Prairie Pod Transcript

Season 5, Episode 46: Deep thoughts on shallow lakes and prairie

Hosts: Sara Vacek, U.S. FWS Wildlife Biologist, Megan Benage, DNR Regional Ecologist

Guest: Nicole Hansel-Welch (DNR), Scott Mackenthun (DNR), John Lindstrom (Ducks Unlimited)

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

Transcript:

((sounds of birds chirping and wind blowing))

Megan: Hey Prairie Pod listeners, I'm Megan Benage, regional ecologist with the Minnesota Department of Natural Resources.

Marissa Ahlering: And I'm Dr. Marissa Ahlering, lead scientist with the Nature Conservancy in Minnesota, North Dakota and South Dakota.

Sara Vacek: I'm Sara Vacek, wildlife biologist with the U.S. Fish Wildlife Service, based out of the Morris Wetland Management District.

Mike Worland: And I'm Mike Worland. I'm a wildlife biologist with the Minnesota DNR Nongame Wildlife Program.

Megan: We are part of the Minnesota Prairie Conservation Partnership and we're here to help you discover the prairie.

Marissa: Discover the prairie.

Sara: Discover the prairie.

Mike: Discover the prairie.

((music playing and sounds of birds chirping))

Megan: Hey, welcome back Prairie Pod listeners. We are super excited for another awesome episode. Sara, pump that you're here with me today.

Sara: Very excited to be here Megan.

Megan: That was your best excited voice?

Sara: When's the spin?

Megan: Well the - -

Sara: I'm very excited. I'm excited that we're going to get our feet wet today.

Megan: Just a little wet though, right?

Sara: Just a little wet.

Megan: Just a little, little wet, although I don't know, we're talking about shallow lakes today, maybe we shouldn't say just a little wet, 'cause we're talking about lakes that are you know generally 15 feet in depth and that's not just a little wet for Megan that's like fully submerged.

Sara: That's all the way in there.

Megan: That's all the way in there. (Laughter) Going 100%.

Sara: Well one of the test things about these shallow lakes regardless of how many Megan can fit in them is that they are really important for wildlife habitat in Minnesota and they're kind of a unique and special type of habitat that we have here.

Megan: I'm excited about it. We've never explored these before on the podcast. We've explored them physically in real life but not on the pod. So we've got three super special guests with us today to discover these habitats. We're going to talk about the important role they play in the prairie landscape and remember, as you're listening, we take our shallow lakes very seriously, don't tell a joke to a frozen lake, it might crack up. Okay, so we are going to jump right in here and start with Nicky why don't you introduce yourself?

Nicky: Hi, I'm Nicky Hansel-Welch. I'm the DNR's shallow lakes program supervisor with the section of wildlife.

Megan: Scott.

Scott: I'm Scott Mackenthun. I'm an area supervisor with the Minnesota Department of Natural Resources. I do fisheries in Hutchinson, Minnesota.

Megan: And John?

John: Hello, I'm John Lindstrom. I'm a regional biologist with Ducked Unlimited in Central Minnesota.

Megan: Wonderful. We're going to jump right in here because we got a lot to cover. So we're going to start with some basic background, get people caught up, Sara and I gave you some of the initial you know, stepping into this lightly or 15 feet deeply, however you want to think about it. (Laughter) So we're going to hear first from Nicky, what are shallow lakes and why do they need to be classified separately from the rest of Minnesota? I was going to say 10,000 lakes but we all know if you're a true Minnesotan that it's 14,380 lakes.

Megan: Hey Prairie Pod listeners, Megan here with a quick fact check update for you. So as I was giving the number of lakes in Minnesota, I realize that this is actually kind of a complicated question to answer. So I wanted to give you a few more details. So right after glaciation about 10,000 years ago or so, the number of lakes and water bodies in Minnesota was right around 4.6 million and we generally think of lakes as being those that are greater than 10 acres in size. So today, we have 117,000 water bodies and yes, the Minnesota DNR database does say that we have roughly 14,380 lakes, but this is only if you count lakes that cross the US/Canada border and you don't count a few lakes that are mostly in other states and of course, we're not counting those water bodies that are less than 10 acres in size when we give that total figure. So it's a little bit complicated especially if you think about things like lakes that might be one large basin but then they funnel into two smaller basins and so then we have to make decisions about whether that's one lake all together or it's three lakes. Lots of interesting things to discover and uncover. If you're super interested in counting and how the DNR tracks all this great information, you can check out the DNR's hydrography database on the Minnesota Geospatial Comments. All right, happy listening.

Nicky: Well first of all, you know, they are 100% laturo meaning usually that the whole lake can support aquatic plant growth and that's what sort of separates them from deeper lakes and because they're full of aquatic plants, aquatic plants are you know, really important component of their ecosystems and that also makes them really, you know, generally good water fall habitat. We think that, or we categorize them as being less than 15 feet deep, so actually most of the lakes that I work on are more like five feet deep.

Sara: Well Megan, you probably could just stick your nose out.

Megan: Stick my nose out, wow. That's really helpful, Sara. Thanks. Thanks for looking out for me. It's important to be able to breathe when I'm standing in a lake (laughing.) I had just, just tilt my head back there and still we'll be making it.

Nicky: I don't always have real firm bottoms though, so you might start sinking.

Sara: Good point. (Laughing.) Better if I just go with a kayak or a canoe, huh?

Megan: Yeah, I'm having some questions about my court-ordered-host here right now and what this, what this is all an attempt to do. Yeah Megan, just walk a little deeper in that lake so we can see how deep it is. See how it is. Okay, so DNR has a shallow lakes program. Tell us a little bit more about that program, Nicky.

