

**TRANSCRIPT**

**INTERVIEWEE:** Mike Morrow, Ph.D.

**INTERVIEWER:** David Todd

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

**David Todd** [00:00:04] Good morning. This is David Todd.

**Mike Morrow** [00:00:06] Hey, David, how are you?

**David Todd** [00:00:09] I'm fine and all the better since you called. It's very nice of you to do this. I appreciate it.

**Mike Morrow** [00:00:19] I'm sorry.

**David Todd** [00:00:20] I was just saying I'm all the better because you called, I'm delighted that you're willing to do this. It's very kind of you.

**Mike Morrow** [00:00:28] Oh, no problem. No problem. Happy to talk with you.

**David Todd** [00:00:34] Well, good, well, good. I look forward to learning about what you've been doing and learning about the Attwater prairie chicken and, you know, I appreciate your time trying to explain some of this to me as a, as a lay person. I really appreciate having a good teacher about this.

**Mike Morrow** [00:00:55] Sure. I just, I just hope I can do your, do your questions justice, so...

**David Todd** [00:01:04] Well, I think that we'll make good progress. And I think maybe as a place to start out I should just explain, for the record, and also maybe to remind you about sort of what we're about and, and then we can move on from there.

**Mike Morrow** [00:01:23] Sure.

**David Todd** [00:01:23] The plan that I had in mind was to record this interview today for research and educational work on behalf of the Conservation History Association of Texas, a non-profit, and to create a book and a website for Texas A&M University Press, and third, to contribute the records to an archive at the Briscoe Center for American History that is sited at the University of Texas, here in Austin. And I guess, secondly, you know, we'd really hope that this would be a record that you might, you know, use in the ways that you see fit, and you'd certainly be free to do that as you, as you like.

**Mike Morrow** [00:02:12] OK.

**David Todd** [00:02:13] And I just want to make sure that that sounds OK to you, before we went any further.

**Mike Morrow** [00:02:18] Sure. Of course.

**David Todd** [00:02:20] Well, great. Well, thank you. Well, let me just lay out kind of, the when and the where of, of this little event.

**David Todd** [00:02:30] It is January 8th, 2021. My name is David Todd. I'm in Austin. And I'm representing this nonprofit educational group called the Conservation History Association of Texas. And we are conducting an interview with Mike Morrow, who has worked at the Attwater Prairie Chicken National Wildlife Refuge as a wildlife biologist. The Refuge is in Eagle Lake, in Texas. And this interview today is being done by telephone.

**David Todd** [00:03:09] Today, our goal is to talk about Dr. Morrow's life and career and, and particularly his work with Attwater's prairie chickens, which he is really very familiar with, and, and maybe learn a little bit about its decline and then the many efforts that he's been engaged in to breed it and release it to the wild and gradually restore the bird. So that is our assignment, and I look forward to working through some of this for the next hour or so.

**Mike Morrow** [00:03:43] Sounds good.

**David Todd** [00:03:45] All right. Well, let's start by just asking you a question about your childhood and if there might have been any people who were a big influence in your interest in working with animals, and birds in particular.

**Mike Morrow** [00:04:02] Sure. So I grew up in eastern Kansas and my, my family were, you know, always big, big outdoors people. So I grew up hunting and fishing and we, we went camping a lot. So, you know, we were always, always in the outdoors and in particular, my father and grandfather were very active in hunting and fishing. My mother loved to, loved and still does love to fish.

**Mike Morrow** [00:04:41] So, you know, it was kind of, kind of a natural evolution into my, my ultimate, ultimate career, career choice. You know, I just loved loved, loved doing that, loved being in the outdoors. And so it was kind of a kind of a no-brainer when it came time to choose a career.

**David Todd** [00:05:04] Well, you mentioned that you grew up in Kansas, and I I think I read that you went to Kansas State and got a B.S. In fisheries and wildlife biology and then went on to Texas A&M, and got a master's and Ph.D. in wildlife sciences. And I'd be curious if there's some folks that you met, either your classmates or your professors or others, who taught you things or encouraged aspects of your own kind of nature that might have led to your career.

**Mike Morrow** [00:05:41] Sure, so, so when I you know, when I graduated high school, I went to, went to Kansas State, you know, my exposure to the wildlife profession prior to that point was, you know, primarily with the, you know, the conservation officers, game wardens, et cetera. And, you know, that's basically all I, all I was so familiar with in terms of the conservation profession.

**Mike Morrow** [00:06:07] And so when I went to went to Kansas State and started my bachelor's program, it opened up, you know, a whole new arena of career choices in terms of,

you know, biologists, ecologists, you know, the academic profession, et cetera. So, you know, it was it was truly an eye-opening experience for me. And then it you know, it quickly, quickly shifted my, you know, my career goals from, you know, not necessarily law enforcement, although I didn't exclude it as an option. But, you know, I was really intrigued, intrigued with the, you know, the whole biologist aspect of conservation and the whole, you know, area of wildlife management and, you know, the application of biological principles to, you know, to achieve, you know, a goal relative to a wildlife population. And so, you know, that was that was really like I said, it was really an eye-opening experience.

**Mike Morrow** [00:07:17] And, you know, in terms of folks that helped guide, you know, or made a big impression on me, I guess the first one would be my, my advisor at Kansas State, R.J. Robel. He was, he did a ton of research and in, you know, upland game, including prairie chickens, greater prairie chickens. You know, he did a lot of research with bobwhites as other other species as well. But certainly I grew up, you know, hunting, hunting bobwhites in eastern, eastern Kansas. And that was certainly something that I was, I was interested in. I, you know, wasn't as familiar with prairie chickens at that time, although I knew that, you know, prairie chickens. I knew what prairie chickens were, and they used to be very abundant in the area that I grew up. But by the time, I, I remember listening to my grandfather and uncle talk about hunting prairie chickens near, near there where, where they lived. But by the time I was growing up, there weren't many prairie chickens in that particular part of Kansas. So, so I was I was very interested in Dr. Robel's, you know, prairie chicken research. Another individual that, you know, another professor was Dr. Ben Brown, who did his graduate work at Texas A&M University.

**Mike Morrow** [00:08:55] And then when it was time to, so when it was time to go on to graduate school, I had decided that I wanted to pursue a master's degree to help expand my education and hopefully improve my, my chances of landing a job ultimately. And so in talking with Dr. Robel and Dr. Brown, both of them had I had a connection with Dr. Nova Silvy at Texas A&M University. Dr. Silvy was, was one of Dr. Robel's graduate students at Kansas State on, on, on his prairie chicken project. And of course, Dr. Brown was familiar with Dr. Silvy because he had, you know, gone to school at Texas A&M. So they both recommended that, that I apply to Texas A&M. I also applied to several other graduate programs and was ultimately accepted into into a couple, a couple, and including A&M.

