

TRANSCRIPT

INTERVIEWEE: Dee Ann Chamberlain

INTERVIEWER: David Todd

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David Todd [00:00:02] Well, good afternoon. My name is David Todd, and I have the privilege of being here with Dee Ann Chamberlain.

David Todd [00:00:08] And with her permission, we plan on recording this interview for research and educational work on behalf of the Conservation History Association of Texas, and for a book and a web site for Texas A&M University Press, and finally, for an archive at the Briscoe Center for American History, which is at the University of Texas here in Austin.

David Todd [00:00:31] And I want to emphasize that she would have all rights to use the recording as she sees fit.

David Todd [00:00:38] And I wanted to check in with Ms. Chamberlain to see if that's okay with her.

Dee Ann Chamberlain [00:00:42] Oh, that sounds wonderful. Thank you so much, David. It's an honor to be included in this project.

David Todd [00:00:47] Oh, well, I appreciate it. Thank you so much. I'm glad that this appeals to you and really touched that you have chosen to spend some time with us.

David Todd [00:00:57] Okay, Well, let's get started.

David Todd [00:00:59] As I said, my name is David Todd, and I am representing a small non-profit called the Conservation History Association of Texas. And I am in Austin.

David Todd [00:01:09] We are conducting a remote interview with Dee Ann Chamberlain, who is also in the Austin area.

David Todd [00:01:15] It is Friday, December 15th, 2023. It's about 2:50 p.m., Central Time.

David Todd [00:01:22] Ms. Chamberlain is a senior environmental scientist who has worked with the Watershed Protection Department within the City of Austin since 1996. Before that, she served as an environmental coordinator with the Lower Colorado River Authority. While she has been with the City, she has been working intensively with the Barton Springs salamander and other amphibians in a captive breeding assurance colony.

David Todd [00:01:50] So, today, we'll be talking with Ms. Chamberlain about her life and career to date, and especially focus on what she has learned about the Barton Springs salamander and related research and surveying and protection and captive breeding.

David Todd [00:02:06] So, with that little introduction, I wanted to thank her again for taking time to do this and to ask her a question.

David Todd [00:02:14] So, I thought we might start by asking you about your childhood and early years and if you could maybe point to any people or events in your young life that might have influenced your interest in animals and science and conservation.

Dee Ann Chamberlain [00:02:31] Yes, absolutely. Yes. From as young as I can remember, I've always loved animals. And really, it's all types of animals.

Dee Ann Chamberlain [00:02:39] I've been thinking about this question. One of my earliest memories is of being at my grandparents' house, and my cousin had a stuffed animal that I fell in love with, which was a toy chimpanzee. And I was thrilled when I, not long after that, I got one for my third birthday. And so, I named him Mr. Monkey.

Dee Ann Chamberlain [00:03:00] But my brother explained to me that it was not a monkey but a great ape. And then we ended up having ongoing conversations about, you know, where did monkeys live, where did the great apes live? You know, what did they eat, What is their range? You know, what is their habitat? What are the conservation needs for those species?

Dee Ann Chamberlain [00:03:20] And then, you know, I applied this sort of question to learning about other types of animals. And for me, it made life just endlessly interesting because there are just so many wonderful species on this planet. So, that was, you know, really early on my life.

Dee Ann Chamberlain [00:03:36] I was, I'd say I was a shy person. I really connected with animals and I always loved stories and movies about animals.

Dee Ann Chamberlain [00:03:44] My mother was an elementary school teacher and fostered exploration and learning. So, I took classes at the Fort Worth Children's Museum of Science and History, which is just, it was just an incredible place at the time, and also at the Fort Worth Zoo. So, those were very memorable and wonderful experiences and had huge influences on me learning about science and nature.

Dee Ann Chamberlain [00:04:10] And my father was an engineer and gave me a good background in math and physics and science and engineering.

Dee Ann Chamberlain [00:04:17] And then, during my childhood, the Endangered Species Act was authorized. And so, that was in the news. There was a lot of talk about conservation needs of species.

Dee Ann Chamberlain [00:04:29] And so, from a young age, I had a dream of working with animals in conservation.

Dee Ann Chamberlain [00:04:35] That's great. And it sounds like your brother might have shared some interests in, you know, about nature and animals, and was certainly, I guess, intrigued by great apes.

Dee Ann Chamberlain [00:04:48] I don't know that he had as strong an interest that I had, but it was nice that he was interested in talking through important aspects of animals and

where they live and habitate. He's five years older than I am, so he had more knowledge and he shared it with me, which I appreciated.

David Todd [00:05:17] Well, you know, it's always nice when you have folks that will act as mentors and teachers, and it sounds like you had that within your family, but that you also went to the zoo, and I guess the Fort Worth, is it the Nature and Science Center?

Dee Ann Chamberlain [00:05:38] Children's Museum of Science and History.

David Todd [00:05:40] Science and History.

Dee Ann Chamberlain [00:05:42] I took classes there.

David Todd [00:05:44] And do you recall any of those classes, or the teachers or classmates that might have been with you?

David Todd [00:05:50] I think in general, you know, I just remember everybody was wonderful and encouraged interest. I took a number of classes. I took a zoology class, geology, astronomy, in addition to, I think I had to take an acting class. But, they were always interested in encouraging learning and so, and then in follow-up years, just visiting both the zoo and the museum, they're just really good experiences learning about animals and science and history and conservation.

David Todd [00:06:36] So, one of the things that I wanted to explore with you ... you, of course, had this nice exposure to the zoo and the museum and the exhibits and the classes there. When you got into grade school and on into college and grad school, were there mentors then that might have incited some interest in the natural world in you?

Dee Ann Chamberlain [00:07:07] And definitely, in college, in later years, so I took kind of a round-about path to get to where I am and I have a, I guess I felt some pressure to get degrees in other fields. So, I have a degree in English and a master's in education. But when I was finishing up my master's, in my last year, I ended up talking to a UT professor in zoology, Dr. Bob Barth, and he allowed me to take his class on birds without first having to take like a year of entry-level prerequisites. And so, I did that and I just loved it. And it opened up a whole new world for me. It was just a fantastic class.

Dee Ann Chamberlain [00:07:54] And then I decided to, ended up actually working for the LCrA, doing bird surveys for the endangered songbirds in the Hill Country in the Austin area, and at the same time going back to school and getting my degree in zoology. And so, when I did that, definitely there were more professors in the zoology department that, you know, were just wonderful and inspired me and taught me a lot. And so, that includes Mike Ryan at UT-Austin. I took a couple of classes on animal behavior, and he studies frogs.

Dee Ann Chamberlain [00:08:36] And David Hillis at UT took vertebrate natural history, including one class where we went, it was a two-week trip through Mexico, looking for animals all day and all night. That was vertebrate natural history. So, just an incredible experience. And he's an expert in amphibians and evolutionary relationships. And so, those were, yeah, fantastic experiences.

Dee Ann Chamberlain [00:09:05] And then actually, just about a year and a half ago, I got to take a class at Highlands Biological Station in Highlands, North Carolina, a class on

salamanders. And North Carolina is like a worldwide hotspot for salamanders. And it was just a, that was an amazing experience for me. I work on one type of salamander and I got to see over 20 species of salamanders there in Highlands, North Carolina, in that area. And so, that was with Drs. Joe Peckman and Ken Kozak. Yeah, they were wonderful. It was just an incredible experience.

Dee Ann Chamberlain [00:09:48] And actually, I've traveled to see wildlife in other parts of the world and. I would say that that experience in North Carolina ranks up there as very high as wildlife experiences in my life. And I've been to Africa and Madagascar and the Galapagos. And, so, I mean, they're all fantastic. But also getting to see all the salamanders in North Carolina was incredible.

David Todd [00:10:20] Well, I'm sure that it really must have connected with you because you know so much about these animals, the salamanders.

David Todd [00:10:31] So, one of the things that I like to explore with people is whether there were items in the popular culture, things like books, or TV shows, or movies, documentaries, fictional films, that might have touched a chord with them and really encouraged their interest in the environment, nature or animals.

