

**TRANSCRIPT**

**INTERVIEWEE: Dr. Pat Richardson**

**INTERVIEWER: David Todd**

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**Google Voice** [00:00:00] This call is now being recorded.

**David Todd** [00:00:03] Super. Well, Pat, you're a wonder to spend a little time with me. I really appreciate it. And I thought before we get too far into this, I should just ask if you could set your phone on "do not disturb".

**Pat Richardson** [00:00:22] If I could do that, if I can what?

[00:00:25] Put your phone on, "do not disturb".

**Pat Richardson** [00:00:29] Oh, shoot. Messages, intercom, pause. I have no idea how to set it on, "do not disturb". Are you there?

**David Todd** [00:00:47] Can you hear me?

**Pat Richardson** [00:00:48] Yes. Can you hear me?

**David Todd** [00:00:50] Yes, I can.

**Pat Richardson** [00:00:52] OK. I had it on speaker, but it wasn't sounding very good. So do you have any idea of what to do, what a button, "do not disturb", would look like? Yeah.

**David Todd** [00:01:00] So are you using an iPhone?

**Pat Richardson** [00:01:03] No, no, no. I'm on a landline. Old phone. I don't even have an iPhone.

**David Todd** [00:01:08] OK. Yeah, then that's perfect. One less thing to have to worry about. OK, so not to worry, I shouldn't have even brought it up then.

**David Todd** [00:01:18] OK. So I just, in the interest of full disclosure, I wanted to just say that we are planning on recording this interview for research and education, for the Conservation History Association of Texas, and for a book and web site for Texas A&M Press and for an archive at the Briscoe Center for American History at the University of Texas.

**Pat Richardson** [00:01:45] OK.

**David Todd** [00:01:45] And I wanted you to know that and ask if that's acceptable to you before we go any further.

**Pat Richardson** [00:01:52] Sure. And and if there's tedious stuff that I say, can you edit it out before you archive it?

**David Todd** [00:02:03] I understand.

**David Todd** [00:02:05] I know. It's a humbling thing. Sometimes we say things that we don't need to or... I understand. But I wanted to also just emphasize that you have equal rights to use this recording. But we just in order to give things to the archive, they ask that we secure a waiver on this stuff. So that's what I was asking. All right. Well good. Good.

**David Todd** [00:02:31] Then let's get started. It is April 8, 2020, and we are conducting an interview with Pat Richardson of Austin, Texas, by telephone. My name is David Todd, and we are looking forward to interviewing her about her many years of work with dung beetles. And I want to thank you for taking time to do that.

**Pat Richardson** [00:02:59] You're welcome, and I'm always delighted to talk about dung beetles since.

**David Todd** [00:03:03] Oh, good. Good, thank you!

**Pat Richardson** [00:03:07] My motto is, "Poop makes the world go round", so.

**David Todd** [00:03:13] Ha ha ha ha. How true! Couldn't have said it better.

**David Todd** [00:03:20] Well, how about if we start by asking a little bit about your background and your general training and career?

**Pat Richardson** [00:03:30] I got a Ph.D. in Biological Sciences at the University of Texas and worked on sequencing proteins for a long time until I met Professor Dick Richardson and ended up marrying him. And he was interested in prairie restoration and rangeland health. From his background as a rancher. And then he became a professor at the University of Texas. He actually graduated with his bachelor's degree from A&M in plant science and plant breeding. In working with him, we were, we got involved with dung beetles, and that will be a bit of a long story. So but that was my introduction was through his work and do you want me to start that story?

**David Todd** [00:04:28] Yeah. Why don't you tell me about the origins of your interest and research in dung beetles in dung beetles? Let's dive into it.