[00:10:07] And I chose the project that at Texas A&M and I went there to, to work on, on mourning doves. Again, I grew up hunting mourning doves and and just loved them. So I was thrilled to be able to work on a, on a mourning dove project under Dr. Silvy's, you know, guidance. And then as I was finishing up my master's program, I hadn't really gotten into the to the job search much, and Dr. Silvy approached me, said, "Hey, I've got got some funding to do this project on on Atwater's prairie chicken. Would you be interested in staying on for a Ph.D.?" And, you know, I'd always wondered in the back of my mind if I had what it took to do a PhD program, and so I decided to take him up on his offer. And so that's kind of what led me to Atwater's prairie chicken. And it was just kind of a serendipitous route, you know, kind of being at the, you know, as often as often occurs, you know, life leads you once you start down a path, life tends to lead you in a certain direction oftentimes. And that's what certainly what happened with me.

**David Todd** [00:11:40] You know, it's interesting listening to you talk about your, your childhood and your education and how a lot of the introduction and curiosity that it seems you have about how wildlife started with hunting and fishing and, you know, whether it was what your father and grandfather and mother did or, you know, your own interest in hunting

quail or mourning dove. And it's intriguing to me that, you know, you moved from game to this very endangered species. And I was curious if you talk about that, that connection.

**Mike Morrow** [00:12:25] Right. So, I know, I know, I know some would probably be shocked to hear me say this, but, you know, I hope that at some point, you know, in the future that we can get to the point where we can hunt Attwater's prairie chickens again. Of course, that's, that's a long ways off. And if it ever is to, to occur. But, you know, I think I think really good, you know, really good, most sportsmen, you know, you know, really respect the species that that they hunt and are, you know, very interested in those populations doing, doing well. So, so there's that that aspect that, you know, I you know, when when you take an animal that doesn't, doesn't mean a disregard for that, that species or whatnot.

**Mike Morrow** [00:13:28] And in fact, you know, I think what many hunters really, you know, I've read and I certainly feel this way that, you know, you one should, you know, really respect and revere the species that, that you're, that, that is being, you know, taken. But but that so that's one one aspect of it.

**Mike Morrow** [00:13:50] You know, you the other aspect is, you know, again, I mentioned the wildlife management that I was interested in the wildlife management aspects of conservation. And I, I really enjoyed solving problems. I'm not, I'm not sure I'm particularly good at it, but I do enjoy it. And I like methodically working through problems.

**Mike Morrow** [00:14:23] And so when the opportunity came to pursue this job at the Attwater Prairie Chicken Refuge, I'm the first biologist that, that this refuge ever had. Prior to that point, you know, it was staffed by, of course, wildlife professionals, but their, you know, their, their job series was more management-oriented. And, and so when when this biologist position opened up, I was, I was really intrigued with the opportunity to try, to try to make a difference for the Attwater prairie chicken, you know, that that was, you know, not not heading in the right direction. And I was, you know, in hopes that we could, you know, that I could, I could contribute to the solution of reversing the population decline. And so that's, that's that's kind of where, what brought, brought me to this point.

**Mike Morrow** [00:15:30] I mean, just because I hunted and fished doesn't, doesn't mean that, you know, (and I don't get to do that as much as I used to), but it doesn't mean that I wasn't interested in species that could not be hunted or taken, you know. So, you know, I think, you know, part of the hunting and fishing outlook as a whole, respect and reverence for the, the complexity of the ecological system that, you know, the species is a part of that you're interested in.

**David Todd** [00:16:09] I see, well, and you mentioned that Dr. Silvy approached you with this opportunity to, to do research on the Attwater prairie chicken and there was funding for that. And that led to your Ph.D. What, what sort of research did you end up doing while you were at A&M?

**Mike Morrow** [00:16:29] So my my research was conducted here on the Attwater Prairie Chicken Refuge for my dissertation. The, the refuge was concerned that the population wasn't, wasn't growing, you know, at a, at a, at the rate that they had hoped that it would, and that, you know, there was concern that, you know, the statewide population was not, you know, was, was not necessarily going in the right direction. And so my my project was basically, you know, an ecological analysis of the Attwater's prairie chicken population here, here on the, on the refuge with the goal of trying to identify factors that, that, you know, gather information,

basic life history and information on the refuge, but also to gather factors that would guide the refuge in trying to affect management, you know, on the ground. So that's, in a nutshell, was what my project was about.

**David Todd** [00:17:45] OK, well, maybe this would be a good time if you could just assume that there's a Martian who comes to Texas and never met an Attwater prairie chicken. How would you describe its, you know, basic life history? And maybe you could say something about its, this very unusual mating display that it does.

**Mike Morrow** [00:18:07] Sure. So so the Attwater prairie chicken is in the grouse subfamily of the pheasant family, of course, the pheasant family includes, you know, not only pheasants, but it also includes quail, turkeys and other, other species. But the grouse subfamily is fairly unique. It contains, you know, a number of species that occupy habitats from, you know, tundra in the northern part of the, part of the range, to both coniferous and deciduous forests, to, to open grasslands. And prairie chickens are, as their name implies, residents of grassland environments. They were historically found in the, in the Great Plains region of North America. There are two, there are two species of prairie chickens - the greater prairie chicken group, and then the lesser prairie chicken group. The Attwater's is, is a subspecies of the greater prairie chicken group.

**Mike Morrow** [00:19:28] And there were actually three, three subspecies - the heath hen, which was *Tympanuchus cupido cupido*, which is now extinct and has been extinct since the 1930s, resided in in the north, northeast East Coast region. They were once incredibly abundant on grasslands that became available as, you know, settlers in that region cleared, cleared deciduous forests and grasslands expanded, at least temporarily.

**Mike Morrow** [00:20:04] The greater prairie chicken, *Tympanuchus cupido pinnatus*, occupied the northern Great Plains from about north Texas to, to the Canadian border. And indeed, ultimately, they expanded their range in into southern Canada.

**Mike Morrow** [00:20:23] And then the Attwater's prairie chicken, which is the southern most representative of the grouse subfamily, occupied grasslands, coastal prairie grasslands, associated with the Gulf Coast of Texas and southwest Louisiana. It's a ground, primarily ground-dwelling bird, very chicken-like in, in appearance. But again, it is not a, it is not a chicken. It is a grouse. They are about the size of a banty or small chicken. They are light brown in coloration, barred with beige and black, which gives them a very cryptic coloration that allows them to blend in well with their, their prairie environment.

**Mike Morrow** [00:21:28] Many grouse are are known for their courtship behaviors, including the prairie chickens and the Attwater's prairie chicken. It's referred to as a, they display where the males gather on, on areas and defend small portions of the area. For prairie chickens, it happens to be several acres in size. So they display in this arena format and that arena is referred to a "lek".

**Mike Morrow** [00:22:10] There are many species of, a diverse group of, species across the taxonomic spectrum that, that use this mating system to select, mating system, from insects and fish to some mammals and birds. And so the, to be more, more specific for at least prairie chickens, the Attwater's and greater prairie chickens, these leks are known as "booming grounds" after the the vocalizations that the males make on on these booming grounds.

**Mike Morrow** [00:22:51] And again, the males gather first thing in the morning, and oftentimes late in the evening, from about February through mid-May, to defend territories of several hundred square feet in size against the other males on these territories, on, on these booming grounds. And you may have, the average size of the booming grounds historically were 15 to 20 males on, on each area. And they are quite animated in defending their, their piece of the turf on this, on this booming ground or lek. And with the idea being that the most, the center-most males that occupies, the male that occupies the center-most territory on that lek, at least theoretically is the, you know, the baddest dude on the, on the block. And so, you know, the theory is that that male is, you know, the most fit and will get the most, most of the, of the breeding activity with, with hens.

