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David Todd [00:00:02] Well, good afternoon. My name is David Todd, and I have the great privilege of being here with Dr. Wade Sherbrooke.

David Todd [00:00:10] And with his permission, we plan on recording this interview for research and education on behalf of the Conservation History Association of Texas, a small non-profit here in the state, and for a book and a website 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 at Austin.

David Todd [00:00:37] And I want to stress that he would have all rights to use the recording as he sees fit. It is his.

David Todd [00:00:43] And before we went any further, I wanted to make sure that that's all right with Dr. Sherbrooke and is basically what he was expecting.

Wade Sherbrooke [00:00:52] Yes, that's fine. I'm in agreement.

David Todd [00:00:54] Oh, good, Good. All right, well, let's. Let's proceed.

David Todd [00:00:58] My name again, as I said, is David Todd, and I am representing the Conservation History Association of Texas. And I am in Austin. We are conducting a remote interview with Dr. Wade Sherbrooke, and he is based in the Tucson, Arizona area.

David Todd [00:01:16] I'd like to note here before going any further that Todd Trigsted is helping ensure that we get a good recording and we are very grateful for his help.

David Todd [00:01:27] It is Monday, November 6th, 2023. It's about 3:10 p.m. Central Time in Austin, which is roughly 2:10 p.m. in Arizona where Dr. Sherbrooke is located.

David Todd [00:01:44] Dr. Sherbrooke is the Director Emeritus at the Southwestern Research Station, located in Portal, Arizona, and part of the American Museum of Natural History. He's also been a Research Associate in Herpetology with the Museum, as well as a Research Associate affiliated with the Department of Ecology and Evolutionary Biology at the University of Arizona in Tucson.

David Todd [00:02:10] He is known as one of the world's experts on horned lizards. So we feel very lucky to be with him to learn more about these interesting creatures.

David Todd [00:02:18] So, today we'll be talking with Dr. Sherbrooke about his life and career, to date, and especially focus on what he's learned about the history of horned lizard study and appreciation and conservation.

David Todd [00:02:32] So, with that little introduction, I wanted to thank Dr. Sherbrooke for his time today and maybe launch into some questions, with his permission.

Wade Sherbrooke [00:02:43] You're most welcome. Thank you.

David Todd [00:02:45] Good.

David Todd [00:02:46] Well, I thought we might start with your early years. Could you please tell us about your childhood and whether there might have been any experiences or people, or both, that might have influenced and encouraged your interest in in animals and science and conservation?

Wade Sherbrooke [00:03:07] Well, I grew up on Staten Island, which is part of New York City. But when I grew up there, it was semi-rural. There was residents, a lot of residents in small towns. Today, it's completely taken over almost by human beings and their residences.

Wade Sherbrooke [00:03:30] But behind my house, on a street that had different homes up and down the street, I could collect red-backed salamanders. There were all kinds of birds. There was a wild patch of blackberries and box turtles eating blackberries. And adventures like that for meto take into account.

Wade Sherbrooke [00:03:53] Not too far from my home, there were ponds with snapping turtles and swamps around the edges of Staten Island that I could walk to from my home, through oak woodlands. And I got my first snake while I was in that residence.

Wade Sherbrooke [00:04:15] Then, in my summers, my great-grandmother had a business at the beach in New Jersey, on the New Jersey coast of the Atlantic Ocean, at Barnegat Bay, at a place called Ocean Gate.

Wade Sherbrooke [00:04:30] And when I was five years old, I was integrated into the activities of a number of relatives. We rented rowboats. We had picnic tables. We had changing places for people to put on bathing suits and things like that. So I became very integrated into activities as a child that way.

Wade Sherbrooke [00:04:55] I was also, when I went there, I would put on my bathing suit and take off my shoes. And they didn't go back on, that didn't change until I went back for school in the fall.

Wade Sherbrooke [00:05:08] And I was able to go crabbing in my little own rowboat and catch crabs a lot. We ate a lot of crab.

Wade Sherbrooke [00:05:16] And I had always had a seine, and I could seine small animals from the not deep waters there.

Wade Sherbrooke [00:05:29] And then, when I was in high school, I had a friend who had volunteered at the Staten Island Zoo in the reptile department. And I decided the next year to follow him in high school. And I had jobs there as a volunteer helping clean the alligator pools by moving the alligators to one side and things like that, and taking care of snakes and tasks like that.

Wade Sherbrooke [00:05:56] But I think the most important thing that happened to me in that episode was that I met the zookeepers and they were very dedicated people. And one of them went on to become a professor in biology - Charley Hackenbrock - and he was taking a lot of photographs and they were in reptile books in those days. And I was very impressed by the way he went about it. He didn't just take pretty pictures of them. He wanted to engage some activity, some behavior. So there was more than one story in each photograph. And I think I picked up a lot photographically there.

Wade Sherbrooke [00:06:33] But the other thing I picked up was that you could become an adult and work with animals. And that hadn't occurred to me on the outskirts of New York City, where everybody got on the train or the bus or the ferry and went to an office in Manhattan every day and came back in the evening. I was not attracted to that.

Wade Sherbrooke [00:06:55] And then I started, with some friends who had some pigeons, I started raising pigeons. And by the time I was an early teen, I had quite a few pigeons and I used to build pigeon coops and got into construction that way. And when I joined the Oakwood Heights Racing Pigeon Club (and I was the only teenager in it and I was probably 12 or 14 in those years, 15), and I was dealing with older men. Many of them were Italian, second-generation Americans and other people, in different kinds of work.

Wade Sherbrooke [00:07:36] So, I integrated into an adult atmosphere again and they accepted me as one of them and gave me jobs. And we shipped pigeons for training. We shipped pigeons for races, from 100 miles to 500 miles, which they did in the day. And then we evaluated the races at the end. So it was all part of learning to operate in an adult world, which I think is important for young people to be accepted and find out that they can have that kind of role.

David Todd [00:08:11] Well, you know, it's interesting. It sounds like you had a number of adult mentors, whether it was these Italians who were racing and raising pigeons, or the zookeepers at the Staten Zoo, or possibly a family member who allowed you to go out in one of these precious rowboats that they could otherwise be renting to somebody. But you were absconding with them. Is that fair to say that there were these three sets of people, or that maybe there were more?

Wade Sherbrooke [00:08:44] Yeah, that was my grandmother. She gave me the rowboat. I had my own rowboat. And I could rent it if the other boats were all rented. If there were a lot of big demand.

Wade Sherbrooke [00:08:55] And I made enough money doing that to buy my first camera, a Kodak. I forget what they call them exactly - Spotmatic? That's too modern a term. But it was a very simple camera. But that allowed me to get that. Yeah. So.

David Todd [00:09:16] And were there any peers? I think you mentioned that there was a friend - I guess he was close to your age - who also volunteered at the Staten Zoo. Were there people like that who, you know, were boys like you?

Wade Sherbrooke [00:09:28] Yeah, we were actually, he is today, he is in Arizona. He's in Prescott, Arizona. And so we followed each other through life. I've known him since I was three and our mothers were very good friends. At one time, we lived very close. But at the time I was on Staten Island, we did a lot of things together: go to these ponds, and he was interested in animals as well. Although he became a tower person in the aircraft business of

guiding planes in and out of airports, including LaGuardia and places like that. But he's retired now.

Wade Sherbrooke [00:10:04] So yeah, no, that's been a big part of my life that I have a lot of joy about, is that I found people who were mentors all along. And I mentioned the Italian family, the one gentleman who I got very close to, Robert Challa, he would take me to his home and I learned that Italians had five-course meals when they, you know, on weekends when they were dining. And there were all kinds of experiences like that.

Wade Sherbrooke [00:10:33] And as you'll hear later, I'm sure, that I've always been very interested in cultural dynamics and how groups of people differ from one another. And that's fun. It's something to be enjoyed and to see how not locked-in we can be to one particular way of seeing the world.

David Todd [00:10:59] Life can be very different and varied among us all, I bet.

David Todd [00:11:04] Well, so it sounds like you have had a very engaged life with experiences outdoors. I'm curious if you also found that there were books or movies or possibly even TV shows or radio shows that you found encouraging and influential?

Wade Sherbrooke [00:11:26] Well, actually, we had the first television in our area. My father was an engineer and he built it. And there were Westerns on and Howdy Doody. And that's all I remember. There weren't much in the way of natural history things on before I went on to college, you know, when I was smaller.

Wade Sherbrooke [00:11:52] I did look at National Geographic magazine a lot, and the American Museum of Natural History was a ferry ride away from Staten Island to Manhattan that cost a nickel in those days. And today, it's completely free.

David Todd [00:12:12] So were there any teachers in a formal sense, people who might have been in grade school, or maybe later in college, who were similarly interested in you and you shared interests with them, and it was a kind of a good collaboration.

Wade Sherbrooke [00:12:31] Yeah, it was, and this is not so much in lower grades, but when I got to Cornell University in the Ag school, I was in the Conservation Department. And they had, one day before classes started, they had people come for a campout with the new people for the department. And I was walking up the hill to go meet, to get to the Department and there was another guy walking up the hill and he had a sleeping bag too. And we figured we're going the same way. And we started talking and I found out he was very interested in reptiles.

Wade Sherbrooke [00:13:11] And his name was Rudy Aarn, and he's passed away now. But he was a very inspirational guy and was very, we just did a lot of wonderful things in our undergraduate at Cornell.

Wade Sherbrooke [00:13:23] And we had good courses. And one thing you don't get at universities these days if you want to be a biologist: I had five courses my first year. Everybody had to take English. I had four biology courses. I had zoology, botany, wildlife management and entomology my first year. And so I was delighted to have high school over and being something, dealing with things that I wanted to deal with.

David Todd [00:13:54] It sounds like it was total and immediate immersion once you got to Cornell.

Wade Sherbrooke [00:13:59] Yeah, and then there was a club there, Jordani Club, and people from all over campus would come there and meet. And some professor would give some talk about what he was doing research on and things like that.

Wade Sherbrooke [00:14:14] And then on spring vacations, which, you know, everybody went south to Florida to have a wonderful time. We went to North Carolina and South Carolina to hunt snakes and frogs and freshwater fish and bring them back.

