Prairie Pod Transcript

Season 3, Episode 3: Diversity makes the world go round (Restoration series: Seed mix design part 2 and research update)

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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! Woo hoo! We're here and we're excited to be here with you! Mike are you excited?

Mike: Woo hoo.

Megan: ((Laughs)) It was like way less enthusiastic than mine.

Mike: Well you just don't know me, okay? That's enthusiasm right there.

Megan: Wow, it was – I hope that comes through to our listeners.

((Laughter))

Megan: The high quality enthusiasm right there. So Mike and I are recording today over Skype. We are virtually away from each other, but through the magic of media we get to see each other through our cameras and so we hope that we're going to bring to you a very good podcast because today's podcast, we're talking about the D word? Do you know what D word is Mike? Do you know what it is?

Mike: Dalmatian? I don't – that was just the first thing that popped into my head or - -

Megan: Wow! Why is that the first thing that pops into your head like D word – Dalmatian?

Mike: Blacked out.

Megan: I don't think that would be my first – I don't know Dunkin Donuts maybe? Diversity, Mike, diversity! That is the D word that we're talking about.

Mike: Right, right, right.

Megan: I am super excited to cover this topic. As many of you know, if you've been listening for a while, this is like the podcast foundation. It's our theme. We bring it up a

lot because it is critical for building a functional healthy, resilient reconstruction that's going to play its part in the bigger prairie landscape. So we also happened to cover this topic more in depth in season one, in our pilot episode and in episode 5, What Goes in the Mix Makes the Cake, where we talked all about seed mix design. So if we don't cover those things today and you want to hear the more in depth, feel free to go back to season 1 and enjoy the dulcet tones of Megan and Jess, as we bring you some easy listening from the prairie.

Mike: Oh, boy.

Megan: Oh, boy.

Mike: Yeah. It's, it's a very interesting topic I think and it's deceptively complex. I think people think about diversity, it's a pretty straightforward thing in people's mind initially, but really when you start digging in - - just as an example, like when I was looking through some papers reading up for today a little bit, some of those papers that focus on species diversity are like half, or not half, but there's a lot of math, there's a lot of scary math in those papers.

Megan: Math is not scary, Mike. Embrace it. Math is beautiful.

Mike: No.

Megan: Math and science hand in hand, life partners. Okay, sorry. Too far?

Mike: You might run screaming with a couple of these papers in care.

Megan: Well, math, when you're talking about diversity and in particular when you're talking about trying to build something back with reconstruction, you basically are a prairie engineer and that's going to involve a lot of math to figure it out, and we don't have all the answers, we don't. We're constantly learning from our mistakes, I would encourage anybody who's listening to not be afraid to try something new because that's how we learn something new when you try something new. But I'm really excited to jump into it. We're going to go through some key research updates. It's just Mike and I today, so we get to really bond with one another. We're going to talk about the seed mix design, plants and pollinator relationships, wildlife benefits, and so much more. Mike and I may even duke it out to see who has the best diversity knowledge. Science!

Mike: Yeah, bring it.

Megan: "Bring it." You sound very convincing, like I'm very afraid. Well, we should jump in.

Mike: Yeah. Maybe defining diversity. Again, kind of deceptively complex to really define it.

Megan: It is deceptively complex and I even - - so if you're new to prairie reconstruction or if you're just wanting to plant a prairie in your backyard, I don't want you to feel like put off by these terms because Mike and I have been doing this for a long time and I know other folks have been doing this for a long time, and we still struggle with trying to make sense of what these definitions actually mean because when you spend so much time on the prairie, it's more like you just get a feeling, a sense of what it means when a

site is right when it's resilient. And then when you have to like step back and define that, it's a little bit intangible in some ways, to put it into words. So we're going to attempt to do that for you to do because we just want you to be on the same page with us.

Mike: To be clear, you said we've been doing this for a long time. Prairie reconstructions I have not, just to be clear, or even just the world of prairie ecology is - - basically, I'm five years into it in my career. So wildlife ecology and forest ecology a long time, but I still have a lot to learn, and so I feel like I may be a bit of the question asker in this episode, Megan.

Megan: Well now I'm scared. Like I was expecting you to bring all this knowledge. Come on, Mike.

Mike: Well, I certainly - - you know, with diversity as a concept in general but applied to prairie and prairie restorations, there's a lot I need to know. I need to learn, Megan, so teach me.

Megan: Well, the first step is in knowing how to fix a problem is identifying that you have a problem, so good job.

Mike: Thank you.

Megan: And I don't want to undercut, I mean, I know I could. I'm feeling generous today and so I don't want to undercut your knowledge, like while you may not be a specific expert in prairie reconstructions, you are certainly an expert in wildlife biology, and so as you said, all of those concepts funnel into one another so that we can understand the bigger picture of the landscape. So what is diversity?

Mike: Yeah. I was just going to bring up I think when most people think about diversity, generally they think about species richness, right?

Megan: We do, which is the count, right? It's the number of species on a given site or the number of species in your seed mix.

Mike: So even that simple measure can get, there complexity there especially when you're talking about scale, like just when you want to maximize species richness, are you thinking of anything from like a small vegetation plot that's like one square meter and you can go all the way up, of course, to the global level or a continental or a regional level. So all those different scales matter when you're talking about maximizing species richness. They all matter and it's important to define what level you're talking about.

Megan: I'm really glad that you started talking about scale and also at that small scale right away because one of the things that we know from looking to the literature is that diversity at small spatial scales is really important for resisting invasion. So I always think of it like this when you're planning the diversity for a site, you want to be thinking of the level of a bison, you want to be thinking at the level of a prairie chicken, and then a chick, and then a little tiny skipper, which is a butterfly, and then the larvae. So if we're planting walls of grass, this is not good for any of those levels other than maybe the bison, right? Like they're just going to eat that grass up, yum, yum, yum. But in order for that prairie to be functional and renewed the way it should be, even the bison need that

diversity there. So I like to think about if we can't make it easily through a prairie, then neither can these other levels, so I always tell school groups like get your bison eyeball on, now get your prairie chicken eyeball on, now your chick, and we make them kind of shrink into smaller and smaller levels and see how hard it is to make their way through the prairie, so scale.

Mike: I really those analogies. Yeah. And that also brings up the topic of structure, which I think maybe we will address that later instead of now.

Megan: We will. So the other important measure in diversity is essentially a measure of richness, which we said is the count, and evenness, so how those species are distributed across a site.

Megan here. Quick fact check update. So I wanted to make sure that I just take a moment and do a really good job explaining species richness and species evenness because I didn't do such a good job on our first cut of the podcast, and Mike and I are going to get in a really interesting conversation about this as the podcast goes on, and we're also going to talk about how the spatial distribution is also really important. So richness, just to be clear, is the measure of the number of different kinds of species present in a particular area. As opposed to evenness, which compares the population size of each of the species present. Let me put this a different way for you. So let's say I had 10 purple coneflowers on a site and I had 1,000 pasqueflowers. I wish, right? Dream prairie right there. But even so, that is not very even because there's a huge gap in the population size of the pasqueflower and the purple coneflower, so what we're searching for is populations that are a little bit closer together. Like I said, there's also the scale part of diversity and how things are spatially distributed, which I think is super important and also very interesting. All right. Hope this makes sense. Fact check update out.