**Mike Morrow** [00:24:09] Hens start coming into the booming grounds about five days before they're receptive for, for mating. When they first start coming in, they, they seem very nonchalant. They'll wander around the booming ground, seemingly to check out the males and, you know, and to, you know, anthropomorphically speaking, you know, I guess one would think that, you know, they're checking out the action, you know, to see, you know, which male they want to, want to breed with. And indeed, and, and.

**Mike Morrow** [00:24:47] And, are you still there, David?

**David Todd** [00:24:50] Yes, I am. Sure.

**Mike Morrow** [00:24:51] Oh, I heard a beep. I'm not sure.

**David Todd** [00:24:54] No, go right ahead.

**Mike Morrow** [00:24:56] OK, and so the you know, at the, at the end and end, that approximately five-day period when, where hens will visit the booming grounds for, you know, a while each, each morning, at the end of that five-day period, they spend more and more time around the males that they will ultimately breed with. And once copulation occurs, the hen typically leaves the booming ground within a few, few minutes afterwards.

**Mike Morrow** [00:25:33] And then she goes into the grassland and starts, you know, laying eggs about one per day. So average clutch size is about 12 eggs. And that that clutch will be finished in about, about 14 days. And then that, so the peak in, the peak in breeding activity is typically, in this area, is typically around the middle of March. And then the clutches, the first clutches, are generally completed about the first of May. So that, you know, the peak of, you know, one of the peaks in egg, the start of incubation is around the first of, the first of April, first, certainly the first week in April. And then incubation period is about 25, 26 days.

**Mike Morrow** [00:26:34] So around the first of, the first of May, then the first nests begin, then begin hatching. And, you know, the hen, the hen receives no parental assistance from the males. It's strictly a polygamous mating system. The females will, are, you know, do all the nesting activities and chick-rearing on on their own.

**Mike Morrow** [00:27:03] The the chicks are are are precocial at hatch, which means they're you know, they're fully, fully downed and are fully, fully mobile at, at, at hatch. And so the female, within a few hours of hatching, will lead the, the brood away from the, the nest site and into the, into the grassland to to rear those chicks. And the chicks are almost exclusively insectivorous for the first weeks of life, the first four to six weeks of life. And so it's important that, you know, a good supply of insects is, is readily available for the chicks to, to, to feed on.

**Mike Morrow** [00:27:53] And so so the chicks stay with the hen for about, you know, they are capable of independent survival at about six weeks of age or so, although it's not uncommon for them to stay with the, with the hen for upwards of two to three months after hatch. They, they, they generally are pretty much fully dispersed from the hen by early-, early- to mid-fall. So, and then those, those chicks are, are capable of, fully capable of reproduction at the first, their first year of life. So the following spring then, the cycle starts over again and you know, typically the, the, the females, because it's a lek mating system or, you know, with the males returning to the same breeding ground each year, typically it's, it's the female sex that disperses away from the the natal area to avoid inbreeding possibilities with their father and relatives. So that's kind of the way it works there.

**David Todd** [00:29:12] This is fascinating. And thanks for walking us through the, this basic life history of the bird.

**David Todd** [00:29:22] You know, I've heard that while the bird is just so rare now that there was a time, you know, one hundred and twenty years ago where there might have been a million of them on the Texas coastal prairie, and I think you mentioned into southwestern Louisiana. But by the late '30s, they're down to less than 10,000. And I guess by the early '90s, less than 500 and then mid '90s, I think the count was 42 in the wild, really just, you know, a precipitous decline. What do you think happened to a bird that was at one time so common and widespread, to now when it's so rare?

**Mike Morrow** [00:30:07] Yeah, so, so there were several factors involved there. You know, initially, like many, like many species, I think habitat loss drove a lot of the initial decline. You know, again, these, these, these birds require grassland habitat. And unfortunately, you know, much of their, what once was nearly six million acres, estimates are of coastal prairie available in Texas and and southwestern Louisiana. Current estimates are that there's much less than one percent of that, that coastal prairie, of those coastal prairie grasslands, remaining in relatively pristine condition. So, you know, there's been tremendous decline in in the habitat.

**Mike Morrow** [00:31:03] And those declines were due to agricultural conversion, due to urbanization. You know, the cities, you know, Houston, the Beaumont area, all, all had prairie chickens at one time. And prairie soils, just by virtue of the way they, their properties, are very productive soils. You know, they're, they are the breadbasket of North America. And certainly the Attwaters were no exception to that. A lot of the coastal prairie has been converted to various agricultural crops, including, you know, cotton and, you know, the small grains, several small grains, including rice and sorghum, milo, corn, you know, soybeans, et cetera.

**Mike Morrow** [00:32:00] And then the other, the other factor that, that has played a huge role in habitat conversion has been brush encroachment particularly well, the tallgrass prairies, which are where, you know, the greater prairie chickens are, greater and Attwater prairie chickens, are found, are very much fire dis-climaxed communities. And what that means is that these areas receive, while they're grasslands, they receive enough rainfall each year, they're far enough east that they get enough rainfall that these areas will support deciduous forests. And, and so the, the ecological succession of these plant communities is always moving towards, towards, you know, achievement of that ultimate forested condition. And it's only through, you know, the influence of fire historically that that these prairies stayed, as as, as prairies.

**Mike Morrow** [00:33:10] And so, you know, with, with, with settlement and, you know, this whole idea of, you know, fire, you know, many, many, many people are concerned about fire, rightfully so. You know, it can be very destructive. But it's also a, you know, a very valuable ecological component to many, many ecosystems. And so, you know, with, with settlement and certainly with urbanization, you know, fires were suppressed. And so a lot of the, what was formerly prairie within the Attwater's range has now been invaded and taken over by, you know, brush and tree species like, like, like mesquite, and huisache and some exotic species like McCartney rose in our area, Chinese tallow in the Houston area, and, and even even East of there, as well.

**Mike Morrow** [00:34:14] So a lot of the problems that the Attwaters had early on was certainly related to those factors. But by, by, by the late, kind of the, kind of the '60s, '70s, the Attwater's population more, if you look at the population trend, it more or less stabilized. It still was a very small number. It was fifteen hundred to two thousand for several years. The population kind of stayed at that 1500 to 2000 level.

**Mike Morrow** [00:34:49] And then about the, the late '80s to early '90s, the population plummeted. And we, at that, that's about the time I started, started work here. And probably certainly was one of the the reasons that my, my job was created. But, and we really didn't have a good understanding at that time of what was going on. Many thought that the habitat loss and fragmentation had reached a, reached a point where, you know, random processes like, you know, adverse weather conditions and et cetera, you know, resulted in the local extirpation of a population. And because it was, these areas were so fragmented that they couldn't be, you know, there was no source stock to recolonize those areas, like would have happened historically when you had one big, big, big area of habitat. That was the thinking at that time.