Dee Ann Chamberlain [00:10:58] Most definitely for me: I mean, that was all I was interested in was animals. And so, I loved books and movies. And so, I think my favorite movie was "Born Free", thinking about conservation. And in terms of books, yeah, "The Wind in the Willows" comes to mind.

David Todd [00:11:17] Mr. Toad!

Dee Ann Chamberlain [00:11:19] And another book, "Around About Turn". So, a toad that wanted to see the world. Yeah.

Dee Ann Chamberlain [00:11:23] I remember as a kid, you know, watching Mutual of Omaha's "Wild Kingdom" and Jacques Cousteau documentaries, reading National Geographic, reading about Jane Goodall. But then, you know, just lots of books about animals, animal stories - I always enjoyed.

David Todd [00:11:49] Did you ever read any Dr. Doolittle?

Dee Ann Chamberlain [00:11:52] Yeah, a little. Yeah. Yeah. That's a great movie, too. And they're great stories.

Dee Ann Chamberlain [00:12:00] Makes me think of James Herriot, too. Veterinarian in Scotland. I loved those stories too.

David Todd [00:12:09] "All Creatures Great and Small"?

Dee Ann Chamberlain [00:12:10] Yes.

David Todd [00:12:11] Okay.

Dee Ann Chamberlain [00:12:12] Yeah.

David Todd [00:12:15] Well, I guess there's no substitute for encounters with animals, the real-life, living, breathing ones. Can you tell us about your first face-to-face, large face to small face, encounter with a Barton Springs salamander?

Dee Ann Chamberlain [00:12:32] Yes, I can. Yeah. I first saw Barton Springs salamanders when I was volunteering with the U.S. Fish and Wildlife Service to help survey salamanders at Eliza Spring, which is adjacent to Barton Springs Pool. So, it's one of the springs that my team focuses on these days. And I just remember just how beautiful they were. You know, their different colors, shades. They're kind of orange, reddish. They can be pink, brownish, purple. And so it's like finding jewels.

David Todd [00:13:13] That's very poetic.

David Todd [00:13:16] And so, tell us about some of the survey work that you did with these animals, and perhaps how you later encountered an Austin blind salamander.

Dee Ann Chamberlain [00:13:33] Yeah. Okay.

Dee Ann Chamberlain [00:13:36] So, I started early on in my career at the City of Austin, I helped with field surveys, salamander surveys. And I guess at the time I was in a temporary job at the City as a biologist, and we were at a spring site called Old Mill Spring. And someone had released a non-native fish, an African cichlid, in the spring, and there were salamanders in the spring. And so, we were there to evaluate the situation and figure out how to get that fish out.

Dee Ann Chamberlain [00:14:11] And during that visit, a tiny salamander that was missing much of his tail swam up to the water's surface, which was maybe, it was maybe three feet deep. And that was unusual for them to swim up to the surface like that. And I had just started taking care of several Barton Springs salamanders in captivity that had been collected for outreach purposes. And so, and we had decided that we wanted to collect more for scientific observation and study. And so, because of the presence of the non-native fish and the fact that that salamander was missing much of its tail, so we were worried about it being able to survive, we decided I should collect that that animal.

Dee Ann Chamberlain [00:14:55] So, we just assumed it was a Barton Springs salamander. And, in watching that salamander over several months, we noticed that it looked different from the other individuals. It had, it didn't really have eyes - more eye spots. And it was a little bit different color - more of a lavender color. Looked like it had kind of a wider, flatter head. And I started thinking that we probably had the same situation in Austin that occurs in the San Marcos area where you have the San Marcos salamander, a species with eyes with image-forming lenses that moves in and out of the spring outlets. And then also they have the Texas blind salamander. So, a blind salamander has only eye spots and spends its life in the aquifer.

Dee Ann Chamberlain [00:15:48] So, I started thinking we had the same situation and. I tried initially, I tried to persuade another scientist in the U.T. system to do the genetic work. Because I was thinking that perhaps it's a new species. And he didn't really have time. And so, in the end, I convinced David Hillis at U.T. to let me learn to do the PCR for the genetic analysis in his lab.

Dee Ann Chamberlain [00:16:24] And it, in fact, did turn out to be a new species. And it's more closely related, actually, to the Texas blind, than it is to the Barton Springs salamander.

It's a blind salamander, and we named it *Eurycea waterlooensis*, after the original name of Austin, which was Waterloo, for the Austin Blind Salamander. So, it was really exciting to get to discover a new species, especially in the middle of a big city with a university, and a lot of scientists that have visited the springs and it had gotten missed and so it's a pretty exciting experience.

David Todd [00:17:07] Well, and I gather this experience happened towards the beginning of your career with the Watershed Protection Division back in '96. And I was curious how you got that first leg up to sort of move on with your career. How did you first start with the Watershed Protection Department?

Dee Ann Chamberlain [00:17:30] And so, I very first started, yeah, I was in a temporary position. I was really hired to identify macroinvertebrates for a project on evaluating water quality in Austin, in the Austin Creeks. And so, I was working on, I was doing macroinvertebrate identification.

Dee Ann Chamberlain [00:17:52] And then also I helped with field work on a short-term project on the Jollyville Plateau salamander, that's *Eurycea tonkawae*, which is in Northwest Austin, in the Bull Creek Watershed.

Dee Ann Chamberlain [00:18:07] And then I had already had some volunteer experience with the Barton Springs salamander, as I mentioned, volunteering with the Fish and Wildlife Service.

Dee Ann Chamberlain [00:18:18] And since the Barton Springs salamander was ... so this was in, it's like '97, '98 and Barton Springs salamander was put on the endangered species list in '97. So, that resulted in kind of a greater focus on the part of the City of Austin on Barton Springs and the salamanders.

Dee Ann Chamberlain [00:18:38] And so, I started helping with surveys for the Barton Springs salamander at that time.

David Todd [00:18:48] It's interesting when you know, they're these big political, scientific, legal events, you know, the listing of the species and it has these ramifications for your career and a job that might open up.

David Todd [00:19:04] So, while the the Barton Springs salamander wasn't listed till the late nineties, my understanding is that it was discovered back in the forties and then described in '93. And I was wondering if you can sort of walk us through that earlier understanding of the Barton Springs salamander.

Dee Ann Chamberlain [00:19:28] Yeah. So, I think, yeah, there were observations in the forties. But so, there are a number of this type of salamander in central Texas. And, I think, superficially they look similar to each other. So, I think the thinking probably was that there weren't that many different species.

Dee Ann Chamberlain [00:19:54] But since then, molecular techniques were developed and improved upon that could be used to look at the genetics, to use genetics to determine species.

David Todd [00:20:19] That's so interesting when you know you're looking at these creatures, but the distinctions - you don't become aware until you've got the right tool...

Dee Ann Chamberlain [00:20:31] Right.

David Todd [00:20:31] You know, these molecular techniques to actually see, ah!, this is the distinction. I've been missing it.

David Todd [00:20:42] Well, so what about its description in 1993? Is that something you can tell us about?

Dee Ann Chamberlain [00:21:01] I don't know that I would have a lot to say about that.

David Todd [00:21:17] Okay. Well, how about if we talk a little bit about just what's known about the Barton Springs salamander? Maybe you could help give us a little bit of an understanding about its life history and the ecological niche that it fills, and these very interesting adaptations that it's developed over the years.

Dee Ann Chamberlain [00:21:45] Yes, certainly. Yeah, so, you know, most salamanders are aquatic when they're young and they become terrestrial adults, so they transform into terrestrial adults. But the Barton Springs salamander is completely aquatic its entire life. So, it's neotenic, meaning it retains juvenile characteristics. So, it retains its juvenile characteristics - so, the external gills that aquatic salamanders have to take in oxygen from the water, so they retain these external gills their entire life.

Dee Ann Chamberlain [00:22:21] And the Barton Springs salamander, we find them at the spring surface, but they move in and out of the spring outlets and they spend part of their life in the aquifer. The Austin blind salamander spends its entire life in the aquifer, pretty much. And we rarely find that species at the spring surface.

