that cause is like hyper vigilance and then problems. So it's a I don't think the story is completely settled yet on exactly kind of the origin of it, but how it work does it infects the skin and causes like a hyper keritosis, the host responses to thicken the is the sort of increased production of skin cells so that you get a thickening of the skin because amphibians also amphibians respond to and. Control moisture and through their skin they actually dehydrate because they can't absorb moisture as well as they used to. And they end up having little froggy heart attacks.

**Paul Crump** [00:15:17] That's the primary mechanism with which mortality occurs. Crazy.

**David Todd** [00:15:23] And is there any response or cure?

**Paul Crump** [00:15:27] There's treatments that can be performed in captivity that can cure it. But the second you release a captive animal that's been treated back into the wild and the fungus is still occurs in the wild because there are species that don't succumb to it. They just hover on their skin. You know, the animal can become reinfected again. So there is some potential treatment options that use a kind of beneficial bacteria kind of skin washes and bacteria that can compete on the skin. But they're unlikely or I don't know of any kind of super successful field trials or re introductions that have gone on. The kind of one I think a little bit of good news about, you know, when I was down there and to that start in 2003 and I went to a lot of these sites before the crashes happened. And it is astounding. I feel like it must have been what it was like for people to see a North American bison or passenger pigeons or something to see these numbers and then go back later in life. It's unfathomable that they would be gone. You know, when I was down there at one particular time, there's a stream we went to in just outside of El Valle de Anton was the name of the town where was kind of a golden frog central and the golden frog that that was the sort of primary species that we worked on as a kind of a cultural icon. There was lots of. So after species like local pet, like pet trade, stuff like hotels would have tanks of them. And there were lots of trinkets and various artwork associated with it. That was a kind of a revered and kind of important species in the area. There's one stream south of the town that we would go to and there were there one day. There were so many for all we saw, so many frogs. It was like the peak breeding season. We probably saw I remember at one strip. We can't. I think it was like a 30 metre stretch of stream. We can't win like 300 frogs. It was it was unbelievable. I got some incredible pictures and then I think it was 2006. Three about three years later. Nobody ever saw a frog again on the stream. They were so thick for a while. And what came through it?

**Paul Crump** [00:17:31] And that particular species was very susceptible to. So I don't think any of been seen since.

**David Todd** [00:17:37] So they never gained any immunity to this?

**Paul Crump** [00:17:40] No, no. And this is a thing like the one bit of good news is that some species that seem to have maybe higher genetic diversity, larger population sizes, I think kind of evolutionary principles worked in that in that case, in that the when the infection hit initially. Ninety nine percent of them died. You know? But as a small number of individuals seem to be either, you know, just a little bit resistant to it or were able to behaviorally regulate the temperature is a bit better or something went on that enabled them to persist.

**Paul Crump** [00:18:14] And then over the last decade, we've seen kind of slight rebounds in some of these species. So we went, you know, probably, I don't know, like 5, eight years that I'm seeing any of these frogs. And people were pretty much convinced that they were gone. But in the last couple of years, they've started to turn back up again with increased survey effort. Some of these places are incredibly hard to get to and difficult terrain to survey stuff. Essentially, mountain streams in Central America so beautiful places, but quite, quite difficult logistically. So it's again, this is a like a work in progress. I think there's a lot a lot still going on in terms of research and understanding the true impacts of all this stuff. Fortunately for us, chytrid doesn't seem to be at least this particular chytrid, doesn't seem to be a huge deal for Texas amphibians, where I think that most of the state is too kind of hot and dry and we have kind of long, warm summers that tend to reduce the impacts quite considerably. But it is here we do detect it on various species, but we don't think it's causing any major population declines.

**David Todd** [00:19:25] Just as a kind of general view from a layperson. It seems like amphibians are having a lot of conservation challenges.

**David Todd** [00:19:36] And I was curious if you would agree with that and if you could sort of share any perspectives on why that might be true.