And I think evenness is the one that I hear most people forget or they just - - I don't hear a lot of people mention that one. They associate diversity with richness, like how many species do I have, but then that second component of diversity, which is vital to any successful planting, that evenness, how can I make sure that I don't just have purple coneflower like one in one spot, like I need lots of them all across my prairie so that way I'm providing a lot better habitat for a lot of different things at all of these different spatial scales because that matters. Another way that people refer to this is abundance of species. So sometimes, they sort of associate evenness with abundance, but abundance only gives out a piece of it because abundance gets to the notion of how much of a certain species you have but to me, it doesn't talk as much about how it's spread out spatially across the site or across the landscape, depending on what scale you're looking at.

Mike: There are indices for evenness that I'm not going to detail at least, but if you want to go online and look up the Shannon Weaver index or sometimes it's called a Shannon Weiner index, W-e-i-n-e-r.

Megan: I used this index like way back in grad school and I used it. It was the Shannon Weaver.

Mike: I think some people just call it the Shannon index.

Megan: It's probably easier.

Mike: Maybe somebody's not getting credit for what they did.

Megan: Well, we're going to mention Weaver later too because he's one of the first folks who looked at all of the prairie roots. So when we end out this season, that's where that fellow comes from. He's all over the place.

Mike: Do you think he's really the person in the name of that index?

Megan: I don't know. Now I kind of want to know.

Mike: It's possible. Weaver is a fairly common name, of course.

Megan: It's true, right. We'll factcheck it.

Megan here. Quick factcheck update number two. Okay. We solved the mystery. Mike is right. It is not the same Weaver as the roots Weaver, which we're actually going to talk about in episode 8, our final episode of this season. So the Weaver reference in the Shannon Weaver index is actually Warren Weaver. And in fact, while he builds on the communication theory mathematics, which is foundational for the Shannon index, he was not the original author of the equation developed by Shannon. Here's what happened. Shannon's work is summarized in a joint book coauthored by Weaver. The book contains two sections or two reports, which are republished versions of previous reports from about 14 years prior. So the first is entitled *The Mathematical Theory of Communication* by... Claude E. Shannon. The second by Warren builds on this and is entitled *Recent Contributions to the Mathematical Theory of Communication* by Warren Weaver. Now, where does Wiener come in, W-i-e-n-e-r? Sorry for earlier misspelling. So Shannon's work builds on Wiener's earlier papers, which set the foundation for the index through his basic philosophies and theory, which Shannon is the one who puts it all together. So Mike was right in his assertion that it's sometimes just called the Shannon index and really that would be the most accurate because Shannon first published the work in 1948. Woo hoo! Go Shannon. All right. Fact check update out.

Mike: I mean, the one lesson from this, though, is that I would argue that any single measure, whether you're using species richness or one of these evenness indexes, we should always be careful about trying to maximize any one measure without thinking about what it means and usually, multiple measures, in this case, both species richness and evenness should be considered.

Megan: Agreed.

Mike: And I think also it's important to remember that at some point, we have to think about individual species and if we're all we trying to do is maximize diversity everywhere, we're not thinking about individual species and their status on the landscape. We could run into problems.

Megan: What do you mean we're not thinking about individual species? Explain this to me, Mike.

Mike: A prime example - - well, I'm not sure if it's a primary example - - going to the forest world, which is where I have experience previous to my job here at the DNR, old growth forest has inherently pretty low species diversity, at least vertebrate wildlife species diversity is probably good for like lichen diversity or something.

Megan: Liking the lichens.

Mike: So if we're all we're thinking about is maximizing diversity at a local scale, we'll never include old growth forests in our management plans, and that would be a mistake. There are species like goshawks, for example, that use mature forest or American martens that use mature forests. And so keeping that habitat on the landscape to keep them in the region is important, even though it's unnecessarily meeting the objective of maximizing local diversity. So those are forestry examples - -

Megan: Local being the keyword there.

Mike: Yes.

Megan: But it contributes to the bigger landscape fabric and diversity of what we want to have out there. So okay, I'm going to push us to expand our view of diversity even bigger than richness and evenness. I think that we should also in these particularly important reconstructions when you're, again, trying to mimic a remnant prairie and build something back, you really need to be thinking about phenology. And that is just a fancy word that means timing of flowering. When does it flower? And so I will always advocate that you have stuff in there that is blooming for the whole season, early, mid, and late. Because that way, you're providing floral resources for all the critters that need them in that specific time. This stuff is not rocket science but it is complicated. They have evolved over thousands of years together, these critters and these flowers, and so if you're not providing them when you're building a prairie back, you're starving something out of your planting, and you know more about these wildlife impacts, Mike. But that's how I think of it. I think of it as I want to make sure that I'm giving you food and resources that you need to live because the more pieces that you have, and I don't just mean vegetation pieces, I mean larvae, I mean insects, I mean mammals, I mean herbs, all of these things, the more that you have, generally, the healthier and more functional your site is because all of those things are playing a unique individual role. That's what I love about prairies. That's what I love about ecology is you get to look at all the different pieces and see how they fit together with their environment to form this beautiful whole, which is the prairie ecosystem. Oh, I'm going to tear up, Mike. Hang on, got to get a tissue.

Mike: Me too.

Megan: I'm getting emotional. But so all this from timing and flowering. But it is, and Aldo Leopold in his books I think one of the things that more than at least in my mind, more than any of his scientific research, just how he describes seasonality and the changes that he observes on his farm and his homestead, it really speaks to me because it's something that we can all share. Like spring ephemerals when they come on. We often talk a lot of times about how unsteady nature is because you talk about a hurricane or a wildlife, all of these things and how unexpected that was, but nature is

also predictably stead in these reassuring ways as well when stuff is functioning well, so like when spring ephemerals come up, they're going to come up. The flowers going to bloom, the rain is going to come. There's some, I don't know, reassurance in that. See? I'm just on a little soapbox here because diversity - -

Mike: No, it's well put.

Megan: - - makes me excited.

Mike: Well put. Yeah.

Megan: Oh, gosh. Tell me something else about diversity.

Mike: The other aspect - - yeah, here we are. Structure. Structural diversity that you brought up a second ago. And I think often, structural diversity and like plant species diversity will go hand in hand. Mainly one simple reason is because plants have - - different species have different structures, like grass compared to most forbs, for example. Grass is dense, can be at least, dense, and forbs tend to be more disperse, easier to walk through, and so that has implications for wildlife. It's interesting for birds, which is a large part of my background, of course. People often associate dense, thick habitat with good bird nesting cover, and that's not entirely true. There's a lot of research showing for many species, perhaps, even most bird species, that they want structural heterogeneity, structural diversity where they nest, and in general where they spend their time.