**Pat Richardson** [00:04:36] Well, he was asked- at the time he was doing remote sensing aerial photography with a special old NASA camera - and was asked to fly the ranch in West Texas, where they were land applying New York City biosolids, which means treated human poop. So they were spreading it on a huge ranch near Sierra Blanca in western Texas, about eighty five miles east of El Paso. And he was asked to fly it. And by that time, I was the camera man with the big NASA camera. So we went out and flew the whole ranch and then landed and got a tour from the scientists that were working out there doing all kinds of measurements of what did this land application of biosolids do to that high desert land. And in walking around, I remembered as a kid living in South Texas that dung beetles would grab the poop sitting on top of the land and roll it off and bury it. And we began to think, because they were just throwing out the biosolids, which looked like black modeling clay. It had been treated to

reduce odors and kill pathogens before it was ever brought to West Texas. So I began to think, well, it's just sitting on top of the land, I wonder if dung beetles would bury it.

**Pat Richardson** [00:06:12] And flying back to Austin, we began to talk about that, and Dick said, well, he knew a rancher who had dung beetles. The rancher was on the Red River just, just on the Oklahoma side. But he had a lot of dung beetles. So when we got back to Austin, we called that rancher and that rancher said, well, you have a scientist that, at USDA-ARS, Agricultural Research Service in College Station that's excellent. He's introducing dung beetles. And that was Dr. Truman Fincher.

**Pat Richardson** [00:06:52] So we went over to talk to Truman Fincher, met him and he gave us some of his dung beetles and we got some of the treated biosolids from West Texas. And they wouldn't bury them. They wouldn't bury it. They wouldn't eat it. They wouldn't even raise their kids on it. So it had been so well-treated. If you look at it from a dung beetle's perspective, or so poorly treated that they had killed all the life in the in the poop. So, at least that's my rendition of it. They didn't like the treated biosolids.

**Pat Richardson** [00:07:31] But in that talking with Walt Davis, the rancher, and then Truman Fincher, the scientist, we got interested in dung beetles again and began to look at them as what is their benefit on range land where you've got big bunches of cattle and and on prairies if you're doing any grazing of buffalo or anything that you've got large ungulates, what what are dung beetles doing? And Truman Fincher just had all kinds of studies and had done a lot of work for 30 years with dung beetles. So he was an excellent source of a lot of information. And that was how we got going with dung beetles.

**David Todd** [00:08:20] And can you prep those that are not familiar with dung beetles? Sort of describe what a beetle looks like. And, you know, the different kinds. I understand there are rollers and tumblers and dwellers. And could you give us a sort of 101 introduction?

**Pat Richardson** [00:08:42] Yes, dung beetles, all dung beetles are scarabs. They're in the Scarabaeidae family. Or, know I'm not an entomologist. So they're in the scarab group of beetles, and are insects. And all of them have the capacity to smell dung, smell fresh dung. They can be the size of a B-B. So they can be quite tiny. They can be of the dung beetles that bury elephant dung can get almost, you know, almost as big as your fist. Not quite that big. But they can get, you know, inch and a half, two inches large. So the size varies tremendously.

**Pat Richardson** [00:09:37] But all of them have a capacity to smell dung. The eau d'dung, as I say, they can detect it, I think as far as 10 kilometers away, some species. When they and they fly, the adults fly. And when they fly to fresh dung, they can either live in the dung. Those are called dwellers. They lay their eggs and raise their leave their kids to grow in the dung. Or they can land at the dung and bury it directly underneath the, the dung pile. Dig tunnels down into the soil and carry dung down and make brood balls of dung and they'll lay an egg in each brood ball. And that egg goes through its life cycle. And till it gets to an adult and crawls, crawls back out. Or they can grab a chunk of the dung and make a ball and roll it away. And then bury it. So those are the dwellers that live in the dung or the tunnelers that bury under the dung or very close to the dung and the rollers who roll some away to bury it.

**Pat Richardson** [00:10:59] They, they use the dung as their food source, themselves. They have a mouth that's more or less like a sieve. And and they eat probably the bacteria and get nutrients out of the dung. I don't think anyone knows yet exactly what they eat from the dung.

**Pat Richardson** [00:11:26] They also use it as the incubator for their young, which they lay an egg. An egg hatches into a larva or a grub. We're used to calling beetle young, "grubs". And then the grub finally gets to the right size eating dung and goes through a metamorphosis and evolves into the adult dung beetle with a hard carapace and wings. And that dung beetle crawls out and starts life looking for fresh dung to eat.