**Paul Crump** [00:19:47] Yeah, I do agree that I do agree that there is, you know, a lot long groups of animals that are having problems. You know, we just heard the news about birds recently. Right. Like how and even how many declines in North American songbirds. And you got white nose syndrome with bats and what was it, starfish wasting disease out on the West Coast, as you know, there's also some problems with all sorts of organisms and amphibians I think are seem particularly susceptible. We used to call them the canaries in the coal mine because they're they. There's something about their physiology, their active therm. So they're really they're really sensitive to kind of changes in climatic conditions and changes in habitat, too. So, you know, you think about if, you know, a forest environment vs. a prairie environment, for example, and the differences in temperature and sort of sheltering effect of the canopy and increase in humidity and light stuff. Amphibians are very susceptible to that kind of thing because they are an ectotherm. But in addition, they have these thin these thin skins, which makes that make them very susceptible to dessiccation, too. So they require not only kind of what I think of is like macro environmental habitat conditions to be kind of optimal for them, but also micro habitat conditions, they need to better get up under logs or, you know, burrow down in the soil to seek refuge during the during the kind of horrible suboptimal periods. And this goes by their thin skin. And of course, the thin skin also puts them at additional susceptibility to things like pollution and some diseases that, you know, we talked about a second ago that are particularly important because of the skin structure. They have, you know, life history strategies that tend to tend to a lot of them do, at least not all of them, but most of them have these life history strategies where they focus on years of low kind of recruitment, like reproductive failure, if you will, and then boom years there. These boom bust cycles then have these kind of consistent reproductive parents and, you know, life history theory like you think about an elephant, you know, that has one baby and then, you

know, that baby has a high likelihood of survivorship and they exist in these very relatively stable kind of population additions, amphibians are the opposite. They have these wild swings. You know, they can get it can be thousands one year and, you know, tens the next then. But because of this incredible reproductive potential, they can they can rebound very quickly. But if you don't have these rebound years, you're actually kind of you know, it's a rather precarious life history strategy to have. So this a bunch of different things that sort of predispose amphibians to conservation problems that I think are unique to amphibians. But the overarching issues, habitat loss, habitat degradation, climate change, pollution and invasive species, diseases. All these things that are affecting biodiversity generally, you know, affect them as well.

**Paul Crump** [00:22:49] And often in sort of specific and unique ways.

**David Todd** [00:22:53] So a lot of the same factors that have that effect. I guess mammals and yet birds and but but they are just more susceptible.

**Paul Crump** [00:23:04] They're a little bit more sensitive to some of them in particular. You know, it's you know, like 10 years ago, I used to think, you know, truly amphibians are probably one of the more endangered groups. But the kind of more I, you know, become familiar with the literature and the conservation issues surrounding all these other organisms, too, I'm less convinced that we have a uniquely kind of amphibian problem going on, that it's more of a broad, more of a broad biodiversity problem. Amphibians are kind of like the first wave of the anatomy, like amphibians or some of the some of the first mass population declines. We're noticing that amphibians reasons that weren't clear initially. You know, when you have issues like the like the bison or whales or any of these other kind of issues, whereas really obviously kind of human consumption and take the clear reasons, you know, it's that it's not kind of the conservation solutions are pretty clear as well. But for amphibians, a lot of these are enigmatic declines.

**Paul Crump** [00:24:09] We had no idea amphibians were disappearing from a pristine rainforest parks where there'd been no, you know, excessive human activity that could possibly be responsible for these declines. But I think that was very startling for a lot of people. And it raised some some concerns because now we're seeing the same kinds of things in bats. Right. We're seeing diseases that are wiping out bat colonies that are you know, that really aren't.

**Paul Crump** [00:24:34] You can't pin the you know, there's no direct kind of human mechanism at play in that particular moment, just like with frogs.

**Paul Crump** [00:24:42] And so, yeah, they're there again, used the term canary in the coal mine. But then if you if you talk to a bat biologist, bat biologist will say, well, they are the canaries in the coal mine.

**Paul Crump** [00:24:52] And he took the turtle people. They were there, the canary in the coal mines. So it's got a it's a bit over used the stage.

**Paul Crump** [00:24:59] And then, of course, the true canary in the coal mines are canaries.

**David Todd** [00:25:06] So, Paul. Let's resume and maybe focus in a little bit on the Houston toad and its, you know, maybe you can describe how it was first found and identified.

**Paul Crump** [00:25:21] Yeah, absolutely.

**Paul Crump** [00:25:23] Was this really fascinating story? The gentleman who first discovered the Houston toad was amateur herpetologist was actually here, I think was an airplane mechanic who worked at Ellington Field in Southeastern and which I guess was either has a military base now or back then it was one of his military anyway. He was working on the speeches in the late 40s was when he first heard a toad in his neighborhood, essentially where he was live. It didn't sound like the other toads. And I guess he passed it, collected a few and sent specimens up to various people throughout the United States, people who study toads and didn't get much attention from people. People weren't too excited about it for whatever reason. Anyway, he he got in touch with a man named Otis Sanders, who was a fascinating guy.