Dee Ann Chamberlain [00:22:42] So, Barton Springs salamander's adapted to the groundwater temperature, which is 70 degrees, pretty much, maybe varies a degree or two either side of that throughout the year.

Dee Ann Chamberlain [00:22:53] It has eyes with image-forming lenses. The Austin blind is blind and just has eye spots and lives in a dark aquifer. Evolutionary pressures have resulted in a species without eyes. They don't need eyes in the dark aquifer.

Dee Ann Chamberlain [00:23:17] So, well, we've only found less than ten eggs ever at the spring outlets, and they presumably just get accidentally washed up. So, they must be reproducing, laying their eggs in the aquifer or the outlets below spring surface. So, we don't know exactly where, and we have a lot of questions about them.

Dee Ann Chamberlain [00:23:50] So, they have, they have four toes on their front feet, and five toes on their back feet. And usually when we see them, so they're hiding from predators underneath rocks, but on the substrate. So, they can swim in the water column. And they can swim quite fast by undulating their tail and they have a little bit of a tail fin. But they usually do that in short bursts. So, maybe if they're trying to escape, and they're going from one place to another.

Dee Ann Chamberlain [00:24:17] But generally they're on the substrate and that's when we find them. They're on the substrate in the cobble and gravel, kind of hiding from predators.

Dee Ann Chamberlain [00:24:28] And they eat the macroinvertebrates that live in the springs, in the aquifer. And yeah, so they're predators. And I assume that they help keep some of those invertebrates in check. And in that process, they're also producing nutrients for other invertebrates in the spring system.

Dee Ann Chamberlain [00:24:55] And then, in terms of their adaptations, so salamanders are amazing in they can regenerate more types of tissue and structures than any other vertebrate on the planet. So, salamanders, as a group - their ability to regenerate is just incredible. And they can definitely regenerate toes and feet, but they can regenerate entire limbs. I've seen them do it multiple times. They can regenerate tails. But also, they've been documented as regenerating eye tissue and heart tissue.

Dee Ann Chamberlain [00:25:33] And they've been the major study organism for the medical field for the last hundred years in studying regeneration. And it still hasn't been completely figured out, as far as how they're able to do it so well.

Dee Ann Chamberlain [00:25:45] Yeah. They're pretty amazing animals.

David Todd [00:25:50] That's incredible. I love that they are, you know, such a marvel. And yet, they're small and modest. But they have great secrets that haven't been revealed quite yet.

Dee Ann Chamberlain [00:26:05] Yeah, definitely.

David Todd [00:26:06] Let's talk about the way you've learned about these salamanders. I understand that you've been involved for many years in salamander surveys at the Springs in Zilker Park, using SCUBA and snorkel. Tell us how the how that works and what the experience is like, if you don't mind.

Dee Ann Chamberlain [00:26:30] Yeah, so, I've definitely done surveys over many years. These days, I help with surveys at one spring site, but I work on a team. And my teammates, they survey all the, several spring sites.

Dee Ann Chamberlain [00:26:48] So I think our most interesting surveys area at Eliza Spring. And our team leader Nathan Bendik - he oversees the surveys and our project at Eliza Spring, which is a capture / mark / recapture project to estimate abundance at that site. Because you think about these salamanders in there: you know, they're moving in and out of those spring outlets. And so, when you do surveys, are you finding the same salamanders every time? I meet how do you interpret those numbers?

Dee Ann Chamberlain [00:27:23] And so, the way we do surveys at Eliza Spring is we'll get in in a line, maybe, it depends on the width of the location in the spring, but we go from downstream to upstream. So, we start out in the little stream that runs from the Eliza spring pool. And then we move into the spring pool. So, maybe there'll be four or five of us in a line all together, and we're moving every single rock back, like 6 to 12 inches, and catching every single salamander that we can find and hold them temporarily, you know, release them at the end.

Dee Ann Chamberlain [00:28:05] But we photograph every single salamander. And the photos go into a photo database, again, to look for recaptures and to estimate abundance at the site.

Dee Ann Chamberlain [00:28:17] So, yeah, so this, this last November, the abundance was over 600 individuals, just to give you an example.

Dee Ann Chamberlain [00:28:29] And yeah, as part of this project, we've photographed over 20,000 salamanders, documented over 10,000 individuals.

Dee Ann Chamberlain [00:28:38] We also survey Barton Springs pool, which has a depth of 16 feet. So, we use SCUBA. Again, I don't do that these days. But I surveyed that spring for many years earlier in my career.

Dee Ann Chamberlain [00:28:54] And we have a different process there. And we survey all, we survey the habitat and make note of the species, the numbers that we find, and the size class that we find. So, we don't ... we tried doing the capture / mark / recapture, where we catch them and bring them to the surface, but we found that they were getting this condition called, "gas bubble trauma", from the change in depth. And, you know, we always put them back. But we decided not to do that. We decided to stop that because we were worried it might affect them adversely.

Dee Ann Chamberlain [00:29:46] But yeah I mean it certainly is a fun, that's a whole other experience to go SCUBA diving in Barton Springs pool. And so, when you think about these salamanders, and you know where they live, and they're moving in and out of those spring outlets. And so, there were times when I was SCUBA diving in Burton Springs pool and I had to hold on, like at the main outlet, I had to hold on to keep from getting pushed downstream by the flow.

Dee Ann Chamberlain [00:30:12] But, you think about these little tiny salamanders that grow to, you know, 2 to 3 inches, total length as adults, and they can move into those spring outlets. They just move from underneath a rock to underneath a rock. And so, they're pretty impressive. And so, you know, back to all their amazing abilities and you think about where they live, moving into the aquifer, it's a very different habitat than the spring surface, and moving and dealing with the flow, and moving in and out of those spring outlets. It's pretty impressive, I think.

David Todd [00:30:49] Yeah. It seems remarkable that they're so agile and strong, as small as they are and as powerful as those currents are.

David Todd [00:30:57] So, I think that it's interesting that you work on surveying these creatures, and I'd be curious to learn about some of the challenges of working with a creature that is as small and as cryptic as they are. I mean, you're not surveying buffalo.

Dee Ann Chamberlain [00:31:22] Yeah.

David Todd [00:31:22] There must be some unique obstacles to trying to find and identify these Barton Springs salamanders.

Dee Ann Chamberlain [00:31:34] Yeah, there are definitely a number of challenges and so some of the major challenges are that, you know, we just can't access the aquifer, we can't access their habitat. We don't know where they spend their time. We don't know, you know, where they lay their eggs, where they're reproducing. We can't watch their behavior, that sort

of behavior in the wild. Everything we know, we know on those topics, we know from what we've learned from our captive breeding program.

Dee Ann Chamberlain [00:32:08] And yeah, they're very small. So, I think it takes, you know, getting experience and working with the animals to be gentle with the animals and, you know, to collect the scientific data needed, and still be gentle with them and protect them. Yeah, that's a challenge too, you know, training people so that everyone who's doing surveys is gentle with them. And I have to say right now that the team that we have doing surveys, that everyone is just so wonderful and great with the animals. The hydrogeology team helps us with surveys and they're just, they've just been fantastic, in addition to the other salamander biologists.

David Todd [00:33:07] You know, I imagine that the stakes are even higher. I mean, these are small, delicate creatures. And I imagine that the risks are sort of doubled or trebled because they are very rare. And I'm curious about, you know, how you think about and deal with the risks of surveying or collecting endangered species like the Barton Springs salamanders. I think you talked about this gas bubble issue, and I imagine there are other things that you are concerned about. And I was curious how you confront those challenges.

Dee Ann Chamberlain [00:33:56] Yeah, definitely. We have to really be aware of the environmental conditions, I guess, especially. If we're handling them, moving, affecting their habitat. Actually we're moving rocks in the habitat and that's, it just becomes a necessity because a lot of sediment gets washed into the aquifer during storms, and what goes into the aquifer comes out in springs. It's a karst aquifer. It's a limestone aquifer. It doesn't filter anything. So, yeah, basically what goes in comes out of the springs. And so, a lot of sediment can get flushed into the aquifer, comes out the spring outlets.