**Pat Richardson** [00:12:07] Now, where do I want to go from that?

**David Todd** [00:12:09] Well, and my understanding is that there are scores of species.

**Pat Richardson** [00:12:16] Yes.

**David Todd** [00:12:16] Of dung beetles and many of them have actually been brought into the North American continent. Is that right?

**Pat Richardson** [00:12:25] There are, there's several thousand species of dung beetles, at least - many of them in Africa, because of the large number of large ungulates that are pooping lots of poop. So there's lots of food for dung beetles. So there's, you know, all the way from zebra dung to elephant dung to antelope dung to all the large ungulates. The dung beetles seem to prefer large ungulate dung. There are, there were fewer dung beetle species in the United States. Maybe to the tune of 150. And all of these numbers change as more species are discovered. I mean, that's true of almost anything we look at. We're always discovering more species. So the numbers that I give are, are ballpark numbers, say one hundred and fifty species in in North America. When you think about it, we haven't had vast numbers of large ungulates since, since the buffalo. So we may have had more species of dung beetles when we had more large ungulates, but when we, when their numbers, when their numbers decreased, then perhaps the dung beetles died out. That's just all, I'm just talking now, perhaps and perhaps.

**Pat Richardson** [00:14:04] But we when we got rid of most of the buffalo, we brought in cattle, and cattle, in the world of poop, sort of have a bit of a wet, sloppy poop and some dung beetles love wet, sloppy poop and other dung beetles don't. So we didn't have a lot of dung beetles that really liked cow dung. And that brought forth the idea of introducing dung beetles. Because if you take the fresh dung that's dropped on the surface of the grassland or a meadow or a prairie or wherever they're eating, one, the, let's just use cattle, the cattle won't eat around near that cow poop. They don't eat near their own dung. The dung sits on top of the ground and becomes a wonderful habitat for flies and parasites and can reinfest the cattle if they're on that same land with with some of the pest insects that, that affect the cattle.

**David Todd** [00:15:24] Would that include horn flies?

**Pat Richardson** [00:15:26] Yes, and face flies and horse flies and include, it includes a variety of pest insects that, that either irritate the cattle and probably make them anxious and affect their grazing. Maybe they don't gain weight as well or actually can be internal parasites and affect their health. So we had a huge problem of all the cow poop sitting on top of the land. And the scientist and I have forgotten his name, but he was Truman Fincher's mentor, realized in his travels - he was he was a grass expert - and but in his travels studying grass, he had been in India and noticed that the one place, wherever he was, the hotel, he looked out the window. And every morning all the people of the, in the area would run into this big dense field that was dense with foliage and maybe even corn, whatever it was, they would all go in there. And he went to what's going on. And he realized eventually went over there and looked

that they all went in there to to to defecate and it all, all the poop disappeared and it was because it was being buried by dung beetles. So and so.

**Pat Richardson** [00:16:59] So he had his idea and to bring in dung beetles, to bury cow dung. And that started Truman Fincher on introducing dung beetles and to introduce a dung beetle, to introduce a species of any kind from somewhere else can bring lots and lots of problems with it. So Truman Fincher, Dr. Fincher had, I believe, the only quarantine lab or maybe one of two quarantine labs for dung beetles. He would bring in dung beetles. He had to make brood balls of dung from dung here in the United States. And he would pack them in, I think, seaweeds, something to keep them moist and the right texture and consistency and take them with him to whatever country that he was getting the dung beetle from. And he had to get the eggs from the dung beetles there and soak the eggs in mild formalin, trying to get rid of any bacteria, anything that were on those eggs. And most of the eggs died because if you soak 'em in formalin, they died. But a few didn't, and get, put them in the brood balls that came from the United States and then brought them back that way and then reared two generations of dung beetles in his lab before, so again, to try to get rid of any any other foreign viruses or bacteria or anything that came along, getting rid of any of those. Not introducing them into this continent. And if all of that was successful, then he would begin to rear enough. He liked to introduce at least 200 pairs if he was going to make an introduction, go out into a pasture where there were adequate cattle. He liked to have 200 pairs to make an introduction. And they were specifically dung beetles that really liked cow poop and that were really excellent at burying large amounts of of cow dung.

