Prairie Pod Transcript

Season 3, Episode 8: Getting back to our roots: prairies do it best

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Guests: Justin Meissen, Tallgrass Prairie Center

Podcast audio can be found online at mndnr.gov/prairiepod

Transcript:

((sounds of birds chirping and wind blowing))

Megan: Hey, welcome back to the Prairie Pod. I cannot believe it, it is already, we're at the end. We're at the end of Season 3 Mike.

Mike: I know and it's been a long journey. I didn't mean that to sound negative when I said like the long journey. You know, it's been a good journey. I learned a ridiculous amount which is really the only reason I did this was to learn.

Megan: Wow, that's very complimentary.

Mike: I hope so and I mean it, yeah.

Megan: You wanted to learn. I thought you did this 'cause you wanted to spend like extra quality time with me.

Mike: Yeah, yeah. That's it exactly Megan, yeah.

Megan: You know when people hesitate before they answer, it kind of gives it away 'cause it's not like legit answer.

Mike: No.

Megan: Okay.

((Laughing))

Mike: And learn, yes.

Megan: So I'm excited to learn even more today. I mean even though this is our last episode, we're not done because we're covering one of my all time favorite topics. Do you know what it is?

Mike: Well, all time favorite topics. Roots?

Megan: Good, you read the outline. I'm really proud of you. I'm proud of you paying attention and focusing.

Mike: I was thinking about you know, we compare prairies to the ocean or to the sea.

Megan: Where is this going?

Mike: This is an analogy, Megan.

Megan: Okay, I'm ready.

Mike: And so, you know, what's going on in the ocean is under the surface - -

Megan: Oh now I'm with - - okay.

Mike: - - for the most part.

Megan: - - I wasn't - -

Mike: You know the ocean is all about life, the life is, except for birds and stuff on the surface, mostly - -

Megan: Birds and stuff.

((Laughing))

Mike: - - mostly it's under the ocean, under the surface.

Megan: hash tag Mike's a scientist, birds and stuff.

((Laughing))

Mike: And so, thank you. Prairie is very similar in some respects, not to the same extent, perhaps, but much of what's going on in prairies is under the surface, just like the ocean.

Megan: Okay, I'll buy that, I'll buy that.

Mike: Thank you.

Megan: And it's also really cool and I think there's so much that we still don't know, so we're going to cover a lot of things that we do know today and I'm very excited because there's no person that I would rather get back to our roots with than our very special guest that we have with us today. Do you want to introduce yourself?

Justin: Sure. Hey Megan. This is Justin Meissen. I am the research and restoration coordinator at the Tallgrass Prairie Center here in University of Northern Iowa, and looking forward to talking about some prairies with you guys today.

Megan: I'm excited too. And we probably should mention that while we delve into this radical world of roots, I had to say it, I couldn't help myself, -- -

Justin: Oh nice alliteration there.

Megan: - - radical world of roots. I know. If I only had a different for the W, like radical ride, I don't know. Radical world of roots. I'm sticking with it.

Justin: Sounds good.

Megan: As we delve into this, we kind of made Justin stretch his learning and knowledge too because he is not the person who's in charge of the roots project at the Tallgrass Center but we like him so much and we know that he's super fabulous and smart, and so we wanted to expand his horizons, see what I did there? Soil horizons, horizons--

Mike: Ohhh ((laughing))

Justin: Yeah, for sure. Most of my work is in like seed mix design and population biology of native plants, so this is a very cool opportunity to talk about something new and something very cool.

Megan: I know. I am really excited. So one, okay, I'm going to start with a little story. I don't even remember when this was but for one of my birthdays, I went to the Field Museum in Chicago, yes, huge nerd, we just get that out there right now. I'm not as big as a nerd as Mike because he's sitting here wearing a shirt that has different kinds of moths on it, so.

Mike: They're beautiful.

Megan: They are beautiful but I just want you to know that when he took his sweater off, I was like nice moth shirt.

((Laughing))

Justin: Don't bash his shirts. I have an awesome prairie plant shirt that I wear all the time - -

Mike: Yeah, Megan.

Justin: - - with all the prairie plants.

Megan: Hey, a coworker and myself, we have a whole list of ideas for shirts like super nerd shirts that we want to create that are all related to our conservation work, so really we could because we care. So anyway, okay, I went to the Field Museum and the reason why I went is because they were doing this whole featured exhibit on roots and prairies and they had made in one of their exhibit areas as if you were a microscopic organism going through the roots, so it's like a Honey I Shrunk the Kids moment where you're walking through the Field Museum and they had these huge towering roots that are way, way bigger than I am, and then you get to be like a little bug going through, and you get to learn about all the different things that roots are doing.

Mike: I want to do that.

Megan: It was awesome. Like it really stuck in my mind, and so I'm hopeful that with this podcast that we can sort of transport you to that type of experience.

Mike: How old were you?

Megan: That's not important.

Mike: When was this?

Megan: I was an adult. It's not a big deal.

Mike: Oh, I think that maybe that led you down this career path to where you are today.

Megan: No, I think I was like 30 or something. I was like whoa.

Mike: No judgment, I want to do it yeah, I mean, it sounds good.

Megan: Okay, yeah it sounded a little judgey but you know.

Hey, Megan and Mike here with a check factcheck update. So I actually looked this up and you can still go see this exhibit. It's still at the Field Museum, it's called the Underground Adventure, and you get to shrink to 1/100th of your size and example soil science from a new perspective. It is incredible and I loved it when I went, so you can actually still go. And while you're there, you might also want to check out the fantastic bug encounters, which they have going on right now too. Mike, want to go?

Mike: Yeah, definitely. I said I wanted to go during the episode and I meant it. I know it redirected your career, maybe it'll redirect mine to become like a museum person, developing these exhibits. Right?

Megan: I love it. Mike and I have a road trip to get to. Enjoy the rest of the podcast. Megan and Mike out.

Okay, we're going to jump in because we have a lot to cover, especially since prairie roots go down 14 feet or more. Spoiler alert.

Mike: Yeah.