Dee Ann Chamberlain [00:34:50] And if you think about it, if you think about where these small little animals live. They're again, 2 to 3 inches total length as adults. When they hatch out, they're less than half an inch long. And so, the sediment can fill in all the little interstitial spaces of the cobble and gravel, their habitat at the spring outlets.

Dee Ann Chamberlain [00:35:10] And so, if that happens, then they don't, they can't hide from their predators. There probably wouldn't be any habitat for the invertebrates that they need to feed on. And so, we have to manage the habitat. We have to clean the sediment out. And so, it's a necessity sometimes to work in a habitat and clean a habitat. And so, you have to be careful - think about the environmental conditions and how you're maybe ... are you affecting the salamanders?

Dee Ann Chamberlain [00:35:48] So, you want to protect the individuals and that sort of thing. Or when we do our capture / mark / recapture, we have to just be aware. We, you know, take them out to photograph them, just watch the temperature, you know, that sort of thing.

Dee Ann Chamberlain [00:36:04] And so, again, I think, yeah, my team is really, really fantastic at being careful with them and thinking about all those factors to try to protect the individuals.

Dee Ann Chamberlain [00:36:19] And so, and then for my program, the captive breeding program, it's an assurance colony. So, we have to collect sometimes. And so, we've always tried to limit collections because we don't want to adversely affect the population in the wild.

There are federal permits and regulations that restrict collections, which is good. And so, we get permission from the Fish and Wildlife Service. You know, we have conversations before collecting. We have plans.

Dee Ann Chamberlain [00:36:59] So, yeah, and in the last several years we've been collecting about ten Barton Springs salamanders per year just to add genetic diversity to our captive population. But there was a long stretch of time, almost ten years, where we didn't collect any at all. So, we try to minimize collections.

David Todd [00:37:25] So, I guess the overall context for the captive breeding program and the concern about them is that the Barton Springs salamander was listed as endangered in 1997. And I was hoping that you could tell us what you know about that whole listing process and how that came about.

Dee Ann Chamberlain [00:37:52] Yeah. So, the main reason the Barton Springs salamander was listed is really a combination of the limited habitat - the Barton Springs segment of the Edwards Aquifer. So, it's a relatively small segment of the aquifer. And the threat of a, or the potential that a contaminant spill on the watershed, on the recharge zone, could go into the aquifer, and cause the species to become extinct in the wild or to extirpate the species at the main spring sites, which are the sites that the City of Austin owns and manages.

Dee Ann Chamberlain [00:38:34] And so, like I said, it's a karst aquifer, so it's limestone. It doesn't filter anything out and the recharge zone has permeable areas where a contaminant could get washed into the aquifer. Our geologists have done some pretty interesting dye-tracing studies where they've injected dye in the watershed, receptor packets at the springs to determine travel times, see how quickly like a contaminant could reach the springs.

Dee Ann Chamberlain [00:39:19] And so, you know, other factors come into play, such as the flow conditions in the aquifer, recent rainfall conditions. But the studies show that under some conditions you can have a spill reach the springs within a day.

Dee Ann Chamberlain [00:39:31] So, you could have a truck that's transporting gasoline, you know, have a wreck and have gasoline go to the aquifer and could come out at the spring sites and it could affect, maybe it wouldn't affect every single spring site, because I think since that time we've found the Barton Springs salamander at more spring sites further out on the watershed. But those are all small sites.

Dee Ann Chamberlain [00:40:08] So, a spill could affect the major spring sites, and that includes all the spring sites the City of Austin owns and manages - so Barton Springs pool and Eliza spring, and there are a couple of more springs that are near the pool.

Dee Ann Chamberlain [00:40:27] So, concerns would be, you know, like gasoline. Some of the major concerns are like a gasoline spill, a sewage spill that could cause an increase in ammonia levels or a decrease in dissolved oxygen, or even a tap water line break if it's a big, a big pipe - some of the chlorine could be toxic. And so...

David Todd [00:41:01] So, I guess what you're touching on here are just the kind of acute concerns, you know, a release of sewage, or a release of gasoline, or a release of chlorine in tap water. That's good to know. What about more sort of long-term worries that might have driven the listing? Are there some more sort of general, you know, not so acute kind of concerns, but...

Dee Ann Chamberlain [00:41:34] Yeah, definitely.

David Todd [00:41:35] But worries nevertheless?

Dee Ann Chamberlain [00:41:36] Yeah. And I think those might be harder to detect. But if you talk about pesticides and herbicides: they get washed into the aquifer. You know, you'd hope that those wouldn't be the very high concentration that would cause, that would be toxic to amphibians and to the salamanders. But at low levels, if it were chronic ... chronic problems I think would be more difficult to deal with.

Dee Ann Chamberlain [00:42:18] And you mentioned sediment. Sediment can carry contaminants as well - travels through the aquifer, settles into their habitat. And as I mentioned, it's an issue and we're always having to clear it out of the spring outlets. And it's a challenge for the staff at Barton Springs pool just to deal with the sediment and to always be cleaning the sediment that comes through the aquifer.

David Todd [00:42:52] Yes, so I guess a lot of this has to do with water coming in and carrying, whether it's, you know, the pesticides, herbicides, whatever other toxins there are. What about situations where it's not what's coming in, but rather what's not coming in: I mean, the issues of groundwater pumping and depletion, drought problems, climate change issues.

Dee Ann Chamberlain [00:43:23] Yeah.

David Todd [00:43:23] Any remarks about that?

Dee Ann Chamberlain [00:43:25] Yeah, those are definitely concerns.

Dee Ann Chamberlain [00:43:30] Yeah. Pumping and depletion, water depletion, could just make situations in which you have like some sort of spill, some sort of toxin, it would make it worse, because if the flow rate is lower because of the pumping, then the turnover rate of the water at the springs is lower. And so, that just would make that a spill potentially a greater threat.

Dee Ann Chamberlain [00:44:13] And those are all things ... we actually have a catastrophic spill plan. And those are all things that we take into account if there's a reported spill in evaluating whether or not something would be a threat to the species.

Dee Ann Chamberlain [00:44:28] But and then, yeah, and then climate change: just having extreme droughts, and we're predicted to have more extreme conditions, so, we might have more prolonged droughts - just the same, the same problem. So, then not only do you have that concern of a toxin in the aquifer, but the turnover rate of the water at the springs is much lower, and so there's just a greater chance of it being toxic. That's a longer exposure time, I guess, to the species. So, yeah, there's definitely worries.

Dee Ann Chamberlain [00:45:20] So, it's kind of a problem of dilution in the case of a drought or overpumping restricting the kind of freshwater that might be coming in.

Dee Ann Chamberlain [00:45:34] Yeah, that's a factor. It's ... Yeah, definitely.

Dee Ann Chamberlain [00:45:36] And then just the, I think, the vulnerability of like a karst aquifer that can transport, so there's areas that are permeable, areas that aren't permeable, but then, you know, water flowing on eventually flows, can flow over the permeable areas, go into the aquifer and just transport the toxins and spills if there's, if there's some sort of catastrophic spill.

Dee Ann Chamberlain [00:46:05] So, karst aquifers, I'd say are pretty, pretty vulnerable to spills.

Dee Ann Chamberlain [00:46:13] I see. Okay. So, it has a lot to do with the the geology of the karst and...

Dee Ann Chamberlain [00:46:19] Yes.

David Todd [00:46:19] Limestone in this part of the state.

David Todd [00:46:23] So, you mentioned that there's a catastrophic spill plan that you helped with. Has that ever been implemented? Have there been releases that have been worrisome enough to trigger that kind of planning?

Dee Ann Chamberlain [00:46:41] So, yeah, definitely there are spills that happen on the watershed. So, and the City has a spill response team. So, they're fantastic and they know if something happens over the Barton Springs watershed, then they call the geologists and the biologists, you know, who help evaluate the situation and evaluate whether or not there's a real threat to the species.

Dee Ann Chamberlain [00:47:09] If we truly thought that a spill was headed to the Springs, then our plan is that we would collect the salamanders, probably at Eliza spring, and bring them to our facility, temporarily, until we determined that, you know, the water quality was fine. But, we would never want to do that unless it was absolutely necessary.