Nicky: Sure. So we have nine specialists across the state plus myself, and we are there to help area wildlife staff manage shallow lakes to enhance wildlife habitat. So we do things like survey shallow lakes to see what kind of habitat they have, if they have great waterfall habitat or not-so-great waterfall habitat, and then we look for ways to improve them if they need to be enhanced, and then help with that legal and technical process of, you know, doing public outreach and writing management plans, and lining up potential management for that lake, which might include engineering and putting in water control structures, so yeah, we do a lot of different things, but mainly the overall

goal is to work with area wildlife staff to enhance wildlife habitat in these lakes across the state.

Megan: So just quick question, Nicky, so you said working with area wildlife staff. I'm assuming that you're also working with fishery staff so there's like a balance there between the fish and wildlife together.

Nicky: Certainly. And each lake is unique and has its own management plan, and some we do, do joint plans with fisheries and some we don't, so it just depends upon the characteristics of each specific lake.

Sara: And John, I know Ducks Unlimited has the Living Lakes Initiative. Can you tell us a little bit about that?

John: Sure, yeah. So in the late 2000s, DU kind of came up with this initiative level goal of protecting what we called at the time the Stepping Stones of Shallow Lake Habitat back 20 years ago, there was a bunch of research done that really showed ducks were lacking food and resources as they traveled north during spring migration. And ultimately, it'll affect how effective and efficient a hen could lay eggs and raise a brood, so we called it our Living Lakes Initiative, and over the past 15 years or so, we've been able to do a lot of wetland and shallow lake projects with the DNR and the Fish and Wildlife Service really taking a really turbid or eutrophic lake and shocking it, doing a drawdown, performing one of those management actions Nicky talked about, getting a good vegetation response, and kind of bringing that clearwater state back to the basin that really provides benefits to a lot of the critters, but also like you get the clean water sorts of benefits too.

Megan: Okay, so you said a word there, John, eutrophic, and I just want to make sure we understand what that is. What are you talking about there?

John: So it's a lake that is really high in nutrients and a lot of times that spurs algae to grow, which is the really green color you see on a lot of lakes especially in south and western Minnesota that really prevents the vegetation we want to see growing on the substrate of a shallow lake from growing.

Sara: And Nicky, I know I hear you talk a lot of times about eutrophic but also about the turbid state and I think John mentioned that trying to flip a shallow lake from a turbid state to a clearwater state. Could you talk to us a little bit about just kind of overall ecology of shallow lakes?

Nicky: Sure. They're known to exist in what's referred as alternative stable states, and one being a clearwater state dominated by just that, clear water with lots of aquatic plants growing, versus the turbid water state, which is turbid with, you know, murky water either full of algae and/or suspended sediments. And so that sunlight can't reach the aquatic plants and they don't grow. And then there's a lot of wind resuspension because aquatic plants protect sediments just like prairie plants and grasses protect the terrestrial soils from being eroded. And each of those states is stable and it takes quite an even to like flip it, flip a lake from one state to the other, and a degraded shell like will be in that turbid state, and that's what we're trying to do with management is to do an action on that lake that will flip it back to that clearwater more desirable state. And such

examples of those would be doing a drawdown, which is kind of like a reset button for a shallow lake, and it often impacts the fish communities that are in those systems, which may be also influencing the water clarity.

Megan: So if I'm just looking for, I don't know, like the bulleted list of things that I want to see in a lake that has good, healthy functioning ecology, I heard you say I'm looking for native vegetation, I'm looking for clear water, what else am I looking for? Those top two?

Nicky: Lots of invertebrates.

Megan: Oh, invertebrates. Okay, got it.

John: Zooplankton, a lot of healthy zooplankton, diversity of the plankton community.

Megan: Now, how do I know how diverse the plankton is by looking at it with my eyeball?

Scott: A lot of times in some of our best lakes after we've got a lake that's put to a clearwater state recently or it's, you know, in a prolonged clearwater state, it goes hand in hand, right? It's all tied together just like you see prairies functioning and working together dependently. We've got a lot of aquatic plants, we rooted aquatic plants, we have cladocerans, we've got, those are these really big bodied zooplankton, we've got mix, and when you're out there, you can look into the water and actually see, you know, macroinvertebrate and insects but also that zooplankton just swimming around and we have photos that we've taken, just document this remarkable, you know, abundance of food for wildlife and fish.

Nicky: I'll call it daphnia soup sometimes when, you know, we have to reflood a basin after a drawdown and the daphnia, which are large body cladocerans, some people call them water fleas because they kind of look like fleas on your dog, except they live in the water, but really excellent both fish food and waterfowl food.

Megan: Nice. Thank you for that. So okay, so all of these things, we're talking about the ecology, and certainly we've touched on some of this that all of these things are contributing to a functioning, healthy shallow lake, right? But what contributes to a shallow lake being able to be healthy and function in addition to the things that we just mentioned? In addition to the plants and clearwater quality, there's drivers behind that, right? So what are some of those drivers that get us to that clean, healthy, beautiful state?

Nicky: Watershed condition and size, the lakes that are in better condition are almost always lakes with a small watershed, or a small contributing area, and also within that watershed, you know, a lot of intact either, you know, native prairie or native cover or restored, you know, grasslands, and wetlands, and then generally lakes that have fewer surface water connections to other water bodies tend to be in better condition as well.