Megan: So there's a lot to unpack here and they do so many things. Flood control, soil health, water infiltration, water storage, trapping sediment and nutrients, oh, my gosh, we've got a lot that we're going to.

Justin: We got a lot to talk about.

Megan: It's true. So before we get started, as always, I know that you said your title of what you do, but tell us a little bit more about the work that you do with the Tallgrass Center.

Justin: Yeah, so as the research and restoration program manager, a lot of what I do is they're designing experiments or studies or demonstration sites to sort of illustrate all these concepts and prairie restoration research that we think that other people sort of need to be able to understand when they're doing that, work on their own, so some of the stuff that we work on is seed mix design, one of the current projects we're looking at is grass-to-forb ratios and how those sort of functional groups are important in making

seed mixes. Some of the other things are looking at demonstrating different kinds of planting techniques like broadcast versus drill, all these other things that people that are going to be doing stuff out in the field can come and look at something side by side that they might have questions about.

Megan: I like it. And I should mention right now that your website, the Tallgrass Prairie Center, has an amazing number of resources that I use all the time related to restoration, so you've got this nice chart based off of your research for how many different kinds of species you should put in each functional group, like warm season grass, cool season grass, legume forb, nonlegume forb, all of that, and kind of suggested numbers of species and then, also, suggested rates like overall like base minimum seed mix rates in order to be successful, so there's that. You've got the seed harvest chart, like when to harvest seed, there's so many things. I love your guys' website.

Justin: Yes. Lots of resources, so I really encourage everyone to go play around and see what they can learn.

Megan: All right, so getting on to roots. This topic came up because last season, Jess asked me a question where she was like well how long does it take for prairie roots to grow, and I just kind of blinked at her and I was like why are you asking me this question? Because I was not prepared to answer it and I was like I don't actually know how long it takes, and so I was kind of guessing. I was like I don't know, I mean, I think they grow fairly quickly, I mean, in a one-year prairie after a season, it's difficult to dig them up but I don't really know the answers to these. So then we just as good people do, as a good scientist, we just nipped that in the bud and said you know what? We're going to spend more time researching this and we will answer that question later when we have more information, so Justin. Give us some information about prairie roots. Tell me all about them.

Justin: Sure, I mean, so we can actually, we can address that question right off the be able to, so it's kind of incredible how fast prairie roots do grow. You know, if you, so I'm just going to preface like pretty much most of my information that I'm going to share with you guys comes from one guy, J.E. Weaver, who is a seminal prairie research scientist from pretty much the entire early part of the 20th Century. So most of the information I'm going to share is from his work where he actually did dig up roots and he did tons of measurements on how the prairie root systems worked and kind of how they were different from each other. So one of the things he did was exactly this was plant seedlings of prairie plants and watched them grow and dug them up. And so even just still like a big bluestem plant, even after just three months, the roots, as long as they're in good soil, actually roots three feet deep. That's not quite full size but three feet is huge compared to they have on top, which is probably only about nine inches tall, so that actually gives you a really good comparison to what's going on under the ground versus what we see on top because most of prairie's biomass is underground, so two-thirds of the prairie biomass is actually beneath our feet, so that's kind of wild to think about. So yeah, so that's just the first year, and then in the second year, they basically get full size, so two or three years they're reaching their maximum size of average maximum size of five feet deep, five to six feet deep for something like big bluestem,

shallower roots like little bluestem, those only take like two years to get to their full size, so to answer, we have an answer to that question and that's max three years. Now, we don't have a good answer with like forbs with taproots or sort of woody systems. It's interesting because again, Weaver had some pretty interesting findings about one of the Liatris species you guys have it up in Western Minnesota, Liatris punctata.

Megan: Dotted blazing star, for those of you who don't know.

Justin: Dotted blazing star, I'm going to have to try a little harder with my botany speak. But yes, so he was finding the roots of those plants were getting 15-plus feet deep but he was able to count the rings on some of those taproot offshoots and they were 35 years old, so those might be grown a little slow where then are grassroots.

Megan: That's crazy, like I never, I'm sorry, Mike, I know you're going to say something, but I never thought about counting the rings on a forb root because they just like, and I'm ashamed to say that because I'm a prairie person but I just think of like counting rings on trees. I didn't even think about counting rings on.

Mike: So explain to me, you said 35 years?

Justin: Yes, 35 years.

Mike: I figured the roots would decompose. How does a forb grow that old?

Justin: Yeah, so you asked the question that makes it so hard to do. Age counting in forbs is a most of the roots are not something that stick around in the soil. Well, most of the roots do stick around but especially with forbs with fibrous root systems, those roots are so tiny, that they are typically decomposing, but you have like a thick taproot, that stays in the soil. It really is like a tree. It stays alive and its growth points are down, down deep in the soil, so and that's a whole cool conversation we can have about the differences between grasses and forbs and the underneath our feet, because they really different strategies as far as how they get their resources.

Megan: I read this paper earlier in prep for this, and we'll cover it more later but they were talking about how like we're always impressed with how deep the roots go, right? Because that's, I mean, we're people, so it's like wow, look at how the depth of that thing got to, it's breaking records.

Mike: I think we compare it to like pulling vegetables out of the garden, right? That's what we're used to.

Megan: Or rolling up turf, for example, like if you, you cannot roll up the prairie. There's just an incredible, like you said, two-thirds of the biomass, but one of the things I found interesting when I was reading is that they said that most of the grasses are really, their think matter roots are in that upper horizon of soil, so they're in the top like 10 or so inches, and then the for both strategy is to go right underneath that to draw their water, and then shrubs go underneath that, so it's like this layering system where these plants have just figured out how best to compete and persist with each other. I don't know, it's super cool.

Justin: Yeah, that's exactly the cases that the forbs typically scavenge through water deeper and the, even though we have something like switchgrass that's putting down roots that are 10 feet deep, 9 to 10 feet deep, it's really not using that depth to bring the water up, so it's all of our grasses focus on sort of a strategy where you have most of your roots up at the top in the top 10 inches or so of the soil, and so and that's also where all the rhizomes are at, you know, that's where all the action happens. Not all of the action but most of the action happens up at that top four inches and top 10 inches as well.