Megan: And it's different for different species, right? I mean, they're not - -

Mike: Oh, yeah. There's variability. Yeah.

Megan: There's lots of variability. This is the largest - - oh, sorry. Go ahead.

Mike: I was just going to say, it's kind of surprising. I think people expect nests to be typically placed in very dense places where they can hide. But kind of counterintuitively, they like openings around their nests quite often, and I think that allows them to see, to sense predators if they're approaching, it also allows them to escape, and so that's just an example of why structural diversity around a nest, around any wildlife habitat can be important.

Megan: We've talked about this on the podcast before, and basically what you're describing there when you talk about dense nesting cover is where we were with prairie reconstruction years and years and years ago and now where we're headed, which is realizing that we really need to find a way to incorporate these different elements of diversity into our plantings. And structure I feel like, I've said it before, and I'll say it again, I feel like it is the largest thing to recreate because when we plant prairies, we often plant them with a climax prairie in mind but they're not in a climax state, like when you have soil that's been disturbed and the structure and biological processes aren't what they would have been in an unplowed or intact site. That takes time to build back and there's even research that shows that soil is probably one of the last things to recover. And I find that very fascinating because I believe a lot of how what we're missing in how prairies progress in a reconstruction is that soil knowledge and understanding of what's going on there. And we're talking about billions of

microorganisms that we need to study and understand how they're making these connections. That's not easy. It's not easy to figure out what's going on. And I also think the old model, right, where you plant like the big five tall warm season grasses and you plant like 10 forbs and just go like this ((hand dusting)), brush your hands, and be like "Woo hoo, that's a prairie!" is not a prairie and does not function in any way how we would want it to. They tend to be very weedy and not able to resist invasion because they're missing the pieces that would make them whole.

Mike: I'll bring up that I think there's potential for species diversity and structural diversity to not always align. For example, if people think that to increase species diversity means to increase the amount of seed in a restoration or to increase plant density overall.

Megan: Right.

Mike: If you're just adding more plants to get higher species diversity and, therefore, increasing the density of vegetation in a prairie, that could be a problem for structural diversity.

Megan: Yeah. One of the hardest concepts I think to wrap your mind around when you're in the seed mix building stage is that when you actually add diversity in, you're doing the opposite. You're planting less things because you need to have a space for all of those other things that you want to grow, to be able to grow. And so it kind of freaks people out, like when you're used to planting, let's say, 10 pounds of a warm season grass mix or five pounds and now you're down to one, that's a little unsettling because there's this question always in the back of your mind of is this going to work? Like, what have I do? Because it's so out of the norm of what you might have experienced. Like you just want to be sure you get cover, but the thing that you have to lean into and rely on is that while you might have less of this one guild, you are fulfilling a lot more other guilds and it will grow. Like it is going to happen. And so you can't be afraid of those amounts. Plus, would you be doing everything in seeds per square foot because a pound does not equal a pound for most species because they have different seed counts. And so to get a really reliable understanding of how that seed is going to perform, you really need to be doing the math to know seeds per square foot. You're still going to order everything from a vendor or you're going to harvest everything by weight because that's the metric that works. A seed vendor has to be able to weigh something out to give it to you, but it's a much more reliable estimate to have seeds per square foot, so you know how much seeds you're actually putting out.

Mike: This is because small seeds, you can have many thousands in a pound.

Megan: Oh, like 200,000. I think Junegrass has 200,000 seeds.

Mike: What's an example of a bigger seed that would have like several hundred in a pound?

Megan: Like milkweed.

Mike: Okay, yeah.

Megan: Milkweed is a really big, flat seed. And there's lots of interactions there about are you a sea turtle planter, are you not? And what I mean by that, I use this analogy a lot because I just love it. Everybody has an image in their mind, right, of like all the sea turtles running, not running, but crawling to the ocean, and then you're like oh, it's beautiful, the babies are so cute. And then seagull, like they make a lot of babies because a lot of babies are going to die. And so there's a similar parallel with our plants that make up a prairie where some species make a lot of seeds because they have not a great establishment success, and so but it's not always true, though. There are also some species that make a lot of seeds and they grow a lot of plants, like black-eyed Susan has a lot of seeds per ounce and you're going to get a lot of black-eyed Susan. But you take these things with a grain of salt, like if it's a sea turtle plant, then like Junegrass is a sea turtle plant, you can plant a ton of that and it would not express as a ton of that on the landscape, so you need to make sure we're using that practitioner knowledge, that scientific research, and everything to kind of build the full picture. I'm on a rant.

Mike: By the way, the listener couldn't see you there, but when you were mimicking the predatory seagull, that frightened me, it really did. You were going down for the kill.

Megan: One of the negative things about podcasting is that I talk with my hands pretty much constantly, so maybe it's a good thing that our listeners can't see all of these gestures that I make. There are a lot of gestures.

Mike: That was an effective gesture for sure.

Megan: Thank you. All right. So we talked about this but you talked about scale and spatial scale, and that's something that's really important in our reconstructions to think about because if you put out a quadrat, let's say you put out like a 1-square-meter, 1x1.

Mike: Yeah.

Megan: Plot. And you look within it. If you don't have diversity within that small scale but you have diversity across the whole planting, you're still going to have problems with invasion. Like diversity is important at every scale that bison, that prairie chicken, that chick, and then the skipper and the larvae. Like you need it for all of those. Do you have anything else you want to say about scale?

Mike: Well, that's interesting and I'm not necessarily disagree with you on that, but I am going to wonder.

Megan: Well, you can disagree. I pulled that from literature, so that's not just Megan Benage philosophy.

Mike: Hey. We both know that nobody ever lies in literature, right?

Megan: Wow ((Laughter)) wow.

Mike: No, the only reason I wonder is because I know for a lot of species, patchiness, I'm thinking about mainly wildlife species, patchiness of habitat matters. So we talk about structure, there's vertical structure, like having openings and heights, plants of varying heights, there's also horizontal patchiness where you've got clumps of plants in

some areas. And so if you have clumps of plants in certain areas, that can be beneficial and really sometimes required for some wildlife species.

Megan: That's true.

Mike: And inherently then in those clumps, you're going to have lower species diversity.

Megan: That is true. I think what this article was specifically talking about, and they weren't looking in a plot as small as 1x1, but what they mean is that if you just look at diversity as a measure across your site level and you don't look at a more finite plot level, and there's not diversity within that more finite plot level, I don't think what they're saying is you need to have every species that you plant and represented in that plot. What they're saying is if you don't have those guilds filled at that micro scale, then something else is going to fill that guilt for you, like a cool season nonnative grass like brome or Kentucky bluegrass or something like that. They're going to fill in where they're allowed to do so, so I think it's more kind of speaking to that. I agree with you. Patchiness is really important for wildlife, so it's complex. How do you both create patchiness and make sure that you have good diversity at a finer scale and a bigger scale?

