

TRANSCRIPT

INTERVIEWEE: David Kilby

INTERVIEWER: David Todd

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David Todd [00:00:01] Well, good afternoon. I'm David Todd, and I have the privilege of being here with Dr. David Kilby. And with his permission, we plan on recording this interview for research and educational work on behalf of a non-profit group called the Conservation History Association of Texas, for a book and a web site for Texas A&M University Press, and for an archive at the Briscoe Center for American History, which is at the University of Texas at Austin.

David Todd [00:00:33] And I want to stress that he would have all equal rights to use the recording as he sees fit.

David Todd [00:00:39] And just wanted to make sure that that's okay with Dr. Kilby.

David Kilby [00:00:43] That sounds good to me.

David Todd [00:00:45] Okay. Well, great.

David Todd [00:00:47] Well, let's get started, then.

David Todd [00:00:49] It is Thursday, March 30th, 2023. It's about 2:45 p.m., Central Time. As I said, my name is David Todd and I'm representing the Conservation History Association of Texas, and I am in Austin. And we are fortunate to be conducting a audio interview with Dr. David Kilby. We're doing this remotely. He is based in the San Marcos area.

David Todd [00:01:24] Dr. Kilby is a professor of anthropology at Texas State University in San Marcos, and he works as an archeologist with a variety of interests, but certainly focused on early pre-history and hunter-gatherers in North America. And he, among his other duties, acts as co-director of the Ancient Southwest Texas Project, which has included in its portfolio study of the Bonfire Shelter site.

David Todd [00:01:58] Today we'll be talking about Dr. Kilby's life and career to date, and especially focus on his work with the early paleoindian hunter-gatherers and their long interaction with bison.

David Todd [00:02:12] As a way to get into this, I thought we might first ask about his early childhood and if there might have been any people or events in his young life that might have influenced his interest in animals and parks and history.

David Kilby [00:02:34] Well, thank you. First of all, thanks for inviting me to do this. This is an intriguing project. And so, I'm flattered to be a part of it.

David Todd [00:02:44] Well, thank you.

David Kilby [00:02:45] In answer to your question, I think I've been as interested in animals for as long as I can remember. I grew up in sort of rural western North Carolina, in the foothills of the Appalachians. And my grandfather and my father, especially, were interested in sort of land management. And we had cattle. We weren't professional farmers, but we had cattle and land. And I always enjoyed the woods and hunting and fishing with my grandfather in particular, and just always had a certain fascination with wildlife and ecology.

David Kilby [00:03:25] And I think in that upbringing, in the mountains of North Carolina, I always sort of looked a little bit westward toward bigger mountains and more wilderness. And I think eventually that's what sort of drew me out west.

David Todd [00:03:45] Well, so, say you took a day to go hunting or fishing in this area of the, I guess this is the Allegheny and Appalachian Mountains.

David Kilby [00:04:01] The Appalachians. Right. The Blue Ridge Mountains.

David Todd [00:04:03] Blue Ridge Mountains. What would be a typical hunting trip or fishing trip would be like?

David Kilby [00:04:13] You know, often with my grandfather. And hunting would usually be pretty, I guess, generalized, usually with carrying shotguns. And, the ultimate, the ultimate game was to find a covey of quail. But, along the way, you'd kick brush piles for rabbits and kept an eye out for squirrels in the trees. We were sort of looking for what was out there to be found. And later on, there was, you know, more specific and more focused deer hunting and stuff.

David Kilby [00:04:42] I think a lot of it was just sort of walking in the woods and walking through fields and observing, observing wildlife. Hunting sort of gives you a focus, you know, a goal to the day. But, really what you're doing is sort of enjoying the day outdoors in the woods and in the fields. And I think that part has just never left me.

David Todd [00:05:02] That's fascinating. So, the hunting was sort of an accessory, but the main goal was maybe spending time outdoors and being with your grandfather?

David Kilby [00:05:14] Right. And I think, you know, come to think of it, that sort of carries through with what I do now with archeology. Like the hunting is the, or was, the focus or the excuse that sort of structured your time outdoors. But, the big part of it, the big, you know, fun and beautiful part of it is being outdoors. And similarly with archeology, it structures the way in which I'm outdoors and what we're doing when we're out there. But, I think part of what really makes me, made me, love it and makes me continue to love it is this, you know, this ability to spend a life working outdoors.

David Todd [00:05:55] I think I understand.

David Kilby [00:05:56] I say that with the admission that that's when I'm doing field work. And the majority of what I do, you know, professionally, is actually sitting behind a computer or being in a classroom. But the, you know, the sort of fun parts, the favorite parts, of my year are often spent outdoors pursuing research.

David Todd [00:06:15] Gotcha.

David Todd [00:06:16] Well, you mentioned time in a classroom, and I understand that you got your B.A. at Appalachian State and then your Master's at Eastern New Mexico University and finally your Ph.D. at the University of New Mexico.

David Todd [00:06:31] And I was curious if there were any classmates or teachers you might have met in school that helped further your interest in the outdoors and wildlife, history, you know, these strains of, you know, interests that have carried you on.

David Kilby [00:06:51] Sure. I went to Appalachian State for my bachelor's degree, which I think was no surprise to anyone. Appalachian has a reputation as an outdoor school. It's right there at the, on the Blue Ridge Parkway and lots of climbing and skiing and hiking and outdoors-oriented stuff. And just, you know, I met up with a whole lot of like-minded friends, outdoors people, and also anthropology people there. And a lot of those friends that I went to college with and studied anthropology with are still some of my best friends today. And so, I think we all sort of equally influenced each other.

David Kilby [00:07:28] As a part of some of those classes we had classes that focused on zooarcheology, which is the study of animals and animal remains from archeological sites. And through that, sort of that ability to recognize different animal species based on bones and bits of fur and that sort of thing, and also their relationship behaviorally to humans, not just throughout history, but deep into pre-history, was pretty intriguing.

David Kilby [00:08:04] I had one particular professor who actually has just passed away this year named Harvard Ayers, and he sponsored every year what he called the Great Southwest Experience. And we would spend about eight weeks of coursework doing background research in the environment of the American Southwest and the Native American cultures of the American Southwest. And then over spring break, we would take about two weeks and everyone drive out in a van from western North Carolina to, basically, to Albuquerque was our first stop, and spend the next ten days exploring around the Southwest.

David Kilby [00:08:41] And as I said before, I was always sort of drawn to the bigger mountains and wilder landscapes. And I just, I just fell in love with the West. And on the, sort of as a result of some of those experiences, I took an internship with the National Forest Service where I worked in Utah for a summer. And then, during that summer, I started looking for places to go to grad school out West. I had decided for certain that I wanted to pursue archeology and that I wanted to pursue archeology in the Southwest.

David Kilby [00:09:14] And so it was, it was during one of those visits that I got in touch with folks from Eastern New Mexico University, where I did my master's degree. And it's a neat little university. It's the, it's quite small. It's about 8000 students, I think, at this point. Maybe fewer than that, maybe 6000. But, it's also, you know, the third largest university in the state of New Mexico, just because of the low population and it has a real long history of Southwest archeology and Southern Plains archeology.

David Kilby [00:09:49] And so, I went there specifically thinking that I would study, you know, to sort of more traditional ceramic period archeology of the Southwest. And sure enough, I sort of did that for my master's degree, and I learned too what's called geoarcheology, which is applying a geological approach to thinking about archeological problems.

David Kilby [00:10:10] But in the process, I, you know, as a, as a steady job for a grad student, I worked at a site called Blackwater Draw, which is right there adjacent to eastern New Mexico University. And this is all on the eastern plains of New Mexico. So you're just a stone's throw from the border of Texas, there, a little bit northwest of Lubbock.

David Kilby [00:10:31] And Blackwater Draw is famously the type site for the Clovis culture. It was the first place that it was discovered that human-made artifacts were associated with extinct mammoths in the Americas back in the 1930s. And so, I got to work there, which at the time seemed pretty cool, but it wasn't really my focus. And, over the course of the couple of years that I worked there, I think I sort of got drawn more and more into thinking about this world of Ice Age America, of a whole world filled with extinct animals, mammoth, mastodon, Pleistocene bison (which are the ancestors of modern bison), saber-tooth cats, you know, short-faced bears, all of this whole different menagerie of creatures occupying a landscape that's quite a bit different than today.