Megan: Explain to me before you move on what a rhizome is and what it does? Because I get this question a lot and I just want to make sure that people understand what is it doing.

Justin: So rhizomes are actually, so we'll probably throw around some terms that are not technically roots, such as corms and rhizomes, so those are not actually roots, they're stems that basically grow underground. So they are essentially horizontal stems of the plant that are growing underground, so they can send up shoots from the ground to the top of the, to the soil surface, and they can also shoot roots down from their growing points from the stems as well, from the rhizomes, so rhizomes are, like I said, stems that are growing underground and they form a really, really crazy dense mat in the prairie, and it's not necessarily - - sometimes it's from species that we don't think of as sod forming or rhizomatous plants like big bluestem actually has tons of rhizomes or at least the capacity to shoot up tons of rhizomes and actually Weaver looked at kind of the square foot of prairie soil and he found that around 50 feet of rhizomes were produced per square foot by big bluestem, for example. And if you think that's a lot, we can talk about prairie cordgrass, which is kind of the king of rhizomes, so the queen of rhizomes, the king of rhizomes, the royal family of rhizomes because it's true, right? They're not male or female, they're all the same. So they have a really significant rhizosphere around the prairie cordgrass, and so they're growing deeper than big bluestem and grow closer to 10 inches deep. They can use up that entire range, and then they actually have 80, average of 80 feet of rhizomes per square foot, so you can imagine just like coiling up a rope that's 80 feet long and dropping it at your feet, that's essentially what's happening here.

Mike: Justin, what's the benefit of a rhizome compared to just a stem above ground?

Justin: Yeah, that's a great question. So in the prairie, if you think about all of the challenges associated with living above ground in the prairie, you've got potential for grazing, at least the way it developed over evolutionary time, you would have bison grazing off your stems, and so that, you could necessarily rely on stems above ground to be resilient that way. And of course, we have fire too, so those are both disturbances that make it not a good strategy to devote most of your energy to growing above ground. So rhizomes are one way to do most of the cool stuff that stems do below ground where they're safe, so that's kind of the story that you'll find a lot of these prairie plants having is that they've moved the sort of vulnerable points under the ground so that you can avoid a lot of the challenges above ground.

Mike: Okay, well put. Let's move on, Justin. Megan kind of, she gave a spoiler alert earlier, they're talking about some of the benefits. Let's dig into some of those benefits more, if you would, of what prairie roots do for us and for the ecosystem.

Justin: Yeah, so I would say to kind of start thinking about the benefits of prairie roots, it's important to think about how they change the soil. So a remnant prairie soil is going to be very crumbly and granular, and it's going to be different from sort of tilled soil that will sometimes be blocky and dusty. So a lot of us have experiences with those soils, right? Kind of going to a field or urban area and picking up the soil, it's hard to break apart. But if you, next time you're out in a remnant prairie, if you can find a spot where badger maybe has dug a hole or some other fresh prairie digging, try to find some of the blacktop soil and just feel how crumbly that is. It should feel like cookie crumbs. And so that crumbly granular texture is important because it's basically providing a lot of space in the ground, so there's tons of - - so basically, that was created by prairie roots, by punching millions of holes through the roots, macro pores in the soil. Some of the roots would die and that would leave space. And so if you think about, it's kind of wild but about half of that prairie soil is actually open pore space, not quite half, but - - and so think about that. Like that's a sponge, right? So essentially, these prairie roots are creating a sponge under the earth, and so there's a lot of benefits to something like that. So flood control is going to be one of those key components, so like I said, that porous space helps hold a lot of water, and then the stems above ground are sort of creating a road down for the water comes from the sky in the ground down to those holes, and so rather than the water moving sort of as a sheet horizontally, it's getting directed downward into that prairie earth where it can be stored and moved a lot more slowly into our streams, so we don't have as much flashy flooding and stuff like that.

Mike: Cookie crumbs analogy, I totally understand that analogy, that was good. Thank you.

Megan: And the sponge analogy with the pore space. These are great analogies, and I like the cookie one too because prairie soil, remnant prairie soil because it's functioning so well and it's so healthy, if you will, it has this really spicy smell, if you guys have ever smelled prairie soil. Like it just smells better than other soil and to me, that's the function that's going on there because it's high functioning things are working as they should, there's billions of microorganisms that you can't even see that are working in there, so it's just, it has a different smell, it has a good smell. It smells rich, good earth. I like it. Any, keep telling us more benefits.

Justin: It does, it smells awesome. I just want to, so one of the cool things that Weaver also showed us, he looked at - - this is we're going to move aboveground really quick. I'm just going to give you a cool little factoid that a lot of the water that can be stored by the prairies is also above ground based on the surface area of all of the grasses and the forbs, so there's a ton of water, and you know this, if you've ever walked through prairie in the morning, that you are basically - -

Mike: Taking a bath.

Justin: - - might as well have taken a bath, so that's another cool little, you know, I think that's pretty cool, so one water gets stored above ground as well as below ground, so.

Megan: That's awesome. Leaves are trapping it as well as droplets on there, the stems and everything else. Yeah.

Justin: Yes.

Mike: Justin, you're getting at some of why it's a challenge sometimes to restore a prairie though too, right? Because of the restructuring of the soil once it's been cultivated, it's basically you really changed the structure of the soil.

Justin: Yes. And so there's a lot of - - there's definitely a literature out there that's sort of looking at that. The ability for restored prairie to provide similar kinds of belowground ecosystem services as a remnant prairie. What we're finding is pretty much that it is really hard to, and I don't know that they're except for a few circumstances ever able to match the ability of a remnant prairie to provide stuff like soil organic carbon and other things like that. But prairie restorations make a huge difference getting close to that. They get often somewhere close to about 60% in a lot of those areas of returning those ecosystem services belowground.

Mike: Even if they're not as good as remnant prairie, they're better a parking lot, right?

Justin: Absolutely, they're much, much better.