Megan: That's really interesting 'cause I just want to ask a quick follow-up question because generally in the prairie world, right, and shallow lakes are certainly part of the prairie world, but I'm just thinking like terrestrially, right? Connection is good, like the whole function of what we're trying to do is connect prairie habitats. But I just heard you

say that when it comes to these shallow lakes, that connection might lead to evasion or more sediment disburse, when sediment goes into a lake, or sediment deposition, that's the word I'm looking for, things like that, so I'm just curious if you can tell me a little bit more about that.

Nicky: There's a paper on that done actually by some pretty well-known researchers from Minnesota that directly addresses that issue. The island biogeography sort of hypothesis, and yes, generally like you want habitats with connections, but it is counter, shallow lakes are counter to that theory, and the better the ones with better habitat tend to be more isolated because they don't have the fish like carp in them or, you know, even bullheads can sort of enhance that internal nutrient loading in a system, which is maybe another thing you want to talk about. You know, these lakes are impacted by both by internal and external nutrient loadings.

Scott: So I'll just jump in quickly to say that, you know, you definitely want to talk about fish and we'll do that here, but so I think a lot of folks that listen to the Prairie Pod are knowledgeable in terrestrial landscapes, nitrogen tends to be the limiting factor, but in aquatic landscapes, it's phosphorus, and one of our researchers with an agency that recently retired published a paper on we can predict very well kind of impairment levels and productivity, of course, it's tied to phosphorus, just looking at phosphorus concentration. It ends up being a big driver for, you know, the flipping back and forth of alternative stable states that Nicky was talking about, and when you talk about a lot of, we do have shallow lakes that are spread across the entire state, but we probably have more challenges in the south and southwestern portions of the state where we have a lot of agriculture, we have a lot of change in our watersheds, and as our watersheds go, so do our water bodies and our shallow lakes.

John: I think what you said, Megan, is really interesting to think about, though, because I think prior to European settlement, the connectivity really would lead to diversity, but things don't function the way they used to now between invasive species and we're not getting those outside of this past summer, we haven't really had too many severe droughts that would dry up these basins the way they would have several hundred years ago. So when things function the way they're supposed to, that would probably be true, but things are not really functioning the way they used to, and that's where DU tries to get involved by helping our partners with infrastructure that kind of does those resets that Nicky was talking about.

Nicky: Another contributing issue, I don't know if you want to get into right now, though, is climate impacts on these lakes and that sort of has exacerbated the connectivity issues and the fish connections. These lakes naturally would have been winter kill lakes, boom and bust lakes, like if they did get fish, they would be a boom and bust population, a short sort of really high population of fish, and then the next one are kill, send them back in. We simply just really don't see winter kill that often anymore, you know, the 30 years that I've been, you know, sort of paying attention to this kind of stuff but I grew up on what would go back called a tweener lake, sometimes had fish and sometimes had ducks, but that lake used to winter kill all the time and it doesn't ever winter kill anymore. So it's really changed the characteristics of a lot of these lakes.

Marissa: So we've talked about a lot of different factors, like the nutrient loading and the landscape context and changing climates and I mean, if you were going to give like a scorecard to the health of our shallow lakes in especially in the prairie part of the state, how do you guys feel like you, how would we score out? Healthy, not healthy?

Scott: I would say not healthy but I think that it kind of gives managers and all us conservationists a goal where things like the prairie plan and the duck plan are calling out managing more shallow lakes, and ultimately those are like I said earlier, they benefit the critters too, but you're getting a lot of benefits like we all need clean, clear drinking water and that sort of thing, and the southwest part of the state, there's a lot of lakes that are in really poor shape and probably the ones that are in the best shape are the ones that DNR, the Fish and Wildlife Service have been managing for one reason or another.

Nicky: We've been collecting data, you know, for the last 20 years now and about two-thirds of the lakes that we've surveyed on the prairie are we'd call turbid, in the turbid water condition, so not good.

Megan: It also sounds like the more we can connect the prairie around these shallow lakes, maybe the better chance we have at getting to that stable state or that healthy state, if you will. And so that's going to vary across the prairie parts of Minnesota because there's certainly prairie in southwest Minnesota but there's also prairie all the way up to northwest Minnesota and central Minnesota, southeast, so depending on, you know, what's going on in that watershed and the context of the natural lands within it, it could be possible that we could get, we can change our scorecard, right? Like nature doesn't always stay the same and it doesn't have to stay the same.

John: I'll build on that and just say you ask how would you score it and I almost feel like we've sort of bottomed out. I think most of us on the call here could point to some lakes that really couldn't get any worse, you know, they were in really poor condition, and I think that there has to be hope for the future because you've seen them bottom out, you've seen public opinion change, we've seen folks become more receptive to the idea of what the tools in the toolbox are for managing shallow lakes, you're seeing the Living Lakes Initiative, you're seeing the Shallow Lakes Program, you're seeing more success stories in a digital area, we have all this information recorded, people are building skillset and how do we interact with the public, how do we educate them about how shallow lake ecology works, and now you're starting to see some of these lake success stories tick up and it starts to snowball. And, you know, you're not going to get it all done overnight. There's too many resources out there, some of them, you know, we were talking about where our candidates work and where you can have an impact and where are places that you can't, you have to prioritize your resources, everyone does that, but I think the future is particular bright. There are places that we can actually have an impact, and we're looking to those places, and we have a funding mechanism here in Minnesota where all of us work with the Lessard-Sams Outdoor Heritage Council, Conservation Partners Legacy grants, any number of Legislative Citizens Commission on Natural Resources, ways to pay for these projects.