**Paul Crump** [00:26:07] He he he wasn't really an academic. He was a.. he was a guy who kind of collected material and sold them to universities and in different kind of, I guess, biomedical, technical, technical companies, technology companies at the time. And and so he would run around and, you know, pick up a bunch of different animals and sell them to the these places. He said he was kind of an outsider in the, you know, in the sort of Texas, herpetological world.

**Paul Crump** [00:26:37] Anyway, so Wottring was the guy from South Houston who originally identified the toad as a as a new species or suspect that was never gonna serve to Sanders. Sanders said, yeah, it's new. And they described it. I think it was '53 the paper came out and it was just it was described as *bufo houstonensis*. And this was the scientific names that the Houston is being from Houston. But he Sanders in the original description dedicated the common name as the Wottring toad.

**Paul Crump** [00:27:04] That's what he what he called it. You call it the Wottring toad. And John Wottring was to to our knowledge, was the first guy who actually used, created a spectrogram or sonogram of the call of an amphibian to compare it to the cause of other amphibians kind of quantitatively. You know, you could hear it was different these. Oh, how do I analyze this? That he being an engineer, he kind of kind of put these things together and created the first sonograms that the Houston tape was, the first time that was ever used, which I find really fascinating. So 53, it's first discovered and it was described from a handful of counties. Colorado.

**Paul Crump** [00:27:40] Austin. I don't think they knew it was in Bastrop at the time. Maybe Burleson, Liberty and kind of you know a handful of counties in the in the general Houston vicinity. But it wasn't until the late kind of. I think it was the 60s when when Lauren Brown first discovered it in Bastrop. Lauren Brown was a PhD student of Frank Blair. And Frank Blair was a famous herpetologist at UT and studied toads had, you know, kind of really cool theories on toad evolution and life history stuff. Really fascinating guy. And so Lauren Brown discovered them at Bastrop. And then it was Lauren

**Paul Crump** [00:28:20] Brown's kind of tenure and what he was getting to in the subsequent years where it became clear that the small geographic range of the Houston combined with, you know, kind of the perception of low numbers warranted kind of conservation concern. You know, the coastal prairie which were being lost in the 60s due to Houston's expansion. They had a real bad drought in the 50s and 60s. That reduced a lot of a lot of amphibian populations. And they basically crashed in Houston in the 60s. I think around I think was like 72 or 73 was the last time they were seen in. Right. Houston, I think that was up and then up in the northeast part.



**Paul Crump** [00:28:58] Randy Oh, what was the road? I can't remember right now.

**Paul Crump** [00:29:05] But Fairbanks was around kind of Fairbanks northeastern area. That was it. And yeah, so it was you know, the obviously the mid 70s was a time time during even all the sort of big environmental laws were passed. And when the predecessor of the Endangered Species Act was passed, I think maybe in the late 60s, early 70s, the Houston toad was one of like two or three amphibians on that list. Very, very little fanfare with which it was added added to the list. And that kind of garnered a little bit more attention on it. More research started to be done. And then the sort of with the passage of the Endangered Species Act, the formerly these species act was added to that list. And then the Fish and Wildlife Service kind of got together. And and the first recovery plan was published in the first and only recovery plan was published in 1984. Coincidentally, the Center for Biological Diversity just sued the Fish and Wildlife Service or issued a notice of intent to sue Fish and Wildlife Service just last week, to produce a new recovery plan being that they have not updated the recovery plan since 1984. It's a little bit out of date. So, yes, 84 a recovery plan comes out and there's you know, this time there's a general sense that the Houston toad is rare. It's kind of declining. And we need a better handle on how it's doing and what it's doing. And really, the only public property with good access at the time is Bastrop State Park. So my two two state herpetologist ago was a guy named Andy Price who began to study the toad in Bastrop State Park around the late 80s. And he conducted these really intense mark recapture experiments that a couple of ponds where he would, you know, pit town where you would tag with a unique microchip, all of the individual Houston toads that came to a couple of these poems and he had some incredible insights. You know, the toads are relatively short lived. Two to three years is about kind of the average, take about a year or so to mature. So they spend the first year off in the woods eating and growing and, you know, hiding in the sand and avoiding predators. And then they come back to the pond the following year, reproduce most toads, any breed ones. Some come back a second year and very few come back the third or fourth year. So they have this kind of quick life cycle in a quick kind of turnover, lots of eggs.