David Todd [00:14:34] Can you recall any one of those particular outings, these field trips to the Carolinas?

Wade Sherbrooke [00:14:46] One in which we had a small accident, which we got through, which was doing things that people don't do anymore: riding on the hood of a car to watch for snakes while you're driving around. But that's a memory from that.

Wade Sherbrooke [00:15:01] But there's a bigger memory than that. When Rudy and I were ready to graduate, we planned to take off for Mexico right away and collect through the whole summer. And he had an old Chevy car. And neither of us spoke a word of Spanish. And I'm 6'2". He was 6'4". And this was in in 1963. And Mexico hadn't been exposed to tourism from the rest of the world at that time in any great sense.

Wade Sherbrooke [00:15:41] So, as we went to little villages and chased lizards around and captured frogs and everything, every kid in town came and engaged us. And we began to learn a little Spanish, and enough so that they could invite us back to their home. And then their mother would feed us. And then we might camp. And then, you know, we camped the whole time, lots of time, just by the side of the road. And people would not do that today. Mexico's changed, just like the United States has changed.

Wade Sherbrooke [00:16:11] And we brought the collections that went back to the University of Illinois Natural History Museum. And one of the snakes that we collected turned out to be a new species. So and the expert on that, on Mexican herpetology at the time wrote up the paper and put Rudy and I on his co-authors. And that was my first publication. So.

David Todd [00:16:38] What an honor. That's great.

Wade Sherbrooke [00:16:40] Yeah. And. Go ahead.

David Todd [00:16:44] No, I was going to ask you. You have experience with all sorts of animals - reptiles, amphibians, the list probably goes on and on. But maybe to narrow it down a little bit to that, we can cover as much as possible today, what was your first encounter with a horned lizard of some kind?

Wade Sherbrooke [00:17:07] Okay. Let me see my notes here. Certainly. I'd address that directly, but I'm not sure it was here. But, okay, here it is. I got more stuff there, but that might be enough.

Wade Sherbrooke [00:17:41] So, I was at the University of Arizona by then. And of course, after I came back from Mexico that summer, I came to the university. I moved to Tucson, to

the Sonoran Desert and the saguaro cactus world. And there were a bunch of graduate students I was with, and one of them was working on plants across, just across into Mexico, in the Pinacate volcanic fields. And I went down there with him.

Wade Sherbrooke [00:18:13] We went to Cerro Colorado crater, volcanic crater. And we were censusing plants, species and abundances, in the bottom of craters. And I found a horned lizard down there. And I was excited about it. But it was quite a while later than that that I really got into horned lizards. Although when I really got into them was 47 years ago, so I'd been looking at them seriously for a few years.

David Todd [00:18:45] So was there some moment where it went beyond just sort of general informal acquaintance with a horned lizard and something clicked and you said, "This is a creature that I could study for a lifetime."

Wade Sherbrooke [00:19:02] You know, when you grow up in infatuated with the natural world, you try to explore all different parts of it and pick up as much as you can. And the more you learn, you finally begin to figure out that you're not going to be able to understand all of it and learn all of it and know everything and anything. And you know, when you're young, you may have some of those things, at least in the back of your mind.

Wade Sherbrooke [00:19:33] And so at some point and actually it was when I was out of school, I was not in school and I was doing other things between a couple of Ph.D. incidents. And I started, I said, "I want to just focus on one thing and see how far I can get with that." And there were only 12 species of horned lizards when I began. Now there are designated 18. Only one of them is a newly discovered species. The others are just rearrangements of taxonomic names that people had changed.

Wade Sherbrooke [00:20:15] But I said, "Well, I'll just focus on that and see how much I can learn on one little part."

Wade Sherbrooke [00:20:21] And then the beauty of that is you get a perspective of the depth and the complexity of a particular piece of the natural world, which then if you reflect on that, you begin to see, "God, if this is how complicated it is in a few species, and we have millions (tens of millions they're talking about today), boy, is it big!

Wade Sherbrooke [00:20:50] It's a lot bigger than my brain is ever going to take it. And then you think about, well, my brain wasn't selected for this. The selective pressures for developing my brain was to survive. It wasn't to understand the entirety of the natural world.

Wade Sherbrooke [00:21:12] So, we have to do that collectively. And that's what science is all about, is to try to do this collectively. And we go through processes of trying to understand one part, and that may take us a little time, and keep adding together over generations.

David Todd [00:21:30] I really like that this idea of many individual minds working and like a hive, maybe you get a more complete understanding of this incredibly diverse world.

David Todd [00:21:44] Well, why don't we go, as you say, and focus on one creature?

David Todd [00:21:51] Could you give us a lay, you know, "101" introduction to the life history and the ecological niche that a Texas horned lizard might fill?

Wade Sherbrooke [00:22:06] Sure. And this will all apply, since my scope is all horned lizards ..

Wade Sherbrooke [00:22:14] [Uh oh. We just lost something. Are you still there?].

David Todd [00:22:18] [I am. I am.]

Wade Sherbrooke [00:22:20] [I'm not seeing you. Todd, I don't know what happened.]

David Todd [00:22:26] [So you've lost my video, but you can hear me?]

Wade Sherbrooke [00:22:29] [Yeah, but it says" "edit settings or cancel." So I don't know what to do.]

Todd Trigsted [00:22:34] Okay We'll see.

Wade Sherbrooke [00:22:36] I don't know what to do.

Todd Trigsted [00:22:41] Oh, that's a stupid thing.

Wade Sherbrooke [00:22:43] Okay, Now I know what to do.

Todd Trigsted [00:22:45] Yeah. Hit cancel.

David Todd [00:22:47] Okay. All right, good. So...

Wade Sherbrooke [00:22:51] I'm with you again.

David Todd [00:22:52] We'll launch you into a little discussion of the natural history of the Texas horned lizard.

Wade Sherbrooke [00:22:58] Yeah, well, I'll just mention first, which I guess I just did, how many species there are. Okay, they have, for lizards, they have a unique body form. They're very broad and wide. And most lizards are thin. And they slip between things easily. And so, what people (before I got involved with horned lizards) had they decided that a big part of that was that they're ant-eaters and they're ant specialists. And they need a large stomach to handle ants because they've got to put a lot of ants in their stomach to digest them well.

Wade Sherbrooke [00:23:36] They also have these cranial horns, and there's no other lizard that has that. And they're probably involved with anti-predator defenses against only certain predators, that is, predators that swallow their prey whole, and have to ingest that. Another predator can tear them apart and throw the head away or deal with that in another way. They don't have to swallow it.

Wade Sherbrooke [00:24:10] Texas horned lizards are egg-laying, but there are live-bearing species within the genus. Other horned lizards give life birth.

Wade Sherbrooke [00:24:22] And I mentioned feeding on ants.

Wade Sherbrooke [00:24:26] They're all very cryptically colored and patterned, so that they're very difficult to see. They don't have color patterns that they flash to other males to defend a territory or to females to attract females for mating.

Wade Sherbrooke [00:24:49] They're not fast, in general, because of their physical composition being wide and things like that. That's not their mode of escape. Their mode of escape is not to be seen, and a few other things which we'll discuss.

Wade Sherbrooke [00:25:06] It's interesting that they're not territorial. They don't defend territories. And part of that, understanding that among lizards, is that the females are larger than males, if you look at the whole population. And that's because males haven't evolved bigness to defend territories against other males so that they can get more females.

Wade Sherbrooke [00:25:37] But females, therefore, spend their time eating a lot so that they can have many young and large numbers of eggs.

Wade Sherbrooke [00:25:48] And then the idea that they squirt blood out of a sinus around their eyes is unique amongst all animals, including all lizards.

David Todd [00:26:06] That's great. And are they found in a variety of habitats? Could you sort of describe what would be their typical homelands?

Wade Sherbrooke [00:26:18] Yeah. Well, they occur from southwestern Canada all the way down to the border with Guatemala. And they occur from sea level up to 14, 15,000 feet elevation. And so they are in many different habitats. They occur in the West, they occur just in the western United States, except for introduced colonies on islands in North and South Carolina. And they're in arid areas in general.

David Todd [00:27:11] And I think you mentioned that they are ant specialists. Any particular kinds of ants, or a way to sort of drill down in that?

Wade Sherbrooke [00:27:24] Yes. Large ants and ants that are abundant. Now, all of the species, some of the species have evolved, particularly high elevation ones, have evolved to ... all of the species can eat other insects. That's not a limitation. And but some of the species are very highly specialized, and the ants are seed harvester ants, and they're noted as having the most toxic venom of any invertebrate, in terms of killing mice, that's how it's tested.

Wade Sherbrooke [00:28:10] And so, that's a big issue that I've been doing research with, and with other people over the years, of how they handle eating such difficult prey.

Wade Sherbrooke [00:28:25] And the other thing is that they have very big mandibles so that they can bite nicely and hold on and then sting. And so, horned lizards don't chew them. They pick them up on the tip of their tongue, and then they throw them with their tongue to the back of their throat, where they get coated with massive amounts of mucus. This enwraps these big ants in that mucus so that they can't sting and bite on their way down the esophagus where more and more mucus is added to them all the way to the stomach. And I discovered this when I was looking at stomach contents. And I'm seeing all these ants are wrapped in this gunk.

Wade Sherbrooke [00:29:14] And so, we researched this, we looked at that. I looked at the cells all the way down the esophagus and things like that. And I collaborated with a guy at the

University of Connecticut, and we put out some papers and things on that. And so that's how they handle that.

Wade Sherbrooke [00:29:31] And I think in one of your questions you were asking about velvet ants and they occasionally ... velvet ants are not abundant. And so that's not food, in general. But things come along and then they try it out and sometimes they have trouble. I had one, a small species that took in a small beetle and it chewed it. The mucus didn't wipe out the beetle for some reason. It survived. And it chewed its way out of the stomach and through the body wall.