Megan: Well, and we're getting better too. I mean, I think as we continue to learn more and understand more, the goal right is always that we could get closer and closer to that remnant prairie state, whether or not we get there is in some ways irrelevant because it's part of this journey to try to get there, and the better we do with more diversity and all of these things that I'm trying to push us towards with our seed mixes and stuff, hopefully the closer we can get. But like you mentioned, structure is the hardest thing I feel like to achieve in a reconstruction. We often have not just the same heights above ground but I would imagine very similar heights below ground and we don't get that nice differentiation of structure like we do in a remnant prairie. It's still one of my big - - it's a challenge.

Justin: Yes, Megan. I would love. Let's talk about that because the diversity of plants belowground is obviously directly related to the plants aboveground, so it does matter what we're planting as far as a diverse prairie mix if we're doing a prairie reconstruction. So Weaver sort of classified, was able to classify prairie roots into three categories, so you have your shallow-rooted plants, which are about two feet deep, so that was only like 14% of prairie plants out there, and they're all grasses, so like June grass was an example of that. Then there was an intermediate group, which were growing at about two to five feet, and that was 20% of the prairie plants, so that was definitely like little bluestem, prairie dropsied, porcupine grass, and then most of the plants were deep-rooted. So 65% of prairie plants are more than five feet deep, and so that's our - - any grass in big bluestem are our forbs as well, so we have some massively deep roots out here as far as forbs go, like prairie grows 20 feet deep, compass plant 14 feet, leadplant is 16 feet deep, and those all have sort of - - those are all taproots but there's sort of a rich types of taproots as well, so you have your typical kind of thick root that goes straight down deep into the soil without much going on except at the base of the root, and that's stuff that we're talking about, leadplants, or sorry, not leadplant, leadplant's a

little different, the classic taproots are more like the compass plants and the roses. But leadplant is actually an interesting one because it has a sort of a branching taproot, sort of the spreading taproot, and it's actually prairie shoestring for a long time while the prairies were being converted to agriculture, so they had sort of these sharp snapping sounds as the prairies are being tilled back in the day that sounded like people were just like breaking shoestrings and so they, so it actually has a common name related to its destruction, so it's pretty interesting. So yeah, so that's definitely a unique kind of growth form of some of our prairie forbs. And then, of course, we talked about rhizomes, which are creating a pretty important sort of a syndrome of root, which is like a rhizome and a fibrous root system, so a lot of our asters are like that, and they still get pretty deep too. One thing, which interesting to me is you guys know pussytoes, right? Little, yeah, antennaria for those of us in the botany world but those are like at most reaching like three to four inches tall but they have roots that are four feet deep, so just think about that.

Megan: Oh my gosh.

Justin: That's really crazy.

Megan: It is crazy.

Justin: Yeah.

Megan: So all of these roots and everything, tell me you mentioned carbon sequestration earlier just a little bit but I always get this question from folks that are like oh, well forest are - - they do such a better job at carbon sequestration. I'm like well, we're not really competing. We need lots of different types of habitat but prairies play a vital role in this too. So talk to us a little bit about the benefits that they provide for carbon storage.

Justin: Yeah, so certainly, the prairie remnant soils are massive stores of carbon. Thousands of years of biomass production, decomposition, those represent something particularly unique, and so kind of rooting those prairie remnants is a huge source of carbon release, and so that's kind of our first strategy here if we're talking about managing carbon is keeping prairie remnants healthy. But as far as a remnant or a restoration goes, it's really the key is to compare it to what other land use was beforehand, so if we're talking about heavily tilled field that was a source of carbon that was depleting the carbon in the soil, now we're talking about a system that is sequestering carbon from the atmosphere and putting it into not only biomass underground and aboveground but also building up soil organic carbon, which has been a large created from the microbial activity by having putting roots in the ground, and so that is typically something that is challenging to totally restore, but in general prairie restorations are good examples of carbon sinks at least for their first stages of the restoration and as you get old restorations, the ability to store as much carbon sort of peters out a little bit but for sure they're not still not a carbon source. Mature restorations are sort of carbon-neutral or depending on how much you burn, a little bit of a carbon sink, so.

Mike: Gotcha. Justin, you mentioned microbial activity associated with the roots. Can you tell us more about that? I mean, it's something I'm interested in especially I think as an ecosystem underground as a whole, how the roots help support that entire ecosystem.

Justin: Right, so it's kind of similar to how we think about aboveground ecosystems. The ultimate source of energies coming from carbon in the atmosphere and sun and the great plants are converting that energy into roots that go belowground, so now there's a new source of carbon and that is once those are decomposed, those die, there's opportunities for bacteria and fungi to decompose those roots. And so there's tons and tons of different kinds of bacteria, tons and tons of different fungi. There's really important sort of mutualisms that happen with the prairie roots, so fungi in particular, there's fungi called arbuscular mycorrhizal fungi and they colonize our (inaudible) 34:14 roots.

Megan: No, it's a great name. Arbuscular mycorrhizal fungi.

Justin: Call them AMF usually. But they are very important symbiotic partners with prairie plants and they help to do a lot of things and some of them help scavenge for minerals and in exchange for the carbon from the starches from the plant, so fungi uses the carbon from the prairie plant and then the fungi can, and then the prairie plant uses the minerals or other benefits that the fungi is you know - -

Mike: That's really interesting, yeah.

Megan: Yeah.

Justin: Yeah, so other important aspects of those fungi, fungal associations are there lots of those fungi that have colonized the prairie roots as providing some degree of pathogen resistance, so if you already got a colony of beneficial fungi in your roots, then it's less likely that you'll get pathogens in there as well, so. And it's important in prairie restoration too, and so there's a lot of cool research looking at how do we cultivate and plant the right microbes and the fungi in particular with our seed mix, and that's pretty cool research that's happening right now that I think is important direction that prairie restoration should probably take.