Marissa: I love that all of you have hit on this idea of partnerships and, you know, working across organizations and divisions within organizations, and I was just sort of

thinking about, you know, we wanted to talk about fish, and of course, I wanted to talk about ducks 'cause that's my thing, and so it's kind of actually thinking about how when I first started my career, you sort of like had to pick, this is going to be a duck lake, this is going to be a fisheries lake, and I feel like that, maybe that line has gotten blurred a little bit, so I was wondering if maybe Scott can start and talk a little bit about sort of that dichotomy, you know, and Nicky had called them tweener lakes, like how do we decide and how are there ways that we can get the best of both?

Scott: Sure. I can take a start at it and hopefully hear from everyone. It's a great question. I think there's been fish and wildlife managers that have gone to their retirement and said what would you have changed, they said boy, I wasn't able to do anything with this lake or that lake, and, you know, Sara and Nicky talked about these tweener lakes. That's where a lot of our shallow lakes that we struggle with, like they might be too deep for us to do something, they're all shallow lakes by the, you know, 100% littoral and under 1,500 feet of depth, but we have even tweener lakes within that subset of we can't do a lot for wildlife here, and then on the flipside, maybe we can't do a lot for fish, and they just kind of limp along. They really don't get really far, and you heard a lot of retiring fish and wildlife managers talk about that phenomenon. And now you kind of look at some of those tweener lakes and you have to take a close look like what can we do and what can't we do, but you try to maximize recreational opportunities, habitat values, whatever it might be, for those lakes, you do the best that you can, and I do see more partnerships coming. So it's all a matter of what is going to work well in the characteristics of the lake that you're dealing with, and you heard folks talk about you've heard everyone here sort of mention dealing with benthivorous fish, that's the first thing. You know, first, well, let me back up and say you start with fishless basins, right? And they're keeping a layer of where our fishless basins, we need to keep them that way because they're very unique resources, they function so much differently than basins that have fish, and then you go on to the next level, do you have benthivorous fish or not, meaning do you have fish that feed in the bottom feed on the substrate. They're rooting around on the bottom of the lake and that causes a couple of issues. One, they're putting those sediments in the suspension. That unlocking nutrients, so now we've got lots of phosphorus in the water literally in some cases uprooting aquatic plants. You just got done hearing us talk about the importance of aquatic plants for holding down the substrates and preventing wind erosion. And completely changing that habitat dynamic, so having control of your benthivorous fish with these turbid or clearwater states as possibilities is really important. And then as far as finding fish that are good fit, I mean, the evolutionary history of our native fishes in Minnesota, some are well-suited for shallow lakes, some are not, some perform well in basins that they're exposed to low dissolved oxygen, which is a case in these shallow lakes, they might go through summer kills with very warm summers, they might go through winter kills when we get the extreme cold or snow, it's trying to find what's going to work for everyone that's involved, whether it's fish, wildlife, what the resources are, I could drill down really deep for brevity sake, I'll just leave it at that.

Megan: Scott, I'm hearing you say, we're going to pivot to John just in just a second, that, you know, you're looking at the suite of fish that you want to essentially add to a lake system. And so we're managing the fish, right? And so my question is are fish a

natural component of shallow lakes? And if they are a natural component, you know, when did we make this shift to managing the fish in the system?

Scott: So not always added per se, there are some that were always there, you know, again, it depends. This is probably a good time to uncork the idea of winter kill and summer kill being a natural part of these shallow lakes, like fire is needed to reestablish and invigorate a prairie ecosystem, you need summer kill and winter kill to reset these systems. Like we were saying, you probably pre-European settlement, pre-massive changes to the landscape, you probably had a lot of connectivity of these systems and it probably promoted the health of these systems. Now as we don't see the winter kill to get those resets, so we end up spending more time with turbid impaired waters rather than killing those fish off and giving the native seed bank a chance to build back. There are some instances where fish are introduced, it's just the practical pragmatic reality of hey, you know, they can provide a fishing opportunity or they can be used as a sort of top-down control. In other words, you could use predator fish to feed on smaller fish. You know, that as you get into the science, it gets a little bit murky. You know, those are short-term interventions. You know, we might introduce a predator like northern pike or in some cases walleye, and you'll see foraging. They'll feed on whatever is their preference or what's most readily available. I'd love to sit here and say yeah, they're going to feed down on all the bottom feeding fishes, that doesn't always happen. It can help you prolong that clearwater state maybe, you know, might add another season or two, but, you know, at the end of the day, they're going to, you're not always going to be able to completely control those bottom feeding fish.

Nicky: I think it's important to point out that we use fish management like as a way to deal with the internal nutrient loading, and it is sort of a shorter-term approach, so we're reducing by managing fish, increasing predator fish, or decreasing benthivorous fish or a combination of both. We're trying to reduce that internal nutrient loading, so those nutrients coming from the sediments. The long, and that's a short-term solution, and it can have an effect really quickly. But the long-term solution is still to focus on that watershed, and to reduce that external loading that's coming in from the watershed. And one of our DNR research scientists just sent me a paper earlier this week about the importance. You know, they did some stabilize isotope work and pointed out the importance of that reducing those external nutrient loads.

Megan: All right, John, we're going to pivot here and talk about ducks. I know, this is a hard - - I don't know if you have any fancy terms that you want to share with us like benthivorous fish, but maybe there's some fancy duck terms that you can share with us and about how they're using these shallow lakes.