Wade Sherbrooke [00:30:04] Well and so everybody's got to make decisions in life. And that's true in horned lizards too. Life is a decision-making process. We are not the only decision-making species on the planet, that's for sure. Some people might try to tell you that, but I don't believe it. And if you have a dog or a cat in your house, you know that they make decisions. If you hang around with animals, they'll tell you a lot.

David Todd [00:30:35] Many options in this life.

David Todd [00:30:38] So, I think that you had mentioned also that ... was there a blood plasma factor that helped them deal with ant venom. Am I mistaken there?

Wade Sherbrooke [00:30:50] Oh, okay. Yeah, okay, we'll do that.

Wade Sherbrooke [00:30:54] So, if they got stung, one would imagine that it wasn't the best thing, because it's fairly potent. But I worked with a gentleman who was expert on these stinging invertebrates - Justin Schmidt and dissected hundreds of these ants. And in their abdomen they have a venom sac and then they can inject it through their ovipositer, because ants are all females, when they sting. And so he mixed the blood, mixed horned lizard blood with the venom and injected it in mice and then did a control. And it was very clear that the toxicity of the venom was reduced when it was mixed with horned lizard blood. So there's something in the blood that helps detoxify it.

Wade Sherbrooke [00:31:56] And another thing about capturing these ants that I did with some people in Austria and in Germany was that they're very particular about the way they pick up the ant on the end of their tongue. They don't want to pick it up at the head where the mandibles are or at the end of the abdomen where the stinger is. They want to hit just the middle of the ant.

Wade Sherbrooke [00:32:22] So, this requires a lot of coordination. And that coordination first comes visually. And we used contact lenses in covering one eye up to find out what kind of visual systems they use.

Wade Sherbrooke [00:32:42] And, you know, we have two systems - accommodation where the lens has changed its shape. This is why I'm wearing reading glasses right now, because when you get older, the lens doesn't change shape so easily. And so that system isn't working very well. But accommodation, that's one thing.

Wade Sherbrooke [00:33:04] The other method we use is stereopsis, using two images, sending two images to your brain, and they put them together in 3-D. But horned lizards, their eyes are much closer together. And making that image in stereopsis: we're not sure that it ... seems like they're doing that, but we're not certain about it.

Wade Sherbrooke [00:33:26] And that's the way scientists proceed. We just get things as close to understanding as we can, and then we wait until we figure out a better way to look at it, or another viewpoint. And so....

David Todd [00:33:45] Patience is required.

Wade Sherbrooke [00:33:46] Yeah.

Wade Sherbrooke [00:33:47] And so another part ... Okay. So, they have to hit them in that sequence just to hit the thorax. They want to pick them up by the thorax, in between those two ends. And then they have to ... so they're focusing on them, and the ants are running. So, they can change their head direction and their tongue direction while it's being protruded. This is in middle milliseconds - very, very rapidly. They can change the tongue direction as it's leaving their mouth as the ant moves. And so they're very precise in their ant capture and processing.

David Todd [00:34:31] That's fascinating.

David Todd [00:34:33] Well, so, just as they are predators on other animals, they are prey for still more creatures. And I was hoping that you might be able to talk a little bit about some of their anti-predator responses to coyotes and snakes and kit foxes and other creatures.

Wade Sherbrooke [00:34:54] Okay. Yes. I mentioned earlier that they squirt blood out of their sinus around their eyes as an anti-predator thing. And I collaborated with George Middendorf in the early days with this, and nobody was quite sure why they do this. If people pick them up in the field, the humans, they will respond infrequently, like 5% of the time. And so we were wondering. And there were rumors around that this was anti-predator and it might involve canids, like coyotes.

Wade Sherbrooke [00:35:32] And so, we said, "Well, we need a coyote substitute. We're not going to go out and catch coyotes and make them do what we want them to do." So I interviewed dogs around Portal, Arizona, and we found Dusty. She was just great and we worked with her for about five years, I think. So she was our stand-in coyote.

Wade Sherbrooke [00:35:54] And in our first experiments, we said, "Well, we'll just expose Dusty and have her, sort of, she had a gentle mouth (she was that kind of dog), and have her go get them, see if she'll chase them, paw them a little bit, bark at them and we'll do ten-minute trials. But the minute there's a blood squirt, we will end the trial.

Wade Sherbrooke [00:36:17] So, we did ten trials. And we ended all of them with just over a minute, like 70 seconds, was the longest one. They all squirted: all ten squirted blood.

Wade Sherbrooke [00:36:29] And then we needed a control, and "Well, what are we going to do?"

Wade Sherbrooke [00:36:33] So, I got down on hands and knees and I barked and I pawed and I chased the horned lizards around. And I got two. Oh, and that was within the 10 minutes, not within the one minute like it happened.

Wade Sherbrooke [00:36:46] So, we said that looks like it. Canids have something to do with eliciting this behavior. And that's what we're trying to figure out: "What elicits this?"

Wade Sherbrooke [00:36:58] And then we did it at low temperatures and high temperatures to see if that had any influence. And then we'd get up in the middle of the night and did it with Dusty, and then we did it in the middle of the day and it worked all of those times.

Wade Sherbrooke [00:37:12] Overall, we got 85% of our experiments with Dusty, blood squirting.

David Todd [00:37:21] So. And you and George Middendorf having little experiments.

Wade Sherbrooke [00:37:27] Yeah. And then I had an opportunity to go up to northern Utah, where there was a big coyote facility that the government had up there for testing all different kinds of things. And so I was particularly interested in where is the sensitivity areas on the coyote. So, I work with some people there who handled the coyotes. And I squirted blood in their eye, one eye, or up one nostril, or in their mouth.

Wade Sherbrooke [00:38:04] And it was very clear that the most negative reactions (by "negative reactions", the coyote shaking its head meant, and salivating some. And so, it was in the mouth, not in the eyes or in the nose.

Wade Sherbrooke [00:38:18] So, we answered that problem there.

Wade Sherbrooke [00:38:19] And then I searched around for several years till I found a kit fox den and put a big net cage around it and live traps and was able to trap a couple of young, just about to leave home, kit foxes.

Wade Sherbrooke [00:38:39] And we did some experiments to answer a question that had come up. The distaste, the material that goes into the coyote's or the canid's mouth, that's bound to be rejected. Where does it come from? Is it circulating in the blood all the time in the horned lizard? Or is it put into the blood is it leaves the eye area from the glands, the lachrimal glands and other glands around the eye.

Wade Sherbrooke [00:39:12] So, we were curious about that. And we'd been feeding these foxes, kit foxes, mice, because we were going to release them at the end of the experiments. And we had dead mice - they were frozen ones. And so we got some of the mice and we would put either mouse blood on a mouse and feed it to them. And then, another was, put horned lizard systemic blood on, or put on some of the tissue around the eye from some horned lizards that we picked up dead on the road, that had been run over.

Wade Sherbrooke [00:39:52] And we found that, what it was ... Okay. So, what was the response in eating? If it was a mouse with mouse blood on it, they would take they have carnassial teeth as canids do in the back. They cut things up very well. They would chomp and chomp. And in two or three bites, they would have that mouse in chunks. And it was down in less than a minute.

Wade Sherbrooke [00:40:21] If it had horned lizard blood on it or lacrimal gland tissues, then it would take them 30 to 45 minutes to eat it. They would pull it apart. They would detect something in the blood and they would work on it, they'd use, they'd hold it with their foot, pull it apart.

Wade Sherbrooke [00:40:41] So, they were telling us in their behavior where it was, and it was in the systemic blood, it was circulating in the body all the time. And subsequent research projects that I've done with several people about the blood have confirmed that.

Wade Sherbrooke [00:41:03] And then I had a request to help with, actually, several times I've had requests to help with do doing movie presentations, natural history movie things - BBC, National Geographic - about blood squirting and to one of them I said, "Well, I've done this with coyotes. I'd like to, I'm curious about bobcats".

Wade Sherbrooke [00:41:27] And I had worked with some people in Tucson here that were in rehabilitation centers and it looked like ... There's two factors. One is will the predator elicit the behavior? And two, is will the blood elicit the negative behavior from the predator?

Wade Sherbrooke [00:41:47] And so, I thought it might work. So, I told the crew, I said, "I don't know if this will work with a bobcat", but they located a bobcat that had been, I think its mother had been run over and they'd had it in captivity for nine months or ten months. And it was very tame. And we went into a big cage and we worked with it and we got great, great video about that.

Wade Sherbrooke [00:42:10] And bobcats react the same way.

Wade Sherbrooke [00:42:12] So at this point, I kind of think that canids and felids are all part of it. And I'd love to know more about other potential predators, but it's hard to get all the stuff set up.

Wade Sherbrooke [00:42:29] Like, I don't know about skunks or raccoons. One time I had a chance to squirt some blood into a mountain lion's mouth, and it seemed like it didn't like it. But I had three black bears to squirt, and they didn't mind at all.

Wade Sherbrooke [00:42:45] So, there's a lot of research potential there, but the world's not waiting for the results of all of that.

Wade Sherbrooke [00:42:54] But one of the things in general that I'm very interested in is how horned lizards categorize their prey world. Are they ... Because they have different responses to different things. They never squirt blood at roadrunners. I've done a lot of trials with that. They never squirt blood at grasshopper mice. They never squirt blood at snakes.

Wade Sherbrooke [00:43:26] And so, they're very, you know, they have categories in their mind: "What's the best defense for this particular situation?"

Wade Sherbrooke [00:43:34] And now I'll tell you about snakes. So a friend had 20 - they came from Texas; they were Texas diamondback rattlesnakes. And he needed a place to keep them for a month. And I had a big cage. "I'll take care of them for you. But I want to do some little experiments that shouldn't hurt the snakes at all."

Wade Sherbrooke [00:43:58] So. And there was. This is a behavioral, this is a facility that I put together for animal behavior. So, there's a room that you can sit in. There's one-way glass there, and you can set things up in this big cage.

Wade Sherbrooke [00:44:13] So, I released all these Texas rattlesnakes, diamondbacks, in this cage. And they were there for a couple of days. Then I come and I put four horned lizards in there, and I just put them, I walk around between the snakes. Most of them are coiled up. They're not doing anything. Some of them are moving around. So I put this, the horned lizards in there. The horned lizards - they just freeze. They don't move. They're not going to move at all.