Mike: Yeah. Study up on that, Megan.

Megan: Get right on that. On the last piece that we really need to think about is functional heterogeneity, and you mentioned heterogeneity earlier, and so I'm going to punt this one to you for you to further explain that.

Mike: Okay. Well, tell me if this is what you're thinking. When I think about function, I think about things wildlife habitat, I think about things like ecosystem services that prairies provide for us. They filter the water, they store water, they sequester carbon, those kinds of things are functions that prairies serve. So when you're talking about functional diversity, are you talking about diversity of those kinds of functions? Like we want prairies that do multiple things for us?

Megan: Well, yeah. I'm thinking about the ecological processes but I'm also thinking about the variability in the system, so that like you would want to include plants from different families, for example, because plants from different families would play different functional roles within the prairie. And so functional heterogeneity is just another way of really saying diversity, in my mind, but you are thinking about how to affect ecological processes so that they work, which is exactly what you just said. Or at least that's what I heard you say. I heard what I wanted to hear.

Mike: Yeah, you're right. I'm really talking about, I mean, a restoration, in order for it to be something besides a nice garden, it's got to have these functions. That's what we mean by functional.

Megan: Well, to make it even more simple for people to understand, this means that you're feeling the guilt, so you have cool season grasses, you have warm season grasses, you have sedges and rushes, legume forbs, and nonlegume forbs because all of those play a different functional role, and same when you expand that to looking at plant families, there are different characteristics or traits that that family provides that

lend themselves to that bigger hole. I'll give you goldenrod as an example. People always pick on goldenrod. They talk about how it's like ah, that's a weed and it makes me sneeze and all this stuff. Okay. Truth bomb moment. Goldenrod is not making you sneeze unless you have a general flower allergy. Like in that case, it might be making you sneeze. However, most of the time, it's ragweed that is making you sneeze, which is blooming at the same time as goldenrod. It's just less visible because its flower is kind of like a green, white thing that's not as showy as something that is this beautiful yellow plume. Goldenrod and asters are a super important late season bloomer and we tend to think of it as this weedy plant, but there are lots of different kinds of goldenrod. Showy goldenrod, for example, is just what it says, very showy. There's also a goldenrod that's like less than a foot tall that grows on some of our dry hill prairies, and those are really important for all of our wildlife species that are out at the end of the season. There's some of the things that hang on the longest, and so they're providing because of their bloom season, they're providing a specific characteristic or trait that would lend themselves to the functionality of the whole. Does this make sense?

Mike: It does. Yeah. You and I really, we are talking about two different kinds of function.

Megan: Okay.

Mike: I think we are. I'm talking about like the benefits of prairie and you're talking about the different functions, the different guilds, the different kinds of plants serve towards the functioning of that, of a prairie ecosystem.

Megan: Well, maybe that's just two ways we need to think about it.

Mike: Yeah, I think it is. Another example is grass is an important structural component for bird habitat, for cover. It's also important for like skippers, for prairie butterflies, and then you have forb resources that provide pollen and nectar and important resources for pollinators. That's another kind of functional heterogeneity that really you're talking about I think, right?

Megan: Yeah, because I'm - - yes, yeah. But it is the bigger concept of functional heterogeneity is what you first described where you're looking at how things contribute to ecological processes.

Mike: Yes.

Megan: And I would argue that by filling those guilds, you are contributing to those ecological processes.

Mike: I think you're right, yeah.

Megan: So I would make a strong case like you're never going to hear me not say that you need to fulfill the guilds. That is part of our main problem that we have historically not filled that cool season guild with native forbs and native sedges and cool season grasses that are native, and then we have all of these issues with the Kentucky bluegrass and brome and everything else because nature is going to fill the hole for you.

Mike: What's the main challenge with filling that gap? Why haven't we done it historically?

Megan: Oh, gosh. This is like a whole other podcast, but mainly one, it's education. Two, it's seed source, being able to find those species in reliable quantities that you could put them out on a landscape is a challenge. There's also a challenge with how we have typically done combine harvests of prairies, so typically happens later in the season, and so therefore, anything that is cool season and in that early guild has already dropped. Sometimes, it's an issue of how difficult the seeds are to hand harvest because not all seeds, it's just not like going out there and being like oh, an apple, oh, another apple, oh, another apple. Like that's not how some of these plants produce their seeds. Some of them are quite difficult and if you have a seed that requires very labor-intensive hand harvest or you have a seed like prairie phlox, for example, that shoots, like it shatters and then shoots its seeds projectile out across the prairie, okay, you got to put nylons on it and bag it, and then it looks like very strange in the prairie as you zip tied nylons on all the prairie phlox so that you can catch the seed before it shatters. There are different dispersal mechanisms that make it difficult for a vendor to just be like oh, yeah, I'm just going to grow a production field and have more of the seed, because they tend to be things that are very labor-intensive to collect. Not all early plants or not all native cool seasons are like that but that is a challenge, and I would argue that instead of us spending our time - - this is Megan Benage soapbox moment. Instead of us spending our time combining common species like big bluestem and Indiangrass that probably don't have the genetic limitations of other things, we should focus more of our efforts on setting aside that time to be hand harvesting species that we can't get but are really important in fleshing out the overall diversity. That's my soapbox.

Mike: It makes sense. Yeah. Come on down.

Megan: Come on down. It's slippery.

Mike: You can step up there. That makes sense to me. You bet.

Megan: Good, I'm glad. So the last piece is phylogenetic diversity, and that's a fun word to say, phylogenetic. So this is talking about including species that are distantly related evolutionarily. This is one that I have the hardest time wrapping my mind around because I feel like we know so little about the individual genomes of plants. I don't even know, like it's hard for me to know where to begin to make sure I'm considering this level of diversity.

Mike: Yeah. It seems to require a lot of like in-depth knowledge of these plants to ensure that you're doing that.

Megan: It does, and we're talking about, okay, so I'll use corn for an example. Corn is an incredible plant, it really is, and what it can do through crossing and other things is pretty amazing because it's a very southern species, but that's - - look at all of the time and energy and money we have put into understanding the genome and the processes of that one species. Now we're talking about being able to do that when you're talking about prairie for hundreds of species.

Mike: Right.

Megan: So I just look at the time it took for us to get familiar with that one species, which is an important agronomic crop, and I think of all the time and energy and effort it's going to take to fully understand the genetics of all of these prairie species that are really important.

Mike: So why would it be worth going through the trouble of understanding these plants more in depth? I mean, why is phylogenetic diversity important?

Megan: Well, I would give you the simple answer that - -

Mike: I'm having trouble wrapping my brain around it.