Dee Ann Chamberlain [00:47:41] So, hence the importance of evaluating the substance: what was the volume, and how far was it from the springs? What are the flow conditions? You know, thinking about that turnover rate at the springs, and, yes, just to evaluate the potential threat.

David Todd [00:48:02] I see. Okay.

Dee Ann Chamberlain [00:48:05] Yes. The spill plan, that was one of the requirements, it was part of the Habitat Conservation Plan.

David Todd [00:48:12] Well, maybe we should talk about that. I think that you helped put together the 1998 Habitat Conservation Plan for the Barton Springs salamander. And what was driving that and what were some of the key aspects of putting that together?

Dee Ann Chamberlain [00:48:30] Yeah. So, yeah, so the Barton Springs salamander, as we talked about, the Barton Springs salamander was listed as endangered in 1997. And so, one of them, some of the major habitat sites for that species are within the confines of Barton Springs pool. And so, because Barton Springs pool is, you know, it's stand-up, it's operated as a public swimming facility. And the City, it was necessary for the City to obtain an incidental take permit from the Fish and Wildlife Service.

Dee Ann Chamberlain [00:49:10] So, the City, we worked with the Fish and Wildlife Service to develop a Habitat Conservation Plan, and applied for the incidental take permit. And so, that basically, that allows for some take during operations. But then also, as part of that, the City agreed to a number of measures designed to protect the species.

Dee Ann Chamberlain [00:49:38] And so, for instance, the catastrophic spill plan: one of the highlights, I think, of the HCP, but there are other things as well, other measures. So, for instance, before the HCP, the City used to open up the gates at the downstream end of Barton Springs pool, and lower the pool by four feet, in order to expose some areas to make it easier to clean parts of the pool.

Dee Ann Chamberlain [00:50:17] And when they did that, we found that they were causing salamanders to get stranded and they were essentially killing salamanders. And then when they, and it depends a little bit on the flow conditions. So, under lower flow conditions, or lower than average, then also they would cause Eliza Spring, which is right next to Barton Springs pool, it would cause that spring set to go dry. And so, definitely, you know, unintentionally, they didn't realize it, but it was a practice to lower the water level like multiple times a week. So, you could imagine that they were inadvertently killing a lot of salamanders.

Dee Ann Chamberlain [00:51:07] And so, the salamander's listed, and some of these practices were then looked at a little bit more intensely because of the habitat. And so, one of the, I think one of the, in my opinion, one of the best things about the HCP was restricting the pool lowering. And so, in not allowing the pool to be lowered, when the discharge is lower, less than average, when the aquifer's like about half-full, when it's lower than that, they can't lower the pool.

Dee Ann Chamberlain [00:51:49] And so, they did put in new gates, which then allowed a little bit more control, which was good. And so, they could do partial drawdowns. So, they could lower it. So, it didn't have to be an all-or-nothing, four feet or not. They could lower it a couple of feet and the whole point was to keep from exposing areas that might be salamander habitat and causing salamanders to be stranded. So, really a fairly simple solution to that problem, I think.

Dee Ann Chamberlain [00:52:34] So, there are limits on the drawdowns. They started, and then they started cleaning the shallow end without lowering the pool every time. They modified the gates system, restricted access to the smaller spring sites, and provided some support for this Splash! exhibit, an educational exhibit on the Springs and the salamander. It's an exhibit that's been at Barton Springs pool, and they're in the process now of kind of updating and changing that exhibit.

Dee Ann Chamberlain [00:53:13] Other measures as part of the HCP includes the Conservation Fund, so we can fund research projects, policies on silt and gravel removal, the catastrophic spill plan, habitat restoration, actually, including there was like a daylighting project at Eliza spring.

Dee Ann Chamberlain [00:53:43] So, the spring basically flowed into an underground pipe that flowed into the bypass tunnel that went to Lower Barton Creek. And we daylighted that, so basically created a stream from the spring pool to the bypass.

Dee Ann Chamberlain [00:54:05] So, unfortunately, it still does empty into the bypass just which was, there was really no way around that, given the elevations of everything. But, we created a lot of habitat in that process, and, which I think has been good for the salamanders at Eliza spring.

Dee Ann Chamberlain [00:54:28] And so, then we have a project planned at Old Mill Spring in the coming years. So, those are all part of the Habitat Conservation Plan.

Dee Ann Chamberlain [00:54:41] And then, in that process, in '98, so, at the very last minute, the Fish and Wildlife Service decided to add a requirement for a captive breeding program, for an assurance colony, and a position to manage that program. And so, that's the position that then I applied for and got. And so, that's my job.

David Todd [00:55:08] Well, let's talk about that. Okay. So, as I understand it, just to try to put some brackets around this, you began in 1998 with the salamander breeding program, is that right?

Dee Ann Chamberlain [00:55:23] Yes. Uh huh.

David Todd [00:55:24] And it was originally focused on the Barton Spring salamander, but later, the Austin blind salamander was included as well?

Dee Ann Chamberlain [00:55:32] Yes.

David Todd [00:55:33] Okay. Well, so let's talk about the origins of that. How did you collect some of these first specimen Barton Springs salamanders for the colony?

Dee Ann Chamberlain [00:55:44] Yeah. So, we started on a small scale. We didn't have really much space to start. And so, I think we started with a small number of animals in a small space, and then expanded the population, and kept moving to new locations with more space over time.

Dee Ann Chamberlain [00:56:05] And so, it actually started, so we collected a limited number of salamanders from each of the four spring sites. So, I've already talked about three of them - the Barton Springs pool (that's Parthenias spring), Eliza Spring, Old Mill Spring, and then there's a little spring in Barton Creek upstream of the pool called Upper Barton Springs. So, we collected salamanders from each of those sites.

[00:56:31] And it actually, actually the project started in my cubicle on the 16th floor of a downtown office building, and then we moved to about two closet-sized rooms at UT-Austin, and then we moved to a city building occupied by the city's building services staff. They were fantastic. And they helped us then.

Dee Ann Chamberlain [00:57:00] And for each of those sites, we had to transport water for our tanks. And then, the salamanders reproduced pretty, the Barton Springs salamander reproduces pretty readily in captivity. And so, we had offspring. We increased our population, added more tanks, with more space. And then, but we were transporting water, which was kind of difficult, kind of a pain, I guess. And so, then we finally moved to our final destination, our permanent location, which is near a groundwater well, which has been a game changer in many ways. And we have a lot more space. And so, that's worked out really well.

David Todd [00:57:54] So, let's talk about these tanks where the colonies are kept and how they designed and built and operated and maintained. There must be just lots of thought and protocols to go into this.

Dee Ann Chamberlain [00:58:13] Yeah, I think it helped to build over time. We started out with, I guess, several different sizes. My favorite is the four-foot-long, 75-gallon tanks. Then we had reproductive groups in the tanks. And that worked well for maintaining ... so, we had to we had to keep them, so, there was a requirement in our federal permits to keep the animals separate according to the spring site where they were collected, or that their parents were collected from. So, essentially we were managing four populations for a while.

Dee Ann Chamberlain [00:58:58] And then we've since been able to do away with that requirement, because it makes sense. We haven't found that the spring sites really represent genetically distinct populations that need to be kept separate. And for the purposes of the colony, it's good to, we want gene diversity, and so we want to be able to mix individuals if needed.

Dee Ann Chamberlain [00:59:28] But, so, yeah, so, these days, so we have a lot of various sizes of tanks are custom-built. A lot of, a number of four-foot-long tanks, but also small tanks so we can pair up individuals if we want, maybe, or isolate individuals also. So, when we have egg-laying events, we remove eggs from the tanks, separate them out for many reasons. The parents, you know, adults, might eat the offspring.

Dee Ann Chamberlain [01:00:09] And but also you need to feed them different sized organisms. So, you want to feed the small juveniles really small, tiny organisms, and then you want them to be able to find it. And so, you know, you put them in a smaller space to make it more efficient to feed them, and track them.

Dee Ann Chamberlain [01:00:34] And so, yeah, we label all our tanks. We track all of our salamanders as individuals, and we know which individuals are in which tanks.