**Paul Crump** [00:31:31] And then I'm trying to think it was around sort of the 90s.

**Paul Crump** [00:31:36] I think it was like late 80s, early 1990s. Another guy at Parks and Wildlife, Jim Yantis who worked, he worked out of Hearn. He did some range-wide surveys for the toad. So he spent a lot of time out just driving the roads. He could hear the toads, unique long male reproductive vocalization during the breeding season, kind of January to June as the breeding season. Really February, March, April is the peak and he found toads in a few different places. Kind of extended the range up to around Freestone, Leon, Robertson, Milam, Burleson, Lee, Bastrop, Lavaca, Colorado and Austin represented the counties that he found Houston toads. I think I got all of them. And that which kind of defined the range and kind of really what we think about where the toad's habitat occurs still still today. So I think it was in the early 2000s was when Mike Forstner got involved. Michael Forstner is a professor at Texas State University, and he began work on the Griffith League ranch in kind of a collaboration with Bastrop County and the Boy Scouts of America, looking at different, you know, different ecological questions, trying to understand, you know, how many toads there were. Most of us were interested in. And it was around two thousand six where after kind of a prolonged a couple of really dry years in the early 2000s where Mike sounded the alarm and said, this thing is in this thing is in bad shape. We need to bring these animals into captivity. We need to start a captive insurance colony. And that was when I got involved initially was at the zoo. But I went to a meeting in two thousand eight, I think it was, and where Andy Price gave a presentation about Houston toads and Mike Forstner gave a presentation about

Houston toads, back to back. And then they basically shared the same data, but interpreted the data in different ways. So any showed his data from it was he had a campus from 1992 to around sorry, 1990 to 2002, about a 12-year dataset that he basically showed kind of, yeah, a couple of years of stability and a drop, a couple of years of stability and a drop and kind of stability down here. So we've seen this kind of a gradual step down. And Andy Price's interpretation was that, you know, we got some we got some cycles going here. We got some reductions, but stability at these lower levels. And it's probably associated with a reduced habitat, drier conditions, whatever it is. And he did he wasn't really alarmed about it because figured that they would probably bounce back up again at some point. Mike Forstner's interpretation was that this is a this is a decline. You know, you just choosing where you put lines here if you plot the whole time series. This is a precipitous decline over this twelve year period. So obviously the implications of those two interpretations are very different, aren't they. One of them is everything's fine. Nothing to see here through to you know, this is this is bad, is really bad. We to do something. So we brought toads into captivity in 2006. You know, Mike has an extremely productive graduate lab at Texas State University. He has a ton of PhD and Master's students doing all sorts of cool research on on the state. He's a geneticist by training, but he's delved into the sort of ecological realm to answer all sorts of neat questions that are management focused and and. Yeah. So in 2006, 07, as we collected the first eggs, two thousand thirteen I think was when we released the first full captive bred toads as eggs back onto the landscape and there's been some really exciting results as a result of the captive breeding efforts that occurred from sort of 2013 14 to this year. So it seems in the short term that it seemed like the program's working. You're seeing returns from the captive propagate individuals that get released as eggs come back and breed in a year or two. They come back to the ponds and reproduce. So I think a few more years of understanding how the whether or not these populations are going to stick or not after we've bred and released them, whether they whether they persist in the wild with that additional kind of augmentation and assistance or whether they just decline again, like the population, it was there before. That's going to be the question, that remains to be seen. Of course, the largest challenge to the toad in recent years was the Bastrop wildfire in 2011.

**Paul Crump [00:36:12]** And I think it was 40 odd thousand acres, something like that was basically destroyed. Bastrop State Park trashed about half of the Griffith League Ranch. The Boy Scout property, not to mention, you know hundreds of homes. And it's a miracle that I think only, you know, it's sad that anybody died. But it seems to me that it's incredible. Only the top three of all people that died from it did die is just mind blowing. But yeah, I mean, tens of thousands of acres of Houston third habitat was lost during that period of time. Bastrop State Park was a stronghold for the Houston toad.

**Paul Crump [00:36:53]** Andy Price did his research there. There were toads had been detected there at various ponds every year since Lauren Brown's work in the 1960s. And it was I think 2015 was the first year ever Houston toads were not detected in Bastrop State Park. They did a kind of a captive propagation program to try and put them back into the park. And I think it was in 15 and 16 and toads were heard briefly in 17 and 18, calling in very low numbers. But again, in 2019, there were no toads again. So it's not a surprise. I mean, the vast majority of the habitat was was removed. And it's going to take anywhere, you know, estimates are for anywhere from 30 to 80 years for the for the forest to become Houston toad habitat again, kind of functional habitat. So we're on a long, a long road to recovery, but it's possible for sure.