Megan: Well, all levels of diversity are important. But partly because you don't want to have prairies that are closely related to each other because, again, it gets back to that functional heterogeneity. So I'll give you an example.

Mike: Yeah.

Megan: If we harvested all of our seed from one source prairie and then we plant all of that seed out, there's going to be a limitation to the genetic variability and I don't want to be too graphic here, Mike, but basically, what you're doing is you're creating a lot of brother-and-sister prairies that are then crossing and then making baby prairies. And as we know - -

Mike: So that's genetic diversity.

Megan: Right, right.

Mike: Okay.

Megan: And so I think that ties into phylogenetics where you're trying to include species that are distantly related evolutionarily because again, there's species that have evolved differently and responded differently - - this is how I think of it - - to different climatic regimes or other things like that where they would be able to withstand some pressure differently. I don't know if I'm explaining this very well and it's probably because it's still something that I struggle with it.

Mike: Partly - - so we're talking about genetic diversity between species and also within species, correct?

Megan: Mm-hmm, yeah.

Mike: Like the brother/sister example you just talked about, that's within species. That's why within species, genetic diversity is important.

Megan: Right.

Mike: But between species, like having - - species that are distantly related evolutionarily.

Megan: Don't you think that is for fitness, like how they would perform in different climate?

Mike: Yeah, that makes sense, yeah.

Megan: I don't know. We're going to have to factcheck this.

Mike: Maybe it's just especially important with climate change, right? That as our climate changes rapidly, like it is doing, ensuring that you have some species in that prairie that can handle that change means having phylogenetic diversity, doesn't it?

Megan: I mean, that's how it makes sense to me, but we'll definitely insert an update here because this is the part where Jess Peterson gives a really good talk about this and I wish she was here now because she would just set us straight.

Megan and Mike here, fact check update number three, number three. Okay, so layers of diversity, diversity is super, duper important and first off, I have to apologize because when we were talking about functional heterogeneity. I went down a rabbit hole and started actually talking about phylogenetic diversity because I was describing how important it is to have different plant families in your planting, right, Mike?

Mike: Yeah. I mean, which makes sense to me, yes.

Megan: It's important. It's a layer of diversity that we need to include and we got this term layers of diversity from Jess Peterson because as we referenced in the podcast, wishing that she was there, we phoned a friend. And so I chatted with her and she's basically saying that phylogenetic diversity, we can measure diversity in so many ways, right? And this is just how many species of each family there are in your planting, and that's important because like we said, those families have different traits. Mike, I don't know why I was overcomplicating this when we went down a long genetic road and I thought it was very valuable and you provided super important definitions and context for our genetic discussion.

Mike: You weren't overcomplicating, okay? I think you were getting at all these different layers that we're talking about. There are - - we can sit here and try and list them, maybe too long as a fact check if we did, but within species' genetic diversity, the between-species diversity, which is kind of this phylogenetic diversity I think, right? The number of different families, right?

Megan: Yes, yes. And so that's what you were getting at and you were actually explaining it really well. So if you want to think about including this in your planting, you do not have to know the entire genome of a plant. That would be helpful and really good but instead, it'd be helpful for many reasons. But really, just include lots of different plant families and while we're talking about functional heterogeneity, include lots of different guilds because all of that contributes to the ecological processes of the prairie. Whoo I hope we got it all in there. Thanks, Mike.

Mike: Thank you.

Megan: Factcheck update, out.

But what you just said about climate brings us into why does diversity matter, and so I do want to explain diversity in a way that I think will make sense for people, or I hope it will. So first of all, the reason why we focus on diversity and why we keep hammering it in every podcast episode that we do is because it's our foundation. Chris Helzer says it's the foundation upon which resilience in prairies is built. And so he is a prairie

ecologist with the Nature Conservancy. We give shoutouts to him all the time because he says smart stuff. So I mean, it's our foundation, right? But the other, so Kevin one time, he used to be our environmental review person who reviewed all of our permit documents, and he one time asked me to explain diversity to him, and I was like, he asked me to explain why it was important, and I just like looked at it and I go because it is, get on the boat, man. Get on the boat. And he's like yeah, I'm going to need you to explain it a little bit better than that. And this is the trouble, right? Like we get into these modes where it becomes such a foundational concept or principle for us, that we forget how to translate it because it becomes more of a feeling than a definition - -

Mike: Well, that's a good point.

Megan: - - and here is my definition that I gave to him. You ready for this?

Mike: Okay. Put it on me.

Megan: You better seatbelt yourself in because this is going to be great, so. The more diverse a planting is, the better chance it has at long-term health and self-sustainability, which translates to lower management cost. Over the years, there will be variations in invasive species pressure, soil conditions, and climate, such as extreme drought or extreme moisture. Having a diversity of plants ensures that more species are able to adapt to these extremes and can therefore respond to changing environmental conditions.

Mike: Okay, I like that.

Megan: That's what I said, that there's an ebb and flow of climate, and you need, and, and that's why we have to get out of this box of this is what a prairie looks like because sometimes, people have like an idea of their very favorite species that they like to see in a prairie and they're like oh, if I don't see those species, then my prairie is not doing well, when really whatever the climate is doing should change the composition of your prairie through year to year, if you have the foundational diversity built into it. It shouldn't look the same every year.

Mike: That sounds good. I think it's just important to have, put the caveat in there that.

Megan: Okay, caveat.

Mike: Diversity is very important, maybe it is, maybe saying it's the foundation is the right way to put it, but it can't be the only consideration, especially when you're just talking about species richness diversity.

Megan: Oh, but we're not, we're talking about all of the other richness, evenness, all of the other things. That's how we're defining it.

Mike: Structure.

Megan: Yeah. Structure.

Mike: Structure is important. And again, that idea of diversity at different scales is important.

Megan: Phenology, all of that.

Mike: We don't want to neglect a low-diversity ecosystem that some species rely on.

Megan: Oh, I agree with you.

Mike: So, yeah. So that is the danger, I think, of overemphasizing diversity.

Megan: What are you trying to say, Mike?

Mike: It could lead, I think it has at least from the forestry world, sometimes it might have led to people solely focusing on local diversity and neglecting a diversity at larger scales.

Megan: Well hopefully, this podcast episode is helping spark the little brain neurons in everyone to realize that diversity is bigger than just at a local scale.

Mike: Yeah.

Megan: See?

Mike: I think it is.

Megan: Okay, so the other reason why diversity is super important is because if a site is diverse, and again, when we're talking about diverse, we're talking about all of the ways that we are defining it as we have said throughout this episode, we're talking about not just richness, not just evenness, but we're also talking about phenology, timing of flowering, structural, different heights, spatial scales, and functional heterogeneity, so that was just quick recap of all the ways we're thinking about diversity here. So diversity can resist invasion. There are lots of studies that point to this. So if you have something that is functionally rich that, again, you have those guilds filled, those plantings are more resistant to invasion. Species and functionally rich plantings mimic the diversity in remnant prairies, which is something we always want. Planted species are better competitors of invaders if they are functionally similar. Native cool season grasses in particular are successful at resisting invasion to cool season invasives. And this is like a whole bunch of research that was put together in the early 2000s up until like 2010, and I was remised in saying this, Mike, but all of this is - -

Mike: Really?