Megan: I'm super interested in it. I have all of these theories about leadplant, which we talked about earlier about how we often see a delay in when it shows up, especially if we put it in, in seeds, and so there can be plantings where we planted it and we don't see it for like 15 years or 12 years later, and all of a sudden, we have leadplant, and so I have this firm belief that there's a connection that needs to be forged in the soil that doesn't happen until that you don't see leadplant until that's built, and so this is my theory. I don't know if it's true but there's just so many things going on in that soil ecosystem that I have this belief that that is some, for some reason, that's driving why we're not seeing leadplant as soon as we might hope to see it. There's also prairie succession too, so I mean there's some other things going on, but (inaudible) 36:53.

Justin: Absolutely, yes. That is exactly some of the hypotheses out there that have support behind them, which is that if you inoculate later successional prairie plants, more conservative species with some key fungi, that they'll actually be a lot more robust

and they'll grow faster, so you would expect to see them earlier, and so that's, which is why I think it's very promising research.

Megan: Yeah, well I'm building healthy soils and prairie soils that didn't just happen overnight. It took thousands and thousands and millions of years, and so this is going to bring us to our fun fact section, I have one that I'm going to start with, and then we'll kind of round robin with our different fun facts. So my fun fact that I want to start with about roots is that there are more microbes in one teaspoon of soil than there are on earth, people on earth, than there are people on earth. So I got to say it right or else it's not as impressive. Well, let's do it again. Okay, there are more microbes in one teaspoon of soil than there are people on earth.

Mike: So more than 7 billion.

Megan: Yeah.

Mike: Wow.

Megan: Isn't that incredible? My NRCS friends gave me that fun fact and I was like that is terrifying and also fascinating. Like there's so much to learn. Mike, do you want to give a fun fact?

Mike: I do. I don't know many. Yes, I do know this one. Okay. Prairies have the ability to absorb an X inch rainfall. So what is X?

Megan: Oh, this is a math problem that we have to do. You want me and Justin to guess?

Mike: Well otherwise, if I just said it what fun would that be?

Megan: Well it's a fun fact, so you're just supposed to say like oh yeah.

Mike: It's eight inches, eight inches of rain. I know you guys knew that but for me, that's what Justin was saying earlier about it being a sponge. And the vegetation, the layers of vegetation catching the rain, slowing the absorption, eight inches.

Megan: That's pretty cool because if you think about it.

Mike: I can't remember an eight-inch rainfall. When was the last time we had an eight-inch rainfall?

Megan: Well, think about it like this. So if you, what the pattern that at least we saw last year through much of Minnesota at least in particular Southern Minnesota is that you would get this inch rainfall and then it just never stopped raining, right? So then you'd get a half inch, and then you'd get another inch, and then you get another inch, so it's really sort of this cumulative thing where the rains were coming so close together and they were so much more than we're used to receiving, that if you think about it, then the prairie is well-equipped to take that in as you get an inch and then an additional inch and additional inch. I don't think they're talking about like a Noah's Ark moment where we're getting like it's a flood, people, and there's going to be eight inches all at once.

Mike: But all these funny, these funny problems we've had in recent years, prairie is potential solution, isn't it?

Megan: Absolutely. Prairies and wetlands working together.

Mike: And wetlands, yeah.

Megan: Yeah. Absolutely. Justin, do you have a fun fact for us? I have a fun fact question to you ask, you don't have to play - -

Justin: Sure, sure.

Megan: - - how long does it take to make an inch of prairie soil?

Justin: Okay, yeah, so I should have been prepared with my fun facts because I already gave them at the very beginning. I didn't know we were going to save for fun facts for the end.

Megan: That's why I just asked you this one because I don't - -

Mike: Megan does this kind of thing a lot...

Megan: - - Just want to hit the spot.

Justin: Bummer is that I have no idea how long it would take to make an inch of prairie, so it would depend on so many things.

Megan: Megan and Mike here for factcheck number two, take it away, Mike.

Mike: Okay, so we looked into this question of how long it takes soil to form a little bit after the recording, and no real specific time period to give you here but bottom line is it is complicated. There are several different things involved in forming soil. The parent material, topography, climate, the organisms that live in soil, and of course, time. And the bottom line is something like anywhere from 30 up to 1000 years to form an inch of topsoil, depending on all those factors, potentially centuries. So Justin is right. It's complicated but certainly, it's a long time.

Megan: And if you're interested in learning more about this topic, Justin provided us with two awesome papers, one of which just came out in 2020, and it's *Soil Health Recovery After Grassland Reestablishment on Cropland: The Effects of Time and Topographic Position* and that's in the Soil Science Society of America Journal. And then one that you might want to check out is from 2008 and it's called *Temporal Changes in C and N Stocks of Restored Prairie: Implications for C Sequestration Strategies* and that's in Ecological Applications. We'll make sure to put both of these up on our website but stay tuned for more and enjoy the rest of the podcast. Megan and Mike out.

We're just scratching the surface here of what's going on underground, so we're going to have to have even more podcasts where we talk about this one, and I think the reason I put this in here is because in that Field Museum exhibit, they answered this question and I can't remember what the answer was. It was on a little plaque on the wall and I remember looking at it and reading it and thinking to myself wow, that's a long time. But I don't remember how long it was, so dang it.

Justin: Yeah, for sure, and there's also issues of the biota, the soil biota, restoring the soil biota. So you know, creating an inch of prairie soil is a lot more complicated than I think we often consider it to be. Figuring we can just kind of plant a couple grasses on an old field and figure that we've got things covered. I think it's more complicated than that and there's a lot more we don't know about there's going to be important questions that need to be answered about the microbial communities that need to be restored and plant diversity, and all these things, so.

Megan: There's so much we don't know, which now we're going to cover some things that we do know, so I think it's time for our next section.

Megan, Mike, and Jess: (Pre-recorded) LET'S SCIENCE: TO THE LITERATURE! Science!