**David Todd [00:37:44]** Well, it sounds like the the toad has had declines for a number of years and that the Bastrop complex wildfire was a cataclysm.

**David Todd** [00:37:56] I was wondering if you could talk a little bit about other factors that might be in play for the Houston toads' problems over the years. You mentioned drought and habitat change. Are there other things that might come to mind?

**Paul Crump** [00:38:11] Yeah. So there's a few.

**Paul Crump** [00:38:14] It's a few different things. I mean, I think of it in terms of priorities, right. I think habitat loss, the direct kind of elimination of forest habitat, conversion to agriculture. Originally these forested habitats to for development for suburbs, as you know, our towns and cities expand are a pretty clear loss. There's actually still some debate about what Houston toad habitat actually is if you can believe it. We've been studying this thing for so long. And the biggest source of confusion comes in the fact that it was described from South Houston, which would have been a coastal prairie, that would've been gallery forests, there would have been maybe some oak mottes. But it wasn't it didn't look like Bastrop State Park, which is the stronghold for the species or was the stronghold of the species. So with this still a little bit of uncertainty surrounding what actual optimal habitat is. But what we think of what we think of it today and it might be influenced by where we know they occur today is a Post Oak savannah, to a mixed pine/oak, to pine forested habitat the toad you need somewhere between 50 to 80 percent canopy cover with a in a diverse, herbaceous layer with grasses and forbs on the bottom to generate food, essentially generate insect biomass for them to eat. So loss of that kind of habitat is really the what we think is is the kind of contemporary one of the larger contemporary problems. And of course, those habitats in Texas, those habitats don't maintain themselves in perpetuity. If you just leave them alone, leave them alone, they become yaupon- infested, kind of tangled jungles of shrub with no herbaceous layer. The grasses that the sunlight can't penetrate, the floor, forest floor, and you get these sort of unproductive, almost sterile kind of forest environments from a forest floor amphibian perspective so that the removal of fire from the landscape has been a huge problem, I think from from from that perspective. But then we also have fire ants, feral hogs, the increase in the road network through these remaining forested patches. Fire ants are particularly bad because of the obviously, they like moister more open environments, which puts them into contact with juvenile toads around ponds that you get into a pond in these forested environments. And that's kind of where the openings are. Right. So you get a ton of fire ant mounds that surround the pond. And yeah, that wreaks havoc on the juvenile toads when they come out. And feral hogs cause lots of problems directly through eating them. They they root around and kind of flip logs and look under for various food items that will consume them, but also their impacts to wetlands with water quality and kind of mucking up breeding sites. We don't think there's any major disease issues with wild Houston toads, although diseases have been a huge complication to the captive program. Whenever you put lots of animals in captivity of the same type, you know there's an opportunity for diseases to pop up. We've had various problems with the captive program. They're are managed in captivity and don't seem to be causing a problem for the wild populations, but it's something that they consider. I am trying to think if there's any other major issues, it really does focus then focuses on habitat in large part. And that's why one of the one of the kind of main things that I work on now is trying to get landowners to enroll in the Safe Harbor agreement, the Houston toad Safe Harbor agreement.

**David Todd** [00:42:06] Tell us about that.

**David Todd** [00:42:06] How does that work? What's the benefit?

**Paul Crump** [00:42:08] Yeah. So the Safe Harbor agreement is essentially a is a is a federal program.

**Paul Crump** [00:42:13] And the Houston the Houston toad agreement specifically is a programmatic agreement, whether where we have a, Texas Parks and Wildlife is the permit holder and and can enroll individual landowners in the in the program. The program essentially is to provide assurances to landowners that are concerned about managing for an endangered species on their property that they won't be if they improve the property or allow and allow increases of the number of Houston toads or Houston to come onto their property.

**Paul Crump** [00:42:51] They won't be subject to any kind of additional regulatory burdens that they were when the toads weren't on the property or when the toads were at lower numbers. If that makes sense. So it's designed it provides that safe harbor agreement comes with a enhancement of survival permit from the from the Fish and Wildlife Service that allows kind of incidental take. So if you are managing having your property for toads, for, you know, woodlands to maintain kind of a functional system, the other half of your property, you're running cows or, you know, making hay or whatever, any of the kind of practices that you were doing on your property, that you know, that are defined at the beginning of the agreement.