Wade Sherbrooke [00:44:38] And then a couple of the snakes start moving around. And they come closer. Some of them come close. They pass the horned lizard. The horned lizard maybe doesn't do anything.

Wade Sherbrooke [00:44:48] And I'm just watching. I'm recording my observations in there.

Wade Sherbrooke [00:44:53] And then a snake comes in past another one. And it runs like mad. It just runs into and hits the wall at the other end. It hits the ground and flattens and it doesn't move again. So that's interesting.

Wade Sherbrooke [00:45:06] So I keep watching that. And let me see, I did, I had 27 of them run. And none of them do any other behavior as a big rattlesnake approached.

Wade Sherbrooke [00:45:21] Now, rattlesnakes, they don't chase their prey. They sit someplace. They bite at it with a you know, to envenomate it. And then they follow the trail with their tongue.

Wade Sherbrooke [00:45:36] So, if a horned lizard runs from a rattlesnake, it's unlikely to be chased. And so, I'm just getting out of here. If I think this snake's interested in me, none of these snakes were eating horned lizards - I should mention that. But I was just observing the behaviors that were happening in the cage.

Wade Sherbrooke [00:45:55] So, if the horned lizard got worried and it said, "This is what I'm up against: I run." That's it.

Wade Sherbrooke [00:46:03] So, the next year, I set up a similar situation and I catch a bunch of whiptail snakes, coachwhips. And I put them in the same cage and I put in some horned lizards the same way, and I would wait to see what they would do. And lots of them, they just let the snake go by. The snakes weren't chasing them to eat in any of these cases.

Wade Sherbrooke [00:46:31] But if the horned lizard was lying there and it did anything, that's what I'd report. And I had 25 things that I'd report. In five cases, they ran. In 25 cases, they did what I call a dorsal shield. They'd lower the legs on one side, extend them on the other side, and they they'd pull their ribs forward. So, they'd take that big broad body they have, and they'd make it as wide as possible.

Wade Sherbrooke [00:47:01] And then, and not in that experiment, but in another experiment, I had a snake come and try to grab that horned lizard. And it tried to get its two jaws around this big flat shield, and it couldn't do it. It'd take four or five big trial bites, and then it would turn around and go away. I can't get this thing.

Wade Sherbrooke [00:47:23] Now, so, that worked for that species and it doesn't have venom. So it couldn't have envenomated it. But if it ran, these snakes are diurnal, just like the horned lizard. They run very fast and they could have gotten one jaw above and one jaw

below the belly of the horned lizard, and grabbed onto it. But when it was up in this dorsal shield position, they couldn't bite onto it and grab a hold of it.

Wade Sherbrooke [00:47:49] So again, the horned lizards were reacting in a way that told me, "We categorize these things. I have different responses to save my life, when I evaluate what the threat is. So, I'm pretty good at evaluating threats."

David Todd [00:48:06] Well, I love this. As you were saying before that they, like all of us, all creatures, make decisions. And I guess have experience that guides them in making good, good choices.

David Todd [00:48:19] So, one of the things that I think you mentioned before is that perhaps one of their best strategies for protecting themselves is just their cryptic nature: their camouflage is so good. Do you have any thoughts that you'd like to share about that?

Wade Sherbrooke [00:48:38] Yes. We will come back to some other stuff, like rain harvesting. But let's do the camouflage.

David Todd [00:48:45] Yes, let's do that. You bet. We'll do that next.

Wade Sherbrooke [00:48:45] Okay. Camouflage. Okay. When I was first writing about horned lizards, I was trying to get people to be able to identify different species. And one thing that biologists frequently use is a dichotomous key. You're asked two questions: "Does the animal have this or does it have something else that's contrary?" Or it doesn't have that. It either has it or it doesn't have it or it has some other thing. And you can look at the animal fairly easily and make that decision. And then that leads you to some other species in each direction, depending, and you finally get to which species you want to identify.

Wade Sherbrooke [00:49:28] So, I'm wondering about these horned lizards and I'm putting things together. And one, the Texas horned lizard, it has a white stripe down its back, the middle of its back, a white stripe there. And the Texas horned lizard lives in grassland areas, the Great Plains. It's up in Oklahoma, all throughout Texas, down into large portions of the Chihuahuan Desert in Mexico. So it's in desert areas where there's lots of shrubs and trees and there's a lot of litter under plants.

Wade Sherbrooke [00:50:04] There's another lizard, horned lizard. It's called the flat-tailed horned lizard. And it lives along down near the bays of the Colorado River, where it runs into the Gulf of California in Mexico. And that's an area that over the millions of years has collected a lot of sand. There's sand dunes there. And a lot of the plants there grow in in this, in the sandy area. And it's windy over there. So, there's hardly, there's almost no litter under the plants.

Wade Sherbrooke [00:50:37] And so, if you look under a shrub as you're walking around during the day there, what you see under the shrub are shadows of the branches that the plant has. And that species has a black line down the middle of its back.

Wade Sherbrooke [00:50:56] So, I put forward a hypothesis. Some graduate student just looked at the Texas lizard part of it to see that they really do have a lot of resemblance to the litter that the grass stems and things like that under plants. The other part hasn't been well-studied yet.

Wade Sherbrooke [00:51:18] So, we're in ... This is science, we're in hypotheses. We keep working. We get little bits and get more and more.

Wade Sherbrooke [00:51:26] But that was one of my things to get started on that camouflage.

Wade Sherbrooke [00:51:31] And then there's another species. It's one of the smaller species. It's called the round-tailed horned lizard. It lives in the Chihuahua desert mainly, and it's quite different in certain ways than the rest of horned lizards.

Wade Sherbrooke [00:51:47] It's a stone mimic. The rest of them blend in with the substrate in the background, is their camouflage in general. And what they have is along the edges of this broad body they have, they have extended scales that are white. They're pointed. They come out from the edges of the body. And they help break up any shadow that might outline the body of the horned lizard. And so that works for them. And some of them have two rows and some have one row. And that's the kind of thing you use to help identify them.

Wade Sherbrooke [00:52:26] In World War Two, I have a manual, a World War Two training manual for camouflage, and they used horned lizards in this. Guys, if you want to camouflage your tank, you've got to pay attention to these images, these kind of things. Horned lizards give you a clue about how to do it.

Wade Sherbrooke [00:52:44] So then, but this guy I mentioned that's the stone mimic. Oh, no, the stone mimic on his side doesn't have those scales at all. It's the only species like that. And it actually has darkened areas that are kind of shadows, because stones have shadows on the edges. And they hunch up their back if they feel threatened and they close their eyes and it's just their back that's one stone. Maybe their head's another stone.

Wade Sherbrooke [00:53:14] And so and then in the area where I was studying them, there's at least five different color forms of these guys. Some are yellow, pink, tan, bluish. And they have chromatophores, pigment cells, that can change their color somewhat. They can lighten and darken very well during the day.

Wade Sherbrooke [00:53:38] But we come back to that.

Wade Sherbrooke [00:53:43] During the middle of the day when stones are reflecting a lot of light, they look light. And early in the day and late in the day, they darken up a little bit so they have more shadows just like stones have more shadows.

Wade Sherbrooke [00:53:57] But so they they take that stance, and become living stones in terms of somebody trying to find them.

David Todd [00:54:08] I think you had said at one point that while these horned lizards have a huge range, that they tend to be in arid areas. And so I was hoping you might be able to talk a little bit about some of their techniques for surviving in these dry zones, maybe by harvesting rainwater.

Wade Sherbrooke [00:54:28] Okay. Let me put one more thing on the two species that I was just talking about in terms of hiding, because that's I talked about things during the day about them not getting seen. But at night, and this is the Texas horned lizard and the round-tailed horned lizard - the stone guy and the guy with the white stripe down his back. Okay?

Wade Sherbrooke [00:54:53] And so, what I had to do was I'd put radio transmitters to find these guys at night. I'd go out there and I have an antenna and I'm holding it up high in the air. And it's in the summer when the monsoon rains and there's lightning going on all around me. And then I'm wearing things around my shins because there's rattlesnakes all over the place, including Mojave rattlesnakes. I never stepped on one. I stepped over, I stepped on both sides of one. Because I'm paying attention to where's the horned lizard, and I saw my footprints later and they were just on both sides of it.

Wade Sherbrooke [00:55:26] So, you know, you're out there doing life, that's all.

Wade Sherbrooke [00:55:31] And okay, now rain harvesting. How do you get a drink in the desert? Because it's not that easy. When I first got horned lizards, I brought them back to Tucson. And I got half sheets of plywood, 4x4 feet, and I put a little rim around, a border around the edge, so they couldn't get out. And I had them out in my front, in my yard.

Wade Sherbrooke [00:55:57] And this was in the summer. And we had a monsoon rain come in. And it started to rain. And I looked out my kitchen window and there's two horned lizards there, standing high on all of their legs. They have their tail down and their head down and their back is arched up, and they're opening and closing their mouth.

Wade Sherbrooke [00:56:17] Well, I knew right away what they were doing. They were drinking water.

Wade Sherbrooke [00:56:21] And there was, there's a lizard in Australia, the Australian thorny devil, which in many ways resembles a horned lizard. They eat ants as well - different kinds of ants completely. They don't squirt blood. There's differences. But their color patterns are similar in really blending and being broken up. And they're very spiny. They don't have horns, but they're very spiny.

Wade Sherbrooke [00:56:48] And they were known since 1923 by scientists to somehow take in water. And the first observations where somebody put them in a plate of water and the water would move up their body side fairly rapidly like a sponge or a blotter, blotting paper pulling water. And they thought, the first people thought, that the water came in through their skin and that's how they were drinking.

Wade Sherbrooke [00:57:20] That's what amphibians can do. Reptiles can't do that. Reptile skin is designed to keep all the water in possible because they live in ... Amphibians, they're committed to water still. Reptiles were the first vertebrates that got out on the land and they had to conquer the land and they needed to keep water in, not let it get out.