David Todd [01:00:54] One thing that seems like an interesting kind of tension is that you talk about how the populations from the four springs were originally kept distinct from one another. And on the one hand, I guess you certainly want to be respectful of the different sources of these creatures. But at the same time, you also want to have as much genetic robustness and diversity. So, how do you balance those two issues?

Dee Ann Chamberlain [01:01:26] Right, yeah, you know you bring up a really good question. So, really the whole program since its initiation is an insurance policy. So, the whole point is if we had a catastrophic spill, as we talked about that caused the species to be extirpated, maybe cause the species to become extinct or to even be extirpated or disappear from the sites that the City manages, which are the primary sites for the species, then we would have a population in captivity that we could use. We would use it to produce offspring to release into the wild.

Dee Ann Chamberlain [01:02:04] And so, it's really all about genetic diversity. And so, we need a population that represents the genetic diversity of that found in the wild. And so, our approach to do that is we track individuals and we estimate genetic diversity using pedigree. And so, we track individuals and data on individuals - so, maybe collection site, or their parents if they're captive-raised. And you don't always know the exact parents, but you know the potential parents, usually.

Dee Ann Chamberlain [01:02:44] And so, then we use, I use, a program called PMX that a lot of zoos and aquariums use to do the same thing, to work with their captive populations and to estimate the gene diversity of the population. And so, you can, and then you can make, using some conventions and you can make some assumptions in your modeling, that you can estimate the gene diversity. And then you can model it out in the future and you can say, "Well, what if there's a catastrophic spill and it takes 20 years to clean it up or, you know, you need to maintain this population over decades, what would your gene diversity be or what could you do now?"

Dee Ann Chamberlain [01:03:25] You can model, you can kind of play with different parameters and model out what the gene diversity might be in the future. And so, it's really helpful.

Dee Ann Chamberlain [01:03:35] And so, then you always want to choose to breed individuals based on their pedigree, whose genes would be rare in the population, so you don't have a lot of relatives in the population basically. So, we use kinship to choose individuals.

Dee Ann Chamberlain [01:04:01] And actually, like I said, the Barton Springs salamander breeds pretty readily in captivity. In fact, it was really more of an issue to get it to stop at one point. So, the population got to over 500, which was getting a little bit difficult, again, tracking all the individuals. And we use photographs (so we can talk about that too, about how we track them), but it can be difficult to distinguish between.

Dee Ann Chamberlain [01:04:42] So, a lot of times females have eggs, so you can see the eggs in their abdomen. It's obvious it's a female, but it can be difficult to distinguish between a female that doesn't have eggs, who is not gravid, and distinguish between that - a non-gravid female and a male.

Dee Ann Chamberlain [01:05:02] And so, once we got better at that and then we segregated them by sex, essentially to get control over the reproduction, essentially. And so, our population got to over 500 at one point, but we're letting it drop. And it's, so now our plan at Fish and Wildlife is we maintain a minimum of 150. And so, now we've got about 200 right now. That's where the Barton Springs salamander is.

Dee Ann Chamberlain [01:05:33] The Austin blind salamander is a different story. We don't find very many of those in the wild. We never have collected very many. We have about 50 and they don't breed as readily in captivity. And they're just difficult. We just don't find very many. We just don't. And then they're usually, the ones we find are, they're very, very small and fragile. And so, they seem very, very vulnerable to raise them up, I guess.

David Todd [01:06:13] Well, I guess tracking these salamanders and understanding their diversity must involve being able to identify them as individuals. And I think you've mentioned a couple of times about this set of what, some 20,000 photographs and the database that allows you to track those. Would you tell us how that whole archive inventorying the different salamanders was developed and how you use it?

Dee Ann Chamberlain [01:06:52] Yeah. So, this, and this is a little bit different than the other photo database I was talking about. So, that was for the salamanders that we find at Eliza spring in our surveys. And so, kind of two separate databases. And so, for this, for our

salamanders in captivity, you know, as I mentioned, we track them as individuals. We assign each individual a unique ID number, and then track other data, and then we photograph them.

Dee Ann Chamberlain [01:07:25] And you can use those photographs by looking at their melanophore or iridophore patterns, their markings to figure out... So, say you have to take five or ten animals, you pull it out, you photograph it, and you compare it with those photos and you can figure out which individual it is by looking at those melanophore and iridophore patterns.

Dee Ann Chamberlain [01:07:55] And then we have all this organized according to their stud book ID number, basically, that that individual's been assigned to. So, then you know the history of that animal and wither where it was collected from and when, and if it's male and female, or if captive-raised, when did it hatch, who were the parents, or who are the potential parents?

Dee Ann Chamberlain [01:08:16] And then, one thing I was thinking about that I should point out in talking about gene diversity, I mean, the whole, you know, one of the main reasons really that we want to focus on gene diversity for the captive population is just the fact that populations that have high gene diversity are going to be more resilient to things like environmental changes, diseases and other stressors.

Dee Ann Chamberlain [01:08:44] And so, just we want our population in captivity to have high gene diversity so that if we need to produce individuals for reintroduction, then we'll have the high gene diversity to produce again a population with high gene diversity to release. Does that make sense?

David Todd [01:09:15] Yeah, sure. I think I understand this connection between diversity and resilience. And, well, I imagine there are just a lot of things to juggle when you're trying to breed these creatures.

David Todd [01:09:31] One of the things I wanted to ask you about is an ordeal that you all went through in 2008, I think, when the salamanders started absorbing their toes and feet. How was that discovered and what did you do? And what do you think was the cause of that?

Dee Ann Chamberlain [01:09:50] Yeah, I definitely have thoughts on all of that. Yeah, that was not, that was about six months after we moved to our new facility. And actually, we had had lots and lots of reproduction. And things initially seemed to be going really well.

Dee Ann Chamberlain [01:10:13] But then we noticed that some of the individuals had maybe just very short toes. Some had, they were missing all their toes and part of their feet. And then there were even some individuals, and not as common, they were missing their entire limbs.

Dee Ann Chamberlain [01:10:40] And they, it was kind of amazing to watch, I mean, they would regenerate. And they could regenerate entire limbs. And then they might, over time, again, we're talking about over months, their toes would shorten again. And it looked to me like they were resorbing them.

Dee Ann Chamberlain [01:11:13] And in looking at the literature, the scientific literature, on regeneration, there are studies that also described what appeared to be like resorption. And it was not understood.

Dee Ann Chamberlain [01:11:32] And so, you know, we worked with amphibian pathologists and there were a few other problems too that made one amphibian veterinarian, a veterinarian that specialized in amphibians - he suggested that maybe there was a calcium deficiency.

Dee Ann Chamberlain [01:11:54] And so, as soon as you take the water out of the the water out of the ground, the groundwater, since CO₂ is higher in the groundwater than in the air, so this CO₂ equilibrates with the atmosphere and it results in an increase in pH from about 7 to 8. And this also causes over half of the calcium to precipitate out. And so, we were thinking that perhaps that either the pH and/or the calcium concentration was the reason why this was happening.

Dee Ann Chamberlain [01:12:36] Now, we have since changed the water systems again so because our current facility is at a groundwater well, which is really nice. We are able to change the water chemistry to be exactly like the ... we use a constant drip of water from the well, basically. So, it's exactly the same as the groundwater and the problem's resolved.

Dee Ann Chamberlain [01:13:04] But we did do a study recently looking at the different levels and calcium concentrations and those individuals didn't develop that problem in the timeframe of that study. Maybe if we had let it go longer, they eventually would have developed it. So, it's still a little bit of a mystery. But it's not a problem that we're dealing with anymore at our facility, which is really nice. Certainly it was, it was scary. I didn't know what was causing the problem. I mean, was it going to result in mortalities? It was a surprise. And it was also amazing to see how they could recover from that and to see them regenerate. It was pretty incredible.

Dee Ann Chamberlain [01:13:53] So, they're, in my opinion, I mean, they're very interesting animals in that working with them they seem, they seem resilient in some ways, and they're very sensitive in other ways. And it's sometimes hard to figure out what you need to do to give them what they need, I guess. So, with, you know, experience and time, you know, you kind of get a better idea for sure.