**Pat Richardson** [00:19:25] And I'm at an end. Again, lead me on.

**David Todd** [00:19:31] Well, OK. So speaking of Mr. Fincher, Dr. Fincher, he, as I understood it was sort of in competition for finding some sort of control for horn flies and face flies with a non-biological approach, rather chemical approach with, with ivermectin and other parasiticides, and what if you could talk a little bit about that kind of competition there, that rivalry?

**Pat Richardson** [00:20:06] Yes. And it and I have strong biases here. So bear that in mind, when I talk.

**Pat Richardson** [00:20:19] So a biological control, which would be dung beetles, varies tremendously with the humidity, the temperature, the soil, the kinds of dung beetles. It if you have a good system going, it can bury all the dung and do very good management of all the face flies and horn flies and parasites, because if you get that dung underground, that is the habitat for the face flies and horn flies, all their eggs and kids have to grow up in that dung. So if you get rid of that, it breaks that life cycle. If you get rid of that, it it can, your cattle can stay healthy and don't need to be wormed.

**Pat Richardson** [00:21:18] But if there is a terrible drought, then dung beetles don't bury as effectively because they can't, there's not enough moisture. I'm not sure what what. I just know they don't bury. Whether it's there's not enough moisture in the soil, there's not enough moisture in the dung, there's not enough nutrients in the dump. But they don't, they don't have as many children. They don't bury as much. They don't make as many eggs. So the control decreases. At the time that Dr. Fincher was doing all of this work, of those several decades, was also a time when we were getting a lot of chemical controls and they are much more... What would be the word?. They're easier to do and they're more consistent. Sadly, when you give your animals the parastiiciides, the warming medicines, itt kills almost

everything in the dung for a while. And there are lots of other small insects that live in the dung. Many of them are also eating fly larvae. And there's a whole ecosystem that goes on in dung.

**Pat Richardson** [00:22:49] And the chemical treatments often kill everything in the dung. And as an, as an ecologist, as an environmentalist, I hate to see whole eco, the whole dung ecosystem destroyed by the chemicals. But I guess from a rancher's perspective, it might make a lot more sense to put to use the wormers. So. My biases, my bias is that to try to work with the whole ecosystem that's going on in dung and ranchers have certainly been effective of that, effective with that, and get good biological control over the things that aggravate their, their animals.

**David Todd** [00:23:47] Well, I think that earlier you had mentioned there was a rancher up on the Red River, I guess this might have been Walt Davis, who is a big exponent of dung beetles and, and sort of natural biological controls. I was wondering if you could talk a little bit about how he found use for these beetles and helped promote them on his ranch and with people he tried to educate.

**Pat Richardson** [00:24:16] He had, and again, I'm if I get any of this inaccurate, it's it's just because I don't remember. I think he had several thousand acres on his ranch and he had one of the introduced dung beetles, a little brown one, that was a tumbler. And he watched his land. So he noticed that he had some dung beetles. I think Truman introduced them there or someone and maybe ARS introduced them to his land. And he watched the dung beetles. And he was working on good grazing management. And for him, that involved moving his cattle. The idea being that you could have a lot of cattle in a pasture and they would eat lots of what was there, but you didn't leave them there for any length of time, you moved them to another pasture, the idea being that almost anything can be grazed pretty, but not severely, I would say but you could graze it down pretty low. And if you move the animals off and give it time to regrow, reestablish growth above ground, and good root structure above ground, that you haven't damaged, that in fact, in ways you've improved that land, you've improved the vegetation that grows on it, but it takes the grazing management.