Megan: Okay, so this is the part of the podcast where we get to continue this amazing discussion about roots and bring you some of the latest and not so latest research about roots since like Justin has been mentioning this whole time, a lot of the research was done by Weaver in his original book, which was we'll just say several years ago. So I'm going to start with my pick and I already mentioned this earlier, but there's this prairie ecologist, Chris Helzer did a blog post on a deep-rooted prairie myth. And so it kind of gets to this idea that we thought for a long time that prairie grasses have such deep roots because they're basically in times of drought or stress, then they would be able to pull water from deeper in the soil profile, but that's actually not true, that's not what they're doing. We don't know what those deep roots are doing. So he's kind of talking about how most, and we mentioned this earlier that most of the moisture and nutrient collection is really happening in that top foot of soil, those top 10 inches, especially for grasses. We know less about what's going on with forbs, Justin mentioned that as well, we do know that they're going to pull from the upper profile of the soil that they're not pulling water any deeper than 30 inches, even though some forbs like you mentioned have roots that are going feet deep. So we don't really understand basically why prairie roots have, are so deep, like we don't really know. I know, right? So it's a deep-rooted prairie myth. So there's a team out in Nebraska who's doing lots of research into this and then I think the key thing that I found out from this article, there were two things that I thought were pretty interesting. One, they're actually surviving drought not necessarily because they have deep roots but because they're doing more with less. And I think that resonated with me because in our conversation jobs, I feel like sometimes that's we're like prairie roots, we do more with less, and so it says that they're just better able to manage that scarcity and live and survive on less water, which I thought was pretty fascinating because it's not really something I think about for our temperate climate. It's something I tend to think about with like cactus or things that are growing in southwest United States, you know, desert plants. I don't really think of our temperate plants being able to do without as much moisture, but there you go. The other thing that I think is super cool is that it's still a mystery. Why you so deep, prairie roots? We don't know. So it's exciting because I like when there's mysteries because it means there's even more for us to learn and discover.

Mike: Yeah, yet another example why prairie is a frontier.

Megan: It is a frontier.

Mike: Kind of like space or the deep ocean.

Megan: You're going back to the ocean analogy.

Mike: Yeah, I can't help it. So many similarities.

Megan: So many similarities.

Mike: There are no whales in the prairie, but you know, yeah.

Megan: No. Well, I mean badgers are you know - -

Mike: There ya go.

Megan: - - just as cool as whales. They're - - ((laughing))

Justin: Prairie sharks, but yeah.

Megan: Yeah, they're more like a prairie shark. ((Laughing)) So my second pick for this one is the National Geographic Digging Deep Reveals Intricate World of Roots. So this is an article that they put out. It features some fantastic photography by Jim Richardson, who's a National Geographic photographer. I think he's also an independent photographer. I had the opportunity to hear him speak at a Soil and Water Association conference in Indiana. This is like, I don't know, 10 years ago now, something like that, and not only is he an amazing speaker, it's the type of presentation that is just awesome to sit there and listen to because it's all pictures, right? Because he's a photographer, and he's an amazing photographer, so he's showing you, he's taking you on this tour of discovery through images, which I am a visual learner, so this is really helpful for me, and he did the same thing with this Digging Deep article, so he worked with Dr. Jerry Glover, who is at the Land Institute in Kansas, and they figured out a way that they could grow prairie roots in these 55, well, grow prairie plants in 55-gallon drums and then in PVC tubes, and then they broke the drums and the tubes apart and washed the roots and then took a series of photos detailing all of them, and it's crazy. Like this matting that we're talking about happening in the upper profile of soil, you can see that and then you see that taproot that Justin is talking about with the forbs, and then you can see those deep roots that go down even further. It's impressive. All right, Justin. Tell us about some of your picks.

Justin: Yeah, so for my LET'S SCIENCE, I want to plug this, I mean, it's a book, it's free online, it's hosted by University of Nebraska's digital commons, and it is a J.E. Weaver book called *Prairie Plants and Their Environment*.

Mike: I downloaded it last night.

Justin: Yeah, and it's like okay, it's pretty dry but if you do nothing else, just like scroll through and look at the pictures because.

Mike: That's what I did.

Justin: This is where all he cool, all the cool pictures of the prairie plants are. And I think one of my favorite sort of drawings or visualizations is he sort of creates this imaginary

block of prairie soil underground that goes however many feet deep and he just kind of draws the different roots in 3D and kind of really gives you interesting sense of space.

Mike: That's a cool image.

Justin: Yeah. It's one of those things that gets you kind of into this new sort of idea of fascination that I've never considered conceiving of a prairie in that way before, and I think that the images that he created in that book are good ways to get, a cool sense of wonder and plus it's old fashioned, good old science back when you were digging up prairie roots and measuring them and it's cool. It's a good book.

Megan: I like that you said there's a sense of wonder. One of the Jim Richardson, the photographer that I was mentioning, one of his quotes that he's known for is he said if you want to be a better photographer, stand in front of more interesting stuff, which I think is just great. And then they asked him to explain what he meant by that and, of course, what he means is that it's your job as a photographer to transport, like to explain the subject and why it's interesting through photograph, and so it sounds like Weaver was really able to do that as well, so I love a good picture that helps paint what's going on for me. Okay, give us another one.

Justin: So the second thing I want to plug is Tallgrass Prairie Center's roots project. So we at the Tallgrass Prairie Center tried to carry on the work that Weaver does in sort of giving people this sharing the wonder of what's underground in tallgrass prairies, so we have as part of our roots project, we do grow native plants in these root pots that are 9-10 feet deep, and then we grow them in this interesting turf mixture, turfus mixtures, like kind of what you would see on a baseball field, and so the roots grew in that, then we crack open those tubes and we pull them out with a crane and then we crack them open, and then we wash them out, and then whether these, we preserve them and so we have these root specimens that get sent to primarily in the past, they've been sent to Iowa nature centers. I think now we're doing more sort of widespread distribution of those. And then we also have root posters, so we have life size prairie plants basically that include the belowground components, so these are banners that are you know, kind of how tall are they, they're six feet tall plus nine feet, like 15 feet tall, so you have to have like a big building to display them at all. And we actually have a lot of folks who have done prairie restoration on their farms or, and they're just excited about it and they want to show people like what - - they want to show people that this is going on above and belowground and I know some people who are buying those root banners, hanging them in their barn, and using it to share that. So that's pretty cool. So yeah, there's a lot of excitement out there for prairie roots and prairie roots project is a good thing to check out, it's on our website, so yeah.