David Todd [01:14:37] Since you've been working with these animals for nigh on 25 years, have you gotten attached to these creatures? Are there some individuals that you recognize, or ones that you've known a long time?

Dee Ann Chamberlain [01:14:55] Yeah. Yeah, most definitely. Yeah. Like I said, we track them as individuals just from using photographs. And so, sometimes, you can just see the individual markings even without taking the photograph.

Dee Ann Chamberlain [01:15:13] But yeah, so, we just had an Austin blind die that I had collected, I collected 25 years ago. So, he was a small juvenile in the collection, so he lived to be 25. It's pretty amazing.

Dee Ann Chamberlain [01:15:33] We have another one that's in its early twenties. Have a Barton Springs salamander that is 23 years old.

Dee Ann Chamberlain [01:15:38] Most of them lived to about 8 to 10 years in captivity. But we do have some individuals that are living much longer and they're reproducing at the older ages, at least 15 or so. Yeah, which is pretty interesting.

Dee Ann Chamberlain [01:15:55] But yes, most definitely. You know, I've had, it's, you know, I took care of that Austin blind salamander for 25 years. It had been with me through all the different locations and the moves and it's one of the first Austin blind salamanders that we collected, actually, when we were trying to figure out. It wasn't the very first one, but it was really early on in that process then of trying to figure out if it was a new species. So. Yeah.

David Todd [01:16:27] Did you name it?

Dee Ann Chamberlain [01:16:34] Yeah. He had the first number in the Austin blind studbook, so the A1 number.

Dee Ann Chamberlain [01:16:43] Yeah, I knew he was slowing down. I mean, everybody could see that he was slowing down over the last year or so. He was maybe kind of slowly, but it was pretty neat to have him all those years.

David Todd [01:17:06] So, aside from making sure the water chemistry is right, and I guess the temperature, how do you provide the right kind of food and habitat, you know, cover, substrate, that they will feel comfortable with?

Dee Ann Chamberlain [01:17:25] You know, that's a really good question. And so, yeah, for food, yeah, that's a challenge, actually, because how do you obtain a lot of the type of food that they would eat? And so, you know, I found that they'll really only eat either live food or frozen food. And so, we do buy the frozen, people call them, "blood worms", but they really, they're like midge fly larvae. They're in the family Chironomidae. And so, luckily, you can buy those at the pet store. And the salamanders really like them. They do really well on them. So, that's kind of a staple for them.

Dee Ann Chamberlain [01:18:18] But then we also collect invertebrates at times to supplement their diet. But we have, you know, we've got hundreds of salamanders. So, it would be nice to find easier ways, I guess, to raise up more food. But we also hatch out brine shrimp. They like brine shrimp. So, we do diversify. They've done really well, actually, I think.

Dee Ann Chamberlain [01:18:56] And as for the small little hatchlings, we feed them the brine shrimp and kind of cut-up Chironomids. So, the Chironomids, the fly larvae, people call them "blood worms", but they're like maybe half an inch long, three quarters of an inch long. And so, we cut them up into smaller pieces for the little hatchlings.

Dee Ann Chamberlain [01:19:21] And so, that's, yeah, for the food.

Dee Ann Chamberlain [01:19:23] And then for the substrate, I usually provide like a gravel base with some cobble. But they, it seems to me, in working with them that ... so, I guess that works for the tanks. But if you take them out and you want to work with them so you put them in a container, they might get stressed. Right? And they need some habitat to feel comfortable.

Dee Ann Chamberlain [01:20:02] Then we've gotten to where we use mesh, and it seems to calm them down like right away. Like I think hiding for them is not, I think it's less of a visual thing and more of a tactile thing. And so, if you put a piece of mesh in with them and they seem to be pretty comfortable with it, pretty much right away.

Dee Ann Chamberlain [01:20:26] And so, then we had other types of, we create other types of hiding places at times, using netting, sometimes mesh. And I bought some what are kind of marketed as rock hides for fish recently to try. So, plastic plants - they like to climb in the plastic plants. I mean, I don't think that's a plant for them. It's just a, I think that they like to have something against them that makes them feel like they're hiding. And they can get, they can climb into the plastic plant and that seems to make them feel comfortable.

Dee Ann Chamberlain [01:21:12] So, moss - we collect moss from the spring sometimes. They like that, definitely. So, it's kind of a trial and error, over time. So, you want them to be comfortable and, you know, you want them to be healthy.

David Todd [01:21:37] That's really interesting: how you put yourself in their little four and five-toed feet to, you know, try to understand when they're feeling comfortable and at ease with their surroundings.

Dee Ann Chamberlain [01:21:54] I try to, yeah, try to think about life from their perspective.

David Todd [01:22:00] Yeah, well, so, it's clear you've invested decades, literally, of time, and a lot of explorations of what might work for prey and substrate. And, you know, it's a big investment. And I'm wondering what sort of concerns you have about the captive breeding colony itself. I mean, there's certainly the ordeal you went through in 2008, but I understand that there have been thefts of salamanders that have been in other assurance colonies. Can you talk at all about that sort of issue?

Dee Ann Chamberlain [01:22:49] Yeah. Yeah. Definitely have concerns about those sort of things. Yes, there's a Fish and Wildlife Service facility in San Marcos where salamanders were stolen. And it was under federal investigation. It's never been solved. And so, you think about that. And so, we talked about the reason why we have this program. They have their program for the same reasons. It's to protect the species in the long term for, you know, to maintain some genetic diversity in captivity. So, you have animals in case something happened to the species in the wild, you would have a population in captivity that you could use to repopulate the springs.

Dee Ann Chamberlain [01:23:47] Then you want, you want the genetic diversity. So, you want to release a population that's going to be resilient. And so, and they're living a long time, so, like I mentioned that our Austin blind lived to 25. Half of them live to about 8 to 10 years in captivity.

Dee Ann Chamberlain [01:24:07] And so, it's a big investment. So, we have, I think, really worthwhile goals and reasons why we want to protect the animals. And it's an investment taking care of these animals.

Dee Ann Chamberlain [01:24:23] And we've learned a lot about them.

Dee Ann Chamberlain [01:24:28] So yeah, .. concerns that something would happen to them, concerns that there would be health issues. I know other facilities have had, we talked about gas bubble trauma at Barton Springs pool from bringing them up from a depth of 16 feet. Well, some think gas bubble trauma, just from the groundwater, if it's supersaturated with total dissolved gas. In fact, years ago we found salamanders in the wild that were like little balloons because of the total dissolved gas. It's a natural phenomenon.

Dee Ann Chamberlain [01:25:14] And it's sort of like, as I mentioned, like the CO₂ is higher in the groundwater than in the air. And so, it's all atmospheric gases in the groundwater and it will off-gas and equilibrate with the atmosphere. It's kind of like opening a soda, you know, and the fizzing. But, and so, for aquatic animals in that environment, those bubbles can also get incorporated into their bodies and can block blood flow, cause all kinds of health problems, cause mortality, you know, secondary infections, mortalities.

Dee Ann Chamberlain [01:25:47] And so, that's another thing that's happened at other facilities is having problems with the groundwater and having a super saturation of it that kills off animals. And so, this, you know, there are a lot of factors to consider and to think about in having and maintaining these salamanders in captivity. And, you know, it's a big investment and you want to protect them. And then again, for the whole, the goal of protecting the species in the long term.

David Todd [01:26:26] Well, it's interesting about the gas bubble issue and super saturation. And those are things that you can sort of understand from a physics and chemical analysis.

David Todd [01:26:39] But do you have any speculation about why folks would steal these animals? That just seems harder, for me at least, to understand.

Dee Ann Chamberlain [01:26:53] You know, one speculation is that someone wanted to sell them in the pet trade. And so, you know, they're not going to live for very long, you know, those salamanders that got stolen. That was really the only idea that I heard that might make any sense.