**Paul Crump** [00:43:34] If you run over some toads or, you know, have a cow squashed some toads or any kind of mortality events that happen in the kind of regular usage, probably that's you know, there's no no kind of complications with.

**David Todd** [00:43:50] You're grandfathered?

**Paul Crump** [00:43:50] Yeah, exactly. Yeah. You kind of covered from all that stuff. So it's you know, a lot of landowners are extremely variable in their and their values and kind of concerns and things.

**Paul Crump** [00:44:02] So I think the Safe Harbor agreement is a good mechanism for people that are concerned about kind of getting caught up with the federal government and any kind of potential endangered species and land use. The perception of land use kind of like a decision making being taken away from them. And that's that's sort of what this agreement provides protections from.

**Paul Crump** [00:44:27] But, of course, lots of other landowners that are less concerned about that, more focused on stewardship and are interested in helping native species. I should've said this earlier, but the toad. Houston toad. It is one of only a handful, a couple of dozen endemic reptiles, amphibians in Texas. And it's the only toad that only occurs in Texas. All of our all the toads.

**Paul Crump** [00:44:50] Even the Texas toad occurs in other places. The Texas toad sneaks off into New Mexico, the Houston toad is the only toad that only occurs in Texas. So it's I think it's a cool animal part of our natural heritage. And I say, our, I've been here for 20 years now. I think I can say, our.

**David Todd** [00:45:10] I think you're entitled.

**Paul Crump** [00:45:10] Yes, part that's part of the natural heritage of the state and kind of a kind of a neat and its persistence despite all of the conservation obstacles it faces, this is

pretty remarkable for essentially a little brown bag of water that lives in the sand. You know, that's all a toad is. It is really comes out and kind of screams for females every once a year and then goes back in. It's yeah, it's pretty remarkable. Remarkable creature.

**David Todd** [00:45:41] And it seems for this little brown bag of water, it has had an outsized political impact. Is, are there any sort of examples you can talk about there?

**Paul Crump** [00:45:53] Yeah.

**Paul Crump** [00:45:54] So, you know, whenever you get a endangered species and kind of economic development come into conflict fairly regularly as the sparks fly, don't they? It's always, always a fascinating thing to watch as a biologist. I've done my best to distance myself from, you know, as much of that as possible. Especially now I work for the Texas government. So. But, yeah. You know, there's there's been various issues have come along the way. You know, I was involved when I worked at the Houston Zoo. I was involved with a situation that was that was very illuminating for me. There was a large powerline, transmission line that they were proposing, Centerpoint Energy was proposing to send through Austin county. It was going to come along. I forget the exact road now, but it was going to run from the power plant in Fayette county down to maybe a terminal in, somewhere near Katy. And they figured the most expeditious way was to run it through through here. And this was in 2011, 12. I can't remember exactly well. But I was I've been I was doing surveys in Austin, in Colorado County as part of that kind of toad team from 2008 onwards. And we'd found toads every year or so. And I was trying to work with some private landowners on on getting access. And I had had very limited success with getting access to do surveys that I had a handful of people that let me on.

**Paul Crump** [00:47:27] There's one guy that lived up there near Cat Spring that I worked with a lot. And we've become very good friends. And he would he is a local guy. And I had a lot of credibility because I was kind of associated with him and we got along very well. Anyway, he he called me before this, before this. I didn't know this powerline thing was going on, but all the landowners got letters in the mail saying, we want to put a transmission line through, here is the proposed route. We're going to have this meeting. And he got he got the letter wasn't his house. His property wasn't to be affected directly, but he got the letters that he heard about it somehow. Anyway, he is extremely savvy guy. And he called me, said, make them dance. So he said, that's not what he means, that you can become very popular. Make them dance. Don't give him don't make it too easy on them. So what are you talking about? So anyway, a day later, my phone starts blowing up land that is like I got toads on my property.

**Paul Crump** [00:48:21] You got to help with this. You know, I've got this power line. You want to come on and protect us. OK. No problem. No.

**Paul Crump** [00:48:28] So I got I probably I bet I went from having access to, you know, like on like four or five hundred acres to have an access to 5000 acres, you know, over overnight. It was astounding.

**Paul Crump** [00:48:39] So we gotta you know, I don't recall if that particular event resulted in any extra toad locations, but it involved it resulted in a bunch of additional relationships and and getting access to a lbunch of new places and meeting a bunch of new new people. So, you know that I think I used to sort of, you know, the sort of landowner politics. But it's very interesting because it's like a rock game of rock, paper, scissors. Right. Like endangered species seem bad until something else is worse. And you know, OK.