**Mike Morrow** [00:35:52] Since then, we've, we've, we've learned. But, but also about that time, there was an exotic species that showed up in Attwater's habitat, which are red imported fire ants. This is an exotic species from, from South America that showed, that most believe were accidentally introduced to North America through the port of Mobile, Alabama, about 1930. And they, this species has, has basically marched across the and now occupies the entire southeast part of the United States. And they, they first showed up in, like I said, in Attwater's range, at least in this area, in the early '70s. There were some records of them showing up in Texas in the, in the, in the '50s. But and then again, they just expanded from there. And so they showed up in Attwater's range for the most part, about 1970 to 19, early '70s.

**Mike Morrow** [00:37:15] And, you know, initially, folks didn't really know what kind of an impact that fire ants would, would have on, on wildlife species, most knew that it wouldn't be a good, a good effect. There was some research on, on quail done by Texas Tech University in the '90s that was kind of interesting in that they they documented changes in quail numbers with the advance of fire, fire ants on a county-by-county basis in Texas. And there was a pretty good correlation between quail population declines and, and, and fire ants showing up.

**Mike Morrow** [00:38:04] And so, you know, so based on, based on the information, that information and the fact that we weren't getting anywhere with, we were really frustrated and not, not seeing much response in the prairie chicken population to a lot of, you know, pretty intensive management efforts. We, we looked at at fire ants. I came across a paper that came out of the University of Texas, the Brackenridge Field Lab, that talked about when, you

know, fire ants first showed up, that insect populations were pretty much devastated, insect communities.

**Mike Morrow** [00:38:54] And we knew that at that time that brood survival was a huge issue. We just weren't seeing the brood surviving. We did some research looking at why those birds were dying. And we found that, you know, it was likely a shortage of insects that were not, that was contributing to the, the the failure of these birds to survive. So we, we started looking at, at fire ants. We did some control treatment areas, comparisons. And, and indeed, we, we documented more, more insects in the areas treated for fire ants and so on. So, so we're pretty sure that, that fire ants played a big role to make a long story short. We're pretty sure that, or at least I'm convinced, that fire ants played a huge role in this final plunge of the Attwater's toward, towards extinction.

**Mike Morrow** [00:40:00] I came across a paper in the fire ant literature that talked about that it may take up to 20 years for fire ants to fully, fully invade an area on the landscape scale. And they were talking about on a county scale. So if you, if you put a 20-year bracket on on the Attwater's populations from the early '70s, you know, to the, you know, from the first time that fire ants showed up and put a 20-year bracket on it, that that takes you to the time that the Attwater's took its final, final plunge towards near-extirpation. And so that...

**David Todd** [00:40:46] So I gather that a fire ant effect wasn't just a chance for actively killing the young, but that they were, they were eating their basic diet of insects.

**Mike Morrow** [00:40:59] That's correct. You know, the fire ants, of course, I mean, anybody that lives where fire ants occur, know that they will attack anything they can, they can. And so certainly they will invade nests at hatch. And, you know, if, if they can, they, they, they will also sting chicks and, and the hens as well. And certainly mortality probably occasionally occurs that way.

**Mike Morrow** [00:41:28] But we think that the bigger, the bigger impacts of fire ants are on on the the insect community, that, that the, that the chicks like most galliform chicks, that is the order of of birds, ground-dwelling birds that like prairie chickens and quail and pheasants, etc. Most galliform chicks require insects during the first weeks, weeks of life. And, you know, when we were trying to figure out why we, you know, why we weren't making progress with recovery, we got pretty pretty intensive with our observations on, on broods. It was pretty obvious. We were not getting, you know, the, we knew the nests were hatching and then, you know, but the next year, you know, it was obvious that the chicks had not survived.

**Mike Morrow** [00:42:28] And so. So we had radios on hens and we monitored the broods during the first couple of weeks of life, and almost without fail, we were seeing almost 100 percent mortality of broods by about day 8 through 10. And, you know, we were find, finding dead and dying chicks, you know, at the at the night, night roost with with the hen. And we had those chicks necropsied. And basically the diagnosis was, you know, inanition and dehydration, which is basically failure to, you know, failure to thrive, most likely caused by, you know, you know, not having enough to eat, enough to eat. And certainly, you know, they get their moisture from from from the food that they as well. So that would speak to the dehydration aspects of it.

**Mike Morrow** [00:43:26] So, you know, so and then the other thing that we did was that we compared, because by that time there were no truly wild populations of Attwater's left. We didn't know how many insects it took to keep a brood going. And so we we did the next best

thing that we could - as we compared insect availability in Attwater's habitat with near Attwater's broods. And compared that with insect availability at greater prairie chicken broods. Again, there's the same species, they're just different subspecies. The data, we worked with an investigator that was working on greater prairie chickens in Minnesota and Wisconsin, Dr. John Tepfer. And what, what, what we, what we found was that there were many more times the number of insects in areas possessing greater prairie chicken broods compared to the availability of insects in Attwater's range.

**Mike Morrow** [00:44:35] The biomass was the same, which, which meant that we had a few very large insects. And in, in in the Attwater's range, compared to, you know, many, many times more insects in, in greater prairie chicken range. And of course, the more insects there are, you know, the more likely a chick would be able to catch and eat it. So. So that's kind of what, what led us down this whole, this whole path.

**David Todd** [00:45:09] Well, gosh, what a story and kind of a detective story.

**David Todd** [00:45:14] Well, you mentioned the several factors to the bird's decline. I think that the loss of the prairie, the brush encroachment, of course, the red imported fire ant. One thing that I've read about, and be curious to hear what you think, is that there was concern about overhunting. I think that they shortened the hunting season in Texas in 1897, and they banned hunting of prairie chickens in '37. Do you think that that was a worthwhile thing to do? Or was the overhunting not really as big a factor as maybe the habitat loss?

**Mike Morrow** [00:45:54] No, I'm, I certainly, you know, in reading some of the old, old literature, as particularly written by Val Lehmann, who did you know, some of the did the first monographic work and research on Attwater's prairie chickens. You know, certainly, from the descriptions in those writings, you know, you know, hunting had to have played, played a role, at least on a local basis. I don't know about, you know, range-wide because there was so many, you know, so much habitat available and so and, you know, so many birds, but certainly on a local basis from the descriptions, certainly had to have, hunting certainly had to have played, you know, had a, had a negative impact.

**Mike Morrow** [00:46:43] The descriptions are that... Well, number one, to give you an idea of how how abundant Attwater's prairie chickens once were, Val Lehmann talks, talks about, you know, talking to.. And he did his work and in the late '30s and early '40s, and at that time, there was you know, there were still people living that, you know, experienced the number of Attwater's prairie chickens that, that may have once existed. And he had, recounts talking to, you know, ranch hands and cattlemen that, you know, used to work cattle on, on these vast expanses of prairie. And he talks about, and he recounts talking to, you know, the cook, the cook who that, that was responsible for, for feeding these, these folks and talked about going out and, you know, getting enough prairie chickens to feed the, you know, to feed the camp and, and was able to do that in very short order, you know. So, you know, again, it just speaks to the abundance of prairie chickens that existed in one time.