Dee Ann Chamberlain [01:27:24] Yeah. I mean, I guess sometimes animal rights groups do things because they think they're doing the right thing. But they're not. But I don't think there is any consideration at this time that was an animal rights group. It was, it's open for speculation, you know, to sell them in the pet trade, probably, because they're such rare and unique animals.

David Todd [01:28:04] So, you know, aside from breeding these animals and making sure that there's an insurance colony there in case there's some sort of catastrophe, my understanding is that you've also been giving support for public education. And I know there's a Splash! exhibit at the Barton Springs pool and that you've provided some support for that. Maybe you can talk a little bit about this effort to make the public appreciate what you're doing and why you're doing it.

Dee Ann Chamberlain [01:28:42] Yes, definitely. Yeah. My team, we do engage in outreach activities at times. And the City also has an education group and they educate about water quality and also about salamanders. And then, kind of a fun thing is we've given presentations to people of all ages and so that can be fun because you never know what kind of questions you're going to get, especially from little kids, you know?

Dee Ann Chamberlain [01:29:18] But and then we support the Splash! Exhibit. I've been helping the Splash! Exhibit from the very start, actually before the Splash! Exhibit. We had salamanders that were on display when the Splash! exhibit was actually a gift shop at Barton Springs pool. But with Splash!, yeah, we've provided salamanders and photographs and information, and assistance and helping if the staff's out of town, that sort of thing.

Dee Ann Chamberlain [01:29:52] So, I think it's been a good opportunity for people to learn about the aquifer and the springs and, yeah, in a nice environment.

Dee Ann Chamberlain [01:30:04] So, they're currently redesigning that exhibit.

David Todd [01:30:09] So, you've left an intriguing little comment there that I wanted to ask you about, that when you give these presentations, you know, you get questions from the audience, of course, and it's sometimes little kids who have particularly interesting questions. Are there any that occur to you?

Dee Ann Chamberlain [01:30:30] Let's see. I don't know if I can think of any questions off the top of my head right now. They always seem to ask really good questions. I don't know if I can think of anything right now. Also at times when we are doing our surveys at Eliza, people stop off, and kids stop and ask us questions. And I've had some funny questions. I mean, certainly the most common ... well, one of the most common questions I've gotten over the years are, "Are y'all looking for alligators?" "Like, no, I don't think I would be in here if there were alligators." But, you know, "Can you stand on your hands?" You know, that kind of thing. They're hysterical.

Dee Ann Chamberlain [01:31:26] But the kids usually do, when you're talking them about and showing them salamanders, they usually do come up with really good and worthwhile questions. And you can tell that they're thinking and that they're interested, which is pretty neat.

David Todd [01:31:45] So, it sounds like the Barton Springs salamander is unique in many regards. But I was wondering if there are some vulnerabilities or other issues that it shares with its fellow amphibians. Can you talk about sort of the challenges facing this larger group of amphibians?

Dee Ann Chamberlain [01:32:13] Yeah, I think, for all amphibians, I mean, habitat loss, or changes in their habitat, would be a major factor. And then that can make them, or just additional stressors from habitat loss: non-native species, climate change - definitely changing, having more extreme weather conditions, could cause mortality, but also just stressors that make them more vulnerable to disease.

David Todd [01:32:56] And is there something about amphibians and the way their sort of tissue that envelops them is just more permeable, that makes them more sensitive and vulnerable to environmental changes?

Dee Ann Chamberlain [01:33:13] Yeah, they can absorb things through their skin a lot of times and yes, that definitely makes more, more vulnerable.

David Todd [01:33:35] You know, you've spent close to a generation working in central Texas, first at the LCRA, and then later with the Watershed Protection Department, at the City, looking at rare birds and then later amphibians. And I was wondering if just as a kind of a group of indicators for what's going on in central Texas, have you seen some trends, some patterns, some overarching concerns that connect these different creatures that are endemic to central Texas?

Dee Ann Chamberlain [01:34:15] Yeah, I think definitely, yeah, protecting their habitat: it is certainly so important, and it's an issue with more and more people on the planet. And, you

know, I think a lot of times people want to do the right thing, but they don't always have all the information, or they don't know what the right thing is to do.

Dee Ann Chamberlain [01:34:43] So, I like our environmental regulations. It's nice that we have the Endangered Species Act, and that there are people working to protect habitat. I think habitat loss is ... across the board, our degradation of habitat is an issue.

Dee Ann Chamberlain [01:35:04] And, you know, I was thinking back to your last question about amphibians and, you know, amphibians are just such a very diverse group of animals - different life histories. And there's just still a lot to be learned about them. And so, there's not, you know, you have to learn about each situation to figure out what that species needs, I think, or what may be affecting them, because they're just also different. I mean, amphibians are amazingly diverse. So, there's a lot still to be figured out in terms of the best way to protect them.

David Todd [01:35:46] It's hard to generalize, I bet.

David Todd [01:35:49] So, maybe it's best to just zero in on the Barton Springs salamander that we've been focusing on today. When you think about Barton Springs salamander, do you see it as an indicator of the health and integrity of the Edwards aquifer, or the Central Texas environment?

Dee Ann Chamberlain [01:36:13] Yes, I do. I think it can be an indicator. Yeah, really whether or not the springs, as the salamanders know it, as they have been adapted to it, as they've been for a long, long time yet. So, whether or not those springs have changed in a significant way, they can be an indicator of that and tell us something about the health of the environment.

David Todd [01:36:52] Well, and then aside from it being, you know, a thermometer or barometer of changes in the environment, how would you describe the value of a Barton Springs salamander, either as a species or as a particular individual?

Dee Ann Chamberlain [01:37:12] Yeah. I mean, I think they have great value in and of themselves. I mean, they're part of the ecosystem that's evolved over time. They're important. And I just think they're amazing, beautiful animals. They can, as we've talked about, they can do things that we can't. And, you know, we still have a lot to learn about them and, I mean, their abilities to regenerate.

Dee Ann Chamberlain [01:37:39] But also just think about their environment - where they live. We don't know how deep they go. And we know that they've been collected a hundred feet below the water's surface. So, we don't know the pressures on them. So, there's just, I think there's still a lot to be learned from them and about them. And I think that's the, it's the same for every species. There's just a lot to be learned, probably about every type of animal on the planet.

David Todd [01:38:05] Lots of mysteries.

David Todd [01:38:11] Well, so, not to get too metaphysical, but when you think about Barton Springs salamanders, having dealt with them for years, do you think that they have a soul?

Dee Ann Chamberlain [01:38:28] Well, I don't know if I would say that. But, I think that they have a presence and an energy on this earth that makes them part of this amazing diversity of life that we're all a part of. So, we're all connected.

David Todd [01:38:52] Okay.

David Todd [01:38:53] Well, as we draw to a close here, I thought that it might be interesting to just ask your view of being an environmental scientist, because you work at this really interesting intersection of science, and politics, and just pay for a good day's work ... and idealism, actually, you know, of trying to make the world a better place. And I'm curious how you've viewed your service for the City and the LCRA, and any thoughts you might want to share there.

Dee Ann Chamberlain [01:39:31] Yeah, that's a good question. You know, the thing I love about the City of Austin is, I think, as an organization, in my opinion, it tries to do good things and through its programs and projects. And I guess a lot of those are in alignment with my values. But I think the City of Austin cares about the environment. And while there are federal requirements that are the base of some of our salamander programs, I feel like the City goes above and beyond to do good things.

Dee Ann Chamberlain [01:40:29] And I like how the City cares about and protects, wants to protect, these salamanders.

David Todd [01:40:42] Well, thank you, Dee Ann.

David Todd [01:40:46] We've talked about a lot of things. Is there something that we might have missed, skipped over, that you'd like to mention before we close?

Dee Ann Chamberlain [01:40:56] Well, I don't think so. No. But I've enjoyed it. I've enjoyed talking to you.

David Todd [01:41:02] Well, thank you. The feeling's mutual. Thank you for your time today. And I hope you have a good weekend and that our paths cross sometime soon. Maybe I'll see you at the Springs.

Dee Ann Chamberlain [01:41:16] Yeah, sure. That would be wonderful. Yeah. Well, thank you so much. You have a good weekend too.

David Todd [01:41:21] You bet.