Megan: I was remised, I was remised.

Mike: You were remised.

Megan: I was remised. All of this is summarized in Jessica Peterson's fantastic factsheet, which we're going to put on the website, entitled Prairie Restoration Diversity: Planting and Seed Mixes. All of this stuff that we're referencing today and the literature, she has packaged for you neatly in a little two-page factsheet. What could be better than that?

Mike: Why are we even talking?

Megan: Just read the factsheet, people. Just reach the factsheet. You know what we should have done for this episode is like we should have put on our story time voices and just read the factsheet. ((Laughing)) They're like now Mikey, read paragraph two.

Mike: Once upon a time - -

Megan: Once upon a time, there was.

Mike: - - there was a prairie restoration. All right.

Megan: Okay. All right. We have to move on. So we're going to move on to our last portion of this main topic, where we just - - I just want to give a quick summary of reconstructions and the factors that affect diversity and I want to put those into two categories, Mike. Ones that are in our control and ones that aren't in our control. This is all in Jess' factsheet too. Explain that again.

Mike: Again.

Megan: But the things that are in our control are the planting method that we use, how dense we're going to seed a site, what is our grass-to-forb ratio, what's our density of dominant species like big blue and Indiangrass. I would always argue that you really need to be putting those no more than 1% of your mix and I would say even that can be too much. I guarantee you they're going to be present and dominant in your site, even if you put them in your seed mix at a low rate. So then you also, if you're thinking about density of dominant species, you need to think about density of nondominant species, your sea turtle plants, ones that are going to take a little bit to establish or they need something that's missing in the soil to come on, or this idea that we talked about earlier of we all want an instant climax prairie. There are certain plants that because of prairie succession, should not necessarily be there in the first or second year of a prairie. There are plants that are climax species that come on later. You have to allow succession to occur even in a prairie, and that is a challenge if you're only going to see the site one time because it's like you have to build in all the stages of succession into that one seeding, so that is a challenge. The big one, inclusion of plant functional groups. Sometimes you hear referred to as guilds. That's those cool season grasses, the warm season grasses, the sedges and rushes. Yes, there are sedges for upland sites, legumes and nonlegume forbs. Those are all playing really big.

Mike: Did you say early season forbs?

Megan: That is included. So okay, so that's different than my functional groups. So that's my phenology, my diversity phenology timing, like bloom time. So good point, Mike. Good call.

Mike: Gotcha.

Megan: So those things are in our control, though, what we put into the mix, how we plant the site, that's in our control. The big ones that are not in our control are the individual site conditions, the entire past history of that site, every choice that has ever been made on that piece of land will contribute to its future, every choice matters. And then climate. I always tell when they're like well, do you think if I do this, will it work? I'm like tell me when it's going to rain and I will tell you when it's going to work. Like, or if I

do it this way, do you think this will work? Okay, well tell me when it's going to snow and I'll tell you when to seed.

Mike: That seems unfair, Megan.

Megan: I know. It's very unfair of me, but if we were able to predict that, we would be way better at this because climate is variable and all what I will offer to people as a what I hope is a reassuring tidbit, I guarantee you, you are not going to fail. No matter if you try something new or however you set out to do this, you are not going to fail. Something will grow.

Mike: Just whatever the mindset, okay.

Megan: Something will grow. It may not be your vision of what you hoped it would be but that's part of the fun of seeing how it turns out, and I know like I take this, I'm not saying this flippantly because I take our role as stewards to the people of Minnesota very seriously and so I'm not suggesting oh, yeah, just plant a half a million dollar seed mix and whatever happens, it's fine, like don't even worry about it. What I'm saying is that we do need to lean in a little bit into the resilience, the inherent resilience of prairies and nature as in the Jurassic Park movie said, nature will find a way. We need to - -

Mike: You said that just like you said that.

Megan: Yeah, like it will find a way. Like it does, it does.

Mike: You know we're into some quality science when we're referencing Jurassic Park.

Megan: That is, I know such a good movie. Such a good movie. But anyway. I just think that I see people a lot of times, they're paralyzed by the fear that they're going to make the wrong decision and if you make sure that you follow these guiding principles and you have diversity as your foundation, your backbone, you're not going to fail. I have done so many plantings in my career and I have not yet seen one where nothing grew. Like that has not happened. I even have had sites where they flooded for 12 days right after we seeded and it was like oh, man, we are in a pickle. Like we're going to have to reseed this whole thing.

Mike: Like a bit mud plat, yeah.

Megan: Yeah, and you know what? They grew. I don't even know how those seeds hung on, I don't know how they weren't washed away, I don't know how they stayed viable under gallons and gallons of water, but you know what? They did. Did it look like I anticipated it would? No, but it actually looked better in that case, so anyway. Mike. Do you think it's time to take this science on the road?

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

Megan: Woo! We made it to the part of the podcast where we're going to science. Of course, we've been sciencing this whole time like super nerds that we are and I love it. So this is where we recommend a book, a blog, or a paper, and so I'm just going to plug one more time the diversity factsheet that Jessica Peterson put together called *Prairie Restoration Diversity: Planting and Seed Mixes* available on our website under Season

1. What goes in the mix makes the cake. That's episode 5. We always try to do a good job of getting our resources up on the website for you all. Mike, do you want to take it away with your science pick for the day?

Mike: Okay, happily, thank you. The paper I chose is called *Effects of Biodiversity on Ecosystems Functioning: A Consensus of Current Knowledge*. So this is a nice summary of, as it says, our currently knowledge on what diversity means for ecosystem function. It is a bit dated, what was the year? The year was something like 2005, 2004, accepted in 2004 it says here, so yeah, it's dated. So I'm sure some stuff has been done since then but you know, one of the important things that we've talking about here is ecosystem resilience or stability and how diversity benefits that. So it's an important point to make that much of what we're talking about, the empirical field, like experimental data that supports that, it's out there but it's not huge. Like in fact, some of the best research out there that supports what Megan and I are talking about was done right here in Minnesota. David Tillman at Minnesota, University of Minnesota. Most of his research - - can you remember of the place, Megan, where he did his research? Cedar something? We may - -

Megan: Cedar... ((Laughter))

Mike: Exact name is not coming to me. Point is much of the research, we're talking on a global level for the relationship between species diversity and ecosystem resilience was done here in Minnesota. This paper, one thing it categorizes findings into certain and uncertain and like big questions.

Megan: Cedar Creek! Sorry. It just came to me.

Mike: Cedar Creek. Yes, thank you.

Megan: You're welcome.