**Mike Morrow** [00:48:00] And also relative to hunting, you know, Lehmann talks about the sport that it was and it wasn't, it wasn't at that time that they were getting them to, you know, chickens to eat. They were, it was just a sport, much like shooting clay pigeons, in which, you know, hunting parties would go out and shoot as many prairie chickens as they could. And, and whoever had, you know, got the, you know, biggest, biggest number of prairie chickens (and we're talking piles of prairie chickens here)m that, you know, they won sort of some sort

of a prize, or the loser had to, had to buy the, you know, the, the booze or whatever, you know. So, you know, it was more of a sport than it was, you know, actually eating them.

**Mike Morrow** [00:48:55] And they talked, and Lehmann talks about these piles of prairie chickens being left to rot. So if you're talking about harvest of, you know, those kinds of numbers in a relatively local, local area, it had to have played a played a role.

**Mike Morrow** [00:49:14] But whether that that overhunting contributed to the ultimate decline of the of the Attwater's, I'm not sure, because like you said, you know, the first, actually and I'm not an expert on, on on the history of, you know, the regulations and whatnot. But again, in reading some of Lehmann's writings, he talked about that the first, the first hunting season for, for prairie chickens was established in 1903, which restricted the, the season to November, December and January time frame. Certainly when you're talking about harvesting piles of chickens, it's it's almost certain that those hunters who were taking, taking broods at that time because they're, number one, they're very easy, you know, they don't, they typically don't fly real far, and, and, and the birds are, you know, you know, they talk about flushing coveys of prairie chickens. Well, those, those certainly were broods. And so they were taking young, young, young, you know, young, young birds. Once the, once the, the birds get older, they're much more wary and they're much more difficult to, to get close enough to, to, to harvest in any sort of numbers. So the restriction of the hunting season to, you know, later months was probably to address those concerns.

**Mike Morrow** [00:50:52] And also in 1903, according to Lehmann, you know, the first bag limits of 25 per day were established. But, you know, those, those early efforts, one has to wonder how effective they, they were just due to the fact that, you know, Lehmann talks about, you know, there were only six salaried game wardens in the entire state of, of Texas. So I'm sure that enforcement of those first game laws were, you know, pretty, pretty spotty. But it was a start.

**Mike Morrow** [00:51:25] And and there were those that continued to, H.P. Attwater, who, who the name, who the Attwater's prairie chicken is named after, as I understand it, you know, continued to lobby for restriction of, of harvests of prairie chickens, both greater, lesser and Attwater's and in fact, according to Lehmann, and up, up until near the time of Attwater's death in 1931, you know, Attwater was still lobbying towards closure of the, of the hunting season on, on Attwater's prairie chicken, which finally occurred in 1937, as, as you mentioned. And the season has been closed ever, ever since.

**David Todd** [00:52:17] That's striking. What a lot of, you know, long effort, gosh, decades, to try to control the hunting and enforce the laws.

**David Todd** [00:52:29] Well, this is good. So you've given me a great explanation of some of the life history of the bird, and then its decline, and, and some ideas, I guess, about the efforts that you had in trying to start some of the protection of the bird. I gather that, that, you know, one big part was, was, of course, controlling the red imported fire ants. Can you talk about any other efforts that you and others at the refuge might have worked on to try to protect these birds that persisted there?

**Mike Morrow** [00:53:08] Yeah, well, of course, some of the, some of the, some of the early efforts to favor the, you know, to expand the Attwater's population centered around the establishment of, of refuges or refugia, for the protection of Attwater's habitat and what not. And certainly Val Lehmann was very, was a very loud and persistent advocate for

establishment of refuge habitats. So that, you know, in the same article that he was talking about, the history of protection through hunting regulations (this was in a 1939 paper), he was he was talking about the need for establishment of, you know, refuges to protect, to protect the habitat. And so, so that was some of the first measures that were taken to help curb the decline of Attwaters.

**Mike Morrow** [00:54:21] Unfortunately, like you just mentioned, with the hunting regulations, it took, it took a long time for these ideas to come to fruition. And it wasn't until the mid-1960s that efforts were taken to to establish a refuge for, whether it be under state ownership or federal ownership. It didn't matter: the, the idea was to protect the habitat. And by the mid-1960s, there were some efforts underway to make that happen. The Nature Conservancy and the World Wildlife Fund were involved, were very integral in starting the first acquisitions for what would later become the Attwater Prairie Chicken National Wildlife Refuge, where I, I work.

**Mike Morrow** [00:55:16] And so so there were those efforts, and there were efforts also to try to, you know, try to establish protected habitat in other areas as well. But those have not come into being yet, with the exception of the Texas City Prairie Preserve at Texas City.

[00:55:47] So those efforts. There was a lot of research done following the listing of the Attwater's chicken in 1967 as an, as an endangered species. That kind of made some money available for, for research and kind of provided the impetus for, for initiating some of that research. And so, you know, there have been some 20, 20-plus graduate projects done on the on the Attwater's prairie chicken there. You know, Texas Parks and Wildlife initiated a big research research project in the '70s. And so, you know, there's been a lot of, there's, you know, quite a, quite a few scientific publications in the literature on, on, on Attwater's prairie chickens and so, so, so, in addition to the land protection and research.

**Mike Morrow** [00:56:52] And then, you know, when the prairie chicken, the Attwater's, took its final plunge toward, toward extirpation, you know, the captive the captive rearing program was initiated. And actually the current captive-rearing program is the second effort at that. There was an effort in the, in the 1970s to establish a captive-breeding program. I think it was it was undertaken by Parks and Wildlife and, and in Texas, the poultry science department at Texas A&M University. And, and that effort was not, not successful. So it wasn't tried again until 19, the early '90s. [And sorry].

**Mike Morrow** [00:57:46] And so, yeah, I guess, I guess those are kind of the three areas, land protection, research and the captive-breeding program.

**David Todd** [00:57:57] I see. Well, can you talk also about any of the efforts to try to protect birds from predators, for instance?

**Mike Morrow** [00:58:10] Right. So. You know, predators are a part of the natural system that Attwater's evolved with and, and certainly, you know, predation pressure is important in terms of selecting the most fit individuals for reproduction and honing the, you know, the, the, the integrity of the, of the, of the population. So predation is not all bad for sure. But when you when you have such small, isolated and extremely vulnerable populations, you know, predation can, can can have a, you know, an exacerbated effect on the population.

**Mike Morrow** [00:59:04] And, and, and so, you know, we do, we do manage predators at, at our refuge. And, also, the you know, the Nature Conservancy also, in cooperation with some of

the landowners in Goliad County, which is another area where we're working to try to reestablish Attwater's populations, we control predators at both, both sites. At the refuge, we primarily focus on, on the nesting season and controlling nest predators, not only through direct take of those, you know, potential predators, but we also, because most of the hens that are on site are radioed, we're able to find the nests. And we, along with Dr. Tepfer that I mentioned a few minutes ago, developed a technique where we are able to surround the fences, I mean the nests, with a predator-deterrent fence. It's not predator-proof, but it does, assuming that predation is a more or less random event, you know, it kind of deflects the predators away from the nest site. And it has been very effective in boosting nest success. So so we manage ...