**Paul Crump** [00:49:14] I mean, I think the endangered species would be a better thing to deal with, especially for these people that worried about, you know, sort of the the federal government entanglement side of things. And the risk of, you know, I think people are worried about the loss of autonomy in their decision making on their property, which, you know, I don't know if that I guess that happened at some point in the past. But to my knowledge, it's you know, it's not something that ever happened with Houston toads, at least in Texas. And certainly, you know, isn't the approach that the Fish and Wildlife Service uses today. That's for sure.

**David Todd** [00:49:46] Well, you mentioned that you're fortunate to get access to these pieces of property. And I gather you went out and monitored. Can you just tell a little bit about what a monitoring program looks like when you look for these elusive creatures.

**Paul Crump** [00:50:00] Yes. So we we kind of utilize the fact that males. So this is generally true for all frogs and toads. Males do this peculiar thing where they they find a site that they think females will like. And they sit there and they they vocalize. And all of the vocalizations of male frogs and toads are different. So you can you know, you can set in a pond and, you know, in the spring and anywhere in the world, essentially, and listen to the calls of frogs and toads that are calling from that particular area. You can tell what species they offer, the noise that makes the noise that it makes. And the Houston toad is a very distinctive call. You know, as you might imagine, you know, just because just like all toads look kind of similar calls or kind of sound kind of similar, but they're different enough where you can tell them apart, just like you can tell them apart that when they look at the Houston toad call is a minimum of 10 seconds and go up to about 30 seconds. And it's a it's a very it's a trill that lasts that is about two kilohertz. The original descriptions of it before, you know, we could Google it and hear what it sounded like. In the original paper, they described it like the rapid tinkling of a small bell was what it was like, a light that goes on for a lot longer.

**Paul Crump** [00:51:16] I find that hard to do those high pitches, too.

**Paul Crump** [00:51:19] Yeah, goes on for ten to five seconds. It is very distinctive. So if you're out surveying, listening for these things, which what we do is we know the way we survey for them is drive around at night, stop at the edge of a pond and sit there for five minutes in the dark and listen. You know, as you can imagine if you have some interesting interactions with landowners and the local sheriff and anybody driving by wonders, what you doing? Sit there in the dark in the middle of the night on the side of the road. But it's the most effective way of doing it.

**Paul Crump** [00:51:49] But all this time we would do it manually. We would drive around. We listen. And manual surveys are still good because they cover a lot of ground. You can listen at a bunch of sites in the same night and get lucky. But we found over the years that because of the limited effort at each site, when you survey manually that manual surveys tend to miss them. A lot of the times when they're actually there, they just call very sporadically. They're not you know, they're not at the side of the pond calling from January 1st to you know, June 30th. They're calling when it's warm, when there's a front's come through and the humidity is high, when it's rained. They have this sort of, you know, very specific combination, environmental conditions that triggers them to breed. And that's really all about. They breed and lay eggs when their offspring are going to have the best chance of survival. Right. So they've got this because their offspring, eggs and tadpoles develop in water that they want to pick conditions where they're going to maximize their chances, survival. And so, yeah, that

those conditions aren't available all the time. So they call very sporadically. And then what we've what we've gone towards is using robots, kind of automated recording devices that we tie to a tree, which is essentially a recorder and a microphone that records sound emanating from the vicinity that enables you to you can record for longer periods of time. You can monitor the same site much more intensively and that results in there being much fewer chances of missing a toad.

**Paul Crump** [00:53:21] So we set the recorded a record for like 10 minutes every hour from 6:00 p.m. to 6:00 a.m. And yeah, we we use. I would say 99 percent of the time we get them if they're there, which is a huge step forward compared to the old survey methods. And you can imagine, you know, if you have a population of toads at a site that has 10000 toads, they make a lot of noise.

**Paul Crump** [00:53:44] They call for a really long time. The chance of missing them is pretty low. But if you have a very small population that's only five toads, you know, maybe they're the, you know, one of these boom and bust cycles I'm talking about there. And one of the kind of one of the low dips, you can miss them pretty easily. So we think that those kind of smaller populations are probably the ones that, you know, we've missed a lot of over the years. And perhaps that's led to part of the reason why their range is contracted and we don't see as many of them anymore.

**David Todd** [00:54:23] So, Paul, we were just talking about how you monitor for Houston toads. And I was curious if you might suggest now how folks can manage for toads to encourage their recovery and survival.