John: I don't know if I have fancy terms but the shallow lakes are super important to ducks, and it all kind of just ties together where the most ideal shallow lake for a duck likely has a very small fisheries component. But given the connectivity that we've been talking about already, that's just really hard to manage. Speaking of DNR research, I just saw the amphipod study that came out that the amphipods, which are super important to ducks both in Minnesota and in the Dakotas historically and currently are really good indicator species for the overall health of some of these types of systems. So from a duck's perspective, they are flocked up obviously heading north to the

breeding grounds, which includes most of Minnesota, and they're trying to key in on shallow lakes because they can land on a shallow lake, and if the lake is in good condition, you have a ton of vegetation out there, which provides some nutrients, but kind of hidden within all that vegetation is a whole host of different aquatic insects that are really crucial for the development with the nutrients needed to produce eggs. So like I mentioned earlier, the stepping stones, these shallow lakes are really the stepping stones connecting the wintering grounds to the breeding grounds, and like I said, breeding definitely occurs in Minnesota too. But we're by managing these shallow lakes for clearwater states, we know we're producing vegetation and insects that are needed by the ducks, and there's a whole suite of research that, again, shows how ducks can be negatively impacted on the breeding grounds by what happens during migration. So these lakes, you can't really put a weight on how important they are, especially in the spring. In Minnesota, we have a lot of duck hunters, so in the fall, you might go out on one of these, and if you hit the right day, you might see a lot of ducks, but you hit up that same shallow lake in the spring during peak migration, it might be covered edge to edge with a whole, with every duck you could imagine. And it's one of the more rewarding parts of my job is just seeing that because we're providing them a supermarket.

Megan: So you said you didn't have any fancy terms, but you definitely talked about amphipods, which are basically plankton, right? They just have walking and swimming feet, is that?

John: Yeah. Yeah, I called them freshwater shrimp growing up and just like a lot of us probably did things and then you learned the right way to do things, either biologically or professionally, so they're a pretty I don't want to say girthy there, independently beautiful, they're really important high-calorie food for these ducks that, you know, we talked about the zooplankton earlier, which are kind of a little harder to see. If you scooped up water filled with zooplankton, you would see specks of, I don't know, pepper-sized creatures floating in the water. If you had a scoop full of amphipods, they're on the small side, like those little salad shrimp you get, they're not much smaller than those. So imagine a duck-sized animal eating a whole bunch of that stuff, they're getting a lot of that especially for the weight and the energy it takes to require those nutrients.

Nicky: They do just look like a miniature shrimp. They even turn red and orange when they dry out on your dock or in your boat.

Megan: Now I'm trying to get a mental image for what is a salad shrimp. I don't know what kind of salads John has been eating, but mine generally doesn't come with a shrimp on it, so.

John: You need to familiarize yourself with the size of shrimp.

Megan: I really do, that's true, especially when it's accompanying my lunch. I'm allergic to shrimp, so maybe this is why I don't know about their sizes.

Nicky: You don't need to know about their sizes.

Nicky: Salad shrimp are like maybe an inch, inch and a half long, and a good size amphipod can be about an inch long too.

Megan: Thank you for that clarification. I appreciate it.

Marissa: John, I love what you were saying about the just the role of the shallow lakes during the sort of like annual life cycle of a duck and, you know, that they've got a place in the spring and in the fall, and another thing I think about sometimes too is in sort of a longer time cycle. We've been talking a little bit about how, you know, a really healthy thing for these shallow lakes is a drought and chance to dry out and how we don't get that too often, but one thing I think about a lot is that they do get a lot more droughts than drying events further west, and so that's I think another tell me if I'm wrong, but like that's another important thing about shallow lakes in the kind of long-term cycle of waterfowl populations is just that we've got this at least somewhat more stable resource for waterfowl regardless of what conditions are like in the Dakotas.

John: Sure, yeah, and I mean, especially in the Dakotas, those prairie lakes are part of largely intact prairie pothole complexes, where there's breeding, so ducks set up territories on smaller ponds in the spring, the drake will set up a territory and defend it, the hen will go up into the uplands and nest, and those are occurring in a landscape dotted with shallow lakes too. And in Minnesota, we've largely lost a lot of those prairie potholes. I mean, wetland drainage is above 90% in the prairie part of Minnesota. So, you know, we have lost the pull for the breeding duck in a lot of Minnesota, so I think it's really interesting that we can kind of buffer against some of that climatic variability because our connectivity actually leads to really weird hydro periods over here where things stay wetter than they should longer than they should, and, you know, I've done some aerial waterfowl surveys. We'll find an approximate height that a duck would fly at, and it's kind of hard to imagine being a duck flying over the landscape. You don't have to get too far from the air, and you can see I don't know 100 miles, and even that far away, you can really pick out like the basins that are high quality and the basins that are low quality. So if you might picture a duck as a very simple creature, but they're doing a lot of things at long distances that are really all about surviving and producing that clutch of eggs for the next generation.

Megan: I like what you said there about ducks doing a lot of complicated things because, I mean, really no matter where you are in the ecological system, we talk about this a lot too, diversity is important, which means that each part of that ecosystem is important, so you never really think of any piece as simple or not simple, they're just part of the whole and necessary for what we're trying to get done here. So we're going to pivot a little bit and talk about management, restoration, and then some things we can do to ensure the conservation of these shallow lakes. So John, start us off here. What are some management restoration options that managers have? Like what can we do?