David Kilby [00:11:28] And that, I think, just, that drew me into that time period, which we generally call the paleoindian period in archeology, meaning some of the earliest humans in the Americas, who are associated with the last part of the last ice age. So, from about 10,000 years ago back, that's always in question. How far back does it go? I think we have, you know, pretty reliable evidence that it goes back beyond 14,000 years and some would say maybe as much as 16 to 20,000 years.

David Kilby [00:12:03] That's, like I said, that's an issue of ongoing debate and probably will be for some time. But, that's one of the things that's attractive about that field of study.

David Kilby [00:12:13] I think in the process of doing that, I became, it became, for me, sort of a window into learning about ecology in a more formal sense, thinking about human evolutionary ecology and the ecology of these extinct landscapes, the different interactions among animals and plants and environmental communities, which opened up a whole sort of perspective on how to investigate and interpret these early sites.

David Todd [00:12:46] That's so interesting because it's not just a distinct individual or group of people, but the entire landscape is different and the whole context and ecosystems that these people and their cultures are based, must be just so different from what we know today.

David Kilby [00:13:10] Well, take us forward just a little bit: you go on to get your Ph.D. at the University of New Mexico. What did you study there?

David Kilby [00:13:19] That's right. I went, I finished up at ENMU, and I did contract archeology for a while, which is consulting, but always with the aim of going on to pursue a Ph.D. at the University of New Mexico. By that time, I realized that, you know, that what I really wanted to focus on was paleoindian archeology. And at UNM, I specifically focused on Clovis age artifact caches as my dissertation topic.

David Kilby [00:13:49] And, Clovis are the folks that famously made these fluted spear points and hunted mammoths and bison and various other animals between about 12,800 and 13,200 years ago, again, sort of during the waning of the last ice age.

David Kilby [00:14:08] And, one of the intriguing things about Clovis is they left behind a series of caches which are just sort of dense collections of stone tools tucked away around the

landscape, presumably to be sort of set aside as toolkits to be used later in case of running short on supplies, in anticipation of things that would be needed on the landscape in the future. These people were highly mobile, and so there was no one particular village or town that they lived in throughout the years. So, they're making a way by making their way, by seasonally moving around the landscape.

David Kilby [00:14:47] And one of those essential resources that they have to keep track of is stone for stone tools. And so, these caches represent ensuring that people have essential stone tool material cached away at certain parts of the landscape.

David Kilby [00:15:04] And so, when I first started studying them, there were about a dozen that were known. And, much to my surprise, no one had really looked at them comparatively and sort of holistically. And so, I took that opportunity and jumped right in.

David Kilby [00:15:23] And, by the time I finished, almost twice that many were known. They showed up mostly not newly discovered in the field, but they show up in museum collections and so on. And it's just a matter of identifying and recognizing them.

David Kilby [00:15:39] And at this point, I think there's about 26 that are known nationwide of Clovis caches. They are almost all from west of the Mississippi and east of the Sierras. So, it's sort of a plains phenomenon as far as we know, and most likely directly related to enabling people to follow herds of mammoth and bison around the landscape, while staying well-equipped with stone to exploit those animals as they do it.

David Todd [00:16:13] So these caches are, they're not necessarily finished tools. They're maybe the raw materials for making those tools and weapons?

David Kilby [00:16:24] They're both. They're often a wide range of things. And so, I would like to describe a typical cache, but there's quite a bit of variability.

David Kilby [00:16:31] But, one kind contains, you know, maybe 100 or more items ranging from just, you know, blocks of raw material up through partially finished tools and maybe a few completely finished tools.

David Kilby [00:16:47] And other caches are much more specific. There will be, you know, a dozen finished Clovis points, all stashed together in one place.

David Kilby [00:16:57] And so, that diversity in caches suggests that maybe there's more than a single function to these.

David Kilby [00:17:04] But, I think the, what I concluded anyway was that the most usual function, the function of most of them appears to be sort of insurance against running out of material while you're moving around the landscape.

David Kilby [00:17:22] One of the things to sort of keep in mind, and this is, you know, as we talk about archeology, we'll probably come back to this again and again. There's this preservation bias in the archeological record. And so, what you find at any particular archeological site is a result not only of what happened there and what got deposited there, but what has remained thousands of years later and hasn't decomposed or been eroded away or taken away by scavengers or any of those other processes.

David Kilby [00:17:49] And so, Clovis caches are no exception. You know, presumably there were also bone and wooden and perhaps woven materials associated with these caches as well. And they're just invisible to us.

David Todd [00:18:02] That's so interesting. So, there's, you've got a filter that these items have gone through, whether it's these scavenging animals or maybe competing tribes that might have taken things or just the rot and weathering that goes on in thousands of years.

David Kilby [00:18:19] Right. And that's a good way to describe it as a filter that, you know, the original deposits that are the direct result of human activity go through these series of filters that take some components of those deposits out. You know, they're filtered by natural processes, scavengers and decomposition and erosion, and they're filtered by cultural processes. Like you said, other people may scavenge materials from the site, people may dig looking for artifacts. People may build highways across portions of sites. You know, there's all these things that can transform the original assemblage into something that is, at best, sort of a subsample of that original assemblage.

David Todd [00:19:01] That's fascinating.

David Todd [00:19:03] Well, you tell us a little bit about your formal education in the field and in classrooms. I always like to ask folks, though, about their sort of informal education from, I guess, this sort of cultural media, you know, whether it's books or films or TV shows that we, I guess, sort of soak up by osmosis or paying maybe closer attention. Where any things like that influential for you?

David Kilby [00:19:41] You know, you asked before about my, you know, earlier childhood. One of my earliest memories of the movies is, and I can't remember what movie we went to see, it's of course in a theater, and they would show shorts sometimes before the movie starts. And this was a Disney short, a nature short on deserts. I think it was called "The Living Desert", and this had to have been, you know, early to middle 1970s.

David Kilby [00:20:04] And that little, that film fascinated me. I remember there was some dramatic sequence with maybe a scorpion and a tarantula and all this sort of, you know, nighttime and dusk footage of crepuscular animals in the desert. And I don't know, for some reason I can remember that experience quite clearly, although I have no idea what the feature film that we were seeing was.

David Kilby [00:20:29] I think, you know, as a kid watching things like that, Wild Kingdom, Mutual of Omaha's Wild Kingdom, was an event, you know, you made a point to catch it on TV. And, you know, there was always National Geographic laying around the house as a kid and as an adolescent. And I, I think, just grew up looking at and reading about nature quite a bit.

David Kilby [00:20:52] And, you know, I think that I should also acknowledge my parents, who took me to visit cool places growing up. I was lucky enough to accompany them to Mexico as a kid. They did some volunteer work in Central America and they would go to Guatemala. Guatemala was a little bit unstable for young children, but they didn't want to leave us out. So, they took us to Mexico a couple of times and we got to see, you know, the Mayan sites in Yucatan and Aztec and Toltec sites in central Mexico.

David Kilby [00:21:24] And, I think that was, you know, truly a formative experience for me to be thinking about prehistoric cultures and to be thinking beyond, you know, known history, to us at least, was really influential.

David Kilby [00:21:41] And, I sometimes joke with students that I was always interested in archeology, but I didn't know that you could make a living at it until I, until I went to college and I took a couple of classes as electives and I found out you could do that. You can make a living. And I always add, just barely. But, but, yeah, but you can.

David Todd [00:21:59] Well, and it sounds like you have indeed made a living doing this and that you're now teaching at the anthropology department at Texas State with research in the fields of North American paleoindians, hunter-gatherer archeology and other areas. How did you first get started at Texas State and what were some of those early highlights?

David Kilby [00:22:26] I guess that story sort of picks up again where I left off at UNM. When I was at UNM, I worked with a professor there named Bruce Huckell, who specifically, at the time, was looking at these Folsom Age sites on the West Mesa of Albuquerque and got to work at Boca Negra Wash, and the Rio Rancho site, both of which are ...

David Kilby [00:22:49] You know, just to back up a little bit, Folsom is a paleoindian hunting culture that comes just on the heels of Clovis. So, after the mammoth have gone extinct, Folsom are focused primarily on bison.