Megan: It'll be on our website as well. We'll post all of these.

Mike: Hey, can I get one of those prairie root displays, not a poster but the actual prairie roots?

Megan: No, I was going to ask for one.

Mike: I beat you, okay?

Megan: We're going to need two.

Mike: Our office is Sakatah State Park is where I want mine, okay?

Megan: Yeah, well I'm going to put mine out front at the headquarters.

Mike: But again.

Megan: Why do you think that your, - -

Mike: I beat you.

Megan: - - okay, here's the deal. Justin's a super nice guy, I bet we can work out some off-podcast deals where we can figure out how we can support their project.

Mike: Justin, you and me buddy.

Megan: ((Laughing)) And we get here - - they're super cool and they're the kind of thing that's great for education events that we do like Farmfest or other things like that where you can just visually see oh, my gosh, look at those things.

Mike: Yep.

Megan: They're really well done. We're giving lots of street cred here. You guys are doing awesome work.

Justin: Those definitely get the most attention at Field Days you bring out the prairie root, and then you put, and you just grab a handful of whatever is on the ground, like big bluestem and put it on top, people get it. Once they see it altogether like that, it's pretty cool.

Megan: There you go. Well because this is our last podcast episode before we leave our LET'S SCIENCE, I have some other podcast recommendations that I'm going to make here. So there are lots of great people who are podcasting, there are lots of great SCIENCE! podcasts, and so Mike and I just wanted to direct you to a few of those, so the first one, because we're on this topic of prairie roots, which also is improving your soil health, is by the Natural Resources Conservation Service. It's called Stay Undercover. It's really fun, they talk about all of your soil health related things, and walk you through different conservation practices, it's a good listen. And then our friends over at Three Rivers Park District also do the Wandering Naturalist, which is a really fun podcast. They cover lots of different topics, like they did one on snow and they explained all the benefits of snow and why it's important and what's going on, they also cover things that are in the park or that you'll see, and so it's a really good one. And then - -

Mike: How about Shortwave Podcast NPR?

Megan: I might say that's one of my favorites. I shouldn't have favorites but I kind of do because even though we designed this podcast so it's a little bit longer, it's a deeper dive, what I like about Shortwave is it's 10 minutes of the latest science research, and they sort of rotate through the disciplines.

Mike: And there's some really fun topics.

Megan: There's some really good ones like they do cover natural resources and conservation topics but it's in the rotation again with these other disciplines, so they might, you'll learn about the latest findings in medical science, for example, or health or climate change. They did one on this lady who studies the upper canopy of trees. It was one of my favorite ones. And so she also made a natural resources Barbie, so which was amazing to try to get kids to understand that they have different career options. She was only on for 10 minutes, right, and I was like I want to meet this woman. Like she's my new, I'm her biggest fan now.

Mike: Haven't you bought one of these yet?

Megan: No, I haven't bought a Natural Resources Barbie, Christmas ideas, Mike, Christmas ideas.

Mike: Okay.

Megan: Jess got me a seed harvesting milk jug bell. You can get me a Barbie because that's not weird at all. ((Laughing)) But they are really cool and actually I think Mattel now makes them officially so they're basically, anyway, you should listen to Shortwave. It's a really good podcast. And then our state parks, many of our state parks also offer podcasts. They're on the individual state park pages and they go through the history of that state park, interesting things about how it came about, how it's changed through time, the one that I recently listened was Whitewater State Park and it's really well done, their naturalist there walks you through different things. And of course, naturalists are excellent at their jobs and they're really good at relaying information and so they're easy to listen to and really well done. Okay.

Mike: Hey Megan.

Megan: Yeah Mike?

Mike: Take a Hike.

Megan: I'd love to take a hike with you and Justin. Road trip Iowa.

Mike: That's true. I would like to go to Iowa.

Megan: I know. There's a lot of really cool things to see.

Mike: I only drive through it on I-35 and I never look around. Well, I look around but I don't explore what you guys have got down there.

Megan: You might need to get out of the car and explore. Justin, give us some places to explore, not necessarily in Iowa, just where should we hike?

Justin: Yeah, so I did my dissertation work in Northwestern Minnesota, so I have a very fond feelings for the prairies up there. So I would say take a hike at Bluestem Scientific and Natural Area up by Fargo and Glendon Moore specifically. And there's actually a, so we're talking about prairie roots, there is this I don't know of very many other places in the tallgrass prairie region that has a sort of functioning remnant prairie stream in it but there is a prairie stream that flows very gently and the water is crystal clear and it's very cool. So that's just south of the headquarters there and it's a very cool plant

community there and yeah. Also that's where the prairie chick is boom too, so we can book some blinds in May, that's also a good one.

Megan: I like it. Mike?

Mike: Mine is Schaefer Prairie. It's a TNC, The Nature Conservancy property. The reason I picked it was it the really first prairie I visited in depth when I started here in Minnesota several years ago. Well, the real reason I picked it is because it's midway basically between Hutchinson and New Ulm and I think it was basically the closest remnant prairie to Hutchinson. It feels kind of like it's out in the middle of nowhere but part of my message with that pick is that if you're in Southern Minnesota or Northwest, as Justin has talked about, you're never too far away from some remnant prairie. I'm guessing, I'm just guessing here, within half an hour, 45 minutes probably of being able to drive to someplace that is remnant prairie, and it's publicly accessible.

Megan: We're pretty lucky in Minnesota because through a lot of efforts of conservation individuals and landowners really working to protect those remnants, so this is a totally different landscape than what I am used to.

Mike: Yeah. So that Schaefer Prairie, it's a cool, it's not that small, it's kind of a medium sized little prairie, and I've really enjoyed whenever I need a prairie fix, I hop in the car and run to Schaefer when I was working at the Hutchinson.