John: So mainly the goal of the management action is going to involve trying to dewater the basin either by gravity flowing just by like letting water flow out of the basin or mechanically by using the pump system. DU has a team of engineers that have done a lot of these types of structures across the state for all sorts of partners. And if possible, we do try and combine a water control structure with some sort of fish barrier if it's mechanical barrier or a physical barrier, rather, where we have kind of bars to prevent carp from getting back in, or if it's some sort of electronic barrier, we've kind of dabbled

in that, but ultimately, we're spending money to build infrastructure that ultimately is going to try and mimic the drought cycle that we've since lost in this part of the state.

Sara: Nicky, I know your office or your crew does a lot with planning management around shallow lakes as well. Do you have anything that you wanted to add?

Nicky: Well, I think we hit on it before, you know, the in-lake management is important to combine with the upland protection and/or restoration. So, you know, we try to focus our management on lakes that have some sort of existing or potential for, you know, grassland and wetlands restoration around them or like I said, to preserve if they have some native prairie components. And we have that in a lot of our lakes that we manage, like Lake Christine is a good example where there's a lot of native and restored prairie and wetlands in that watershed. And like anything we can do to reduce those nutrients coming is just going to prolong any of that in-lake management that we do and the in-lake managing those in-lake nutrients easier, so we try to have sort of a holistic approach. And also, you know, there's a lot of ducks that need grasslands to nest, so it's helpful to have all those components of what a duck needs throughout the year, right, in proximity to each other, managing the wetland and shallow lake and grassland complexes.

Megan: So it's interesting 'cause this is like sparking a lot of thoughts all at once in my mind and I just can't get them out fast enough. But we think about so you mentioned holistic management, we are talking about ducks as sort of a surrogate marker for health because I know one of the things that we talk about a lot on the podcast is we're not really doing single-species management. But we might be trying to make sure that elements that are necessary for certain groups of wildlife are there that are mutually beneficial. It's not, I'm sorry John, I'm going to say it, it's not just about ducks, right? It's about them as a marker for all of the other things that are then supported when you supply, as you said, the supermarket, right? And so I'm just wondering how you would respond to somebody who's listening to this and they're thinking to themselves, gosh, that sounds like a lot of manipulation and a lot of decisions that are being made by people that used to be made by nature. So how do you really get to that point of ecological management or where we can step back? And you kind of alluded to it already, Nicky, where you were saying the more habitat that we have on the landscape, the more native prairie we have on the landscape, the more we can boost the health of that system, and maybe through time I'm hoping would need to do less manipulation. How do we get to holistic, I guess, or ecological, not holistic?

Nicky: Yeah, I don't know if there's a specific number that's been identified like you need to restore X percentage of the landscape. I don't think we know that yet. But we also have to approach it knowing that, you know, we're probably not going to make the landscape look like it was prior to European settlement, so you have to find a balance there I think. And doing some of that active management is, you know, a way to mitigate for those landscape changes.

John: One way DU is trying to help that with DNR specifically is if we can identify a shallow lake that really needs enhancement and we can identify properties in that watershed immediately adjacent to that lake or in its watershed that we can restore, I mean, we can go in and restore 20 drained basins adjacent to a shallow lake to try and

buffer that lake too. So I know we've done a lot of work with DNR trying to identify these complexes because I'm sure on previous podcasts, you've talked about the importance of complexes and that same rule kind of applies to a shallow lake complex. That if we can invest time and energy into complexes, that would make more sense than postage stamp everything across the landscape, and that's kind of what we've tried to do. We have some complexes like the one in Indian Lake is the one I spent a lot of time on since I've started with DU where we bought several pieces and now we're trying to enhance the lake as the second phase.

Megan: That's a good point. I mean, I'm trying to put this all together in my mind 'cause, you know, I spend so much time on land, and not really in the water, but I am a landscape ecologist, so I should be thinking about landscape impacts here, you know, we're in a fire suppression mode society-wise, right? It's not that wildland fire isn't just necessarily allowed, I'll use that term allowed in quotes for the listeners who can't see what I'm there 'cause as you know, we can't control nature all the time. It does what it does. But generally, we're in a wildlife fire suppression mode where we're trying to make sure that risk to property and human life is contained, right? And so somehow, us as managers and people have to put these mechanisms back because of the things that help the prairie persist. And so I like what you said, Scott, earlier too about how this is kind of in the absence of some of the climatic variation that we might have had, like drought, we're trying to figure out a way to bake that back in so that we can get those systems functioning a little bit more naturally while we're dealing with all the things that we're normally dealing with as managers, right? Fragmentation, climate change, all of those things, and also the complexity of just the randomness of nature, not really knowing what would come next in the natural system. So it's, man, it's complicated.

Nicky: Yeah, it's sort of interesting too, like humans don't generally like change I don't think, we like consistency and we like things to stay the same, and what we saw happen, I mean, I guess I didn't see it, I wasn't alive, but the remnants are there, you know, after the drought of the '30s and lakes did dry out, which is a natural thing, but people got upset about that, so what did they do? They went in and they put dams on the outlets, and, you know, we're still dealing with sort of the repercussions of that, you know, some of these lakes that used to dry out naturally don't anymore because they had artificial, their water artificially raised. We deal with that all the time too.