David Kilby [00:23:05] And so, I got pretty interested in this, you know, this pre-history of early bison hunters on, I'd say on the plains, and that's the southwest. But, at the time it was more of a plains-like environment during the last ice age.

David Kilby [00:23:20] And, when I graduated from UNM, I was invited to come back and apply at ENMU, where I'd done my master's degree, for a position there. And so, I did and was able to go straight there and find myself now being in charge of some excavations at Blackwater Draw, which was a real, a real thrill.

David Kilby [00:23:40] And particularly what we focused on while I ran a couple of field schools and did a couple of projects there at Blackwater Draw, were these late paleoindian bison kills that are surrounding an ancient pond. Blackwater draw was an ancient spring-fed pond that attracted groups of hunter-gatherers for thousands of years.

David Kilby [00:24:02] And we focused on an area that was a concentration of extinct bison bones that, it wasn't known for certain if they were the result of human hunting, or if they were some natural accumulation that you can imagine, you know, herds of animals around an African waterhole, some of them are killed by predators or by lightning strikes or other sorts of catastrophes.

David Kilby [00:24:27] And so, I got to spend quite a bit of time trying to suss out the nature of that bone bed. And it turns out that we're pretty convinced that it is a late paleoindian bison kill. And by late paleoindian, I mean, between eleven and ten thousand years ago, probably, so right at, you know, right as we're entering the modern era from the end of the last ice age.

David Kilby [00:24:55] And so, that was, sort of gave me, you know, experience working with bison bone beds, is what we call them. When you have dense concentrations of bones of a particular animal, we often call those bone beds.

David Kilby [00:25:07] And, when I applied to Texas State and was hired here, pretty quickly, I was contacted by Dr. Steve Black, who is now semi-retired from Texas State. He founded the Ancient Southwest Texas Project in 2009. Steve Black is a, you know, a longstanding archeologist and expert in Texas archeology. And he has a long career, especially in CRM [Cultural Resources Management] archeology. If you've ever looked up the Texas Beyond History website, that's his brainchild and his creation. If you haven't, I encourage you to go check it out.

David Kilby [00:25:49] Anyway, he asked me sort of casually and informally. It was before I'd even signed the contract. He said, "We're probably not supposed to be making plans yet, but I wanted to talk to you about possibilities at Bonfire Shelter." And he asked if I'm familiar with the site. And, you know, that was a little bit of a rhetorical question. If you're a paleoindian or a hunter-gatherer archeologist in the West, you know, the site of Bonfire Shelter.

David Kilby [00:26:14] And he asked if I thought, if I thought I might be interested in undertaking some research there under the umbrella of the Ancient Southwest Texas Project. And it took me, you know, probably about 1.5 seconds to answer that. And that was, "Oh, yeah, that would be a fantastic opportunity."

David Kilby [00:26:34] And so, I was fortunate enough to be able to come to Texas State and hit the ground running with some what to me was new and exciting research centered on Bonfire Shelter.

David Todd [00:26:45] That's great. Well, it's amazing that some of these sites have been excavated by, you know, generations of archeologists over decades, but they're still, you know, revealing their secrets gradually.

David Kilby [00:27:03] Right. I think that's important to sort of mention that you can excavate a site, revisit a site repeatedly for generations, and learn something new and different each time. Part of that is because our methods change, and new technologies become available, and new approaches become available.

David Kilby [00:27:26] For example, when Bonfire Shelter was first excavated in the 1960s, radiocarbon dating was still pretty young. Radiocarbon dating had only been around for about a decade at that time. And, they were able to get a few radiocarbon dates on some of those deposits. But, a radiocarbon date is an estimate and it has a standard deviation, so it has an error. And, you know, their error ranges were 500 to 1000 years, which is sort of within what you might be able to figure out based on the geology anyway.

David Kilby [00:28:00] And so, you go back in, you know, in 2017 and we now have techniques that enable us to do radiocarbon dates that have standard errors of maybe 20 years.

David Kilby [00:28:13] But, we may get into this a little bit later. The dating at Bonfire Shelter has continued to be challenging and problematic. So, it's something I think everyone who's worked at this site has struggled with.

David Todd [00:28:30] Well, this might be a good sort of segue to focus on some of this work that you've been involved with for so long, as well as Dr. Black, before you, as the co-director of the Ancient Southwest Texas Project. This Bonfire Shelter site, I guess, is out in Val Verde

County. Maybe you can help sort of give us an idea of the landscape out there and then some of the research that you've been doing. And, of course, we're particularly curious about this bison jump that I think it's pretty famous for.

David Kilby [00:29:08] Sure. So you're... That's right. It's in Val Verde County, which is far southwest Texas, right along the border with Mexico. And this is, you know, a region that we call the the Lower Pecos, although we're a few miles upstream along the Rio Grande from where the Pecos enters it. But, this larger region is the westward extension of the Edwards Plateau. And so, it's mostly limestone bedrock and canyons deeply incised into that bedrock, which creates lots and lots of caves and rock shelters. And so, that region is sort of just pocked with rock shelters, which provide excellent preservation for archeological sites.

David Kilby [00:29:54] People are drawn to rock shelters in general because they provide shelter. They are, you know, good spaces to carry out activities and to spend the night in and to cook food in and that sort of thing. And so, people are drawn there pre-historically and historically.

David Kilby [00:30:12] And then, in addition to that, they're often protected from the elements, protected from erosion, sometimes even completely dry. And so, some of those preservation issues that we talked about a few minutes ago are ameliorated a little bit. And so, we get to see things in rock shelters that we don't always get to see. We get to see basketry and sandals and wooden and woven artifacts that are invisible to us on open sites.

David Kilby [00:30:40] So, Bonfire Shelter is one of those sites, although it's not completely dry. And so, whereas some of the adjacent sites in what's called Eagle Nest Canyon are completely dry and have excellent preservation, Bonfire Shelter, I would say, has moderate preservation. And, well, we'll come back around to that maybe in a minute.

David Kilby [00:31:04] But, Bonfire itself is best known among archeologists for two big sort of questions.

David Kilby [00:31:12] One of these is that there is potentially the oldest and southernmost mass bison jump in North America. And, by bison jump, I mean the hunting technique by which people sort of manipulate herds of bison toward a cliff or an overhang and sort of panic them at the last minute and drive them over the edge as a hunting strategy.

David Kilby [00:31:38] That's, you know, a lot of us sort of think of that as a maybe a stereotypical or common way of hunting bison in the past. It's not as common as most people think. And, where it is the most common is on the northern plains and in later pre-history. And so, if the deposits at, the 12,000 year old deposits at Bonfire Shelter indeed represent a bison jump, then it's the southernmost and the oldest bison jump in the Americas by thousands of years and by a couple of thousand kilometers.

David Kilby [00:32:13] I keep saying if it turns out to be a bison jump. There's a little bit of dispute there that we can talk about in a few minutes.

David Kilby [00:32:20] The other thing that comes to mind when people hear about Bonfire Shelter are these even older deposits that include, most famously, mammoth, but also including horse, an extinct form of horse. There's lots of ice age horses around the landscape in North America, and then they go extinct at the same time as mammoth and mastodon.

They're eventually brought back in the form of domestic horses by Europeans. But, much of horse evolution actually took place in the Americas.

David Kilby [00:32:49] Also more bison, an extinct form of pronghorn, all of which are about 14,000 years old and expanding, extending back probably older than that. And the original excavators suspected that those animals might be in the shelter as a result of human hunting, also, not from driving them over the cliff, but maybe hunting them elsewhere on the landscape and bringing them into the shelter to process and consume.

David Kilby [00:33:22] However, there were never any stone tools found associated with them. And so, the evidence of that interpretation is based on is just the way that bones are broken, the way that they're arranged. And so, that's always been sort of unconfirmed whether this represents an earlier-than-Clovis, 14,000 year plus, human occupation in Bonfire.

David Kilby [00:33:48] So those are sort of the two big things that Bonfire Shelter is well known for.

David Kilby [00:33:53] And the third is the namesake of the Shelter itself, which is a late archaic bison jump, which is, almost without a doubt, the result of a jump drive event that took place about 2500 years ago. And, literally hundreds of bison appear to be driven off the rim from the canyon above, or from the terrace above, into the mouth of the Shelter and into the canyon below, those ... creating a bone bed that, in some places is a meter thick, is more than three feet thick.