**David Todd** [01:00:45] What are the common predators that y'all are trying to deflect?

[01:00:52] Predators - it's primarily primarily egg-, egg-eating snakes like Texas rat snakes. Mammals are striped striped skunks, raccoons, 'possums, coyotes. Those are the primary ones, I think. And then the other thing that we do to try, to try to manage predation is what we've done a couple of things relative to avian predators. We...there was a master's student who did a project on great horned owls here at the refuge looking at how far out they were foraging from, you know, from wooded areas and and whatnot. And based on his findings and that, that and literature, the, I understand, the average distance that an, a great horned owl, which is a major, major predator of, of prairie chickens, is about 100 meters from a, from a perch site or so, although they can hunt farther.

**Mike Morrow** [01:02:07] So we we make a concerted effort to remove as many potential perches as we can on on the prairie. We have taken made an attempt to place perch, perch, deterrence on our fences. We put spikes on, on the fence posts to discourage perching by raptors. And then the other thing that we do is we try to minimize the number of fences and other structures that are out on the, on the prairie that that could serve as perch sites for, you know, for raptors that might be predators on prairie chickens.

**David Todd** [01:02:57] And then I think that you'd said earlier that one of the problems that I guess the bird has face is that fire had been suppressed for many years in the grasslands and allowed to some of this brush to encroach. Have you all done much in the way of prescribed burns?

**Mike Morrow** [01:03:16] Yes. So the habitat management on our refuge is primarily focused on, as you might imagine, on maintaining, you know, the prairie, of the prairie habitat. And, and so fire is a big part of that management. On average, we burn about 25 percent of our grasslands a year so that, you know, the average return, fire return, interval is about, about four years on any given point and on any given spot of the landscape.

**Mike Morrow** [01:03:55] We also use a management system. It's called patch burning, or there are other other names for it. But basically it's an integration of grazing and burning whereby, you know, and, and we, just to back up a little bit. You know, we believe that grazing is a very important management tool as long as it's, you know, closely managed. The, as I mentioned previously, we get enough rainfall in this area and our growing season is so long that if we didn't do something to open the grasslands up a little bit, that they, they become too dense for use, certainly by young, very young prairie chickens. And even the older, the adult birds don't like to use incredibly dense stands of grass, except for things like escape cover. And, you know, they may roost in, in them at night. But, but even at night, you typically don't find them roosting in the really, the really dense grassland areas.

**Mike Morrow** [01:05:12] So they like, you know, one of their, one of their, one of their primary, they have two primary predator avoidance mechanisms. The first is because they are so cryptically colored, they they try to crouch and and avoid detection. But if that fails, then their second avoidance mechanism is to, is to fly. And they're incredibly strong fliers and they can fly for, for very long distances.

**Mike Morrow** [01:05:42] So I'm not sure where I was going with this. But anyway...

**David Todd** [01:05:51] I guess you're talking about how the prairies can get so dense that it could be difficult to use it except for escape cover.

**Mike Morrow** [01:05:59] Right. Right. So so, so, so that that was the point. In those really dense grassland areas, it's, you know, it's more more difficult for them to, for prairie chickens to see approaching predators, and it's more difficult for them to flush out of those extremely dense grassland areas. And so, so we use grazing to help open up the grassland and create, you know, patches of more open, more open areas. And this patch burning system is, is really ideal. And the way we apply it, the system was developed and formalized out of Oklahoma State University. But and as they originally envisioned it, it was kind of a mimicking of the historic burn, burn patterns as they interacted with migratory bison, bison herds and whatnot. And so they, they, they, they tend to use fairly large, burn fairly large areas and allow the cattle to graze on, on that, with cattle or bison.

**Mike Morrow** [01:07:11] And we have used much smaller patches, again with the cattle in place. And so what, what typically happens in that scenario is that you're in the newly burned areas, that, that those grasses are much more palatable and more attractive to, to the, to the cattle. And they will tend to over, overgraze those areas, at least temporarily, while grazing less on the older burns. And so in our situation where we burn on a four-year return interval, the, the newly burned areas are, you know, very over, do receive a lot of grazing pressure. The second-year areas receive less, the third year even less, and by the fourth year, the cattle pretty much avoid those, those areas. They don't graze in those areas much. So it's a self-deferring type system. And it's really kind of ideal for, for, for wildlife management, especially species like prairie chickens, because the prairie chickens will use those intensively grazed areas for foraging and for as, as, as booming areas. That's, a lot of times we'll see males displaying on those short grass, newly burned areas. By the second year, that grazing stimulates a lot of forb cover that attracts a lot of insects and is ideal for, you know, for brood habitat. And it's starting to become nesting habitat by that time, and by the third year, you know, it's, it's ideal nesting habitat. And of course, the fourth year you do see some nesting, but it's also good for escape cover and, and roosting habitat as well.

**Mike Morrow** [01:09:07] So... You know, those those are the kind of management tools that that we use to maintain the prairie grasslands on our refuge. We also do use some some herbicides on invading brush species where, you know, where, where fire is not completely effective in controlling those, those invading species. So.

**David Todd** [01:09:37] Well, here, here's a kind of related, but maybe slightly different question. You know, you've been talking about this this coastal prairie and how you manage it and maintain it and try to, you know, promote it as a prairie. Can you talk a little bit about the role of some of these torrential rains that we get. I know Hurricane Harvey was a, you know, a big problem. And I think some of the tax day floods there weren't even associated with a hurricane caused problems for the preserve. You know, what's your view about these, these

storms, and, you know, whether there's a climate change component to them, or if this is just a problem you face because the population is so small and they're just vulnerable to most anything?

**Mike Morrow** [01:10:29] Yeah, I think I think it's a probably a combination of all. Certainly these, these huge rainmaking events like, like Hurricane Harvey and the tax day flood were, were catastrophic for, for the local, for the chicken populations locally. You know, the thing we need to keep in mind is that these kinds of events, I mean, that's just life in coastal Texas. You know, we tend to get a lot of our rain in, in those kinds of events. And certainly those kinds of events, you know, happen, have happened repeatedly through history. The difference now is that, you know, historically, when when a local population got, got, you know, wiped out or, you know, our numbers severely decline, there were always source, source locations to repopulate those, those areas. And we don't have that now.

**Mike Morrow** [01:11:35] So I did some, I found in one of Val Lehmann's papers, they surveyed prairie chicken, Attwater's prairie chickens in the Refugio / Victoria area following passage of Hurricane Beulah in I think it was '67, '68, somewhere in there. And the declines that, that he observed following passage of that hurricane were comparable to the declines that we saw following Harvey. The difference was then the 82% decline that Val Lehmann observed still left them with, you know, several hundreds or maybe even at that time several thousand prairie chickens remaining, whereas 82% decline following hurricane Harvey nearly wiped us out, kind of thing.

**Mike Morrow** [01:12:36] And, so, you know, that's just one of the, one of the, one of the problems of having all, you know, the population in one or two small areas and certainly, you know, we hope to expand the population as rapidly... I mean that's the first step is to get the population in that location up to a level that they can withstand some of these some of these insults. And then secondly, to spread the, spread the population out across, you know, geographic areas so that hopefully, you know, one catastrophic event at one location won't cause the extinction of the species, potential extinction of the species.