Megan: I'm so glad you said that 'cause we say it a lot on the podcast, the prairie is about change and adaptation, and we all have our favorites, right? Sara knows. She goes to a prairie and she's like if I don't see these plants, I'm not sure about this prairie because there are certain plants that they're just our favorites, they just are, we're people, we can't help it. If I don't see purple prairie clover, I'm not happy, okay? But every year it shouldn't be a purple prairie clover year, we should allow, the prairie should have enough diversity in it to be resilient to change and different species should be coming out on the top, right, as the dominant species. We saw this last year through drought conditions in much of Minnesota where I have never seen so much side-oats grama. It was a hero of the drought. I have, I mean it was adorable, it's only like six inches tall in many of the places that I was at, but it was prolific in a way that we typically just do not see, and so it's a great reminder to me that beauty doesn't have to stay the same. Like what I think is beautiful can change because that's the best thing we

can do for a prairie is to allow that change to happen. It's normal, and we just need to get comfortable with it, right? We need to get comfortable.

Nicky: Same with shallow lakes.

Sara: Yes, it is. It's a great analogy because we should see something different every year, right? In a shallow lake or any kind of wetland for that matter as far as how much vegetation is out there, how much emergent [vegetation] is out there, and all that kind of stuff, so. One last topic before we run out of time that we wanted to make sure to touch on was just the, you know, we talked about management of individual basins but we want to talk a little bit too about conservation and protection of shallow lakes in Minnesota and what that looks like. What are some of the tools that we have as far as the actual conservation protection? Scott, let's start with you on that one.

Scott: Sure. Working within DNR fisheries, we have aquatic management areas. Where I work in Hutchinson, we have over 2,000 acres of aquatic management areas. They are around some shallow lakes, larger lakes and rivers, any sort of upland protection you've heard it here and probably on other earlier episodes of the podcast about the importance of taking care of riparian areas, of taking care of tracts of land and, you know, making sure that there are opportunities out there. There's so many ecosystems services we get from those parcels in particular anything that's in the watershed of a shallow lake that's in permanent cover is going to be helpful.

Sara: Nicky, do you want to talk about the shallow lake designation, if you call the program or what that entails?

Nicky: Sure. That's a process that gives us the authority to manage water levels on lakes, but we do focus, you know, trying to get those lakes designated that also have a public land component. And there's various programs to protect the land around shallow lakes, and that's the best way, you know, to protect the lake itself, like Scott mentioned is, you know, to protect that habitat around it. There's, you know, DU has easement programs and DNR can try to acquire WMAs and we have some other partners too that are looking to protect shorelines with easements primarily that prevent, you know, development on those parcels.

Megan: Okay, I have to ask one last question. I just can't help myself. Why do each of you like shallow lakes? And I'm going to start with John.

John: I like shallow lakes probably the base of my pyramid is probably my background as a hunter conservationist. But they're also just really fulfilling ecosystems to hang out in because you can take a basin that is pea soup green, work with a partner to draw it down, bring the water back, and it's crystal clear, and if you were to paddle through that lake with a canoe before anything happens, you hear nothing besides maybe some carp sucking air at the surface of the water, herded up in large quantities. You go out there the first year after drawdown when the lake's refilled, the water's clear, the vegetation has all come back, it's filled with invertebrates, and it just feels alive. You see and hear all sorts of different birds that it's like the Field of Dreams concept. If you build it, they will come. And, you know, that dynamic response is what really intrigues me about shallow lakes.

Megan: You need to come up with a different like aquatic analogy for Field of Dream. Like I don't know, Field of sago pondweed or something. Scott, how about you?

Scott: It's kind of what John just hit on. It's being able to see what has happened over the course of my career. I tell folks that I was born on third base but I don't think I hit a triple. There were a lot of people that did a lot of work before me that had to learn the hard way about what didn't work, and we have a lot of works that had to bottom out. We have a public that's a lot more informed now, we have a lot of success stories within the management agency, and then it's the idea of being a kid. Everybody growing up and having their own forays into the natural world. I grew up less than a mile away from a shallow lake. I used to ride my bike down to a culvert crossing and just, you know, I was the weird kid that had an insect collection, and, you know, it was, you know, getting my hands in everything and putting dip nuts into the water and checking stuff out. I mean, to be able to go down to this lake and hear the frogs like John was talking about, to hear the birds, see all the matter of life that's down there, and just to see how the small lake has changed over time, to visit it as a hunter conservationist, to see it as a resource professional, there's a lot of cool stuff you can see and experience in shallow lakes in Minnesota.

Megan: You're in good company, Scott. I think we were all that kid. Nicky, go ahead.

Nicky: I was for sure, I was bringing jars of crayfish and amphipods to school all the time. I grew up on the shores of a lake and that's, you know, that's where I spent my life. I happen to grow up about 10 miles from Lake Christina, which is a really famous shallow lake in Minnesota, I had my first field trip to Lake Christina when I was in high school, and I just became enamored with aquatic ecology, you know, in high school. And I decided to go to North Dakota State University to pursue a wildlife degree and just coincidentally my advisor was Dr. Matt Butler, who was doing research on Lake Christina. This was before the internet and I'm aging myself greatly, but it was total coincidence, you know, or maybe I filled out a form that said I was interested in aquatic stuff, but he was my advisor, and so I got the opportunity, you know, to actually do work on Lake Christina myself as a graduate student, so I don't know like I've been working on shallow lakes more than half of my life. They're extremely interesting systems and like John pointed out, extremely rewarding when you can improve one.

Megan: It sounds like spending time in them for most of your life too, so that's pretty exciting. Thanks for answering that. We're going to move on to our next section.

LET'S SCIENCE: TO THE LITERATURE.

SCIENCE!

Megan: This is the part of the podcast where we talk about a book, a blog, or a paper, and so can you guys tell us your picks and then just give us a little bit of information about why you picked that? I was going to say to reel us in just as a pun. That was all for Scott. Okay. Nicky, we'll start with you. What are your picks?