**Paul Crump** [00:54:37] Yeah. So, you know, with these that we think it's we think it's all about habitat. And we have a kind of a I would say, semi clear set of like future desired conditions, you know, and the. Yeah. Because, you know, most of the time we're dealing with with private landowners, we're obviously very sensitive to the management goals of the landowners. We're trying when we worked with the landowner to try and create a more hospitable conditions for a Houston toad. We obviously have to factor in the management goals of the land. That is it is not one kind of cookie cutter thing. We tell everybody to do, but there's a few few things we really like to emphasize. First of all, you know, restoring kind of ecosystem function to the woodlands is the first thing we like. We like to do. And that can evolve. That basically means clearing brush by some mechanism. Usually when we first start working with the landowner, the levels of brush, whether it's cedar, yaupon, whatever inside the forest is so high you can't control it with fire initially. But fire is the preferred kind of mechanism in the end because it's cheap - costs pennies an acre versus mulching using a mechanical tool to go through them. Sure, to chew up the understory can cost 500 dollars an acre. So it's you know, you obviously have many to invest initially in mechanical clearing. But then once you get to the point where it can be maintained by fire, that's that's the more perfect tool. And the great thing about fire, of course, is it resets the sort of successional development of the of the understory promotes diverse a diversity of grasses and and her herbs forbs that provide then again, high abundance and diversity of insects which provide food for the Houston toad in addition to providing cover and micro habitat and stuff. So that's one of the places we like to start. And even if there aren't you know, even if it's not necessarily woodlands, even in native prairie is kind of grasslands that exist on our property, provide more kind of insect biomass, provide better foraging, better cover conditions for not only human toads, but but, you know, most wildlife in general. So we kind of we kind of steer we suggest people, you know, think about native both both kind of grasses and and plants, but also kind of restoring some of the processes that would have been at play and grazing could

also play a role in that cow grazing. Some people use goats to clear out the yaupon. They can be a little bit trickier to manage because they like to eat everything, not just the yaupon. So some sort of vegetation. So of kind of successional control is one of the things. The other thing the other kind of critical thing is the protection of the breeding wetlands. So if we were working with a landowner and we'd detect or suspect Houston toads may be at the site, one of the things we'll often suggest people do is fence off a portion of the wetland that if they have cattle or other livestock to sort of protect part of it. And that will allow some kind of wetland plants to grow up around the periphery, which can provide support and cover for the eggs and provide places for the juveniles to hang out while they're completing their development. It can be you know, we've all seen kind of a pond where cows can have access to the edges can get beat up a little bit. Cattle can kind of stomp down and I can provide kind of kind of difficult obstacles for four little toads. So that can be it. And then connecting up wetlands with canopy or native grasses or something to kind of larger forest blocks can often make sort of passage of those juveniles into the terrestrial habitats a little bit easier, too. So there's a couple of there's a sort of obviously the main things you can do this is really about, you know, restoring native vegetation, restoring kind of, you know, processes that keep the forest understory vegetation under control. And then some you know, in some places if the if the properties are large enough and have good enough habitat or enough habitat, I should say, you know, we'd love to get to the point where we're starting to do captive breeding and releases onto people's properties to increase the number of Houston toads. One thing that I think people I think people always kind of forget is that we want to delist this species. We want to get this thing. We want to get this species in good enough shape where it no longer needs protection from the Fish and Wildlife Service. And I think to do that, it's going to take all of us. You know, it's going to take collaboration with private landowners, the Texas Parks and Wildlife, the universities, the zoos, all the different players come together to. Because I think, you know, I think there's a a I don't know if the perception's out there that, you know, we want this thing. You know, it's great that it's the Fish and Wildlife Service, you know, has jurisdiction over this species. But I don't think it's great. I'd love. I'd love to get it to the point where Texas Parks and Wildlife has jurisdiction over it, you know, which we we do to a certain degree. But we kind of co administer it right now with the Fish and Wildlife Service. If we can get it, we can get the species back to the point where it's robust enough, where the Fish and Wildlife Service don't need to worry about it. I think that would be a great thing both for the species and for for Texas and Texas landowners.

**David Todd** [01:00:00] Yeah, that's a good goal.

**David Todd** [01:00:03] Well, just to wrap things up. Is there anything you'd want to add about Houston toads or your work with them?

**Paul Crump** [01:00:12] I can't think of anything, right now.

**Paul Crump** [01:00:18] No I think I'm good. Yeah. All right, covered everything. Thank you.

**David Todd** [01:00:19] Good, good. All right. Well, we'll call it a day.