David Kilby [00:34:29] At some point, that whole bone bed caught fire and burned. And, that's the, you know, the namesake of Bonfire Shelter. So, you have this, you know, 80 centimeter thick lens of burned bison bone there, representing hundreds of bison, associated with spear points and other stone tools, some of which are burned as well that have been used to process them.

David Kilby [00:34:56] The other thing that I should point out, which always has been overlooked over the ages, is between that 12,000 year old bison bone bed and the 2000 year old bison bone bed is a whole series of more ephemeral, archaic occupations, where people use the shelter for brief periods, possibly processing plants, simply getting out of the elements and so on. And so, we've tried to focus on figuring some of that out as well, since in the past, the bone beds have gotten the most attention.

David Todd [00:35:31] So trying to fill out the story, I guess.

David Kilby [00:35:34] Right. I mean, in all, you've got, you know, at least 12,000 years of intermittent use at that particular point on the landscape.

David Todd [00:35:46] You know, one of the things that intrigues me is that it seems to have, that Bonfire site, and maybe some of the surrounding area, has given you clues about these bison jumps and strategies that were used to take bison. Do you think that the these paleoindians who lived there were mostly hunters, or were they scavengers of bison and other animals?

David Kilby [00:36:20] That's, that's an excellent question. At Bonfire Shelter, what we have, just focusing on bone bed two for now, which is that 12,000 year old, give or take, series of

bison bones. Those look like they were intentionally hunted. They're associated with Folsom points, which we know date from about 12,200 to 12,800 years old, and with another spear point called Plainview, which dates to - it's poorly dated - but between about ten and twelve thousand years. And to our knowledge, those, the cultures represented by those spear point styles don't overlap in time.

David Kilby [00:37:06] And so, already that suggests you have, you know, maybe two different kills at two different time periods there. Both of them, Plainview and Folsom, are understood to be pretty focused and somewhat specialized bison hunters. And so, I think those cultures are, you know, they do more than hunting. They of course, ate plant foods and pursued other economic resources as well. But, hunting, and particularly bison hunting, is probably what structures their social organization, their annual scheduling, their movements around the landscape. All of those things are probably driven by this, you know, most important economic species, which is bison.

David Kilby [00:37:51] Asking about scavenging, that's been more of a question with regard to Clovis, which is the preceding period. Were they hunters of mammoths in particular or, you know, this question is particularly with regard to mammoth as opposed to bison, or are they more often scavenging carcasses? And, that's a matter of some ongoing debate as well. But, I think most of us, and certainly I, see Clovis as active hunters of mammoth. I think the spear points are broken in particular ways and the mammoth carcasses are articulated in particular ways that suggest that that's an intentional hunting as opposed to just scavenging.

David Kilby [00:38:36] But, at Bonfire, you know, the Bonfire Shelter, that's sort of relevant to bone bed one where you had this 14,000 year old accumulation of bones that doesn't have anything in the way of stone tools associated with it. Is it possible that that's related to human scavenging that didn't require stone tools for killing or processing? That's always a possibility.

David Kilby [00:39:03] However, I consider stone tools sort of the calling card of modern humans. Right? Sort of the smoking gun of human involvement. Anyone in the Americas are fully modern humans, and if anything, they make quite sophisticated stone tools. And so, wherever they are engaged in intensive economic activities, we tend to see stone tools.

David Todd [00:39:32] So, you've told us a little bit about Bonfire Shelter, and maybe some of the clues there as to how these bison might have been taken and butchered, used. And I'm wondering, if there are other sites that you're familiar with in Texas that may help fill out the picture of how people and bison interacted? Are there any sort of campsites that you might be able to help us understand more about?

David Kilby [00:40:08] There are other sites from these time periods around Texas. Most of them don't have the level of preservation of Bonfire Shelter because of that rock shelter context. But certainly, you know, sites like Gault and Debra Friedkin, which are just there north of Austin, these look like they are enormous base camps that people returned to year after year for generations.

David Kilby [00:40:36] And, one of the reasons for that is that you have an excellent source of high-quality stone for making stone tools there - what's sometimes called Georgetown Flint, the variety of Edwards Plateau chert.

David Kilby [00:40:50] And Clovis people were there, Folsom people were there, Plainview, all the way up through the remaining 10,000 years into the late prehistoric period. You have

people exploiting those stone resources and also that environment. There's reliable springs there. Here, as Dr. Collins points out, you have an ecotone where you have multiple different environments, ecological communities, that are coming together and they are all within reach from this one point on the landscape.

David Kilby [00:41:19] Other places, I think, have some similar records that are not as well known. And, right here at Texas State, at Aquarena Springs, that may be one of those sites. Again, it's a reliable spring with fresh water. And there are, you know, it's just seen persistent use by hunter-gatherer groups over millennia. And we know that there's Clovis and Folsom material from here, as well as later material.

David Kilby [00:41:50] The interesting thing about Aquarena Springs is we don't know exactly where that Clovis and Folsom material is coming from. And, one of my colleagues, Dr. Heather Smith, is trying to get to the bottom of that. Do we have any intact remains of early paleoindian campsites there at the Springs, at Spring Lake?

David Kilby [00:42:09] Part of the challenging part there is that that's, of course, been dammed up and a lot of that archeological record is underwater. And so, that makes for some interesting challenges for the archeology.

David Kilby [00:42:22] The Folsom and Plainview bison hunters at Bonfire Shelter are largely a Plains adaptation. And, you know, in certain periods of prehistory, the plains would include almost all of Texas and other periods less so, but only on Llano Estacado, in the Texas Panhandle, that's one of the sort of hotbeds of paleoindian sites in the West. And so, sites like Lubbock Lake and Plainview and Milnesand and Lake Theo there on the Texas Panhandle are all sort of pieces of this puzzle for figuring out early paleoindians in Texas.

David Todd [00:43:08] But not necessarily the range of early bison. Is that right?

David Kilby [00:43:16] That they're not ... I'm sorry, I'm not understanding the question.

David Todd [00:43:21] Yeah. So, I'm just curious if these campsites at Lubbock Lake and Spring Lake or Gault suggest where people were, but maybe not necessarily bison, that people might have been able to survive in other ways besides depending on local bison?

David Kilby [00:43:40] Sure. You know, there is a, there's a little bit of a caveat in using archeological sites that contain bison as evidence for prehistoric ranges of bison. One of those is that these archeological sites are, you know, little snapshots here and there of bison hunts or bison consumption that are preserved. And so, there's lots and lots of probable bison range that's not showing up in the archeological record.

David Kilby [00:44:18] On the other hand, humans move things around, and so we trade in bison meat and then bison hides and bison horns and that sort of thing. And so, you can get bison parts showing up at archeological sites where there may not have actually been bison present on the landscape.

[00:44:33] And so for that reason, the archeological record sort of an imperfect reflection, I think, of bison ranges. But, on the other hand, you know, in a lot of ways, it's, that imperfect record is the best record we have. And so, certainly, the Plains and Panhandle part of Texas probably hosted bison, you know, throughout its pre-history, since the last glacial maximum, since at least, you know, since tens of thousands of years ago.

David Kilby [00:45:06] But the rest of Texas, southern Texas and East Texas, seems to have experienced these sort of pulses and contractions of bison, of bison herds, as the habitat changed with climate changes.

David Kilby [00:45:24] And one of my colleagues, John Loess, has done an excellent job of trying to reconstruct when do we have bison present on the landscape in central and southern Texas as opposed to just the plains of the Panhandle? Then, what he did is relied on the archeological record and did some intensive collection of radiocarbon dates from some of these sites that we've already mentioned and a bunch of others.

David Kilby [00:45:49] And, he, sort of, you know, came to the conclusion that you have this pulse of bison expansion about 6000 years ago into southern Texas and western Texas and probably into the deserts of, you know, what's now southern New Mexico and so on, associated with the Calf Creek Horizon, which is a series of, you know, archaic projectile points that are known from Texas and Oklahoma and the Southern plains.

David Kilby [00:46:17] And then, they disappear for several thousand years, and don't become abundant again until about 3000 years ago, when you have, again, a little bit of a change in climate, an expansion of grasslands and expansion of of bison habitat. And then we see bison hunting again in the late prehistoric, from about 2000 to 3000 years ago, around Texas.