Wade Sherbrooke [00:57:40] So, that wasn't a great explanation, but that's where we start.

Wade Sherbrooke [00:57:44] And then some other people looked at them and they could see on the scales of horned lizards there were little, little indentations on each scale. And they said, "Oh, those, that's what's moving water."

Wade Sherbrooke [00:57:57] Well then, 20 years later, some other people looked at it and they could see, "Oh, if you put a drop of colored water on the lizard's back, you can see the water move between the scales, around the scales. And it covers the whole body - the colored water does. And so you can see, oh, it's moving between the scales. It's not moving across the

surface of the scales, and then it comes around to the mouth. And then we suppose it could drink."

Wade Sherbrooke [00:58:22] And then I started, and then I was in the situation with, with the two that I'd seen in my yard. So that was thorny devil stuff.

Wade Sherbrooke [00:58:32] And so, in my own yard, oh, well, I'm just going to ... The next day I get out my hose and my squirt thing and I start trying to water them. Come on, Bunch up, drink, have a drink. There's a lot of water here.

Wade Sherbrooke [00:58:47] No way. No.

Wade Sherbrooke [00:58:49] And I did many things to try to get them to arch - for a long time, for several years.

Wade Sherbrooke [00:58:53] And it's because I'm standing there. And I'm a potential threat. And for horned lizards, that's the last thing they do is move.

Wade Sherbrooke [00:59:04] And that's why when I'm out collecting them, you know, I'd becomea horned lizard predator. I have to learn how they behave as I'm trying to find them in the wild. And because what they do is, unless I'm about ready to put a foot on them, they freeze. They would just be very happy to see me walk right past.

Wade Sherbrooke [00:59:26] And later, we did some experiments where if you walk directly at a horned lizard and you walk towards it, but at an angle off to the side, a tangent pathway. Okay? If you're walking directly at them, they run away at a further distance from you than if you were walking tangentially to them. So they're very much in tune to how you're coming at them. Okay.

Wade Sherbrooke [01:00:00] And then I got interested in the thorny devils in Australia and I took a trip to Australia in 1990 and I went across the continent and got thorny devils and tested them. They don't hunch their back. But they do if they're out in the rain - I lucked out and had rain in the desert of Australia -and they drink that way. And I had some that a light rain afterward, they rubbed their belly in the sand and the capillary pressure that they could generate between their scales pulled the water out of the sand up into their scale structure.

Wade Sherbrooke [01:00:48] And then many years later, when I retired from the research station, in 2004, I went back to Australia and was with the James Cook University for a year and worked on the details, both with thorny devils and Texas horned lizards to see. And it's not just between the scales. If you go down between two scales, there's a hinge because the integument, just like our integument, it's a continuous thing. They just fold it over in a lot of places so it becomes scales and so it's continuous.

Wade Sherbrooke [01:01:21] But if you go down between two scales, you can go down to a groove. And at the bottom of the groove, they have a semitube down there. And the water moves through those tubes around every scale on the body. And that's where the water gets pulled by capillary action. And the inner surface of those tubes is very rugose, that is, it has a lot of protrusions on it, which enhances the water transport, the capillary forces that are pulling water through those around to the mouth so that they can open and close.

Wade Sherbrooke [01:01:53] And then to make sure all of this was happening, I had trouble getting the behavior as I told you, to get them to drink. So I built a box, a rain harvesting box, that I could put them in. And I put them on wire - they were standing on wires so it would drip through into a pan, the water. And I had a pipette above them, and I could set it with different speeds to drop water on their back. And then I would video them. And I would count the number of times they opened and closed their mouths, and were drinking I assumed at each time.

Wade Sherbrooke [01:02:31] And then I weighed them prior to each trial, and I weighed them after each trial, after I'd gotten the skin all dry, to see how much they had gained in weight. And it correlated perfectly with the number of times they'd open and close their mouth.

Wade Sherbrooke [01:02:47] I couldn't train them to open and close their mouth a certain number of times. I just had to take whatever they did. But then I just fitted into to how much they drank and it answered that question.

Wade Sherbrooke [01:02:59] So, that was rain harvesting. It's been a fun, fun adventure.

David Todd [01:03:07] Well, that is fascinating because you know how they, you know, through evolution, and maybe some smarts, figure out ways, find strategies where they can live in these really hostile environments.

David Todd [01:03:20] But let me ask you a little bit about horned lizards. It sounds like there have been some predecessors to you who have shared your interest in horned lizards. I think that the horned lizards apparently appear in ancient Indian rock art and in some of the markings that Spanish explorers left behind. Is there some truth to that?

Wade Sherbrooke [01:03:52] Yes, the Spaniards recorded some stuff. Not a lot.

Wade Sherbrooke [01:03:58] And I've been taking pictures of petroglyphs, which are designs put on to rocks that have a patina on them that discolors the surface. And people have taken a stone or whatever and chipped off the patina so that the design is left.

Wade Sherbrooke [01:04:20] And also pictographs, which are taking material, clay or whatever, and painting, making paintings on rocks, hopefully in protected areas.

Wade Sherbrooke [01:04:31] They're widely scattered across the Southwest and down somewhat in Mexico.

Wade Sherbrooke [01:04:38] And but they don't tell you very much about the biology of the animal. What they tell you is that the people then recognized them as a distinct kind of organism. And they recorded it there. And I'm not sure what they thought about it then.

Wade Sherbrooke [01:04:57] The only insight I have is that there is a group of people in Arizona, near Phoenix, that along the Gila River and other areas around - Hohokam people. That's an archeological term. We know them from archeological ruins, particularly a place called Snaketown, which was very heavily studied quite a while ago.

Wade Sherbrooke [01:05:27] And when I got interested in horned lizards, and because of my interest in cultures as well, I went around to all of the archeology museums in the Southwest

and I said, "You have any one lizard stuff? "And they, at that time, they didn't have things that well cataloged. But a lot of the curators knew their curatorial materials very well. And so they'd say, "Oh yeah, come with me." And we'd go find this and we'd go find that. And I take pictures of it.

Wade Sherbrooke [01:05:57] And then particularly at Snaketown, there was a lot of stuff - carved stone things, slate plates that had designs carved into them, ceramic things that had designs on them. Quite a few.

Wade Sherbrooke [01:06:13] And all of a sudden, when I was trying to help people identify horned lizards, when I'm writing about them, I'm looking at the horn patterns and I'm seeing each species has pretty distinctive horn patterns. So, that's all in my mind. And so, I look at these patterns on these archeological things and, "Wow, this is very clear!"

Wade Sherbrooke [01:06:38] One species - this is up near Phoenix, around Phoenix - there's one species that's out in the desert, very dominant, called the regal horned lizard. And it has an extra pair of horns and it has a complete series of horns that are touching each other at the base around the back of the skull and extending out with their spines in one plane behind it - the regal horned lizard.

Wade Sherbrooke [01:07:03] And so, then I know, because I've been up in the mountains a lot looking at other horned lizards, if you go up into the mountains, there's another species called the short-horned lizard. And it has a different kind of pattern. It has horns off to the side of the back of the head, but there's a big niche or empty area between the ones on the right side and the left side. And I look at the archeological artistic representations and I find both patterns.

Wade Sherbrooke [01:07:35] What does that tell me? That tells me those people knew two different horned species. I don't know what they thought about them. But the people then, they got up into the mountains. People in the New World, before Europeans came, they moved around a lot. They didn't just stay. I mean, they didn't have vehicles to get around or animals to ride, and stuff like that. But they walked a lot and they'd be up in the mountains because there were resources for them up there.

Wade Sherbrooke [01:08:06] And so, I know they were up there. What I would like to know, which is hard to pull out of the archeological record, is if they knew that horned lizards down around them in the desert, the regal horned lizards, they dig nests in the soil and they lay eggs. The ones up on the top of the mountains give life birth to young. They don't lay eggs.

Wade Sherbrooke [01:08:34] But I'll probably never know if they knew that.

Wade Sherbrooke [01:08:39] But if you keep asking the question, maybe something will come out, because we've lost so much knowledge about the indigenous people in the New World. It was, you know, the Spaniards tried to wipe it out and so did the English, too, to a certain degree.

David Todd [01:09:08] Well, let's talk then about some of these people that came afterwards, after the indigenous folks in the Americas. I understood that Lewis and Clark actually brought a horned lizard to President Jefferson. Is there some truth to that?

Wade Sherbrooke [01:09:27] I think they sent it to him from the Midwest someplace. Yes. He got a horned lizard. But that's about all I know about it. What he did with it, I'm not sure. He probably passed it on to a zoo or something like that.

Wade Sherbrooke [01:09:41] And my guess is it died because nobody had ... Horned lizard have been very difficult to keep in captivity. Zookeepers, people who were taking care of animals in zoos, have just advanced hugely in my lifetime in their ability to take care of them. And they're doing very well. That's why they have breeding programs going on now.

David Todd [01:10:07] Well. So, let's talk a little bit about the recent history of horned lizards. They, not too long ago, maybe in the fifties and sixties, they were considered pretty common, you know, a lot of people of a certain generation remember playing with them and trading them at Jamborees and so on. But, it seems like many observers have noticed a decline in horned lizards.

David Todd [01:10:35] And I was wondering, sort of a two-step question here: A) Do you think they have declined? And B) if you think they have, what might be some of the factors that have contributed to that decline?

Wade Sherbrooke [01:10:51] They definitely have declined. There's no question about that. And in recent times, and as far as I can understand, all of that decline is a result of human interference. And although some people might argue that some of the climate change is not human-caused, and I'm not sure but to finesse it at all, certainly a major part of climate change is human-caused. But other climate change can happen, and so I don't know about that.

Wade Sherbrooke [01:11:35] But, and so, at certain time periods, there was huge amount of trade and curiosity, use of them. When Boy Scout Jamborees, National Boy Scout Jamborees occurred, the kids in Texas took Texas horned lizards to trade. They were a hot item.

Wade Sherbrooke [01:11:58] And the pet trade also went on strongly in California.

Wade Sherbrooke [01:12:04] I think they, the Boy Scouts there, did the same thing.