**Pat Richardson** [00:26:05] And he had, he liked, and I think he had a hundred pastures and he did it with electric fence. They might be, he was dependent on what the land look like in that particular pasture and he would move his animals every few days. So they became sort of, sort of a mowing machine and moved them out. And the idea was that he paid close attention to the regrowth in all those pastures. And he tried to make it so that he never had to move the cattle back to a pasture until it had regrown to good health for the vegetation that he wanted, for the best grasses that he had on his land. He wanted them to be healthy and strong again before he moved those animals back to graze that pasture again.

**Pat Richardson** [00:27:07] And as he got more and more dung beetles, he, he watched all the manure in those pastures get buried or a whole lot of it get buried by the dung beetles, which put that I mean, dung is a whole lot of organic matter. So you're, you're putting organic matter back into the soil. The dung beetles that he had the most of dug the tunnels. If he got rain, that gave the water avenues to flow into the soil, down those tunnels. So it improved water infiltration into the soil, improved organic matter in the soil. Those were some of the benefits that dung beetles were providing to his pasture land.

**Pat Richardson** [00:27:56] And he also noticed and he's a wonderful naturalist. He's an excellent rancher and a wonderful - he just observes everything. He noticed that he got more

and more earthworms, that he hadn't seen earthworms, didn't have them on his land until until he began noticing dung beetles. And that enabled the earthworms came along to over time. So he was very, very pleased with the health of the land that was happening with and he could he could have a lot of cattle as long as he paid very good attention, very close attention to how, when they moved and how long they were in each pasture. Now he's one of my idols in the ranching community.

**Pat Richardson** [00:28:53] On the other hand, when he had drought times, the dung beetles weren't burying all of the dung, the, under ideal conditions on his land, which he had, no, you don't have 'em all the time. The climate and the earth is is not that stable, but under ideal conditions, he was getting a burial of a ton of wet manure per acre per day. Now that's not on all 2000 acres. That's where the cattle were. But they were, where the cattle were, if they were in a paddock for two or three or four days, it was getting a burial of a ton of wet manure per acre per day, which is pretty phenomenal.

**David Todd** [00:29:44] And so he in that way, I guess, managed to recycle a lot of nutrients that were in the waste into the soil and aerate the soil, and I guess that would be good for his pastures and for the cows?

**Pat Richardson** [00:29:59] And yes, it got rid of. Yeah, but so the grass that grew, and this doesn't happen overnight, obviously, this is an observation over different seasons, but the grass that grew, would have more nutrients in it and be healthier. There's more organic matter in the soil, easier for roots, dependant trade. And. And all of, and the cattle, when they were brought back to the pasture, would graze more of it because there weren't, there weren't a lot of old dried cow pies sitting on top.

**Pat Richardson** [00:30:40] Now there are different ways: I think you can drag your pastures. You should talk to Walt Davis. He's just one of the pioneers of understanding dung beetles on the land, as a rancher. But, you know, you can drag your pastures and try to break up that manure. But the dung beetles work for free and and love their work. And you don't have to send them to college. And he, so he went from, he went to A&M and he went from sort of a sort of a conventional rancher using chemicals. He, over a period of time went to where he didn't have to worm his cattle and he, he could have more cattle because of the way he was managing the grazing. And just delighted in the dung beetles and the earthworms and the health of this land. It was, it probably took, I don't know, five years to begin to see those differences.

**David Todd** [00:31:58] Well, it is interesting to me to think about, I guess, Walt Davis's role in the ranching community and I think when I spoke, when I got the chance to speak to him before, he felt like he was an outlier and that people were somewhat skeptical about his approach, although I think he was very conscious of trying to keep costs under control and keep things simple and, you know, not do anything too exotic. Do you feel that was accurate?

**Pat Richardson** [00:32:36] He had to make a profit. He was a rancher. So he couldn't he couldn't be, you know, Mr. Sweetie Pie or something with, ecologically. He had to make a profit. That was his living. So that was what I felt. And I don't have a ranching background at all. I'm an urban environmentalist. So the, the, the factor that made it all work was that he could make a good profit. And that really had to be as an essential outcome. Now, if he could do that, and which is what delighted him, if he could do that, improve the land as he'd made a profit and increase the numbers of cattle that he had. So he made more profit, then everything fit into place. And of course, if you don't have to buy chemicals that saves some money, and if

you're improving the grazing on your land, then you, you get, get more animals and, and healthier animals.