Megan: Okay, so mine is Pipestone National Monument because why? Because I'm a sucker for a junior ranger badge. But in real life, it's also just a super cool place to go. It is managed by the National Park Service, and so it's a historical monument, as you could gather from the name, Pipestone National Monument. One of the things that I love about it is it has this trail that I think is called the Circle Trail that goes through the property and you can see the pipestone quarries, which are still active, there's still tribal peoples who that is pipestone has much significance for them and so they mine that for different ceremonies and other things. There's historical markers. You can see the old stone face. And then probably my favorite is the Winnewissa Falls that are out there. They're just, they're really cool, it's all pipestone rock around there, it's just this beautiful red rock that's also sometimes to me it looks a little bit purple too, so it has these different shades, and there's these big boulders there that have moss covering it and you can get some pretty neat shots where you feel like you're just transported to a different time. And I really like learning about different cultures and the visitor center does a great job of talking about the significance of that area and how tribes have used it through time, and I just think it's fascinating and interesting and a really special place. It feels holy to me when I go there. I don't know. I just feel kind of instantly at peace, whether it's the prairie or the history that I'm getting from it. I don't really know but or because I'm just a sucker for national parks or National Park Service managed sites. I don't know. It could be a little bit of all the things.

Mike: I need to get there, it sounds like.

Megan: You do need to get there and if you have, if you're a super nerd like me and you have a passport, a National Park Service passport, you can get a park stamp in it, so.

Mike: Okay, good to know.

Megan: Mike's just looking at me like wow, you just took it to the next level. Hey, this is a real thing and it is Megan Benage's life goal to get every single National Park stamp in her book.

Mike: I wish you the best in that.

Megan: It is also my mom's life goal and this is kind of a funny thing. The other day she was like I'm never going to reach my goal because the Park Service keeps making more parks. So how am I supposed to reach my goal if they keep adding more after I've already been to that state? And so I thought it was really funny thing to complain about. Of course, she was joking obviously. She thinks it's a great thing that we're expanding and having more national parks so that we can preserve these treasures across the landscape because that's what they are. They're treasures. So don't forget, you can check these out on the DNR Recreation Compass to find more of your amazing public lands like Mike said. You're never too. I like that, Mike, you're never too far from a prairie that you can get your fix, visit, decompress, recharge, I like it. Wow. I cannot believe that we just wrapped another season of the Prairie Pod.

Mike: Well, I've really enjoyed it and I sure thank you for letting me - - I give you a hard time sometimes. - -

Megan: We'll I've enjoyed it with you.

Mike: You are, of course, adept at giving it back, so.

Megan: I enjoy it with you more with you than I thought I would. ((Laughing)) I'm not going to like compare you to Jess because I don't feel like that's a fair comparison.

Mike: It is not a fair comparison, absolutely not.

Megan: But I have enjoyed this tremendously, I really like this time with you. I'm so glad that Justin was able to join us today. I'm always impressed with the depth and breadth of your knowledge. I mean that in all sincerity. - -

Mike: Me too.

Megan: - - Like you're just a fascinating person and I love being able to work - -

Justin: Thank you.

Mike: I don't know you that well Justin and I feel the same way after an hour of talking to you.

Megan: We all feel so close to you. We're going to get bracelets that are going to be made out of prairie roots twined together.

Justin: You need to come down to Iowa and we can absolutely.

Megan: We'll just fill out our out of state travel requests one year in advance and we will be there, buddy.

((Laughing))

Mike: Sorry Justin, before we close off, I want to make sure I acknowledge my program that I work with for the Department of Natural Resources. It's the Nongame Wildlife Program. I am a nongame wildlife specialist working within that program, so it's due to them that I was able to work with you on this Prairie Pod. I think they support the Prairie Pod in other ways I know sometimes.

Megan: They do, they absolutely do. They help us making our podcast accessible, which is incredibly important, so they help us with transcription so that way anybody can learn and participate in the Prairie Pod.

Mike: For our listeners, a very easy thing you can do to support prairie conservation and prairie is a big emphasis because it's the most threatened terrestrial ecosystem in North America, right, if not the world.

Megan: There you go.

Mike: It's a big emphasis for us in the Nongame Wildlife Program, so support prairie conservation donating to us is a very simple step you can take. We are mostly dependent on donations. We don't get any revenue from general tax funds. So to support us, go to our website, the Nongame Wildlife Program, go to our Facebook page, it's easy to donate.

Megan: It is. There's a little handy button that you just click and then you just donate. And you can also donate directly to the southern region. You can mail a check to our headquarters here and you can just write in there that you want it to be donated to our program specifically because there's a nongame program as a whole and then we do different things across the state as well, so.

Mike: Yep, yep. Oh, and I should mention taxes, there's the chickadee check off or the loon check off on income taxes that makes it easy to donate some of your return.

Megan: I don't think I've ever heard chickadee check off before but I really like it.

Mike: Nice alliteration there, yeah.

Megan: Chickadee check off. Well, okay. It's hard to believe it but we are at the end here. Don't get too sad because there's lots of Prairie Pod episodes to revisit and relisten to. We just want to remind you to rate us and review us on iTunes. It is how we draw people in so that they can get some of this prairie knowledge. It brings in the great prairie peeps like you. So we just want to say from both of us thank you for listening.

Mike: Thank you.

Megan: It's great. We love doing this, we hope you're enjoying it, feel free to send us ideas about episode topics, that's what we love the most, season 3 basically built itself through your recommendations, so thank you for that. And I hope and we both hope and Justin hopes too that you have many more days on the prairie yet to go. So don't forget to get out there and explore especially in my favorite season as the bluestem turns purple, the Indiangrass gets golden, and the prairie dropsied starts to smell like buttered popcorn, it's my favorite. As always, you can find all of the LET'S SCIENCE! and Take a Hike resources on our website at mndnr.gov/prairiepod. This episode was

produced by the Minnesota Department of Natural Resources Southern Region under the Minnesota Prairie Conservation Partnership. It was edited by Dan Ruiter and engineered by Jed Becher. Thanks, you guys.

Mike: Thank you.

Justin: Yeah. Thanks, Megan.

Mike: It was good.

Justin: It was fun.

Megan: It was fun.

((sounds of birds chirping and wind blowing))