David Kilby [00:46:43] And then they contract again, and they don't become visible in the archeological record until late pre-history after about AD 1300, which is, you know, depends on your perspective, as someone who studies paleoindians, that seems like late pre-history, but the Toyah phase and expansion of bison hunters again across Texas, apparently following the expansion of bison range.

David Kilby [00:47:12] There was more I was going to add to that. Oh, that sort of late Archaic pulse between two and three thousand years ago corresponds exactly to the uppermost bone bed at Bonfire Shelter. And so this, you know, one-meter thick layer of burned bison bone associated with dozens of spear points dates to 2500 years ago. And so it's part of that pulse. It's part of that expansion of bison southward from the plains, and into what is now Chihuahuan Desert.

David Todd [00:47:49] This is just fascinating to me. You know, so little that I know, but, I mean, I often think about history as being sort of a continuum, I don't know, sort of homogeneous time where there wasn't a lot of change. But, it sounds like there were shifts and, you know, expansions and contractions of these bison herds, you know, with differing kinds of climate. Am I following you?

David Kilby [00:48:19] Yeah. And, I think from the perspective of, you know, of modern history, it's easy to think of pre-history as being sort of static. You know, this sort of notion of an ideal Garden of Eden that was unchangingly, you know, healthy and abundant. And in reality, the closer we look at pre-history, there's lots of change, and there's periods of great abundance and there's periods of drought and periods of climate change that are that are evident both in the, you know, the ecological record and also in human cultural responses and adaptations to that.

David Kilby [00:49:00] And arguably, I think that's one of the things that archeology can sort of provide some perspective on in, you know, our current concerns about climate change as, you know, what are the various ways that humans have adapted to abrupt climate change in the past, or failed to adapt? I mean, one of the things that is one of the drivers of quick cultural turnover and changes in demographics, prehistorically, are these abrupt climate changes.

David Kilby [00:49:27] And, you know, I think I'm not telling you anything to point out that, yes, there are abrupt climate changes in the past, but what we're seeing now is, you know, potentially more catastrophic than what is, than the gradual change we've seen over the past 15,000 years or so.

David Todd [00:49:47] Yeah. Well, this is just a wonderful insight you've shared with us. Thank you.

David Todd [00:49:54] You know, we've talked a little bit about how bison remains are often associated with human settlement remains. And maybe you can help us understand a little bit about why the two are linked so closely. I mean, what the interest was for humans in bison, whether it was food or clothing or shelter or maybe other kinds of uses, maybe even spiritual.

David Kilby [00:50:24] I think the answer to all those is yes. You know, they are, one perspective, sort of an ecological perspective on prehistoric economics is looking at what we call diet breadth models or optimal foraging. And it's a way of looking at the potential subsistence resources, the potential edible resources on the landscape, in terms of their caloric return, relative to how much it requires to gain those calories.

David Kilby [00:50:58] In other words, you can spend, you know, a week hunting bison, but when you get one, it's hundreds of thousands of calories, right? Or you can spend several hours grinding up rice grass and also create something consumable, but you're getting fewer calories for the amount of effort that you put in.

David Kilby [00:51:21] And so, throughout pre-history, I think, whenever they're present, bison rank about the highest as far as caloric return. You know, they are, as far as economic utility, they are huge packages of high-nutrient calories out there on the landscape.

David Kilby [00:51:44] And so, I think people have adapted to and with bison in the West and on the plains throughout pre-history. They are probably, you know, much of the deep history of humans in what is now the American West is intertwined with bison. And I say, they're anywhere that they are on the landscape, they're probably the highest ranked item.

David Kilby [00:52:12] That may not have been true during Clovis times when you have mammoth on the landscape. And sure enough, Clovis seemed to take advantage of mammoth every time they could. You can imagine the calories represented by a mammoth kill.

David Kilby [00:52:27] And so, Clovis hunters look like they're, they may be a little more diverse in their diet. They're hunting mammoths, and they're hunting bison. And we know, you know, in the Rockies they're hunting mule deer and elk, and they're probably eating lots of turtles and fish and those sorts of things.

David Kilby [00:52:44] After the end of the ice age, when those larger animals go extinct, you know, the last megafauna standing is the bison. And a lot of the Plains and Western cultures become really focused on specializing in bison. And it does, I think there are changes that

ripple throughout archeological cultures as we can see them. You know, what we really get a glimpse of mostly is, you know, stone tool technology. But, there's pretty abrupt changes in stone tool technology. There's changes in ways people use the landscape, where sites are located on the landscape. And presumably that represents changing strategies for following and hunting bison.

David Kilby [00:53:31] And so, I think, I don't know to sort of expand on that a little bit, if you think about the way that, say, the transition to agriculture in prehistory completely reorganized human society, you know, it reorganizes our allocation of labor. It reorganizes social units and family units all around, you know, a new way of making a living by agriculture and herding, as opposed to hunting and gathering.

David Kilby [00:54:05] And that has, you know, effects on practical things, like I said, like social organization. But then that is shored up and has ripple effects on more sort of intractable things like ideology and religion and norms and values and those sorts of things.

David Kilby [00:54:25] And so, I think in the same way that the agricultural revolution probably really, you know, had a pervasive effect on the structure of human culture, I think, in the American West this focus on bison as the keystone species of a larger diet breadth probably had similar effects.

David Kilby [00:54:45] You know, lots of your social organization, lots of your timing of movements around the landscape, even your kinship systems are related in some way to efficiently taking advantage of this most important resource out there on the landscape.

David Todd [00:55:02] So it sounds like a lot of the interest was just in the sheer calories, all the meat that was draped over a bison's body. But ...

David Kilby [00:55:10] Well, let me throw in a little bit of a caveat.

David Todd [00:55:13] Yeah.

David Kilby [00:55:14] That's how we're, that's what we're able to look at, you know, archeologically. That's something that we have a window into. Other things are much more difficult to access archeologically: you know, things like values and even language, you know, prehistoric words, prehistoric kinship patterns and those sorts of things are very difficult.

David Kilby [00:55:37] And it doesn't mean we don't try, but it means there are often sort of indirect interpretations, whereas we can more easily and confidently look at simple things like calories, you know, things that are sort of mechanical and practical or more accessible through the archeological record.

David Kilby [00:55:57] And I don't think that means that those are necessarily the most important things to understand about culture, but they are the, you know, the clearest windows we have to look through.

David Todd [00:56:10] Got you. And so more difficult maybe also to figure out how they might have been using these bodies of bison for clothing or shelter or maybe spiritual uses, or is there any evidence for that?

David Kilby [00:56:31] Certainly, we know that bison hide is used, you know, for making lots of things. It's a very tough leather. It's tough. It's thick enough that you don't want to use it for just everything. Right? It's going to be a little heavy for most clothing. So, deer is more often used for a lot of leather clothing, I think. But, certainly for tough things like gloves and pads made out of leather, the hide is very important. Bison robes are very important for insulation, you know, for wearing.

David Kilby [00:57:06] And, you know, all kinds of animal parts have potential uses. So, you can of course, you can eat the meat and you can dry it and preserve it through smoking and through drying. And, you can pound it up with berries and nuts and make pemmican, which is sort of like, you know, sort of a beef jerky that can be, you know, preserved and carried along for for weeks or months.

David Kilby [00:57:32] But, in addition to that, you know, bones are useful as tools. The marrow of bones is, can be rendered into broth and into other food products. The brain can be made into a glue and is helpful for tanning hides.

David Kilby [00:57:49] The tendons are an important component. So, the tendons are the, you know, the muscle attachments or at least the cords that attach muscle to bone. Those are often harvested. And, if you soak them in water, they get pretty soft and kind of slimy, and they're very useful for attaching components of tools together.

David Kilby [00:58:11] So, for example, putting a spear head on a spear: you use that wet tendon, you soak it and then you cut it into strips using a stone tool and wrap that around the haft of the spear point, and around the spear itself. It serves as a glue. It's very sticky. And that stickiness dries and hardens into a glue. But, not only that, it shrinks as it dries. And so, it gets tighter and tighter and creates this very tight bond. And, we know that a lot of prehistoric tools when we see complete tools found in dry caves and so on, they are they're put together using animal tendons.