**Pat Richardson** [00:33:53] I have to say, as a, as a scientist. I intensely admire land managers because what they do is so complex. There are so many variables in a laboratory. I liked to set up an experiment where I had one variable and then I could measure what that, the difference that that variable made. I mean, I could add one dose of a of of a nutrient or you could add two doses or three doses and you're measuring what the difference with that one change makes .

**Pat Richardson** [00:34:36] Well in the environment on the land as a rancher, you're dealing with many variables all the time. You're dealing with the climate, you're dealing with rainfall, you're dealing with insect variability, you're dealing with predators. You're, you're dealing with many, many, many variables all at the same time. So management is, is, takes such skill to do a good job. And I think for a lot of people, and I bet I would have been one were I a rancher, my, afterward would just say, I just want to do the easiest, most convenient thing. And, and, and I think I would have been that kind of rancher myself, because it takes a lot of energy and a lot of constant observation tom this is my opinion. But to be a good land manager and I was privileged to work with with Dick, my husband, with just fine ranchers all over the United States, and watched them incorporate all of the ecological benefits into their management system, and, and make a profit because you don't make a profit, you don't stay a rancher.

**David Todd** [00:35:58] So what, do you think that it was that, that aspect of the complexity and difficulty of being a really observant land managers that sort of pushed back against Dr. Fincher's efforts. And I mean I understand that he had to take early retirement and he lost a lot of his lab.

**Pat Richardson** [00:36:25] I'm trying to be very diplomatic and everything I say to not shoot anyone in the foot. But again, my observation is he had, I believe it was about 30 years of research with dung beetles and had brought in, oh, I want to say, oh, gosh, I had forgotten all the numbers, now, to be exact. I think he brought in several dozen kinds of dung beetles from different continents. Always focused on the ones that would be excellent for, for, predominantly for cattle, because that's, you know, the one big, large ungulate that we have. And, in competition with chemical warmers and things, it was decided that it was more efficient. And now I'm using my words, so you'd have to look back to what was really said, but more efficient and maybe even cheaper. If you look at just the one thing killing parasites to use chemicals and the research to do to look at biological control just was was less efficient. And so he he lost his grants.

**Pat Richardson** [00:37:57] He didn't have large grants to do the work that he did. That was the real tragedy. It wasn't a whole lot of money. He just was so good at what he did that it, I consider it a real, real tragedy that he lost his grants when he did. And he was, I don't know the right word - requested, required to kill the cultures that he had, to, or let's just say, to not release any of the cultures that he had. So a lot of the work of going to the other continents and going through that whole quarantine process and having these viable, now large, numbers of these particular dung beetle species - to not be allowed to, to introduce them all, was a real tragedy, a real tragedy, and when he lost his funding, we lost the only quarantine facility for dung beetles, I believe at that time in the United States.

**Pat Richardson** [00:39:07] So from a, it was just a sad consequence, that, that something biological and again, as you when you're doing biological research, it's not the same as engineering or mechanical research. You, you constantly are running into questions you didn't



know yet that you should ask because you, in biology there's if you go through, if you answer a question and go through to the door that you just answered, then you find, oh, no, there's ten doors that I didn't even know existed. And so you have to explore each one of those because of the complexity of biological systems. So it is much easier and much more convenient to just have a chemical. And I understand that. But it's a tragedy because as we understand, the whole ecosystem functions as a, as a huge living organism. And if you take a piece out, then you don't know all the other pieces that you're affecting. And if a chemical is supposed to kill two kinds of parasites and it kills, you know, 100 kinds of organisms, then you have all kinds of consequences that you don't even know to ask about.