**Mike Morrow** [01:13:21] You know, whether, whether these kinds of catastrophic events are, are occurring in more rapid succession than than they used to, you know, I'm not qualified to answer that. You know, it sure seems so, to me. So I, I looked at some of the data for the last hundred years or so that I could find for this this area. And, and I was surprised when I crunched the numbers that it didn't appear that, that the chances of one of, one of these events was increasing in, in likelihood. But but I'm not a climatologist, so, you know, I may not have used the right techniques or whatnot, but I think, I think these these events tend to run in patterns. It appears to me that, you know, the climate of the area is somewhat cyclical in nature. And, you know, it may be, and I think a lot of what happened to us during the last 10 years or so has been a run of really bad luck. And, you know, the chances of that occurring were not great, but it happened. And I'm, I'm just hopeful that hopefully we're you know, we won't see that repeated again.

**David Todd** [01:14:53] Yeah. Well, we've covered lots of ground with your help. You know, you've talked to us about everything from habitat protection and management to, you know, hunting controls to predator controls, brush controls as well.

**David Todd** [01:15:13] And then, you know, how you look into the future. What, what would you take as some of the remaining hurdles to really getting a viable population out there on the refuge and elsewhere in Texas?

**Mike Morrow** [01:15:29] Well, you know, like, like we just talked, it's critically important that we grow the population as, as, as, as quickly as we can. You know, one of, one of the hurdles of reestablishing any population is that, you know, any population, any biological population goes through, you know, a kind of a characteristic growth curve in which, you know, you start out in a lag phase where things move fairly slowly and then you get into an exponential growth, growth phase where things start moving pretty, pretty quickly. And then once you approach carrying capacity, things, you know, hopefully level off and you're able to maintain your population, their carrying capacity.

**Mike Morrow** [01:16:19] Well, you know, with, with the Attwater populations declined to the point that they they did, you, we're in a situation where we're starting from nearly ground zero. And so, you know, we're, we're, we have to get populations out of that lag phase of population growth, because as long as they're at that critically low level, in that lag phase, they're extremely vulnerable to, you know, perturbations in, you know, the weather, the environment, et cetera, et cetera. It's very easy to wipe the population out when you're, you're at that critically low level.

**Mike Morrow** [01:16:59] And so, you know, our first, our our first order of business is to try to get to two populations that that we're working with right now out of that that extremely vulnerable point in the population growth. And while it's discouraging that, that, that that they remain at that, that low, low level, we've had evidence that in looking at the population growth curves that, you know, at least twice in the last 10 years, the refugee population appeared to be on the cusp of making some, some really good gains. So we were finally starting to show some gains in the population. And then, you know, we were, we were set back by another, you know, catastrophic weather event.

**Mike Morrow** [01:17:50] So the encouraging part of that is appears like the population is is capable of doing that. And I'm just, you know, one of, one of the things that, you know, we have to we've just got to get several years, you know, several, put several years of good, good growth together so that ultimately, you know, we can we can realize, you know, some, some numbers that will hopefully give us, you know, some sense of stability.

**Mike Morrow** [01:18:23] Actually, you know, for for a number of a number of years, for probably at least the first two-thirds of my career, it was extremely frustrating undertaking in that, you know, we were we were we were working incredibly hard and there were a lot of folks that were working incredibly hard and invested in trying to make a difference with the Attwater's populations. And we just weren't seeing it happen and we didn't know why.

**Mike Morrow** [01:18:55] And, you know, while in recent years the weather has frustrated, frustrated us, you know, like I said, the population seems to be displaying the capability of, you know, of, of showing some great, great gains if, if we can just get a break, a break and luck. And so while a lot of people will tell you that I'm not the most optimistic person in the world, I tend to try to be more realistic. I'm, I'm more optimistic about the potential for the Attwater's showing some really good gains here, in short order, if, you know, if things just, you know, fall, you know, fall, especially the weather. If we can just get some breaks on the weather, I think we can really show some some huge progress in, over the next five or 10 years.

**David Todd** [01:19:56] I see. Well, you know, not to to cast any aspersions on how hard you've worked on this and you know, many of your colleagues. But I've heard that some, some critics have said, well, the prairie chicken, the Attwater's prairie chicken, you know, it's

become sort of conservation-reliant, that just enormous resources are put into captive-rearing and then release to the wild and then trying to manage lands where those refugia are.

**David Todd** [01:20:28] What is your thought about, you know, folks who say, gosh, those resources, limited as they are, should be spent on creatures that are also at risk, but maybe, you know, would respond better to help.

**Mike Morrow** [01:20:42] Well, I certainly, I certainly appreciate that, that line of thinking, and if I, if I were convinced that that was the situation that we were dealing with, with the Attwater's, it would be pretty hard for me to come to work every day. Because if, if, if I thought the Attwater's prairie chicken were completely conservation-dependent or management-dependent, I, I'm not sure I could I could necessarily support. I would, I would, I would say that some some of those critics may, may, may be right.

**Mike Morrow** [01:21:30] However, I think that, that, that way of thinking relative to the Attwater's right now is not, is not correct. I don't think it's, yes it is conservation-reliant right now. But as I explained just a little bit ago, that, you know, we have to, we have to get the populations through this lag phase of population growth. And at that point in time, they say, will remain conservation-reliant just like any other species would. Some species require less effort than, than others. Our selected species, which tend to be boom or bust in their, in their population growth, which the Attwater's are, certainly falls into that group. Bobwhites, some of the others, are in that, that category. Those tend to be hard to, require a lot of, a lot, a lot of effort from a conservation standpoint, because, again, you know, while you're in that lag phase, if you get a bust period, which tends to be driven by, by, by the weather in a lot of, the lot of these species, then you have to start over again. And, you know, if we can ever break through that lag phase, we're, you know, we're going to be in a much better, better place.

**Mike Morrow** [01:23:09] And, you know, I don't know, I guess it takes a lot better mind than what I have relative to triaging a species for conservation effort, you know. You know, I'm not, if I, if I, if I think there's a chance that we can make this work, then I'm going to give it my, my all. And I think we owe these species nothing, nothing less. You know, we, as humans, have contributed to their, their decline. And if there's a chance that we can reverse that decline, then I think we need to, we need to, like I said, give it our all. And if we ever reach a point where they are conservation-, completely conservation-dependent in the wild, and there's no hope for that turning around, then then yes, we need to reevaluate that. And maybe we should just keep them in zoos at that point.

**Mike Morrow** [01:24:17] But right now, that's not that's not how I see it. And I think we need to, in fact, I think we're, like I said, I think we're on the cusp of really seeing some great gains in the near future. I really think this fire ant issue was a, was a huge piece of the puzzle that they were we were missing for a long time. We, when we have had not catastrophic weather during the nesting season, we've seen really good reproduction. And I think we're really on the verge of making some some really good progress.