David Kilby [00:58:54] Horns, you know, serve, are made into scoops and cups and decorations, buttons and beads, and so on.

David Kilby [00:59:05] And so, you know, the old sort of trope is that, you know, nothing is wasted. And I think there's a kernel of truth to that, in that there's, I think there's a potential use for almost every part of the body.

David Kilby [00:59:20] But, a lot of people are surprised to find out, especially in these big mass kills, like in bison jumps, there's quite a bit that can't be used before it gets probably, you know, starts to decompose. It becomes inedible. And so, you find a lot of bison in these mass bison kills, only partially butchered.

David Kilby [00:59:41] David Meltzer, sort of jokingly talking about the Folsom site, which is in northeastern New Mexico, those, some of those bison appeared to be butchered on one side and then left intact. They weren't rolled over. And he sort of jokingly referred to those as, "bison on the half shell".

David Kilby [00:59:58] But, the point is there's, you know, there's often, something like a bison jump, which is a mass-killing technique, results in more resources than you can possibly prepare and consume before it goes bad.

David Todd [01:00:14] Yeah, I guess they might have gone from a long drought and to just, you know, a great boom of.

David Kilby [01:00:25] Right.

David Todd [01:00:25] You know, of calories and robes and skins and tendons and bones and maybe more than they can absorb.

David Kilby [01:00:34] We sort of estimate, just along those lines, and again, this is looking at things very economically, but a bison kill like that at Bonfire Shelter, one of the smaller ones, it probably required at least 50 people. And if they dispatched 100 adult bison, each, you know, averaging about 2,000 pounds. And I can't remember the numbers with regard to calories yet, but it basically comes out with enough calories to sustain 50 people for almost a full year.

David Kilby [01:01:06] And so, of course, you can't carry all that and you can't process and preserve all of that. But, that gives you an idea, a little bit of the windfall, the economic windfall, of a hunt like this, and gives a little bit of insight into why it would be worth your time to do all the planning and organizing and strategizing that goes into a communal bison hunt.

David Todd [01:01:29] This may feed into the question I had for you, and that is, why do you think these mass bison kill sites like Bonfire Shelter might be so rare?

David Kilby [01:01:47] I think maybe there's two potential answers to that. I'm sure there's more than two, but I have two answers in mind.

David Kilby [01:01:53] One of those is for the reasons that I just mentioned. From what we know, based on historic, historically documented bison hunts among historic Native Americans, and what we know about hunter-gatherer organization in general, it takes quite a bit of coordination and planning to pull one of these bison drives off. It's not something that can be done with half a dozen people.

David Kilby [01:02:20] And we think of especially paleoindian hunter-gatherer groups of moving around in bands of maybe, you know, on average 25 people or so. And so presumably one of these hunts would require coordination among two, three, maybe four bands of people, if you, especially if you consider that any band might have, excuse me, you know, only eight or ten people that are of appropriate age and, you know, of physical condition to participate in that kind of hunt. And who knows what other restrictions might have been in place with regard to, you know, social systems and ideology and so on. It may have been that only certain people are eligible to participate in these hunts.

David Kilby [01:03:04] And so, it requires that sort of organization and leadership, and it requires timing, finding bison grouped together at places on the landscape where you can execute that kind of plan. And that plan involves, you know, finding a group of bison, presumably, that can be separated maybe from the larger herd and that can be manipulated along a certain path. And by that I just mean you want to move them without stampeding them, right? You just want to make them nervous. If you've ever worked around cattle, you know, there's a distance that they'll allow and then they start sort of moving off. And so, sort of easing a small herd up, up a drainage or up a valley and toward whatever the drop-off or cliff is.

David Kilby [01:03:53] And then you have to have people stationed there hidden in a way that at the last minute you can panic them and funnel them to exactly where you want them to go. And the idea is that the ones, that the bison at the front, you know, don't see the fall until it's too late. And the momentum of the herd behind them continues to push them over.

David Kilby [01:04:13] And so all of this requires a lot of moving parts. And I think that's one of the reasons that they're fairly rare.

David Kilby [01:04:23] On the northern plains, among historic Native Americans, they tended to be big sort of social events. And so, multiple bands would come together. There would be feasts associated with it. There would be all these other sorts of things that were associated with an aggregation on the plains, like, you know, meeting potential marriage partners, families getting back together, you know, establishing and affirming kinship ties and those sorts of things.

David Kilby [01:04:49] But then, as part of that, this communal bison hunt and then, you know, the feasting and camping and allocation of resources that would follow on that.

David Kilby [01:05:01] And so, I think that's one of the reasons that they're...

David Kilby [01:05:03] The other point I was going to make about historic bison kills is that, you know, they're seasonal and perhaps annual. It's not something that you do once a month, all year-round. And so, I think that's perhaps one of the reasons that the kind of rare.

David Kilby [01:05:23] The other, my other sort of question is, you know, maybe they're less rare than we realize. So, in a place like Eagle Nest canyon, in the lower Pecos, where Bonfire Shelter is, there are lots of good deep, narrow canyons with potentially lethal cliffs that would serve well for bison drives.

David Kilby [01:05:48] But, most of them don't happen to have a rock shelter right underneath them. And so Bonfire Shelter preserves, you know, maybe a handful of the bison drives that might be, you know, representative of several dozen or maybe even several hundred that happened across that landscape over the course of many years.

David Kilby [01:06:08] And so, you know, the conditions ... on the one hand, the conditions have to be right for the hunters in the past. And on the other hand, the conditions have to be just right archeologically and geologically for us to be able to see it. And so, that I think that contributes to their apparent rareness as well.

David Todd [01:06:27] Well, so something that I I'd love to hear your thoughts about is how these, you know, customs and lifeways that paleoindians might have developed over the years for using and relying on bison might have then carried on into the habits of relatively modern Native Americans. Do you see any connection there?

David Kilby [01:07:03] I think especially on the plains, certainly. You know, at the end of ... So, what we think of much of the West, and including the desert southwest and most of Texas, as being sort of part of a plains ecosystem in the late Pleistocene, in the late ice age. And, as, after the end of the last ice age, as the climate gradually is becoming more like we know it to be today, bison sort of contract onto the plains so that, you know, they're no longer found in the southwest, no longer found in the Gulf coastal plain and the deserts of West Texas and so

on. And, as we see the bison herds contract onto to the plains, we also see those specialized bison hunting cultures contract on to the plains.

David Kilby [01:07:55] And so, I think a lot of that, you know, the hunting techniques, the social organization, the sort of basics of prehistoric cultures from the paleoindian period live on, especially on the plains, where people continue to pursue bison throughout much of the year.

David Kilby [01:08:15] You know, how that, how you might trace some of the, you know, contemporary Native American ideals and values and belief systems back into the paleoindian period is difficult. We've been trying to figure out creative ways to do that for a long time. And, you know, mostly what we do is pretty clumsy. You know, we take what is common among hunter-gatherers that are big game hunters, you know, in the modern era, in the historic era, and sort of project back some generalities onto what we think paleoindian belief systems and ideals might have been like.

David Kilby [01:08:59] So it's hard to say which, you know, what modern Native American systems might be traced directly back to paleoindians. But, you know, they are direct descendants. And so, certainly those things must be there.

David Todd [01:09:15] So it sounds like this shift in the climate of ten, twelve thousand years ago might have concentrated both the bison herds and the kind of culture that early Native Americans might have had to sort of focus on the use of the bison. I'm curious if there might have also been kind of similar, maybe more rapid, changes, when the horse arrived and when the Europeans started to head out over the plains area of North America.

David Kilby [01:09:57] Sure. And I think that that, too, is probably a, you know, a particular period in a larger pattern. Once the ... starting again back at the end of the last ice age when parts of the American Southwest and much of Texas begins to sort of heat up and dry out after the ice age people begin, people who remain in the area, people who are not bison hunters.

David Kilby [01:10:27] Their diets become more diverse and they start developing systems for processing plants. And, in some places, like in the southwest, that means agriculture. In much of Texas, that means using earth ovens to do the slow baking of succulent foods. And so, you see throughout the sort of archaic and late prehistoric period people becoming more what we call broad-spectrum hunter-gatherers, as opposed to specialized bison hunters or other sort of economic specialization.