Wade Sherbrooke [01:12:08] But the Boy Scouts weren't the only ones.

Wade Sherbrooke [01:12:10] But that trade has largely been exterminated in the United States by states passing protective legislation. And Texas has been a leader in that: that you cannot just go collect horned lizard, individually for yourself, or certainly not commercially.

Wade Sherbrooke [01:12:32] And, but other factors that are human-induced, as Texans are well aware, are fire ants. And fire ants were introduced somehow from South America to New Orleans and probably some biological things happened there that made them more aggressive and more successful. And they've spread across the South.

Wade Sherbrooke [01:13:02] And then there were huge programs to try to control those. And that resulted in the federal government being induced by people who were impacted by all these fire ants, "Do something about it." And so spread some insecticides. So they sprayed insecticides like mad. Well, that wiped out a lot of the other ants that the horned lizards depended upon.

Wade Sherbrooke [01:13:32] And also, the fire ants did that as well. They're very good at getting rid of other ants.

Wade Sherbrooke [01:13:37] And in California there's an Argentine ant that was similarly imported from South America and has been a major factor in wiping out horned lizards in that area.

Wade Sherbrooke [01:13:50] But the other factor ... Eastern Texas, they've been eliminated completely. Western Texas there's still populations, and southern Texas, of horned lizards. But, and what's happened in those areas, Southern California, it's not only the Argentine ants (we could worry about that), but that's not the only problem.

Wade Sherbrooke [01:14:12] It's the human problem. The human always ... I try to put it like, "Animals don't lose habitat. It's taken away from them." And habitats are removed from the natural world and from nature by humans. We put roads in them, we put homes in them, we put businesses in them. We put ... shopping malls, agricultural fields, corporate businesses, factories, airports, highways. Keep adding what you want. Every time we take a piece of territory, a piece of land, and we bring in some way of getting rid of everything that's on there because we don't want it there. We want something else.

Wade Sherbrooke [01:15:02] All those homes are gone, not only for horned lizards, but for everything else that was living there. We may plant a few trees around and stuff like that, but that doesn't help 99% of what lived there before.

Wade Sherbrooke [01:15:16] And if any of it tries to come back, we have lots of pesticide companies that will be happy to come and try to get rid of whatever might try to come back.

David Todd [01:15:33] Do you see this horned lizard as sort of a lone victim? Or do you think that they're an indicator species for declines among other species that have similar travails?

Wade Sherbrooke [01:15:50] Well to be a good indicator species, it's politically important to be attractive. And horned lizards ... they're not threatening. They don't bite. They're very cute.

Wade Sherbrooke [01:16:12] And actually, in Texas in particular, they have ... when I went to the first Horned Lizard Conservation Society meeting in Austin, Texas, and everybody was worried about the disappearance of horned lizards: that was why the Society was formed. And so they said, "Well, maybe we could get some and take them and start raising them and release them. And we can repopulate the area."

Wade Sherbrooke [01:16:42] And myself and a few scientists who were there said, "Well, wait a minute, there's some reason they're gone. They're no longer there. And if that reason is still there, I think we're wasting our time doing that. So unless we have a situation that's been ..."

Wade Sherbrooke [01:17:00] You know, if it's a parking lot there, we're not going to release horned lizards in parking lots and get them to live there.

Wade Sherbrooke [01:17:06] So, it's complex because these, as I said, the fire ants probably wiped out a lot of natural ants.

Wade Sherbrooke [01:17:14] Eastern Texas, it's going to be hard. There's other places and there are three zoos now in Texas that are involved with breeding horned lizards and releasing them. And they're having a great, they're doing very well in breeding them. They've had some releases, and that's difficult because the animals have to be ready for that. They're not fully grown because you're not going to keep them all their lives. And I think there's been some successes, but there's been things that haven't been successful at all.

David Todd [01:17:51] So, one of the discussions that I have heard about is that at one point these horned lizards were, you know, pretty popular and common and seen far and wide. And so, maybe people didn't take note of them. And now that they're more rare, it's difficult to pin a particular baseline because maybe not enough research was done in those early days. They weren't appreciated enough as there something that was special. Do you think that that there's truth to that about this sort of baseline problem?

Wade Sherbrooke [01:18:28] Well, that's an interesting way of putting it. And I'll come it from two different directions. Okay.

Wade Sherbrooke [01:18:37] One is that, yes, scientists, were not running around. There wasn't an ideal animal for them to study. And for, in a lot of areas, they weren't that common. Let me put it that way. But in other areas, they were. The ranching people and things like that.

Wade Sherbrooke [01:18:53] The people that came to that first meeting, the Horned Lizard Conservation Society, some old dude would get up and he'd say, "When I was a kid, all the kids had horny toads and ice cream cones. And that's the future of Texas that I want to see. Horny toads and ice cream cones." And so, that was a lot of ... those people were very supportive of the idea of having conservation for horned lizards.

Wade Sherbrooke [01:19:24] And that's why horned lizard wound up on Texas license plates, if you want to have one on your license plate in Texas.

Wade Sherbrooke [01:19:32] But so, the scientists weren't paying a huge amount of attention to them.

Wade Sherbrooke [01:19:36] And the other thing, one reason was, there weren't as many herpetologists and scientists back then either. I mean, there are so many more scientists now, working on horned lizards, it would be interesting to have that data, because a lot of people aren't working on horned lizards, but just scientists working on reptiles, it's really, really grown a lot. They just weren't that many people doing that kind of thing.

Wade Sherbrooke [01:20:12] We have more scientists now than we've ever had. Sometimes I remember I've heard, and I don't know what today's data is on this issue, that there are more scientists living today than all of those who live scientists live before in the existence of humanity.

David Todd [01:20:34] That's fascinating.

Wade Sherbrooke [01:20:34] We have scientists doing all kinds of things now, and they were rare things before.

David Todd [01:20:41] Good point. So, so maybe that's part of the issue with the baseline, if it is a problem, there were just fewer eyes and ears and people doing experiments and making notes and trying to take some sort of conclusions from what they found.

Wade Sherbrooke [01:20:57] Yeah, but, but then horned lizards as being a key species and getting people's attention is that they arouse curiosity. They look strange. They look like dinosaurs. They don't bite. You can hold them in your hand easily. And they're not threatening. And they're big enough to hold in your hand: If you have tiny little things, some beautiful little bee that, you know, if you put under a microscope: what a creature this is!

Wade Sherbrooke [01:21:29] But horned lizards don't have that problem. We don't have to put them under a microscope. We can see it. We're in the same size world that we can relate to easily.

David Todd [01:21:44] So, small enough to fit in your hand, but not so small that you can't see it. And not so large that it might eat you.

Wade Sherbrooke [01:21:53] Yeah, exactly.

David Todd [01:21:54] That happy medium, I guess.

David Todd [01:21:58] Well, so let's talk a little bit about efforts to try to recover these creatures. I think you mentioned that there are three zoos in Texas, and I guess probably other institutions elsewhere, that are trying to help with their recovery. I gather that one of the issues to try to figure out how to breed them and where to release them is to make sure that you're releasing them with and breeding them with creatures that are genetically similar. And have you been involved or heard much about the genetic research on horned lizard species?

Wade Sherbrooke [01:22:43] I have not. Okay. There's a lot of genetic work going on. I don't do that.

Wade Sherbrooke [01:22:51] The zoos that I know of, in Texas, that are breeding them are in Dallas, Fort Worth and San Antonio. And Texas Christian University, there's a big program there about the genetics. And they have found five different genetic groupings that have similarities in different parts of the state.

Wade Sherbrooke [01:23:21] But I think if we did a lot more DNA work, we'd have more groupings. It's a matter of how much data we gather because they only identify a certain number of genes. But if you expand that 100 times, I'll bet we could divide it up into a lot more subunits. And that's what we're doing.

Wade Sherbrooke [01:23:42] And so, in a certain sense, the horned lizards on the west side of Houston, well, they're not over there, but let's come west of someplace, of Phoenix, and the east side. There's probably some genetic differences between them.

Wade Sherbrooke [01:24:00] So, every time we wipe out a community, probably that genome is gone. It was adapted and happened to develop in that area. So and that's true of every species we're talking about.

Wade Sherbrooke [01:24:18] Biology is very complex. I remember going to school and physicists always having more elite feeling about what they did because they were very precise and they could come to very strong conclusions and things like that.

Wade Sherbrooke [01:24:36] Of course! They've got a very simple system to deal with.

Wade Sherbrooke [01:24:39] Biology and with the chemistry and all that world is extremely complicated. And we just have to recognize that. That's all.

David Todd [01:24:52] Well, I think you said early on that biology and animals are just very complex and that if there's any hope to become sort of cognizant of what they're all about, you have to study one creature, one, I think you said, one tiny sliver of life, you know, to be able to see the universe.

Wade Sherbrooke [01:25:16] Yes.

David Todd [01:25:17] And I was hoping you could talk a little bit more about that, what your view about studying horned lizards as maybe a sample or an example of life in general.

Wade Sherbrooke [01:25:29] Yeah, well, I kind of mentioned it earlier that you can't absorb everything. And as you're trying to understand the natural world, it becomes more and more important.

Wade Sherbrooke [01:25:44] And I think the big message of this sliver is just to show how complex any part is. And then if you kind of expand that, and what we know about DNA now is that I like to remind people of this: "every living cell on this planet today has a history as deep as any of us." We all come from an original origin of life on this planet.

Wade Sherbrooke [01:26:26] They're all our relatives. Every single plant, animal, fungus and other groups on the planet are our relatives. It's locked into our genes. Geneticists are showing that every, all the time.

Wade Sherbrooke [01:26:50] Neanderthals: unless you're still in Africa and haven't bred with anybody outside, if you're a white person or a brown person or a yellow person on the planet, you have Neanderthal genes in you, who our ancestors bred with another species.

David Todd [01:27:19] We're all brothers and sisters.

Wade Sherbrooke [01:27:23] Exactly.

Wade Sherbrooke [01:27:24] And it would be nice if we could acknowledge that and incorporate that into our social systems and our belief systems. That's, I think that is a major step we need to take.