Mike: That's where Tillman did his research. One thing they say here we have high confidence in the following conclusions, and one of those conclusions is that susceptibility to invasion by exotic species is strongly influenced by species composition. So that goes right along with what Megan was saying, that we can't say with high confidence that species diversity helps stop invasives, which is probably the most, if not one of the most, important things we do in prairie management, right?

Megan: It is. We struggle with it.

Mike: So there is, however, still a fair amount of uncertainty when we're talking about ecosystem stability like surviving climate change and surviving disease and surviving big disturbances. How species diversity helps ecosystems survive those things, there's still a lot of questions. The amount of solid field or experimental data that supports those things is actually kind of, it's quite limited. Like I said, Tillman is one of the few that has really given us some good data about that. But even then, you have to remember he's doing these fairly small experimental plots and in the real world, what diversity does for ecosystem stability, there's still a lot of questions about. It makes sense.

Megan: It does make sense. I'm going to give you my Lego analogy. I've used it before but I feel like it's appropriate to bring it out now. Any time you're trying to build

something as complex as an ecosystem back at a site or even a landscape level, you're basically building a Lego, except your dog ate half of the instructions and some of the pieces fell into the couch cushions, they're maimed, the cat was playing with them, like you're basically trying to build this with only a partial instruction manual and not all of the pieces, well understood, and you're still putting the effort to build it. It doesn't mean that's not worthwhile, we're still going to get something, but there's so much to know and that's oh, gosh, prairies just fascinate me. That complexity and building that puzzle and filling in the pieces of the mystery really appeals to me, and that's why I really think people need to try new things so that we can learn different ways that puzzle pieces work or fit.

Mike: I like that analogy a lot. You know, and you talk about restoration a lot, of course. It is important to emphasize that much of prairie management is not just restoration, right?

Megan: Correct. There's remnant sites that we have to manage too because prairies are disturbance-based habitats. That's how they renew themselves. And we don't even understand the complexity of timing of a prescribed burn, for example. Like when should we do it? How often should we do it? How does that impact all of the different species that are within a prairie community? It's complex.

Mike: It is. Still much to learn. This paper also has a section focused on management implications, what we're talking about. And because of the time, I won't go into much more detail, but that section, the beginning where he talks about what we know currently, towards the end where they talk about management implications, those portions are worth reading. I don't think I mentioned the authors. First author is D.U. Hooper and many others after that, so it's a big review.

Megan: We'll have it up on our website so you can see everybody and get a link to the article. My pick for the day is *Persistence of Native and Exotic Plants 10 Years After Prairie Reconstruction*. And this work was done by Diane Larson, J.B. Bright, Pauline Drobney, Jennifer Larson, and Sara Vacek. If you have done work at any point in Iowa or Minnesota, I hope that you have heard these names because the prairie reconstruction community is a very small but close-knit bunch, and so I really wanted to highlight the work that they did. This was in restoration ecology and it's really interesting because it's the follow-up paper to their five-year evaluation that they did in 2011 where they evaluated these same plots that were basically put into nine former ag fields that were in Iowa and Minnesota, and so they planted those in 2005 in a randomized study design across these states and then they wanted to look at how planting method, particularly dormant season broadcast, growing season broadcast, or I believe it's growing season drill. I hope I don't get that wrong. How it affects establishment of species richness. And they also wanted to look at invasive species, exotics, and so they took a particular close look at Canada thistle and they also looked at our two nemeses on the prairie landscape, Poa pratensis and Bromus inermus, which are otherwise known as Kentucky bluegrass and smooth brome.

Mike: Smooth.

Megan: Smooth brome, which is not so smooth at all. Or I guess just smooth because it sort of sneaks its way into the prairie, so it's smooth like that. Anyway.

Mike: Yeah, there you go.

Megan: Some of the key things that they found in this study and this is what I keep harping on to people and I found this very interesting, and then like all good research does, it leads to even more questions that you want answered because you're like oh, you found that. Well, what if this? Oh, we didn't analyze that, well maybe we should analyze this. And so that's really good research, gets you thinking. So one thing they found is that there really wasn't a difference across planting method across the 10 years. It seemed cover was fairly consistent. In the first years, it looked like there was a little bit of a bump for dormant seeding broadcast in terms of forb establishment, and that's something, that's a concept that I would say is pretty widely known by restoration folks. The reason for that is a lot of our seeds need to go through stratification and a cold stratification, a warming process, some need pressure, all these other things, and so if you put them in winter or in late fall when they normally would be going through a natural stratification process, it seems like that works really well to get them to that grow, and then we don't have to figure out all of the details of what each individual species needs, you're just hoping that nature will do it for you. But it was interesting that after 10 years, there really wasn't much difference, no matter what. They did see that there tend to be more, it wasn't statistically significant more warm seasons grasses on the drilled sites, and that makes sense too because some of the forb seeds are like dust, and so if you try to drill them in, you're often getting them deeper than they need to go, and so that might be some suppression there. Man, I'm having trouble saying words.

Mike: Okay, Megan.

Megan: Okay. This is the best part of this article. It's the best part of this article. Patience can pay off. So from 2005 to 2007, Canada thistle just increased through all their plots, but then after 2007, it just decreased, particularly on the plots that had higher richness, and this is without herbicide. They weren't using any herbicide, they were just burning the sites uniformly across. I'm telling you Mike, I need a cookie or something. Really struggling with words right now. So I think one of my take-homes from this is all of the research that I'm reading lately about Canada thistle in particularly is that if you mow it, if you aggressively spray it, ultimately you do more collateral damage than good. So what I mean by that is if you're just aggressively spraying it, not target spraying it, for example, you are wiping out the other things that are going to fight the Canada thistle battle for you and you are just making Canada thistle mad and that much harder to control because it is highly rhizomyids and spreads that way primarily. And so the more things you do like mowing or spraying, it just stimulates its growth, it stimulates its spread. And so I really truly believe that instead of spending all of this time and money on herbicide application. That's not to say that there aren't times when herbicide application is necessary. But this study in particular is reinforcing that point that if you put your investment into the foundational diversity, it will fight these battles for you. And we see that across the board with Canada thistle management. The more we try to do to control and manipulate it, the worse it often becomes where a lot of times it drops out.

And so I think that is one of the key takeaways of this paper that patience really can pay off and if you just let it go through. The other really interesting thing that I want to point out is that none of the species richness that they had were able to put off cool season grasses, so this Kentucky brome and the smooth brome or Kentucky brome, help me. Someone help me. Kentucky bluegrass and smooth brome. Thank you, Mike. So none of those levels of richness were able to put off that. The one thing I want to note is that the highest richness that they had was 34 species, which isn't shabby but is still fairly.

Mike: For like an entire prairie.