**David Todd** [00:40:37] Well, this makes me wonder, is there, if you step back and I guess it's been a few years since some of the things that we're talking about happened, did you, I mean did you take away some sort of overall ecological or environmental messages from your experience with dung beetles?

**Pat Richardson** [00:41:05] Well, I mean, I'm serious. Poop makes the world go around. It is one of the habitats that if we, for all kinds of organisms, that, that keeps the ecosystem of wherever that poop is being handled biologically, it's, it's a definite step in the health of that ecosystem. It's the management of a, what we call a wretched thing, too. But it's a, it's an important because it stinks and it smells. And we think it's yucky and nasty, and we don't. We want to flush it. Have it go away. But it's, it's really one of the biological cornerstones of, of, of an environment that it's in. So I really just use the dung beetles just as an example of how the earth manages that particular resource, the resource being poop. I mean, you know, we, we eat poop all the time. We just don't think of it as poop. You know, there's bacterial poop in cheese and wine. And so we're eating poop. We just think of it as delicious food. So the dung beetles think of cow poop as delicious food and human poop as delicious food and pig poop as delicious food. And so it's, we're just all connected in many ways. That's not a very clear understanding of it. But it's, I feel pretty strongly about it and dung beetles were just marvelous things.

**Pat Richardson** [00:43:01] Ranchers would, would say, well, you know, my, my father remembers them. I remember dung beetles as a kid, but I haven't seen them in a long time. And all that poop is sitting on top of the ground and not being reincorporated into the environment, or it sits there a long time.

**Pat Richardson** [00:43:22] I mean, the whole, there's a huge, I mean, Australia was even more unique than the United States in, in not having large ungulates. And when they introduced cattle, they had a terrible problem with all the hard poop rocks from cows, poop piles, poop bricks, whatever you want to call them. And it was an it massive introduction, wonderful stories of introducing dung beetles into Australia - again, the ones that were really good at burying cow dung.

**Pat Richardson** [00:43:59] And the nice thing about dung beetles is that they only eat dung - haven't come across any, there may have been a, and Truman would know about this, an issue with dung beetles burying pig dung. But there haven't been any other issues of, well, you introduced foreign dung beetles and they caused massive problems. They only eat dung, they live in dung. If they don't have dung, they die. So if you want to get rid of dung beetles, then take your cattle away.

**Pat Richardson** [00:44:39] Although there are there's an incredible, beautiful little emerald green dung beetle that's not much bigger than a B-B, and it's a ball roller. And in this part, our

graduate student, Peg Wallace, came across these. It's a ball roller and it likes dog dung. And I worked a lot with cow dung in the lab. Peg worked with dog dung in the lab. And I'd tell you right now, dog dung stinks a whole lot worse than cow dung. But there's this beautiful little emerald green ball roller that rolls. So it. I've forgotten where I was going with that because then I just remembered the little green ball rollers, they were so extraordinary.

**David Todd** [00:45:31] I think that there's a wonderful insights that you've offered today about the beauty and utility of these very small animals that we probably disdain or, you know, fill us with disgust. And you see, you recognize a lot of the value in them. And I think it's a wonderful story. So, thank you so much for your time today. I really appreciate and always enjoy being with you.

**Pat Richardson** [00:46:04] Well, thank you. Thank you for all your work, for all the all the years that we've known of you and appreciate all your efforts. Look at the web site. Walt Davis is no longer on his ranch, but he's still about. He would if you had an opportunity to talk to him. Gosh, that would be a wonderful source of information. And Truman Fincher, I believe he lives in Georgia now on a family farm. But he's, he's also available.

**David Todd** [00:46:41] Well, I should follow up with both of them. And thanks for the good leads. I appreciate it very much. I hope we can visit again soon. Have a lovely day and take care of yourself

**Pat Richardson** [00:46:54] All right. Stay safe as we go through the the trials and tribulations of this virus.

**David Todd** [00:47:02] Oh, absolutely. Well, do stay safe, and I'll be thinking of you. Take care.

**Pat Richardson** [00:47:08] OK. Thank you.

**David Todd** [00:47:09] Yeah. Bye bye.