Wade Sherbrooke [01:27:43] And one of my interests with indigenous peoples is that they live very close to the natural world. And they understood that in their spirit, in who they were and and their belief systems. They knew that they were kept alive by the natural world.

Wade Sherbrooke [01:28:08] And one of the things I share in discussions sometimes with people is (and many times the people don't even know what I'm getting at) ... I'm sure you know what chloroplasts are. But some people may or may not remember that from some

biology class. These are the organisms that somehow got incorporated into plants that made them photosynthetic, and they produce the oxygen we breathe. Every time you take a breath in, it's a plant and a chloroplast that keeps you alive.

Wade Sherbrooke [01:28:48] And, they are the ones that capture the energy from the sun, almost all the energy, there's minor exceptions to this, but almost all of the energy that humans use, and all animals use, on this planet comes from plants capturing energy from the sun and building molecules out of it that we can use, taking carbon dioxide out of the air and making carbohydrates out of it.

Wade Sherbrooke [01:29:21] And that's the dependent system.

Wade Sherbrooke [01:29:24] We think we're dependent on the economy. We think we're dependent on the stock prices. That's not what we're dependent on.

Wade Sherbrooke [01:29:34] We are dependent on chloroplasts and plants for keeping us all alive.

Wade Sherbrooke [01:29:40] Horned lizards? Where do they fit? They eat the ants that eat the seeds of the plants. That captured carbon is fed to their larvae and they develop and come out as ants. And then they send searchers out to the surface to bring back more of what the plants are producing. And they're breathing the air just like we are - using the oxygen.

Wade Sherbrooke [01:30:13] Boy, the interconnections are just pretty staggering.

David Todd [01:30:18] You know, one thing that I think is interesting about your career, as I take it, is that you have spent a lot of time, maybe like these indigenous people that you were mentioning, close to the ground, close to these systems that are out in nature, doing field research. And you have many sisters and brothers in the scientific realm that are probably happy to be in front of a computer or in a lab these days. But you seem to be a field researcher. Is that fair to say?

Wade Sherbrooke [01:30:56] That's what I, when people ask me, I say, I'm a field biologist.

Wade Sherbrooke [01:31:01] And I didn't take the perhaps normal pattern of going into academia. And actually a lot of people now are going into other avenues of applying their knowledge about the natural world. I ran a research station that scientists came from all over the United States and around the world to do field research. So I within ... I had a whole community living around me all the time.

Wade Sherbrooke [01:31:28] And when I first started working on horned lizards, I got a grant for $200 that probably covered my film cost for the summer. And I've never had another grant. I've gotten National Science Foundation grants to improve the facility that I was in charge of, five National Science Foundation grants for that.

Wade Sherbrooke [01:31:54] But, aside from that, I've done it on my own with working with other people, finding people who I could get interested in things, who had equipment that they were, and they knew how to do something I didn't know how to do. And I had questions that they were enchanted by. And we worked together and I just put in a lot of time by myself, you know, put gas in the car and go do it. That's it. And you live out in the desert and things like that.

Wade Sherbrooke [01:32:23] And E.O. Wilson, who has passed away but was a major innovator and outstanding evolutionary biologist - just had huge impact - and he described in one of his books how scientists are society's "scouts". And that's what we do. We go out into the unknown.

Wade Sherbrooke [01:32:52] As Europeans were coming across North America, each group, they had a scout. They went out ahead of everybody else and they figured out where you could get across the rivers, where you could get between the mountains, where you could avoid the Native Americans defending their areas, and all kinds of things like that.

Wade Sherbrooke [01:33:11] We're scouts. What we scout for is new understandings. That's our job. And if we make mistakes, who cares? That just gets thrown away. And each time we think we discover something new, we share it. And then other people say, "I wonder if that's true?" And they look at it from a different way. They have a little bit different perspective. And we keep refining it, generation after generation.

Wade Sherbrooke [01:33:39] And so if we keep building this social wealth and to my mind, we're not so successful because we're very competitive. We are a success because we are the largest socially advanced animal on the planet.

Wade Sherbrooke [01:33:59] Others are queen ants and queen bees and things like that. Those are big social structures.

Wade Sherbrooke [01:34:06] No, we are a very advanced social species. And what do we share? We share knowledge, and that builds our strengths, communal strengths. Those are communal strengths that we all share.

David Todd [01:34:24] So, one of the things that I think you've shared over the years are your specimens and photos. And of course, ideas are a big part of what you contributed. But, I'm wondering if you could talk about some of those contributions to herpetological collections at the University of Arizona, the Smithsonian, the American Museum of Natural History, probably other institutions.

Wade Sherbrooke [01:34:49] Sure. That's one of the things one does when you're just trying to understand what's going on in an area frequently you're doing a lot of collecting. And it happens in different ways.

Wade Sherbrooke [01:35:05] I was in in the Peace Corps, in Amazonia and Peru for two years, teaching at a small university that was just starting there. I did a study while I was there on a semi-aquatic lizard for a year to find out if they continued, since it was near the equator, if they continued their reproductive cycle throughout the year, or if they hibernated or did something else for part of the year. And the males were ready to breed all year 'round. The females had a part of the year, they more likely to lay eggs. But they were ... it was a pretty much a year-round system.

Wade Sherbrooke [01:35:41] But so, when I was traveling on my vacations, I would go on rafts and canoes and I'd talk people into taking me to different places, just on my own. And I was carrying formalin and alcohol to preserve animals. And I was collecting animals as I was going down rivers.

Wade Sherbrooke [01:36:00] And I brought those specimens back and put them at the Smithsonian Institution. And then when I went back to school, in the summers, I went there a couple of summers to work on identifying those collections. So that was one collection: it wound up at the Smithsonian.

Wade Sherbrooke [01:36:17] When I was working at the University of Arizona on my master's degree, I had an opportunity to work for my master's degree on the distribution on the north rim of the Grand Canyon of amphibians and reptiles, how they were distributed between the bottom where the river, Colorado River, flows through, to the top of a volcanic mountain that was just off the top of the north edge of the Grand Canyon.

Wade Sherbrooke [01:36:46] And those specimens, it was an area that was, not many people live there. It's called the Arizona strip because the Colorado cuts it off. All north of that is based in Nevada or Utah. And because the Colorado River is there, there's no underground water there built up. And so, not many people live there.

Wade Sherbrooke [01:37:11] And so, I was getting a lot of new material that was made available at the University of Arizona, where there's a very good herpetological collection for scientists to come. They were interested in this species of lizard all over the place and they would go and get, they'd take some of those samples that I brought back and could fit them into a pattern that they're trying to understand about that species, whatever species it was.

Wade Sherbrooke [01:37:38] And I was also understanding what their distribution was, ecologically, within different habitat types, different elevations in particular.

Wade Sherbrooke [01:37:51] And I took photographs up there of vegetation a lot. And scientists in the Southwest in general have used old photographs, and are still doing this, to understand vegetational changes over years in response to different climates. And so people are still doing that kind of thing.

Wade Sherbrooke [01:38:12] And I think that probably people are taking enough photographs today, I hope somebody is doing it somewhat systematically of coral reefs and glaciers, and to see... I mean, change is going on on the planet. And we want to understand things about change. And photography is one way to help with that.

David Todd [01:38:36] I think you mentioned earlier that the horned lizards have suffered because of habitat change and habitat loss and habitats really being taken away. And I guess in that same vein, you have worked with land managers to try to advise and counsel them on how you know, sites can be used for research or conservation. And so, I was hoping you could maybe give us a little insight about what that practice has been like.

Wade Sherbrooke [01:39:11] Okay. Most of that, for me, there was a point... Well, we were surrounded when I was running the research station for the American Museum of Natural History in the Chiricahua mountains. We were surrounded by the Forest Service. And one of my job was to make sure we always had access for our scientists at the station to work in the Forest Service lands, and to see the development that was going on in the Forest Service was beneficial to the organisms that lived within that, and to bring the expertise that we had at the research station to help them with what they were doing.

Wade Sherbrooke [01:39:53] But one of the magic parts of a research station, and then I had people come to me who were trying to set up research stations in different places and to

evaluate what was going on there. And I thought a lot about the role of research stations. And the research station, it was in quite an isolated place. I mean, you'd drive into it and things like that.

Wade Sherbrooke [01:40:23] And we had our own community of scientists. They were all there with a generally sympatric agenda. And we all ate together. We played together. There wasn't another community we were playing with. We were all together all the time, 24/7.

Wade Sherbrooke [01:40:41] And being a director of a situation like that, when you're living there, you don't have a 40-hour week. It's 24/7. Something happens, you're there, they come to you. You need to solve it. My maintenance man's off for those days and if something happens, I'm the one getting the water system to run again, getting the heat back on, stuff like this. It's a multi-task job, which is one thing I loved about it.

Wade Sherbrooke [01:41:09] But in terms of the people ... We had a big volunteer program. I expanded the volunteer program. We had, at one point, we had half of our volunteers were coming from other countries.

Wade Sherbrooke [01:41:20] And so, you know, I've thought about a lot about research stations and their impact on people. I had students come and I'd give them a questionnaire after they left. I interacted with them a lot. And one of the things was they were what, juniors in college or seniors, or are going to be seniors the next year. And they, by the end of the time they were there, what happened to them there?

Wade Sherbrooke [01:41:48] They helped us do tasks for half the time. And that was 20 hours a week, I think. And, and that was to pay for their room and board, so they didn't have to pay to stay there. And then they worked with scientists. And they went out in the field, and they collected data. They helped the scientists. And they were part of doing research in the field.

Wade Sherbrooke [01:42:09] And they would tell me, "You know, I was so burned out by being in college and taking tests all the time and memorizing all this stuff. I wasn't sure I wanted to be a biologist anymore. But, after spending this summer, I'm going to graduate school.".

Wade Sherbrooke [01:42:27] And so, I've developed this idea that research stations, you know, Harry Potter, I'm sure you've been exposed, and Hogwarts. Okay, it's a place you go to learn magic, things that occur that aren't in the natural world that you live around. And the research station's kind of our Hogwarts.