David Kilby [01:11:06] And, that's true even on the plains where you continue to have bison, we generally see a gradual diversification of diet breadth. And when we do get the reintroduction, sorry, I'm getting tangled up here. To address the question that you're asking, probably around the time that European colonists are, you know, making their, having an impact on the landscape, many Plains Native Americans are, they're hunting bison, but they're also practicing agriculture. They're also doing lots of food processing.

David Kilby [01:11:47] And the introduction of the horse sort of changes things, especially coupled with the population pressure and sort of economic pressure of expanding colonizers. And so you have, you know, people of European descent expanding from the east and from the south via Mexico, and you have Plains Indians squeezed into smaller and smaller territories.

David Kilby [01:12:16] Harkening back to this idea of diet breadth and caloric return, one of the effects that horses and guns have is that they make it easier to hunt bison. Right? And so now, the cost of hunting bison goes down. And what we see as a result is that Native Americans turn more and more toward hunting bison more frequently because guns and horses make it easier. And their options for, you know, focusing on other foods are dwindling because they're being pushed out of their territories. You can no longer move freely around the landscape that you used to be able to, you know, freely, freely make seasonal moves and follow resources seasonally. Now you're more and more either confined to a smaller territory or unable to sit still anywhere - you're on the run.

David Kilby [01:13:14] And so, I think you see in this new historic period, this return to specialized bison hunting that really only lasts, you know, a century or so. And yet so much of our sort of, you know, whatever cultural tradition in, you know, colonial America is to see Native Americans as seeing that that's what Native Americans did always and all the time. And much of that, you know, what we consider sort of the stereotype of plains Indian lifestyle, you know, was what we witnessed as a result of that loss of territory and introductions of new technology and these very different, you know, living conditions for Native Americans than had been true a couple of centuries before.

David Todd [01:14:05] So, this may be getting out of the period that you have really focused on, but I'm curious if you have any sort of speculation about how or if Native Americans' hunting goals changed from more subsistence to maybe economic hunting for trade, you know, as the 19th century rolled on.

David Kilby [01:14:36] Sure. I think, you know, anyone on the plains got sucked into that economy, meaning trade for bison hides. I think when bison, in that short window, when bison were abundant and yet you had, you know, industrial-era trade on the plains, let's say, the late 1800s, after the Civil War, you know, you could you could make a fortune, especially with a gun. If a gun cartridge was \$0.25 and you could get \$80 for a hide and you could kill 100 a day, then that becomes just like diet-breadth models, that becomes the most economically viable adaptation on the landscape.

David Kilby [01:15:19] And so, I think Native Americans, you know, were drawn into that economy as well.

David Kilby [01:15:26] But, you know, the other thing that happened, in addition to just the hunting of bison economically, is there, you know, increasingly was this policy of trying to wipe out bison, especially on the southern plains, because, you know, the European colonists in the United States knew that Native Americans were so dependent on bison that if you got rid of the bison, then you got rid of the Native Americans. And so there was a pretty dark side to that whole era.

David Todd [01:16:00] Yes.

David Todd [01:16:04] So, maybe we can just switch focus a little bit. I think that most of the discussion we've had so far is about the modern bison and maybe the *Bison antiquus*. But, my understanding that there may have been some overlap between some very early paleoindians and the *Bison latifrons*, if I'm saying that right, that may have died out even earlier in the ... Is that possible? I mean that sounds like it would have been a brief moment but they died out I guess the *latifrons* died out maybe 20,000 years ago?

David Kilby [01:16:50] Right. And so, you know, you said, "Is that possible?" I think it's always possible. To my knowledge, we don't have any evidence of any direct interaction between *Bison latifrons* and humans. And, by that I mean we don't have *Bison latifrons* that are on archeological sites that we know are there as a result of human hunting or interaction.

David Kilby [01:17:16] But then, you know, you sort of never say, "never".

David Kilby [01:17:18] You know, gomphothere are a good example. A gomphothere is a mastodon relative that we thought were extinct long before people were on the landscape, and thought that humans would have never interacted with. And then, it turns out in Sonora, Mexico, we have this Clovis site called Fin del Mundo, the end of the world, that is a gomphothere kill. And it turns out that there were still gomphotheres in, on the Sonora landscape, as, you know, as late as 13,200 or 13,400 years ago.

David Kilby [01:17:51] And so, you know, we don't have any associations with *Bison latifrons* until we do, you know. But, on the other hand, it doesn't look like that was the bison that people were hunting prehistorically. *Latifrons* is potentially an ancestor of modern bison. It's somewhere in that, in that lineage.

David Kilby [01:18:16] *Bison* themselves are, the way we think of bison, anyway, as these, you know, woolly herd animals of the plains that are, you know, that keystone grazers of grassland environments and so on are truly an American icon. They're an American thing.

David Kilby [01:18:34] The ancestors of bison come from Europe and Asia, and they're more of a of a woodland bovine animal, you know, a woodland cow. There's a wisent in Central Asia, northern Europe, that looks quite a bit like a bison, but behaviorally they're very different.

David Kilby [01:18:51] And so, some, you know, group of those bison made their way into the Americas a quarter of a million years ago, 250,000 years ago or so, presumably across the Bering Strait when it was open at an earlier time, and make their way into the Americas and then began this sort of separate and unique evolution into the modern bison that we know today.

David Kilby [01:19:19] And that included *latifrons*, which is always worth mentioning, because they have these enormously long straight horns. Whenever you see an artist's depiction of one, you think that can't be right. You know, that's got to be an exaggeration. But then, you know, when you look at their skeletons, they really do have these long straight horns that are, you know, 8 to 10 feet wide. And they're bigger animals in general. But the horns are enormous. That's probably something you can only do on the plains, right? You can't walk through the forest with those sorts of horns.

David Kilby [01:19:55] The overall trend in bison evolution is one, you know, from that point into up to modern bison is one of gradually smaller horns and gradually smaller body size. As big as modern bison are, you know, two to three thousand pounds, you know, over a ton, and seven feet tall at the shoulder. You know, it's the smallest representative of the evolution of that genus.

David Kilby [01:20:23] And the ones that we know people are interacting with is *Bison antiquus*, which is the Ice Age ancestor of modern bison. As far as we can tell, based on both fossils and genetic evidence, it's a direct ancestor of modern bison. They were larger by about

a third than modern bison. They had straighter horns, less thickness to their skulls, which is interesting in a way that I'll describe in a minute.

David Kilby [01:20:54] And, in addition to being sort of physically different, they probably were behaviorally different. They moved in smaller herds. We don't have any indications that there were herds of tens of thousands of *Bison antiquus*, the way there are or were of modern bison. I think of them more like Rocky Mountain elk. You know, you may have cow and calf herds that consist of 50 to 100 animals, and then you have bull herds that are maybe a dozen animals or so. And the average paleoindian *Bison antiquus* kill was, you know, right around 25 or 30 animals.

David Kilby [01:21:30] After the end of the Pleistocene, when, so that's ... The end of the Pleistocene is not just a gradual transition. You get this warming and drying for over two or three thousand years and then fairly abruptly, about 12,800 years ago, you get this kind of whiplash return to Ice Age conditions that lasts a few hundred to about a thousand years. We call it the Younger Dryas.

David Kilby [01:22:01] And it's right in that whiplash, for whatever reason, that most of the megafauna check out. That's when mammoth go extinct or at least they go missing from the paleontological record. Mastodon, sabre-tooth tiger, all these other animals seem to meet their demise right there at the beginning of the Younger Dryas.

David Kilby [01:22:20] But the megafauna that survives that is the bison. And the bison becomes sort of the keystone species of the grasslands from that point forward.

David Kilby [01:22:32] And genetically, it looks like bison go through what we call about a bottleneck at that time, too, meaning they were impacted by that climate change.

David Kilby [01:22:42] But what we see coming out the other side of that is relatively smaller animals in much bigger herds. There's a transitional form that is sort of imperfectly defined called *Bison occidentalis*, which may be, you know, between *Bison antiquus* and modern bison.

David Kilby [01:23:02] And then, we see the emergence of what we would consider fully modern bison by about 6000 years ago, six to eight thousand ago.

David Kilby [01:23:10] And, one of the things that probably carried them through that big ecological change is that they have these specialized multi-chambered stomachs that allow them to subsist on lower-quality grass. Elephants, and presumably mammoths and horses and these other grazers were dependent on these, you know, high-quality, high-calorie, what we call C3 grasses on the plains.