**David Todd** [01:24:53] Well, that's encouraging. I just, I just have a last question, which maybe segues from what you were saying a moment ago tha, that, you know, we, as the human species, kind of owe these endangered creatures an effort to, to try to restore them because we are responsible in large for part for their decline. And and I just wonder if you could explain to somebody, not sort of question of triage, where you have, you know, some species that are more susceptible to restoration than others, but just the whole idea of of trying to protect and restore rare species. You know, some folks may say, hey, you know,

survival of the fittest. These, these creatures are not made for the modern world. Let them go. Why should we care? Could you give us the sort of elevator talk about why, why does this matter?

**Mike Morrow** [01:25:55] Right. Well, those, those that that submit that, you know, this is a natural process, which it is -extinction is a natural process. But, the, the, the place where they're they're wrong, though, is that the extinction that we're observing now is hundreds of times, I've read not too long ago that the extinction rate is 400 times that that should should naturally be occurring if it were strictly survival of the fittest population.

**Mike Morrow** [01:26:35] So I think, I think we as humans can approach this whole idea of endangered species management or conservation from several different perspectives.

**Mike Morrow** [01:26:50] One is the perspective that you just talked about, that we should just ignore it. Let them go, you know, and what we'll end up with is, is a world that's made up of a few generalist species, and many of, many of, some of, many of whom are, can become problematic because they are able to survive in, in, you know, these adverse harsh conditions that we, that, that result from our habitation of, of humans. So so so there's that perspective. There's kind of another..

**David Todd** [01:27:30] You're talking about rats here?

**Mike Morrow** [01:27:31] Rats, cockroaches, you know, those are two that come, come to mind. You know, some of the rodent species, some of the, some of the species, plant species that become problematic fall in, fall into that category as well. So coyotes are another one that there are, I mean, you know, they they can become very problematic. And, you know, for livestock, certainly in some areas and even our pets where we, where we live.

**Mike Morrow** [01:28:10] So, so, you know, another, another perspective is kind of a mechanistic one, I guess, is in that, you know, as as we all learned in, in our education that, you know, most of the, you know, most of the biospheres as we know it, is made up of interconnected, you know, systems that are made up of, you know, of interconnected parts and, you know, that removing one of those parts may, may or may not result in collapse of the collapse of that system. And, and, you know, certainly there are, there are species that are, are indicators, are indicators in, you know, are indicative of, you know, problems in, in the, in a particular ecosystem or community.

**Mike Morrow** [01:29:17] And certainly, you know, prairie chickens fall right into that, in, in that they, they require large areas of grassland. And so they're they're, they indicate the health of grasslands for a host of other other species, as, as well. So, you know, so the question from, from a mechanistic standpoint is, "how many, how many species can, can we watch go extinct or maybe don't care if they go extinct? How many of those species can we watch go by the wayside before, you know, the collapse of the system starts, starts affecting, you know, the ability of us as humans to, you know, survive in that environment?"

**Mike Morrow** [01:30:10] And unfortunately, the answer to that question will, will, will come, will come too late, because by the time we realize that, you know, we're at that point, it will already be too late.

**Mike Morrow** [01:30:22] And, and so, you know, so that, that, that's one approach.

**Mike Morrow** [01:30:29] That, you know, another, a second way to look at it is from a moral perspective, you know, what gives us the right as, as one species on this planet to dictate whether another species lives or dies, or or not?

**Mike Morrow** [01:30:47] And, you know, if you happen to be a, you know, a religious person from, you know, kind of an extension of that from a theological standpoint, if there is a, you know, a creator God, you know, that created a perfect, a perfect world, what, how arrogant of us as humans to decide, you know, which of those creations lives or dies, or not.

**Mike Morrow** [01:31:13] So, you know, there's, there's, there are several ways that you can, you can, you can look at it. But I don't think ignorance, and ignoring, ignoring the, the problem is, is a viable solution for us as a human species, in, in the long term. That's just my opinion.

**David Todd** [01:31:38] So, no, that's just well put. Um. Well, I see we've had a nice long conversation. I should maybe ask a final question, if you don't mind, and that's just, you know, is there anything you would like to add about what you've learned or experienced or what you foresee from from your life with the prairie chicken?

**Mike Morrow** [01:32:02] Right. I guess I would just like to emphasize, I know a lot of, a lot of, a lot of folks, we've been working at this a long time and a lot of folks get frustrated with the fact that we haven't seen more response of the, of the population, of the prairie chicken population than, than, than we have. And I, I would just submit that, you know, they didn't become in danger of extinction overnight. And we're not going to be able to flip a light switch and make it all go away overnight either.

**Mike Morrow** [01:32:40] You know, one of the, one of the, one of, one of the assumptions is that, you know, that we know all the factors that have limited the population. And again, I guess I'm a very logical, mechanistic sort of, sort of thinker. And one of the, one of the things that I learned in in my educational career was something called Liebig's law, law of the minimum, which can be applied to a lot of, a lot of different systems, from chemical reactions to agricultural systems to wildlife systems. And what that, that, what Liebig's law of the minimum says is that the, you know, the population or the chemical reaction or whatever you're talking about is only going to proceed to the point that it's limited by the most limiting factor in the system.

**Mike Morrow** [01:33:36] And, you know, when we're dealing with endangered species, and critically endangered species, you know, the assumption is that we know all the factors that are, that are limiting that particular population or that particular species. And I think the Attwater's prairie chicken is a case in point where we, you know, had we had the wrong, we didn't have perfect knowledge going into this.

**Mike Morrow** [01:34:06] You know, when I came to work here, well, actually, when I was in grad school, I can remember asking about, about fire ants being a potential problem. And the conventional wisdom at the time was that, yeah, they're not good. But, you know, that's not what's limiting the, that's not a huge problem for the Attwater's. And it turns out that was wrong.

**Mike Morrow** [01:34:28] And, you know, we could, we could put all the, all the, you know, all the, protect all the areas in the world or all the, you know, the prairies remaining in Attwater's range and restore prairies and, you know, and do a hundred other things too, that we think might benefit the population. But if it turns out that's something else like fire ants was limiting

that population that, you know, all those things, while good on on the face, will not make, would not make an ultimate difference in, in the population.

**Mike Morrow** [01:35:06] And so I just, I just hope that people that folks would have patience. And, you know, again, I'm optimistic that, that we're on the verge of seeing some great gains. And I am concerned that we can manage enough area for fire ants to make a difference, you know, ultimately in the ultimate recovery. But hopefully, you know, technology will proceed to where we can more effectively manage fire ants on a, on a landscape scale.

**Mike Morrow** [01:35:43] But for now, we just have to take one step at a time. And that's, that's what, that's what we're doing. And I think we're going to we're going to see some gains shortly.

**David Todd** [01:35:54] Well, that's that's great. And, you know, along with your many other fans, I appreciate your, your patience and resolve and diligence on working on what's such a challenging thing.

**David Todd** [01:36:07] And I wish you all the best and really appreciate your time today to talk to us about the problem and some of these solutions that you've been working on.

**Mike Morrow** [01:36:17] Well, I enjoyed, enjoyed talking with you, David, and I appreciate the opportunity.

**David Todd** [01:36:24] You bet. Well, I hope we get to talk again soon, and until then, take care of yourself and have a good weekend.

**Mike Morrow** [01:36:31] All right. You, too. Thank you.

**David Todd** [01:36:33] All right. Bye, Mike.