Wade Sherbrooke [01:42:51] People come there, they leave their lives behind. They're not taking care of their children or their spouse or their job that they have back there that they have to do weekly, all year long. They're out there to engage the natural world in a specific way. That's what they're doing. And they're learning about things that nobody knows about, that we're trying to define what's going on out there.

Wade Sherbrooke [01:43:19] And so, to me, a research station is a Hogwarts. And we, it's an institution. And so, that's what I try to promote when people come to me with problems like that is that we need to get people to get excited about those things and see the world that way.

David Todd [01:43:41] Well, you know, it's striking to me that you both worked with people who are, you know, undergraduates and grad students and, I guess, professors - people certainly with a lot of experience and knowledge. But you have also led a number of natural history tours where I imagine that your fellow travelers, were not as knowledgeable, maybe enthusiastic, but didn't have that sort of, you know, wealth of knowledge that they're bringing with them. And I'm curious how you worked with them, reached out to them, help guide them on these trips.

Wade Sherbrooke [01:44:22] The majority of those trips were from the American Museum of Natural History, and we went to whale watching in Baja California. We went all over Australia and to the Amazon Basin in Peru, which I know from living there for two years in the Peace Corps. And we went to wonderful, wonderful places.

Wade Sherbrooke [01:44:44] They were very well organized. And my job was to give overall lectures about the significance of what was going on around us. We had local guides do the local stuff, whether it was pictographs in northern, in Arnhem Land in northern Australia, or the birds of the Amazon, and all things like that.

Wade Sherbrooke [01:45:14] So these people were and in a certain way it was a little bit like, like I was talking about Hogwarts, because we were taking people ... You go on vacation, and you leave your normal life behind and you're finding out something new. And it's an exploration. So I had people that were open that way. And since they were associated with the American Museum of Natural History, they were interested in natural history. So they were interested. They were easy to reach that way.

Wade Sherbrooke [01:45:47] And my job was to not only make sure that they were content with everything that was going on, and that everything was going fine for them, but to get them to branch out as much as possible to see the bigger pictures that don't get to you all the time that I've talked about so far, to see to see how they fit into these different places.

Wade Sherbrooke [01:46:18] What's our personal relationship with what's going on around us? It takes ... you have to focus. You have to be in the place. I mean, it's wonderful to see on television, or some other media. But being in it and catching a piranha and eating it, rather than it eating you, changes your world, because there's a lot of information that floats around that's not very real, like piranhas. We think that they eat up people all the time or something like that. No. The people down there eat a lot of piranha because it's easy to get them to bite. They have huge teeth. You don't want to get bit.

David Todd [01:47:08] So, you've worked with people one on one and one to a group in these natural history tours. What do you think about the work that you've done on various media projects? I think from books to video where, you know, you've helped wrangle some of these creatures and teach lessons through those kind of media.

Wade Sherbrooke [01:47:36] OK. I've mentioned already that I did some of that, or actually I did quite a bit of it, with blood-squirting. And so, I went with a group to work on some horned lizards in southern Mexico is one - Phrynosoma asio. It's the largest horned lizard. And we were working with them, we were out in the field, and it was in a small town. And of course, some kids are attracted to these adults running around in the field. And so, these kids, they were helping us find these horned lizards.

Wade Sherbrooke [01:48:09] And so, and one of them, at some point when we're taking a break, he came over to me. He said to me, "Do you know that these lizards squirt blood out of their eyes at some time?"

Wade Sherbrooke [01:48:24] And I said to him, "How do you know that?".

Wade Sherbrooke [01:48:27] He said, "I saw it on television!"

Wade Sherbrooke [01:48:30] And I said, "I got that animal to squirt the blood out so that they could video it."

Wade Sherbrooke [01:48:35] So, that was a real insight into the impact. I mean, and this is southern Mexico, where, you know, televisions are few, and things like that. It was a small community. And so, you just see that you do something like that that the media people pick up on. And it goes way beyond.

Wade Sherbrooke [01:48:58] I mean, I write scientific papers. Very few people read those. But that's where we try to stay as close to the truth as we can understand. That's what we're doing.

Wade Sherbrooke [01:49:14] But it wonderful to see that kind of stuff go around. I did a lot of that for one period of my life of setting up things with horned lizards for film crews.

David Todd [01:49:29] Well, I guess it really helps some of your ideas and insights grow legs and reach many people in countries around the world.

Wade Sherbrooke [01:49:38] That's what we do with each other. We share. And that's what makes life worthwhile, that we can share with each other and pass things on.

David Todd [01:49:54] So one of the things that I think is very intriguing, and I think you've touched on this a couple of times, maybe you can just give us another view of it, is that while reptiles are often a little off-putting to some people, you know, they have sharp teeth, or, you know, they have venom. Yet, the horned lizard seems to be very appealing and popular. And I'm wondering if you have any insight in why it's so attractive, not just to yourself, but to many, many kinds of people.

Wade Sherbrooke [01:50:33] I think because they're unusual. We're attracted to unusual frequently. I don't know in Texas, because longhorn cows and, you know, cows have horns, if that was a part of it or not.

Wade Sherbrooke [01:50:47] But I think they're just ... when something is unusual, we take an extra look at it to see if we can figure out a little more.

Wade Sherbrooke [01:50:57] And these guys don't bite you. They're a size that you can take in easily, and you're not afraid of them. They're not too big. And so they have a number of qualities.

Wade Sherbrooke [01:51:17] And actually, that was one of the reasons ... two things attracted me to work on horned lizards. One was very little was known about them at that time. Scientists had not worked on them very much at all, because a lot of the species are kind of hard to find. And so I said, "Well, I'll just give it a try."

Wade Sherbrooke [01:51:36] And the other thing is that I knew people were curious about them and I thought they had a role to play with humans, in trying to get them to understand the natural world better. And that's what I've been doing for 47 years.

Wade Sherbrooke [01:51:58] Sounds like a good run. Well, yeah. And one that it will carry you for many years to come.

David Todd [01:52:04] So, to let you get on with that, I was just hoping that you might have one last sort of view that you would share with us about horned lizards, something that we might have missed, forgotten, overlooked. Anything you'd like to add?

Wade Sherbrooke [01:52:25] Good question. I don't think I have other lizard stuff, other than what I've just been saying, is that ... All right, yeah...

Wade Sherbrooke [01:53:00] We're all worried about climate change today, and what's going to happen. And horned lizards are at risk as are many species. And we've, human populations, since I was growing up as a youngster, there were 1 to 2 billion people on the planet. Today, there's eight plus billion people on the planet. That's a big impact on every other thing that's alive on the planet.

Wade Sherbrooke [01:53:32] And we've spread across the planet everyplace but Antarctica, although we're doing that and we're even trying to spread to the bottom of the oceans now in terms of our exploitation of things.

Wade Sherbrooke [01:53:50] And I wonder if tackling this issue has a lot to do with reducing our consumption and in part doing that through the number of humans that we have on Earth...

Wade Sherbrooke [01:54:13] Economists keep telling us our economic system needs to grow. We need ... That's how it's built. That's the economic system we have today is built on growth.

Wade Sherbrooke [01:54:26] I think that's a pretty high responsibility in what's happened in terms of climate change.

Wade Sherbrooke [01:54:34] And so, if we could turn around that growth and economists need to figure out ways to do that, I'm not an economist. I can't figure that out other than people just you know... I can throw out ideas. They're not politically salable.

Wade Sherbrooke [01:54:49] But the other thing is to get fewer people. And the economists now are telling us, like in Japan, oh, this is a crisis. In Russia, there's a crisis. In Italy, there's a crisis. There's fewer people. People aren't having enough replacement of humans.

Wade Sherbrooke [01:55:10] And that's because they think we need to have more people all the time, because the economic system we've created seems to be built around that.

Wade Sherbrooke [01:55:19] And so, how do we get fewer people? Maybe we have family planning worldwide free.

Wade Sherbrooke [01:55:31] Another thing that I just thought of fairly recently was, suppose Social Security benefits were higher for people who did not have progeny than people who had progeny. I mean, we're not trying to wipe out humans. We're just trying to reduce the population some.

Wade Sherbrooke [01:55:51] And the other thing is we could give better livelihoods to people who don't have very much now. And so, they don't feel like they have to have four kids or eight kids in their old age. We have a social welfare, social security type systems worldwide.

Wade Sherbrooke [01:56:12] And this is very, very complex. So, I'm not trying to put up all the solutions at all. I'm just saying that that's one thing that occurs to me as I think about us addressing climate change and its impacts on all of us.

Wade Sherbrooke [01:56:31] And, by "all of us", I mean us, our horned lizard relatives, and all our other living relatives on this planet.

David Todd [01:56:42] I love that you move from this creature that, like you said, fits in your hand. But you start to think about this globe that's 25,000 miles around and that it is all connected, living relatives all linked up.

David Todd [01:57:02] Well, great. Dr. Sherbrooke, what a wonderful way to spend a little time. Thank you. Thank you very much.

Wade Sherbrooke [01:57:10] I thank you for engaging me. And I wasn't sure what it was all about when you first got in touch with me. And I learned a little bit. I'm still not sure. I haven't gone on the site for everything. I don't know what all is available that you're making available, but I look forward to listening to this.

Wade Sherbrooke [01:57:34] And having Todd, maybe I should get Todd in here and you guys work out how it's going to, how he can just send this. I think he said he can send his MP3 version of this on the Internet to you. And I don't understand or see that well. But, that's great.

David Todd [01:57:56] You focus on the horned lizards. And we'll have Todd deal with the MP3s.

Wade Sherbrooke [01:58:01] Yeah.

David Todd [01:58:01] But thank you so much for your time today. I'm going to turn off our recording device on my end, and I'll be in touch with your friend Todd shortly, I'm sure. But thank you so much for your day. You've been very generous.

Wade Sherbrooke [01:58:18] Thank you for being a great host and asking interesting questions that have allowed me to bring out some of my understandings and feelings.

David Todd [01:58:30] Thank you for sharing. Appreciate it.

Wade Sherbrooke [01:58:32] Okay.

David Todd [01:58:33] All right.