David Kilby [01:23:40] And those contract after the end of the ice age and there's an expansion of these C4, more drought-tolerant grasses which are probably part of the reason that some of the bigger animals check out. But bison are able to exist on that, and are able to eventually thrive on the lower-nutrient grasslands.

David Kilby [01:24:04] And so, they become the dominant species on the plains, and they start to play that same role that mammoth had previously as being a keystone of the ecology of the plains. Their manure, their trails, their, you know, their existence on the plain drives a lot of the health and quality of other habitats.

David Todd [01:24:26] And did you also... so it sounds like the way the bison's stomach was configured may have helped them survive this transition from the C3 to the C4 grasses. Do you think that the configuration of their teeth, the type of teeth they had, might have helped them survive that bottleneck that wiped out so many other megafauna?

David Kilby [01:24:53] It certainly doesn't hurt. You know, most animals who are what we call obligate grazers, meaning that they must graze to live, have special adaptations for making their teeth last. Because if you're not killed at an early age by predators, it's your teeth that kill you. They wear out. Grass is very high in silica, which is glass. And so it's very abrasive.

David Kilby [01:25:17] Mammoth are kind of cool because they have big molars that cycle through their jaw, almost like shark's teeth. And so, you use them a while until they wear out, and then you spit them out and new molars move in behind them.

David Kilby [01:25:30] Bison have teeth that come in, molars that come in kind of like human molars at certain times in their life. And so, in some ways, you're conserving molar surface till later life. So they're relying on pre-molars and front molars for the first several years of their life. And then these rear molars come in and when those wear out eventually, then, you know, that's fatal.

David Kilby [01:25:58] But, certainly these adaptations to prolonging the use of your teeth are essential to grazers. And bison have that, both in terms of their teeth and in terms of being able to do this sort of ruminant digestion, this multi-phase digestion.

David Kilby [01:26:15] And, yes, a lot of people think that's key to why they survived megafaunal extinctions and why they thrive on the plains.

David Kilby [01:26:24] I say all this, but there is, you know, one of the prominent bison specialists on the plains is Lee Bement at Oklahoma. And some of his research indicates that maybe it's not C4 plants that are driving these changes in bison.

David Kilby [01:26:39] And so, that's, you know, like all things in science, I still think that's, that idea is up for revision as we get more data.

David Todd [01:26:47] Well, and what sort of role do you think humans and their hunting might have played in the gradual die-out of some of these other kinds of megafauna and actually the disappearance of some of the ancestors of the modern bison?

David Kilby [01:27:07] You know that's another one of these sort of perennial questions in archeology that makes it makes it fun, is what role did humans play in in the ice age extinctions, in the megafaunal extinctions?

David Kilby [01:27:19] And there's been sort of some extremes over the ages. Some people argue that they played practically no role, that human populations were so low that they couldn't have had much of an effect. And the other extreme is what's called the overkill hypothesis, which is that humans are the direct cause of especially mammoths and mastodon, that they have long gestation periods and low reproductive fertility.

David Kilby [01:27:42] And, they were, and they'd never been hunted by people before in the Americas. And so, they were vulnerable. And then as soon as they as Native Americans get here, they wiped them out pretty quickly.

David Kilby [01:27:55] That idea was more popular when we thought that the ancestors of Native Americans showed up about 13,000 years ago, which is the same time these animals go extinct. More and more, it's looking like Native Americans coexisted with mammoth and mastodon for well over a thousand years. So that sort of tempers that argument a little bit.

David Kilby [01:28:16] I think the more we learn about the megafaunal extinctions, we learn that it's not simple. And that's probably true of anything, you know, that you look at in science, you start realizing there's lots and lots of variables and lots and lots of scenarios and big things like that don't have any one cause. And they're more likely, you know, the result of several changes that have sort of ripple effects throughout ecology.

David Kilby [01:28:42] When you have, you know, just as an example, if something happens that reduces the number of mammoth on the landscape, as I suggested before, they're keystone species, and their browsing and their dung and their activity on the landscape is and you know, their dust wallows and those sorts of things are part of the ecology that all the other plants and animals are part of. And when you lose that, the system changes.

David Kilby [01:29:13] So, you can think of these as, you know, as interacting systems and you tinker with a couple of components in those systems and then the whole system sort of breaks down. And so, I think that's probably, you know, more likely what's going on at the end of the Pleistocene. There are several changes associated with quickly changing environments that caused this reorganization of the larger ecological system in North America.

David Kilby [01:29:43] And, you know, one of the interesting things is people are definitely hunting bison before those extinctions. They're hunting mammoth and bison. There's a number of Clovis sites that have, that are bison kills. And for some reason, you know, humans never drove bison to extinction. As a matter of fact, bison thrived, and continued to thrive even with people focusing on them in greater and greater numbers and with greater and greater efficiency.

David Kilby [01:30:14] So, I think my, you know, my perspective on that is that humans are maybe an exacerbating factor with these other megafauna. But, there were larger systemic failures that were at play, and getting a handle on exactly what those are, I think will keep paleoecologists and paleontologists and archeologists busy for several more generations.

David Todd [01:30:38] Well, good! The Full Employment Act.

David Todd [01:30:41] Well, so one other theory I've heard, and I'd love to hear your thoughts about whether there's any credence to it, is that, you know, humans were one of the later arrivals on the scene in North America and I've heard some theories that maybe they brought diseases that, you know, some of their prey species, these megafauna or maybe smaller animals as well, had no tolerance for, and you know, that they were wiped out because of not anything that the humans did, but just that they were carriers for parasites or amoebas or, you know, some sort of virus that, you know, the mammoths, the mastodons, maybe some of the early bison had no resistance to this.

David Kilby [01:31:32] I'm going to sort of beg ignorance on that question. I'm aware of it. I'm aware of that argument and that model. But I really don't have any sort of expertise to address it, except to say that, you know, that's exceedingly difficult to see in the archeological or paleontological record. And so, I think testing that notion has proven difficult, whether there are, you know, or viruses associated with it.

David Kilby [01:31:58] For one thing, it would require viruses that jump from people to, you know, pretty distantly-related mammals, which is not impossible or unheard of. But it requires that. And it also requires that these animals had had no immunity despite being related to, like in the case of bison, to having come from ancestor species that had also interacted with humans.

David Todd [01:32:28] Okay. Well, good point.

David Kilby [01:32:30] Any of my opinions on that particular model are, you know, should be taken with a grain of salt because I'm just not that knowledgeable about it.

David Todd [01:32:41] Well, you're very knowledgeable about so much of what you've told us, and I really appreciate that.

David Todd [01:32:49] You know, as we come to a close here, is there anything that you'd like to add, you know, about, you know, early human habitation in North America and how it might have overlapped with their prey, the bison in particular?

David Kilby [01:33:10] Maybe even more general than that. I think that some of the relevance of all of this research is the sort of deeply interwoven paths of humans and animals and ecological communities, and the impact not only that humans have on the world, but the way human culture and human belief systems and so on are deeply intertwined with the animals and the ecology that we interact with.

David Kilby [01:33:43] I think one of the most important sort of foundations of variability in human cultures is how they interact with their environment. And I think we're continuing to watch that unfold throughout human history.

David Todd [01:34:02] Yeah, I think you've made it clear just talking about the, you know, the various shifts in climate and habitat and the ways that people have had to respond and the animals that they share the landscape with, how they have had to shift as well. It's a remarkable kind of co-evolution, I guess, and one that we're still watching.

David Kilby [01:34:31] Right. We're all in this together.

David Todd [01:34:34] Well put. Well, I think I have wrapped up all my nosy questions.

David Todd [01:34:40] Is there anything you'd like, might like to add, just on a closing note?

David Kilby [01:34:45] Well, I'd just like to thank you for talking to me about this. This is stuff that's near and dear to my heart, and I have a great admiration for the project here that you've created and our pulling together. So, I'm honored to be a part of it.

David Todd [01:35:03] Well, we're very grateful for your help here. Thanks for taking time out today to do this.

David Kilby [01:35:09] Thank you.

David Todd [01:35:10] All right. Have a good day.

David Kilby [01:35:11] You too. Bye bye.

David Todd [01:35:13] Bye, now.