Megan: Yeah, that's still fairly low when you're comparing that to a remnant site, so I do want to point that out. The other thing that I found was interesting is the native cool seasons that they planted sort of peaked in 2007 and then that's also when we started to see an increase of the nonnatives. And they don't talk about this too much in the discussion but right away in my mind, my question was so if you've got your cool seasons to persist, would you see that same incremental increase? And how do you make sure that richness persists through time? Because there's been many studies that show that diversity declines through time. So how do we as managers tackle that problem? So I'm just leaving you with more food for thought questions but I thought that was really interesting because right away, my brain was like wait, but if we had more things persisting, maybe we would be able to do a better job at keeping these nonnative cool seasons at bay, so that's my story.

Mike: Hey Megan.

Megan: Yeah, Mike.

Mike: Take a hike.

Megan: Gosh, I need a hike after all this talking, I tell you what. What does the saying go? Five minutes in nature restores the soul. Oh, let's hike. Mike, where are you hiking today?

Mike: Well, I'll tell you, it's hard to say. It's not that hard to say. It can be a challenge to spell. Higginbotham Wildlife Management Area.

Megan: Was that a dig at me? Because earlier I could not spell it?

Mike: No, I would never do that, Megan. Come on.

Megan: Wow.

Mike: Yeah. H-i-g-g-i-n-b-o-t-h-a-m. It's a wildlife management area. Two reasons I picked it, I guess more than that, three at least. One, it's a wildlife management area. So I know you guys have covered this in a past episode, but I just want to reiterate the importance of wildlife management areas in the state for prairie conservation. I think I've read the remnant prairie that's the public protected remnant prairie, some large percentage of it resides in wildlife management areas, doesn't it? Have you heard of this stat, Megan. I don't know. Anyway.

Megan: I don't know.

Mike: Okay. Bottom line is it's important for prairie conservation in Minnesota. In addition to other public ownerships, of course, state parks and state natural, scientific and natural areas, and let us not forget, private ownership. But wildlife management areas are pretty key. Higginbotham is a good example of that, especially up in the northwest where we have these large relatively large chunks of remnant prairie. It's got a lot of woody cover mixed in, aspen and other species mixed in, which is also characteristic of those prairies up there. But for that reason, because of the mixture of mesic prairie, wetlands, shrub component, adjacent forest, it's really diverse. I forget how many bird species we had there, when I did a bird survey there. Yeah, so it's diversity, that's the second reason, which I thought was appropriate for this talk. And oh, yeah. The third reason is it's up north. So Megan and I largely work in the southwest part of the state. The northwest certainly deserves some emphasis because of the large prairie resource that is up there.

Megan: I agree.

Mike: That's my place.

Megan: That is a good place. Well, I'm going to hike today to Ottawa bluffs, which is an aptly name because it is a Minnesota River bluff, and so it's just outside of St. Peter. It's kind of on a backroad. I always think of it on like this, the road that runs parallel to the town of St. Peter. That's a terrible way to describe it, but it is next to Ottawa Wildlife Management Area, so there's kind of this conglomeration of public lands right there, so you can hike and visit those. I really like it because it's an incredibly steep hill and when I was doing my research to prep for this episode, I didn't know this but when you hike to the top of the hill, it's actually you're next to an American Indian burial mound. And I didn't know that. Like I had no idea. I have admired it all the time because it's this incredibly steep prairie slope and you can see pasqueflower and some other really cool really early spring bloomers on them, and it's an oak savannah, so it has all of these oaks at the top and I have a special place in my heart for oak savannah. I know that might surprise some people because that is grating more towards the woodland side of the ecosystem spectrum but oak savannahs are the transitional fabric of the landscape and I just find them really cool, like these big open grown oaks and prairie underneath, what could be better than this?

Mike: You bet.

Megan: It's beautiful. You betcha, Mike. You betcha. So Nature Conservancy has done a really good job of trying to get rid of extensive invasion by woodies, woody vegetation up there, and they've been trying to restore the site and get more of that prairie opening, and it's really, really beautiful. Like there are not a lot of the Minnesota River bluffs that are still in remnant, and so this is a site that's definitely worth seeing. Be careful when you pull off on the side of the road, it is a very narrow road, so you want to make sure that you try to find where the - - it's one of those dangerous roads where on the one side as you go towards the river, it's just the steep drop-off, and on the other side, it's a little tiny narrow shoulder because it's all hills, the river bluffs if you will, so you want to be - - that's my safety message for the day. Use caution.

Mike: Well done, Megan.

Megan: Thank you so much, Mike. I can't believe we're at the end. I mean, people who are listening are probably like thank goodness they're at the end, that's longest episode of the season but.

Mike: Megan, they can't be saying that surely.

Megan: No, surely they're not. They're busy like could this just keep going? I hope that it keeps going. Well.

Mike: Megan, I want to before you close here, I want to acknowledge the Nongame Wildlife Program again and emphasis to listeners the importance, the necessity for us from my biased perspective of donations to keep that program running. So yeah, just props to the nongame program, it's the best job I've ever had, and a bunch of very passionate people that really love prairie. I mean, all of us do in that program and recognize it's the emergency really that is required to save that ecosystem, so support the Nongame Wildlife Program please.

Megan: Indeed, and you can do that online or you can write a check directly to the regional headquarters here in New Ulm, to support the regional program if you wanted to.

Mike: To clarify, when you do your income taxes, that nongame wildlife checkoff goes to this program that I'm talking about, so.

Megan: Good job.

Mike: I'm done, I'm done.

Megan: Hey, you don't have to be done. These are good things. Like the reality is, is that we're Minnesotans, Mike, and we value conservation and in order for that good work to continue, yeah it does take money. So that's not a bad thing to say. Well, this party doesn't have to end, luckily, because next week, the season continues, so we're going to feature a very special prairie enthusiast. Yes, we mean that literally. Prairie enthusiasts are not just people who drive around getting excited any time they see grasses and wildflowers blowing in the wind. Ah, a prairie, I'm enthused. No, that's not just what they do. They are groups of dedicated individuals, they take their retirement time, their volunteer time, their personal time to educate, protect, and restore prairie and savannah habitats in the Upper Midwest. In short, they're fantastic and we're going to chat with prairie enthusiasts and Minnesota landowner Henry Panowitsch about his experiences with the prairie and how he first fell in love with this incredible landscape. You're not going to want to miss it.

Mike: I'm really looking forward to this.

Megan: Yeah, he has a beautiful German accent because he grew up in Germany, and so I just like could listen to him all day long. When we talk about dulcet tones, I mean, this is truly dulcet tones. As always, you can find all of the resources, Take a Hikes, literature that we mention. This is a literature heavy podcast 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 the fabulous Dan Ruiter, and engineered by the magnificent Jed Becher. D word diversity.

Mike: You bet. Diversity. Not Dalmatian.

Megan: Why don't you do it with me? Like why weren't you like D word? I feel like we're at like sporting event.

Mike: Little off my game here.

Megan: Diversity! Okay, well you're just really not helping me at all.

Mike: It's too fun listening to you, Megan.

((sounds of birds chirping and wind blowing))