Nicky: Well, there's only one textbook on shallow lake ecology, and it's The Ecology of Shallow Lakes by Marten Scheffer. And Lake Christina is one of the case examples on there, but Marten Scheffer is like the godfather of shallow lake ecology, and he also

wrote a really famous paper back in the '90s that sort of drew attention to the fact that these lakes can exist in alternative stable states, so those are two like classics if you're interested in shallow lake ecology.

Megan: Perfect. Scott.

Scott: All right, I'm going to go with a recent publication here. This was a 2021 publication using hidden Markov models to inform conservation and management strategies in ecosystems exhibiting alternative stable states. It's in the Journal of Applied Ecology. Basically, you've heard us talk briefly about alternative stable states and one of the questions is how do these things flip between the two. What are the drivers, what's going to happen with some of these systems, and as a resource manager, it's always like oh, how do we predict it? There's lots of models out there, but this is one that perhaps it takes minimum inputs, it might be able to help us you know, have a day to sit on these lakes and say okay, are we close to having one flip, you know, anything that you can learn about how to manage these systems is useful but it all plays into what is the state that you're in?

Megan: Awesome. John, what's your pick?

John: Mine is a paper from the early 2000s called Nutrient Reserves of Lesser Scaup During the Spring Migration in the Mississippi Flyway: A Test of the Spring Condition Hypothesis. So this is the first in a series of I think three different papers that Mike Anteau and Al Afton had posted in the early 2000s that we're looking at the amount of food available and how it was impacting Lesser Scaup hence as they were traveling north and I mentioned earlier the loss of amphipods on the landscape and how important those were. And those papers really looked at those abundances and they kind of kicked off this whole recent idea about like it led to the living lakes initiative in part that DU's been working on about making these stepping stones, connecting the breeding grounds to the historic prairie or to the historic wintering grounds and trying to provide abundant resource of those amphipods and it's just really interesting that I had mentioned the other paper that I just saw this week too that came out from Minnesota DNR about the amphipod abundances and kind of acting as an indicator or high quality wetland because it just, it all ties together and just it's like this research is now 20 years old and now new research is just kind of compounding just how that scientific process works on the history to build the knowledge base is really cool.

Sara: Awesome. Hey Megan?

Megan: Yeah, Sara.

Sara: What do you say we go take a hike?

Megan: Yes, let's take a hike or a swim, or a float, or maybe I'll just stand in a shallow lake and we can measure it. (Laughing) That could be something we do. So this is the part of the podcast where we recommend some of your amazing public lands or publically accessible places, and so Nicky, we're going to start with you. Where are we hiking, swimming, or floating today?

Nicky: The Seven Sisters Prairie Preserve that overlooks Lake Christina – can get fantastic views at Lake Christina. And also see a lot of cool and rare prairie plants that's owned by TNC.

Megan: Wonderful. Scott?

Scott: Let's go down to Phelps Lake Wildlife Management area and Cody Phelps Lake in Rice County. Take my kids fishing here, watch and listen to birds and wildlife. I collect black bullheads, my bait of choice for fishing on the Minnesota River and there's a nice restored prairie that is underway.

Sara: John, how about you?

John: Mine is the Big Stone National Wildlife Refuge out in Western Minnesota, so growing up I have a lot of memories there hunting with my family and close friends and I've been fortunate enough now as a professional to get to work there, as a partner, so anything I, I spend out on Big Stone National Wildlife Refuge, it's pretty near and dear to my heart.

Sara: Just watch out for the cactus 'cause they hurt when you sit on them. (Laughs)

Megan: Pro tip, don't sit on a cactus from Sara Vacek your friendly helpful wildlife biologist.

Sara: I'm here to help.

Megan: Here to help. I love the take a hike part of the podcast. You can find these public places to explore on the DNR's recreation compass, by typing DNR Recreation Compass into your Google machine or your web browser of choice and it can get you there and you can explore all these amazing places that you can go take a hike at with our without cactus, it's up to you. Next week, we are going to be back here on Prairie Tuesday, we're covering one of my favorite topics, get ready for it – Prairie Economics. That is not what you thought I was going to say but I said it 'cause your girl loves math. So one of the hardest things to quantify is how much things like clean air, drinkable water, flood control and healthy soils are worth. How do you quantify the benefit of these ecosystem services that we all need to survive and thrive and what's the cost when we lose the land that provides them or water. So arguably even harder to quantify are the intangible benefits, right? Like mental health, well being, spiritual connections and the sense of peace that one can drive from the prairie. From pheasant hunting to an improved quality of life, we've done the math to help you make dollars and cents out of the prairie. That was a pun, so you can spell it c-e-n-t-s or s-e-n-s-e see? That's, that's clever. Okay, so talk all about that and Sara provided us with my favorite question that we're going to cover in the episode should you even try to quantify these things? What does that say that the basic things that we need to survive we're trying to add a monetary value to. So you're not going to want to miss it. It's gonna be great. As always you can find all the resources and links that we talked about today 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 magnificent Dan Ryder and engineered by the fantastic

Jed Beecher. Gosh, till next time don't crack up. No, I need a different joke. What should we say? Shallow lakes are great. (Laughter)

Sara: I don't think that's it either.

Megan: That's not it, that's not how we sign off? Yay for shallow lakes! Guys gotta help me out here.

Nicky: We had deep conversation about shallow lakes.

John: Don't tip your canoe.

Megan: Deep conversation that's the winner. Thanks for being here. Y'all did great.

((sounds of birds chirping and wind blowing))